Sraffa's 1920s critique and its relevance for the assessment of mainstream microeconomics*

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ABSTRACT

- The present essay re-examines the scope of Sraffa's critique of Marshall's supply curves the former developed in his 1925 and 1926 articles showing that neoclassical supply curves derived from non-proportional returns are not robust both in the short and in the long run.
- After examining what a short-run and a long-run equilibrium means both for the original Sraffa's articles and for Marshall's pioneer contribution, the paper discusses the common procedure in conventional economics to introduce the limitations to the growth of the firm. The argument of the paper will be based on the 1920s articles as well as on the "Lectures on Advanced Theory of Value" delivered in 1928-1931 by Sraffa at Cambridge University, now publicly available on-line by the Wren library, Trinity College, Cambridge.
- For short-run analysis, it must be assumed that the number of firms is fixed. This assumption entails serious problems with regards to the notions of competition and competitive behaviour. For long-run analysis, the source of increasing costs are problems of management and control. However, this idea is untenable both on logical and empirical grounds.
- We argue that contemporary mainstream microeconomic treatment of costs and supply in the context of perfect competition still present several problems. These problems, rather than being superficial, lie at the root of supply and demand approach of value and distribution.

Keywords: Sraffa, Marshall, Supply curves, returns, short run, U-shaped cost curve.

JEL Classification: B13, B21, B24, D21, D22.

1. INTRODUCTION

It has been more than ninety years since Sraffa published his devastating critique of Marshall's theory of value that launched him to the centre of the economic debates on the international stage, inaugurating the period of theoretical renovation that would later become known as "the years of high theory" (Shackle, 1967). Yet, theoretical renovation did not lead to fundamental changes in the supply and demand approach to value which was dominant at the time, and still is. Rather, it led to analytical refinements of the Marshallian theory "towards completing and correcting it where that is necessary" (Viner, 1931, p. 24). Such 'refinements' now constitute the basis of almost all mainstream textbooks introducing the cost behaviour and supply of firms in competitive markets. To what extent have these modifications of the original theory overcome Sraffa's critique?

The present essay aims to reassess the scope of Sraffa's critique of Marshall's supply curves developed in the former's mid-1920s articles (Sraffa, 1925; 1926). The main issues we try to discuss are the subsequent developments of the conventional theory regarding the differences between firm-level and industry-level supply curves in both the short and long run. We examine the formal conditions allowing marginalist theory to derive short- and long-period industry supply curves based on increasing costs from conditions internal to the firm. We argue that contemporary mainstream microeconomic treatment of costs and supply in the context of perfect competition still present several problems which, if not poignantly ignored, are at least widely overlooked. Support of our argument chiefly examines the articles Sraffa wrote in the 1920s as well as his "Lectures on Advanced Theory of Value" (archived as D2/4) Sraffa delivered in 1928-1931 in Cambridge University, and deposited at Wren library, Trinity College, Cambridge.

Following this introduction, Section 2 discusses Marshall's version of marginalist theory of value and distribution and briefly presents Sraffa's critique. Section 3 presents the different streams of thought that emerged as a reaction to the critique. We focus on the branch of the literature that attempted a refinement of Marshall's analysis of cost and supply based on identifying the sources of increasing costs within the individual firm both in the short and long run. Section 4 focuses on the analysis of short run and some associated problems, while Section 5 discusses the proposition

of diminishing returns to control and management as the basis of increasing costs in the long run. We finally provide some conclusions in Section 6.

2. MARSHALL'S THEORY AND SRAFFA'S CRITIQUE

In order to understand Sraffa's critique, it is necessary to briefly reconstruct the object of his enquiry developed in his early articles of the 1920s as well as in his "Lectures on Advanced Theory of Value" delivered in Cambridge in the late 1920s.[1] As is acknowledged in the literature (Roncaglia, 1978, pp. 9–14), Sraffa's work on value in the 1920s (1925, 1926) primarily deals with the Marshallian approach to value and distribution and its method of partial or 'particular' equilibrium (Marshall, [1890] 1920).

Marshall's approach is based on both classical (Ricardo, [1823] 1951) and utilitarian (Jevons, [1871] 1888) grounds. According to Marshall, equilibrium prices are determined by the interaction of two independent forces, that of supply and that of demand; the former is built around the nature of returns in production, while the latter on the basis of subjective utility derived in its turn by consumers' preferences. Although this supply and demand apparatus is common to all marginalist authors, Marshall isolated the study of income distribution from the determination of value of single commodities. This is in contradistinction with other versions of marginalist theory such as those based in a 'simultaneous' or general equilibrium framework (Walras, [1926] 1954).

Another key component of the Marshallian apparatus is Marshall's methodology in economics. The method of 'particular' (as referred to by Sraffa)[2] or partial equilibrium (as is broadly known)

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[1] Henceforth the following abbreviation for citing Sraffa's writings will hold:

Full citation:	Abbreviation:
Sulle relazioni fra costo e quantità prodotta, Annali di Economia, V. II, No. 1 (1925) [Translation by John Eatwell and Alessandro Roncaglia]	*Annali*
The Laws of Return under Competitive Conditions, Economic Journal, V. 36, No. 144 (Dec. 1926)	*EJ*
16 Lectures in Michaelmas Term 1928-1929 "Advanced Theory of Value" e 1929-30 e Lent 1931	*Lectures*

[2] Sraffa (1926, p. 539) may have derived this notion from Marshall's *Principles* in which in several passages he refers to the analysis of value of 'particular' commodities; see in particular Marshall 1920, preface to the eight edition, p.xxvi.

is what, in principle, justifies a separation of the analysis of value of a particular commodity from that of income distribution. Following this approach, value is determined under competitive conditions one commodity at a time by the interaction of the two opposing forces, supply and demand, independently of what happens in the rest of the markets. This methodology is usually called the *ceteris paribus* condition, which translates as 'other things being equal'.

The salient characteristics of Marshall's version of marginalist theory are the approach to value as separated from the issue of distribution and the methodology of the 'particular' equilibrium. And both were well known to Sraffa, on which he not only wrote in his published work but also in many of his manuscript pages used to deliver his *Lectures* at Cambridge. Thus, for example, as regards the former feature, we can read from Sraffa's hand:

> {In the theory of general equilibrium,} the theory of value of particular products and the theory of the distribution of the total product between factors are not regarded as entirely separate and distinct (as is done in Marshall's Principles); but the two problems are solved simultaneously—and in fact are regarded as a single problem. (Sraffa, *Lectures*, D2/4/3: f123r; emphasis added by Sraffa, curly brackets added by present authors)

About the second feature, it is important to remind ourselves of the basic conditions for applying the partial equilibrium method. The core conditions to applying the *ceteris paribus* condition are: (i) independence between supply and demand of the single product in question such that any change in the determinants of the supply curve of a particular does not shift its demand curve and *vice versa*; and, (ii) supply and demand conditions of the single product must be independent of supply and demand conditions of all other commodities. For the Marshallian approach, these conditions are important to conduct comparative static analysis, such as to analyze the impact of taxation or environmental regulation in a particular market, or a change in tastes by consumers who demand the specific product.

Marshall (1920) thought it possible to coordinate the different laws of returns so that they could be employed as the basis for the analysis of supply. However, as Sraffa will later note, Marshall's use of non-proportional returns to lay the basis for the industry supply curve radically differs from their use by the classical school. For Marshall, costs in a particular industry will be increasing if diminishing returns are dominant, and decreasing in the presence of increasing returns.[3] The

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[3] Note that Marshall considered supply for the whole industry, allowing firms to have different size and life cycles. This implied the introduction of dynamic elements in the analysis. However, the analysis of supply and demand at

classicals by contrast associated diminishing returns with the explanation of the emergence of rent (Ricardo, [1823] 1951, vol. 1), and the increasing returns with the general economic progress due, for example, to the extent created by the division of labor (Smith, [1776] 1904). Sraffa was skeptical with this alleged linkage of the classical economists with the new theory. In fact, for Sraffa (1926, p. 538), the "really serious difficulties" for the marginalist theory appear when it is examined to what extent an industry supply curve based on non-proportional returns satisfies the two "conditions necessary to enable them to be employed in the study of equilibrium", i.e., the two conditions enabling the *ceteris paribus* be applied to the study of value.

Sraffa (1925, 1926) found a contradiction in the systematic coordination of the laws of returns as the basis for the analysis of supply conditions to conduct a robust partial equilibrium analysis. Since his critique is widely known, we will only mention it briefly[4]. For the case of diminishing returns, there are two possibilities to consider:

1.   An industry employs a *considerable part* of the fixed factor of production. In this case, if there is a small increase in its production it will need a more intensive use of the factor concerned, so that the costs will increase more than proportionally. This will imply, however, that the prices of those other commodities whose production require that factor will also rise when their production is increased. Based on purely empirical grounds, Sraffa remarks that since commodities using a common fixed factor in a considerable amount are "frequently" (1926, p. 539) substitute for one another (such as agriculture products), then the rise in the costs of production will likely affect both its own demand and the demand for other products. This means that supply conditions are not independent of demand conditions, and therefore features i) and ii) of the particular equilibrium method cannot be satisfied.

2.   An industry employs a *small quantity* of the constant factor. In this case, a small increase in production will give rise to a higher use of the factor which can be obtained by withdrawing "marginal doses" of it from other industries so that the effect on costs will be

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the industry level was of a static kind. The link between industry (a static concept) and firm (a dynamic concept) was made possible by the idea of a representative firm (see Aslanbeigui & Naples, 1997, p. 518).

[4] To provide a thorough critique, Sraffa first developed and refined properly the concepts of diminishing and increasing returns. Ironically by doing this, he helped to develop certain doctrines that latter emerged as a response to his critique (Keppler & Lallement, 2006). We will focus on this in the following sections.

negligible. Therefore, in this case, a systematic relation between quantities produced and price (*i.e.*, a supply curve) cannot be postulated.

Sraffa's negative conclusion is that the law of diminishing returns can be applied to derive the supply curve only to those "minute class of commodities" which specifically employ *the whole of a factor* – a case Sraffa deems very unlikely to observe.

It is interesting to note how important these theoretical discoveries might have been to Sraffa who, upon a long reflection, drew from the central arguments of his articles a good deal of material for his *Lectures*, to the point of calling into question – in those *Lectures* – the logic of the very *ceteris paribus* condition itself in the context of Marshallian economics[5]. For Sraffa, it concealed much more than it expressed since there are "innumerable things that can change without affecting the particular problem in hand (*sic*)", while at the same it is dangerous to consider as fixed "quantities which cannot possibly remain unchanged if the variables change" (Sraffa, *Lectures*, D2/4/3: f84r). Whatever the reasons behind Marshall's peculiar use of the classical notion of diminishing returns to found increasing industry supply curves, clearly the most important concern for Sraffa was the logical flaws behind the notion of such a construct in the first place.

When turning to the case of increasing returns, Sraffa notes they can emerge in three different situations: in an individual firm, in an individual industry, and in all industries. Economies of scale internal to the firm are not considered since they violate the competitive conditions for any given firm working in a competitive market whereby the selling price is given thus preventing the firm from individually affecting the price. For the case of external economies, Sraffa says that they usually benefit a wide group of industries.[6] The only possible case would be one of external economies for a firm but internal to the industry. However, Sraffa (1926, p. 540) points out that

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[5] Before drafting the *Lectures* delivered in 1928-1931 in Cambridge, Sraffa had previously written a 70+ page document titled "Notes/London, Summer 1927 / Physical real costs, etc" (archived as D3/12/3). These notes were drafted in a preparation his lectures which were to begin in 1927 but were was postponed until October 1928. In both the *Lectures* as well as in the earlier "pre-Lectures" (as referred to in Garegnani, 2005), Sraffa devotes a good deal of analysis to the critique of Marshall's economics and method.

[6] A drop in the price of a given commodity due to the advantages the firms could eventually draw from the general progress of the industrial environment (e.g. an improvement in road transportation) cannot be considered within the method of partial equilibrium, which necessitates of the working assumption that other industries' prices and quantities remain equal, but which is impossible to attain since it is very likely the improvement in road transportation will give rise to changes in the conditions of a whole branch of other industries also using improved road infrastructure.

"those economies which are external from the point of view of the individual firm but internal as regards the industry in its aggregate constitute precisely the class which is most seldom to be met with".

Sraffa's conclusion, always *in the context of Marshall's theory*, *i.e.*, in the context of partial equilibrium, is that "as a simple way of approaching the problem of competitive value, the old and now obsolete {classical} theory which makes it dependent on the cost of production alone appears to hold its ground as the best available" (1926, p. 541, curly brackets added by the present authors)[7]. This conclusion, however, should not be interpreted as the *actual prevailing conditions of production* in industries and firms, but as the *only logical possibility* for partial equilibrium analysis in the context of competitive markets[8].

Before moving forward to the reactions to this critique, one aspect of the analysis requires clarification. Both Marshall's and Sraffa's analyses of competitive value is framed in the context of long-period equilibrium (or normal positions). A clear evidence of this can be found in several passages of Marshall's *Principles*. For example, in the following passage Marshall says:

> we are specially concerned with movements of price ranging over still longer periods than those for which the most far-sighted dealers in futures generally make their reckoning: we have to consider the volume of production adjusting itself to the conditions of the market, and the normal price being thus determined at the position of stable equilibrium of normal demand and normal supply. (1920, sec. V.III.3)

The same idea is found in Sraffa, who in his 1925 article writes:

> throughout this essay we are dealing with long periods; which means to say, it is supposed for every variation in the quantity of the commodity produced, a period of time is allowed that is sufficient to introduce all resulting modifications in the organization of production, and the transitory effects that occur during the curse of such adjustments before a new equilibrium is achieved are ignored (*Annali*, note 2, p. 279).

This aspect of Sraffa's analysis regarding the time of adjustment has important implications when dealing with costs, and therefore prices. In his *Lectures* Sraffa comes back to this aspect,

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[7] For the historical context explaining the analogy in Sraffa's 1920s articles between the classical approach to value and the constant returns Marshallian case, see Garegnani (2005).

[8] Commenting on this conclusion, Sraffa wrote to Keynes that his Italian readership have "taken [that conclusion] to imply that in actual life constant returns prevail: although I believe that Ricardo's assumption is the best available for a simple theory of competition (viz. a first approximation), of course *in reality the connection between cost and quantity produced is obvious*. It simply cannot be considered by means of the system of particular equilibria for single commodities in a regime of competition devised by Marshall". (Sraffa to Keynes, 6 June 1926; quoted in Roncaglia 1978, p. 12, emphasis added; see also Mongiovi 1996, p. 212).

associating *long periods* "to continuous production, {where} costs cannot be ignored" (*Lectures*, D2/4/3: f77r). Also, in another part we find the following definition: "{T}he theory of normal value, … is not the actual state at any one given moment, but a limit about which market price fluctuates, and is valid over a long period" (*Lectures*, D2/4/16; underline by Sraffa).

On the other hand, short-period supply and demand analysis implies considering the quantities as fixed, *i.e.* "supply is limited to the stores which happen to be at hand" (Marshall, 1920, sec. V.I.20). But it is clear from Sraffa's definitions that short-period analysis is not the appropriate time frame to be adopted for the analysis of value, and this more broadly became a sharp critique of the logical tenets behind Marshall's approach. It is now natural to turn to see what happened after Sraffa's critique and the several adaptations by the conventional theory that soon followed. This is important especially because (though not uniquely) mainstream microeconomics continues to base its analysis of production and costs on Marshall's insights.

3.   REACTIONS AFTER SRAFFA'S CRITIQUE

Sraffa's critique was not the only attack on Marshall's theory at that time. Indeed, the subject matter was much debated during the 1920s and early 1930s especially regarding the applicability of the concepts of increasing, decreasing and constant returns conceived in a logically-unified manner in order to classify different industries. Clapham (1922) for example critiques the erroneous unified variable cost notion as conceptual 'empty economic boxes' into which different firms can be placed according to the direction of their non-proportional cost structure. Also remarkable was the debate between the most prominent economists of Cambridge on these issues (see Robertson, Sraffa & Shove, 1930). However, Sraffa (1925; 1926) was the first to question the *logical possibility* of coordination of the law of non-proportional returns to derive a systematic relationship between quantity produced and prices.

For Sraffa, if constant costs are the only logical case to analyze the determination of competitive value in the context of partial equilibrium, then the number of firms producing within an industry becomes indeterminate. This turns out to be problematic for the marginalist theory because one

firm could produce the whole of any industry's output and this would undermine the very definition of competition.[9]

These logical and empirical problems made explicit by Sraffa's devastating critique led scholars to subsequently explore some alternative lines of research:

a) Refinement of Marshall's apparatus (Cost curves and supply curves in competitive conditions)
b) General equilibrium
c) Imperfect competition

While our concern in this paper is with point (a), with which we shall deal in what follows, it is appropriate to state briefly some considerations with respect to points (b) and (c) and their connection with Sraffa's work. Regarding point (b), some scholars (Newman, 1960; Panico, 1991; Talamo, 1976) have maintained that Sraffa's later work (1960) was the adoption of a simultaneous equilibrium model and therefore the solution to the problems of the partial equilibrium method. While it is plausible to admit that in his two articles Sraffa pointed to the general equilibrium method as a solution to the partial equilibrium approach, nevertheless on this version of the theory he cast serious doubts, since general equilibrium is "a well-known conception, whose complexity, however, prevents it from bearing fruit, at least in the present state of our knowledge, which does not permit of even much simpler schemata being applied to the study of real conditions" (1926, p. 541).[10] As argued by Mongiovi (1996, pp. 216–217), if Sraffa had really intended to endorse a general equilibrium approach he would have probably picked up the versions of Walras or Pareto, which were available to him at that time.

Regarding point (c), it is important to note that while Sraffa in 1926 devoted a good deal to the examination of monopoly conditions,[11] that is, to propose to abandon competitive conditions as a

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[9] Modern notions of competition do not present this problem since they dismiss it by assumption. For example, Shy (1996) considers competitive behavior as a belief on behalf of a buyer or seller that market price is given and he/she does not influence on it. This definition rests too much, in our opinion, in the subjectivity of buyers and sellers.

[10] Sraffa notes in the *Lectures* that "[t]he disadvantage [of the general equilibrium], as compared with the simpler scheme [of partial equilibrium] is however very great; it is much more removed from any possible practical application. Even if all the knowledge of circumstances which it assumes could be obtained, the system of equations would be so intricate that, as Pareto says, the resources of algebra would not be equal to the task of solving them" (*Lectures*, D2/4/28).

[11] Sraffa proceeds to criticize the traditional view for which if production is in the hands of many firms entirely independent of one another, then competitive conditions must be applied, even in the market "in which the goods are exchanged is not absolutely perfect, for its imperfections are in general constituted by *frictions which may simply*

way out to save Marshallian economics being applied to the problem of value, research shows that it seems likely Sraffa might have abandoned that agenda, partially because "by 1930 [Sraffa] had lost whatever enthusiasm he might originally have had for monopoly as a foundation for the analysis of normal value" (Mongiovi, 1996, p. 214). Still the question remains: how is it possible that an author like Sraffa who was reluctant to publish anything not fully trusted wrote on imperfect competition only to later give it up? Reasonable as this questions may sound, some Sraffa scholars (e.g., Garegnani, 2005; Mongiovi, 1996) have argued that in the years 1926-1930 Sraffa's thought underwent a deep change regarding the economic theory to which he had previously ascribed. Viewed in this perspective, there appears a conundrum in Sraffa's thought: by 1926 Sraffa still viewed Ricardo as the constant returns case of Marshall's, not to mention that he had no qualms on the standard demand theory which is necessary to carry out the analysis under imperfect competition. The break with the Marshallian tradition would come sometime between 1927-1928 in what Garegnani (2005) labelled as a 'turning point' in the development of Sraffa's thought, when Sraffa showed Keynes a first draft of the 'equations' (later to be fully developed in 1960) in which constant returns to scale were not assumed (Sraffa, 1960, p. vi). This departure from orthodox thinking plausibly explains why we find no more traces of anything resembling imperfect competition in Sraffa later published work.[12]

The first line of research (a) to refine Marshall's apparatus focuses on identifying the internal factors that set a constraint on a firm's growth. Given that the definition of perfect competition implies that an individual firm can sell any amount of output at the given market price (infinitely elastic demand curve), limits could not be sought on the demand side. This meant that emphasis was made on the supply conditions of a firm. Factors that set limits on a firm's growth have been identified as technical, managerial, financial, and marketing difficulties, as well as and risks and general economic fluctuations (Aslanbeigui & Naples, 1997). This led to the development of the famous U-shaped average cost curve (Keppler & Lallement, 2006), which Sraffa himself introduced in his original 1925 Italian article.

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retard or slightly modify the effects of the active forces of competition". However, for Sraffa such "imperfections" or obstacles which impede competitive forces cannot be regarded as "frictions" only but also as *active forces* which "produce permanent and even cumulative effects" (1926, p. 542, emphasis added).

[12] Not even in the 1930 Symposium on increasing returns and the representative firm, where Sraffa would publicly and definitely break with anything Marshallian.

4. (NOT SO) MODERN TREATMENT OF COST AND SUPPLY CURVES: SHORT-RUN ANALYSIS

The landmark article that settled all the disputes within the orthodox paradigm, and still remains the basis of many microeconomics textbooks, was Jacob Viner's article "Cost curves and supply curves", published in 1931. Viner introduced the U-shaped cost curve in "a period long enough to permit any desired change of output technologically possible without altering the scale of plant, but which is not long enough to permit of any adjustment of scale of plant" (1931, p. 26). This was defined to be the *short run*.

Sraffa had already introduced a U-shaped cost curve in the *Annali* article of 1925 but did so in the context of long period analysis, as defined above (Section 2). In this latter definition, firms are allowed to change the proportions in which factors are combined to deliver a given quantity of output, *i.e.* producers can choose different sizes of plants to combine with different quantities of 'variables' factors.

It may appear that short run for Viner is the same as the notion of Sraffa's long period. To clarify the confusion, let us compare Viner's "short run equilibrium for an individual concern" diagram, and Sraffa's U-shaped cost curve presented in the *Annali* article.

Insert Figure 1

In Viner's diagram the author is trying to accurately describe how costs behave in the short run for a single concern. The U-shaped cost is, in principle, an accurate description of what happens in reality:

> Since the increase in output is the result of the application, to a constant amount of "fixed" factors, of increased amounts of the variable factors, the law of diminishing returns, if it is operating, should make the output per unit of the variable factor employed diminish, i.e. should make the "direct" technical coefficients of production increase, as total output increases. As the prices of the factors by assumption remain constant, the average direct costs must also increase as output increases, if the law of diminishing returns is operative. It is assumed, not, I believe, without justification, that within the useful range of

> observation the law of diminishing returns is operative, and the average direct cost curve is therefore drawn positively inclined throughout. (Viner, 1931, p. 27)

Thus, for Viner, the positively sloped curve (ADC in the graph) would actually be the result of reckoning how the law of diminishing returns operates in the short run along a "useful range of observation".

Consider now Sraffa's U-shaped cost curve for the representative firm:

Insert in Figure 2

Although graphically identical, there are important theoretical differences between the two diagrams. First, as we have mentioned, since Sraffa's discussion is in the context of long-run equilibrium, no assumption about scale plant or fixed costs are made (note that 'fixed' or 'direct' costs are not present in Sraffa's figure). Second, Sraffa's U-shaped cost curve is discussed in the context of increasing returns; specifically, he is interested in discussing how to build a decreasing supply curve that is compatible with competitive conditions. This case is possible only if the following conditions are met:

> by considering 'an industry' as the set of firms that produce a given commodity, each firm must be so small relative to the industry, that the influence of a variation in the quantity produced by the firm on the market price can be taken as negligible. Further supposing that each factor of production is used by a large number of different industries, a variation in the quantity of it used by an industry does not exercise any appreciable influence on the remuneration of that factor, since this is determined by the general conditions in the totality of the industries that use it. The quantity of factor that each industry can obtain for itself at the market price must be considered as practically unlimited. (Sraffa, 1925, pp. 307–308)

Considering these conditions, Sraffa asks (and subsequently answers) what form the cost curve of a representative firm should exhibit:

> First of all, it cannot display increasing costs for all its length: because in such a case competition would tend to make every firm infinitely small and the number of firms infinitely large. Hence, because the need for each firm to reduce its own production so as to reduce its costs, there would be no possibility of achieving any equilibrium. The curve *must* therefore, in each case, initially display decreasing costs. Secondly, it will not show solely decreasing costs, since if it did, a firm would necessarily acquire a monopoly in the industry, contrary to the hypothesis of competition. The supply curve of the representative firm will therefore have in each case a shape of the type CC'… This curve presupposes,

among its conditions, that *the industry as a whole produces a fixed quantity*, let us say z. (Sraffa, 1925, pp. 309–310; emphasis added by present authors)

Note that in Sraffa's analysis no reference is made to the law of diminishing returns *at the firm level*, as is the case of Viner's approach. In fact Sraffa shows that, if there are decreasing costs for the industry as a whole under free competition, firms *must* have U-shaped costs curves. Contrary to standard microeconomics,[13] the U-shape is the result of a *logical necessity*, not a point of departure of how costs actually behave on a firm level, to then cover the industry level costs curves.[14]

Since the context in which these curves are discussed and introduced is different, so also will the nature of each curve. When Viner first introduced his U-shaped costs curve in the context of short run equilibrium, he claimed it to be "the *fundamental* graph, and is incorporated in or underlies all the succeeding ones" (1931, p. 25). Why is it that this concept is so fundamental?

According to Viner, the curves on his diagram intend to provide a realistic description of how firms behave in the short run in competitive markets. The demand curve for a particular firm is flat and, by following the marginal pricing rule, it determines the amount of output it produces in the short run. As seen in Figure 1, when price is above P, such as in P_1, it has positive quasi-rents, and individual output increases; the contrary happens when price is below P, such as in P_2. The industry supply curve is the result of adding up the individual marginal cost curves of each firm.

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[13] See, e.g., Varian (2010, pp. 398–400).

[14] The issue of the logical consistency to derive industry supply curves based on non-proportional returns is recurrent in Sraffa's thought over the years following the 1926 publication. Indeed, in his *Lectures* notes, Sraffa makes it clear why he considers the case of diminishing returns at the firm level totally irrelevant:

> So far we have examined the tendency to diminishing returns as it arises in consequence of changes in the proportion in which different factors are combined in production. So long as it is looked upon from this point of view, it is a fact that has importance for the individual producer, only because it supplies the criterion which enables him to discover the most profitable adjustment. But it has no importance for the determination of the equilibrium of industry as a whole, as it results from the competition of a large number of independent producers and not from the decision of anyone individual seeking to obtain the maximum profit for himself. In fact, even from the individual point of view, it does not throw any light upon the conditions of equilibrium - it merely illustrates the sort of steps that are taken by the individual producer in trying to approach to such a state of equilibrium: but it tells nothing about the point at which equilibrium is realized; when we simply know which is the optimum proportion in which the factors can be combined we know nothing about the optimum size of the individual firm. The best proportions may be equal for firms of different sizes and, at the same time, one given size may have advantages over the others which in general are quite independent of the proportions in which factors are employed. In fact the causes which make for variations of the efficiency of the business units according to its size are of a nature which is much more similar to the conditions from which increasing returns arise, that is to say, economies of [large scale] production, than from the changes in proportions which are connected with diminishing returns. (*Lectures*, D2/4/3: f115r and f116r, underlined in the original).

Sraffa challenges such a procedure in marginalist production theory, and initially he compares the adding up of costs curves to a seemingly parallel procedure in the construction of a collective demand curve. The latter consists of adding up the quantities which individual consumers are willing to buy at given prices levels (Sraffa, 1925, p. 300). However, the procedure of adding up costs curves cannot logically be applied in the presence of diminishing returns. If diminishing returns is the consequence of having a constant factor which cannot be increased, then, the origin of such a decrease in returns "operates only for the industry as a whole". This is so because:

> The quantity of that factor available for the totality of the producers is constant, but the single producer can increase or decrease the quantity that he uses of it without appreciably influencing the price of the factor itself. It is therefore possible that, while the industry has increasing costs, the single cultivator might, up to a certain point, increase his production while lowering his own private cost of production, because he can take advantage of the economies of large scale production, and yet, without being forced to intensify the exploitation of the constant factor, can obtain for himself a large quantity of it at the expense of his competitors. But although this is possible for each producer separately, it is not possible for the totality of producers, and therefore the sum of a series of individual curves of this kind is absurd, since each one of them is valid only on condition that the production of the other individuals remain unchanged. (Sraffa, 1925, p. 301)

For Sraffa, it is invalid to build a collective supply curve by adding up individual cost curves, because each one of them is valid only on condition that all the others firms keep production unchanged. Moreover, the whole construction of a U-shaped cost curves for describing the behavior of individual costs would be meaningless. Sraffa, nonetheless, points a way out of the problem available for marginalist production theory:

> In order to make it possible to add up the individual [cost] curves it is necessary to have recourse to a stratagem {*artificio*} that moves the cause of the increase in cost from the conditions of the industry to the conditions of the single producer. This is achieved by supposing that the number of producers is fixed, and that each of them, with the increase in production, cannot increase the quantity used by him of the factor of which there exists a fixed quantity for industry as a whole, so that the individual cost of production has to increase. (Sraffa 1925, 301; curly bracket is the Italian word in the original article).

This 'stratagem' is the key to understand the theoretical importance of the short run. In the short run it is *assumed* that no entry or exit occurs, and therefore that the number of firms in a particular industry is given. This assumption makes it possible to construct a logically consistent industry supply curve based on increasing costs for the individual firm. Moreover, assuming that the number of producers is fixed will allow, under competitive conditions, to assert that costs will

effectively rise when production increases because only under this *stratagem* will the individual costs rise; otherwise they would not be able to increase the quantity used of the constant factor.

At this point, the relevance of the short run for understanding the behavior of an individual firm should be questioned. As we have seen, the only way to build an individual U-shaped cost curve is to consider the quantity of firms in a particular industry as fixed. This implies that the firm's reaction will be to adjust the relative use of the fixed factor disregarding the entry of potential competition or exit of competitors. It may be useful to illustrate this process with the help of the following diagram:

Insert Figure 3

In this diagram, *k* stands for the factor proportion that minimizes costs in equilibrium (TC^*/Q_1 is the minimum point of *ATUC* curve in Figure 1, above). Assume an increase of demand that requires an expansion of output (of the industry as a whole). The individual firm has two possible choices: increasing the quantity of labor for the given capacity, or expand capacity. The latter is ruled out since according to the short run definition, plant size or scale cannot vary. Consequently, in order to accommodate the new demand, increases in production must come from a higher intensive use of K^* relative to L. Given the increase in demand, for the firm to produce Q_2, it will use K^*/L_2, which is not a long-run optimum choice, and cost per unit of output will increase to TC_2/Q_2.[15]

This result can be chiefly achieved thanks to the working assumption that the number of firms in each industry is fixed. However, this cannot be an optimum decision in the long run since newcomers can provide additional output by replicating the original plant at lower unit costs. Producers always take into account potential competition from firms that are not yet in the market. It is thus more sensible to distinguish between transitory and persistent changes in demand, and assume that firms have some spare capacity to accommodate transitory variations while expanding capacity when changes in demand are more permanent (see Ciccone, 1999). This, however, would

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[15] If Q_2 was produced using the equilibrium 'proportion' then it would cost less than in the new equilibrium position E_2, as it can be seen from the isocost curve tangent to the point E' (assuming linear homogeneous functions, i.e. tQ = f[tK,tL]). But this would not be relevant in the context of short run equilibrium where K cannot be increased.

undermine the U-shaped average cost curve, and with it the notion of competition held by marginalist authors. It is, nonetheless, consistent with the classical notion of free competition. Within this definition, it is no longer necessary to assume a fixed number of firms in the short run, let alone in the long run.

5. COSTS IN THE LONG RUN: DIMINISHING RETURNS TO MANAGING AND CONTROLLING, AND RISING SUPPLY PRICES

In standard microeconomic analysis, the boundaries delimiting the short-run and the long-run, and the corresponding different analytical implications, are quite unclear. Take, for example, Varian's analysis of the firm supply functions for the short run and for the long run. We read:

> The short-run supply curve involves the marginal cost of output holding *k* [plant size] fixed at a given level of output, while the long-run supply curve involves the marginal cost of output when you adjust *k* optimally.
> Now, we know something about the relationship between short-run and long-run marginal costs: the short-run and the long-run marginal costs coincide at the level of output *y** where the fixed factor choice associated with the short-run marginal cost is the optimal choice, *k**. *Thus the short-run and the long-run supply curves of the firm coincide at y*.*
> In the short run the firm has some factors in fixed supply; in the long run these factors are variable. Thus, when the price of output changes, the firm has more choices to adjust in the long run than in the short run. This suggests that the long-run supply curve will be more responsive to price more elastic-than the short-run supply curve. (Varian, 2010, pp. 407–408; emphasis added)

For Varian, the long-run marginal cost is the curve that consists of the various segments of the short-run marginal cost for each level of output and of plant size. As can be perceived, standard microeconomic analysis takes for granted that the U-shaped cost curves derived in the context of the short run still holds true in the long run, even if it is apparently acknowledged that plant size can change in the long run. But, as discussed in Section 4, since in the short run the average and marginal costs curves are positively sloped (Viner, 1931), then the long-run cost curves will also depict increasing average and marginal costs, and therefore an industry-level supply curve in the long run will almost exactly resemble the features of the short-run supply curve. As the citation makes it clear, Varian disregards both decreasing costs and constant costs. So, we are back to the original problems posed by Sraffa, that is, to find the source of diminishing returns to derive industry supply curves.

Sraffa's original critique fully applies to the long-run cases. Sraffa (1926) states that the only case logically possible under partial equilibrium analysis is the "minute class of commodities" which specifically employ *the whole of a factor*. Curiously enough, this is the only case considered by Viner (1931, pp. 30–32). However, even if an industry may have increasing costs, each individual firm could increase production with constant or decreasing costs the curves of which, nevertheless, could not be added up as this would be "absurd", since each firm's cost curve is valid provided the production of the rest remains constant.

Since a rising costs curve for an industry cannot be derived from the behaviour of the individual firm, the *mainstream* literature started looking for some source of decreasing returns, claiming that in the long run there might arise difficulties of controlling, coordinating and managing the labour force and its efficiency in the execution of tasks. In fact, some renowned Cambridge economists proposed to consider these sorts of difficulties as the source for decreasing returns (Kaldor, 1934; E. A. G. Robinson, 1934). Accordingly, it is argued that when firms grow (*e.g.* it duplicates or trebles its production level by duplicating or trebling the factors of production), the task of controlling turns out more difficult due to problems of agency (supervision) and coordination (information flow). Yet, to the best of our knowledge the introduction of difficulties of control as a source of decreasing returns has not been empirically proved. In fact, other outcomes could emerge out of the increase in the size of the firm; even accepting the increasing difficulties of control, yet duplicating the size of a firm may drop marketing costs and enhance R&D which may more than offset the difficulties of control. Moreover, it is a common practice in many firms to tie the top managers' salaries to economic results, thus diminishing the likelihood of agency problems.

Edith Penrose, based on a large empirical research on firms, challenged the view of decreasing returns based on difficulties of control to make compatible the theory of the firm with the marginalist theory. For example, she writes that:

> Reliable empirical evidence does not exist and all studies of the matter are inconclusive, but there is no evidence that a large decentralized concern requires supermen to run it. Neither is there significant evidence that the ability to fill the higher administrative positions is excessively rare or that the demands on the men occupying these positions exceed their ability to cope with them effectively. (Penrose, 1955, p. 542)

Or more in general, Penrose later wrote:

> [E]conomists have looked to the limitations of management (causing increasing long-run costs of production) … to provide a limit to the size of firm.
> The whole problem has been the source of much controversy, especially the question whether managerial diseconomies will cause long-run increasing costs; to establish such a result management must be treated as a 'fixed factor' and the nature of the 'fixity' must be identified with respect to the nature of the managerial task of 'co-ordination'. This identification has never been satisfactorily accomplished and many theorists have given up the task, preferring to rely on other limits to size. (Penrose, [1959] 2009, p. 11)[16]

Still, as the issue is not settled, assume we accept that increasing costs are presumed to arise due to the presence of diminishing productivity in managing and controlling several plants *within* a single firm. This phenomenon would, in principle, set a limit to the growth of a firm. Then, from a general standpoint, we can reasonably ask if it would not be more sensible to decompose the single firm into several ones: the single firm could split itself whenever it reaches the optimum minimum cost scale of production. Hence, the limiting case would be constant costs.[17]

Consider the logically possible case of external economies to the firm but internal to the industry. There is no logical difficulty that prevents us from considering a similar situation of economies external to the plant and internal to the firm. Then we would have decreasing costs thereby undermining free competition, unless there are also decreasing returns to managing, which would eventually lead to constant costs again.

Contrary to the short run, in the long run the number of firms is endogenously determined with free entry and exit. For the market to be competitive, the number of firms must be large enough, and hence increasing costs is a *sine qua non* condition. Yet, based on our previous analysis, the idea of increasing costs in the long run based on decreasing returns to 'managing' and 'control' is untenable. The boundaries of the firm are not well defined, they may split, regroup or reorganize production in alternative schema. And this implies that either a single firm or a select group within

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[16] Penrose has in mind Kaldor (1934) and Chamberlin (1948) in those passages. Kaldor argued that 'entrepreneurship' can be treated as a fixed supplied factor for every single firm and therefore provides the ultimate source for diminishing returns (for a criticism of Kaldor, see Mongiovi, 1996, p. 210). Chamberlin proposed to abandon the notion of the (fixed in supply) entrepreneurship ability held by Kaldor and in its stead proposed to argue that increase in "complexity" of the organization, as the firm expands, will bring about rising costs in the long run. Yet, as Penrose argued, whether managing an expanding organization is "complex" will ultimately depend on the capacity of the personnel, not on complexity *per se*.

[17] As Sraffa explains in the symposium on increasing returns and the representative firm: "the firm is in equilibrium when the internal economies due to an additional unit of product are exactly balanced by the disadvantages of expansion -and this happens at a point of constant returns" (Robertson, Sraffa, & Shove, 1930, p. 93).

a given industry may produce the whole output of the market, undermining the idea of a competitive setting.

Finally, another stream of the literature focused on showing that increasing costs may emerge in the context of general equilibrium analysis. Based on this framework, it is claimed that Sraffa's critique of the impossibility of increasing costs is wrong. Paul Samuelson has been one of the champions of this criticism of Sraffa. He writes:

> [W]hen primary factors other than a single homogeneous labour exist, rightward shifting Marshallian and Walrasian demand curves will generally trace rising price intersections on the relevant supply curves. (Samuelson, 2008)[18]

This hypothesis has been objected to in the literature by Panico (1991), who claims that it is misplaced. What Sraffa shows in his 1925 and 1926 articles, is the incompatibility between different supply curves *and* partial equilibrium analysis.

Contrary to Samuelson's thoughts, Sraffa is fully aware of the possibility of diminishing returns in a general equilibrium framework. He discusses this possibility in the *Lectures*. Sraffa considers the effects of a change in tastes that increases demand of a commodity produced with a 'high' proportion of labour per unit of land (cabbage), relative to other commodity whose demand is reduced (wheat). In that situation, labour and land will be transferred to cabbage production, but given that proportions of production remain the same, part of the land will be unemployed. This land will be spread over all industries until its marginal product has fallen. In this situation, the price of cabbage will rise relative to wheat (*Lectures*, D2/4/3: f122r, f123r, f124r, f125r, f126r and f127r). This is nothing but a simple general equilibrium model as taught in an undergraduate microeconomics course. Yet, as we have shown above (Section 3, especially footnote 10), Sraffa considered that the general equilibrium approach has "very great difficulties" in providing a robust method to conduct analysis.

6. CONCLUDING REMARKS

Sraffa's main object of critique was Marshall's version of marginalist theory based on the method of partial equilibrium. According to this method, one could study the determinants of the value of

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[18] By interpreting Sraffa 1960's book, *Production of Commodities by Means of Commodities*, as a special model of general equilibrium, Samuelson (2008) claims that 1960 Sraffa is incompatible with 1926 Sraffa.

a single commodity independently of what happens in the rest of the markets. Marshall also separated the analysis of value from that of distribution. This was in contradistinction with other contemporary versions of marginalist theory, specifically, that of general equilibrium.

Sraffa scrutinized the logical conditions for Marshall's version of marginalist theory to be consistent. He attempted to analyze the coordination of the laws of returns as the basis for supply analysis and concluded that constant costs were the only possible case to study the determination of competitive value within the method of partial equilibrium.

After Sraffa's critique, several attempts were made to reconstruct Marshall's theory. Three streams of the literature have been identified: (i) the refinement and development of U-shaped average cost curves in competitive conditions; (ii) the development of models of imperfect competition; and (iii) the analysis of returns in the context of general equilibrium.

We have focused on the first of these streams which attempts to identify the internal limits for the growth of the firm both in the short and long run. In the short run it is assumed that no entry or exit can occur so that the number of firms is given. This assumption makes it possible to construct a logically consistent industry supply curve based on increasing costs at the firm level. However, we showed that the relevance of the short run analysis in microeconomics textbooks should be questioned, at least for the sake of the understanding of the behavior of an individual firm, since it rules out potential competition. Both the individual producer as well as a collection of such producers will always consider potential competition from potential firms that are not yet in the market. If we may reasonably take economic reality to behave in such a way, then it would be more sensible to distinguish between transitory and persistent changes in demand. Thus we may more safely assume that firms having some productive capacity will accommodate production to the transitory variations, while under permanent changes in demand they will expand capacity. However, this story will undermine the U-shaped average cost curve of marginalist theory, and with it the notion of competition. On the contrary the classical notion of free competition is entirely consistent with such a state of affairs.

In the long run, in order to have increasing costs, at least one fixed factor of production must be assumed. The usual assumption has been that of decreasing returns to 'managing' or 'controlling' due to agency and coordination problems. However, to our knowledge, these propositions have not been empirically proven and has been challenged by several scholars. Moreover, within this

discussion it is by no means clear what marks the boundaries between 'plant' and 'firm', as well as with 'firm' and 'industry'. Firms that grow beyond the critical point of minimum costs may adequately split before incurring in increasing costs. Yet this would imply that eventually one firm could supply the whole market, again undermining the idea of perfect competition.

Finally, increasing costs in the context of general equilibrium analysis is logically possible, and evidence from Sraffa's *Lectures* shows that he was fully aware of this possibility, contrary to what some critics of Sraffa have claimed. However, this does not contradict Sraffa's original critique of increasing costs, since his analysis was limited to partial equilibrium.

We have tried to argue that the problems of the orthodox theory of the competitive firm and its supply conditions as presented in the current mainstream literature have their origin in Sraffa's critique. One could argue that, as a first approximation to the subject, the pedagogical approach of mainstream economics, that of simplifying the matter and ignoring older theoretical debates, may be valid. The interested student –the argument goes– may be able study these problems in other subjects such as industrial organization or contract theory. However, what lies at the bottom of this line of defense is not the analysis of the boundaries of the firm or the different types of markets that exists and how firms strategically behave in each context. What is in debate is the logical validity of the supply and demand approach to value theory. On this matter, Sraffa's analysis is blunt, and the quest for an alternative approach is still in order.

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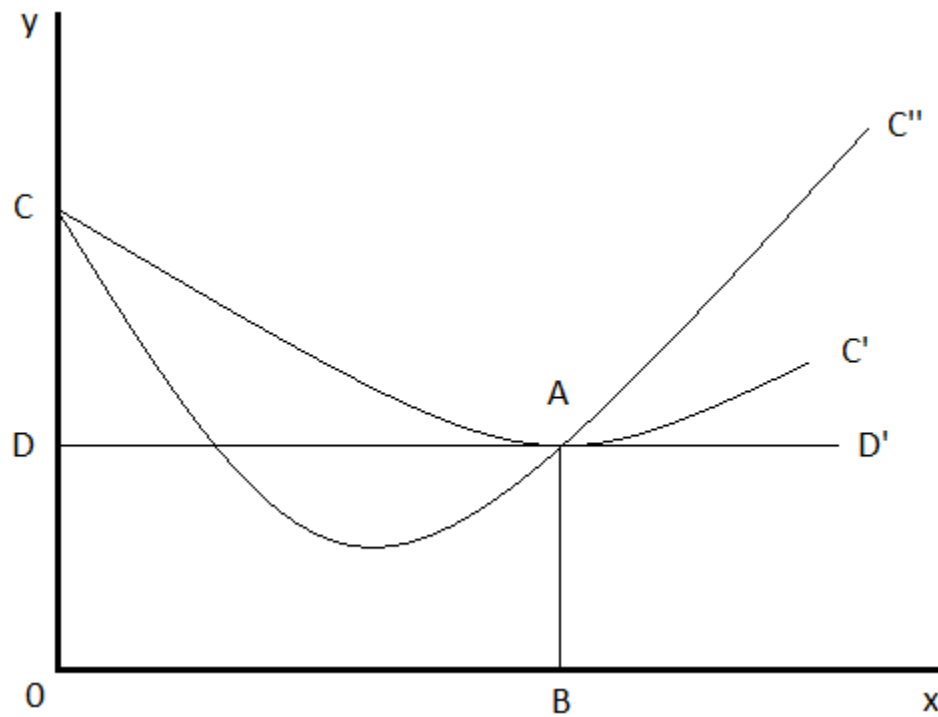
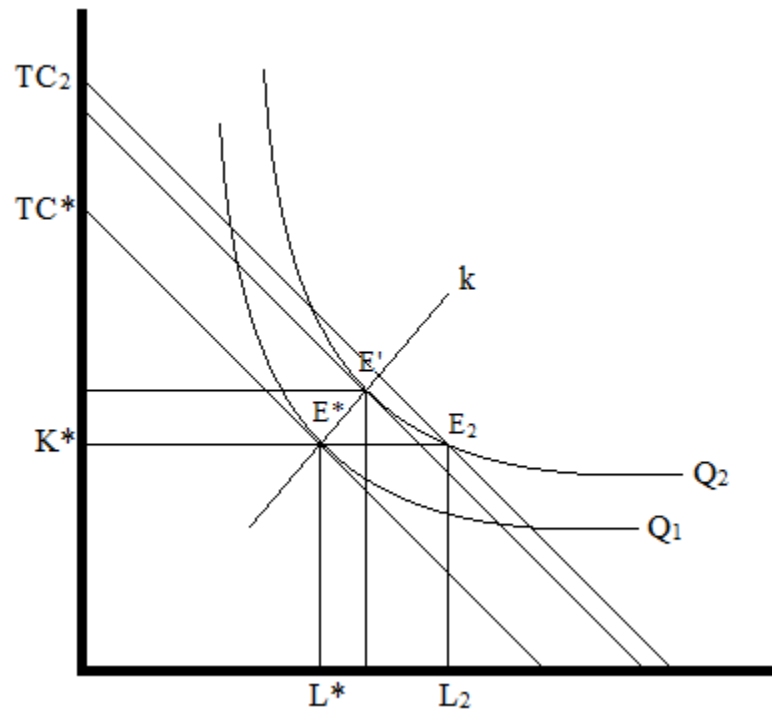**Figures**

Fig. 1: *Viner's U-shaped curve*
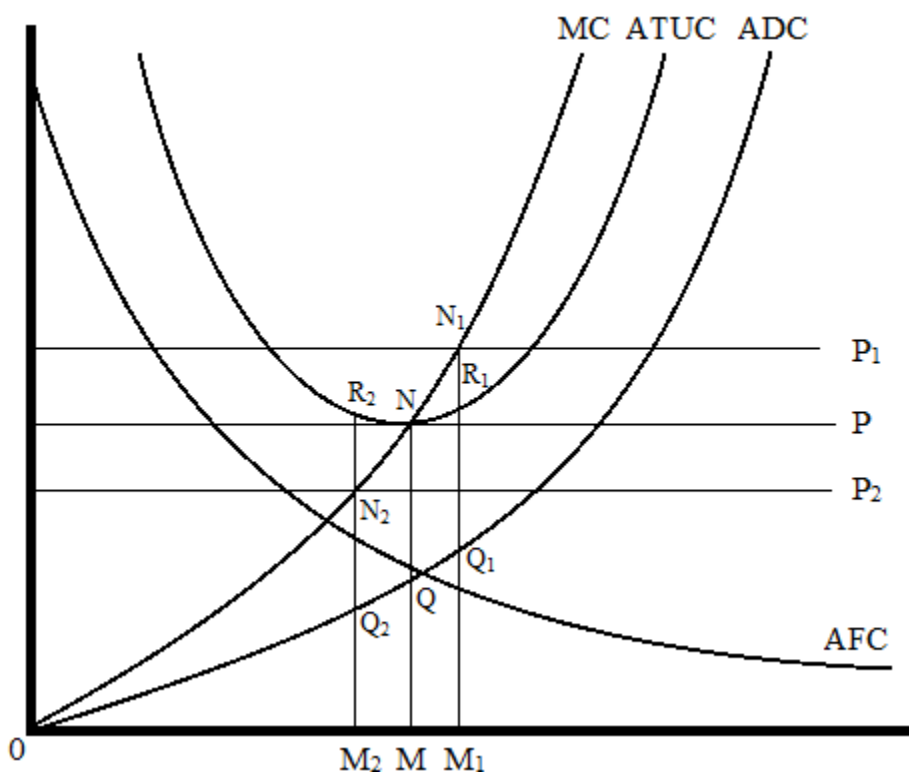
Source: Viner (1931, p. 26)

Fig. 2: *Sraffa's U-shaped curve*

Source: Sraffa (1925, p. 308)

Figure 3: *Output and cost adjustment in the short and long run*

Source: Authors' elaboration.