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THE CLASSICAL NOTION OF COMPETITION REVISITED

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1. Introduction

As is well-known, the Classical authors affirmed, without formally showing, the gravitation of market prices towards natural prices in all those markets characterized by free competition. Thus, in the wake of the revival of interest in Classical economics fostered by the publication of *Production of Commodities by Means of Commodities* (Sraffa 1960), since the mid '70 a vast literature has blossomed concerning the stability of long-period equilibrium within multisectoral models of Classical inspiration. (For a survey of the literature on gravitation see Bellino 2010.) Besides the formal results achieved on the subject of stability, the debate on gravitation has stimulated an in-depth investigation of the specificity of the Classical notion of market competition (Arena 1979, Semmler 1984, Steedman 1984, Duménil and Lévy 1987). Such investigation has also highlighted some unsatisfactory aspects of the latter, particularly as regards the actual process of market prices determination in a situation of short-period equilibrium:

> little is said concerning the actual process [which govern the functioning of the market for commodities]. For example, it is not clear who is changing prices, what information is used, when this change occurs, what the outcome is on the market etc. (Duménil and Lévy 1987, p. 136)

> [L'originalità della teoria classica della libera concorrenza] non è però in grado di nascondere certe insufficienze: l'economia politica classica si scontra infatti con il problema centrale dell'articolazione tra prezzi di mercato e prezzi naturali. La soluzione di queste difficoltà richiede una nuova definizione di questa articolazione. (Arena 1978, p. 323)[2]

The aim of this paper is to show how the modern notion of mixed strategy equilibria may be used to give formal precision to the Classical notion of market prices, thus overcoming some of the above drawbacks of the Classical view of market competition. With this aim in view, we compare two different conceptions of market competition: the walrasian notion of perfect

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[2] [The originality of the Classical theory of free competition] is not however able to hide certain inadequacies: the Classical political economy clashes with the central problem of the articulation between market prices and natural prices. The solution of such difficulties requires a new definition of this articulation (our translation)

competition and the Classical notion of free competition: while the former may be described as an equilibrium state in which atomistic agents treat prices parametrically, the latter is a situation in which agents employ their market power by setting prices strategically. We show that, for the Classical authors, in particular Adam Smith and Karl Marx, price undercutting or outbidding are the typical phenomena which occur in any market characterized by free competition. Moreover, we show that the Marxian view of market competition, hidden behind Marx's extensive use of metaphors and numerical examples, foreshadows the modern taxonomy of buyers' market, sellers' market and mixed strategy equilibrium in the capacity space of a standard Bertrand duopoly model.

The structure of the paper is as follows. Section 2 compares two different notions of the concept of market competition: the Classical notion of free competition and the neoclassical notion of perfect competition; while Section 3 highlights some problematic aspects of the latter, absent into the former. Section 4 and 5 are devoted to an assessment of the Classical theory of free competition, as developed by Adam Smith and Karl Marx, with particular concern to the issue of market prices determination. Section 6 investigates how the Classical notion of competition has percolated into modern literature on the so-called Bertrand competition. Section 7 concludes.

2. Two different notions of market competition or just one?

Few commentators would disagree with the following statement:

> Although the concept of competition has always been central to economic thinking […] it is one that has taken on a number of interpretations and meanings, many of them vague. (Vickers 1995, p. 3)

In particular, Vickers distinguishes the neoclassical notion of perfect competition – a "seemingly tranquil equilibrium state in which well-informed agents treat prices parametrically" − from the "original and 'real' concept" of competition − a "rivalrous behaviour with respect to prices and other variables in a world characterized by flux, uncertainty and disequilibrium." (*idem*, p. 7)

Despite the differences between these two notions, an authoritative school of historiographical thought has claimed that the Classical notion of free competition is but a primitive and pre-analytical version of the neoclassical theory of perfect competition, a version still imbued with casual empiricism:

> Competition entered economics from common discourse, and for long it connoted only the independent rivalry of two or more persons […] it is a remarkable fact that the concept of competition did not begin to receive explicit and systematic attention in the main stream of economics until 1871. This concept … was long treated with the kindly casualness with which one treats of the intuitively obvious. (Stigler 1957, p. 1)

Such an interpretation has deeply influenced many of the leading exponents of neoclassical economics. (See for example Arrow and Hahn 1971, in particular Chapter 1 'Historical Introduction', and Samuelson 1978.) Even outside the neoclassical camp this interpretation has found supporters, such as Lord Kaldor when he claims that "one can trace a more or less continuous development of price theory from the subsequent chapters of Smith [the fourth Chapter of *The Wealth of Nations*] through Ricardo, Walras, Marshall, right up to Debreu and the most sophisticated of present-day Americans" (Kaldor 1972, p. 1241).

Nonetheless, historians of economics have not been lacking who have endorsed an alternative point of view. McNulty (1967) not only has argued that the Classical notion of competition as a behavioural process is radically different from the neoclassical notion of competition as an equilibrium state; but he has gone so far as to claim that the neoclassical assumption of individual price-taking behaviour is entirely alien to the Classical analysis:[3]

> Smith's concept of competition was decidedly not one in which the firm was passive with respect to price but was, rather, one in which the market moved toward equilibrium through the active price responses of its various participants. (McNulty 1967, p. 397)

Moreover, McNulty adds that, *pace* Stigler, the Classical notion of competition is far from being derived from casual empiricism. Smith is the great systematizer of the analysis of the concept of market competition carried out by a series of authors before him and his specific contribution has been that to raise the concept of competition to a "general organizing principle of economic society […] After Smith's great achievement, the concept of competition became quite literally the *sine qua non* of economic reasoning" (McNulty 1967, pp. 396 – 397).

A corollary of such interpretation is that the Classical notion of market competition can be fully understood only within a vision of the economic science as a study of the forces that are in action in a given economic system. The distinction between two different notions of economic science − i) economics as the science that studies a system of forces and ii) economics as the science that studies a system of relations − has been recently introduced by Dardi (1983) and emphasized by Giocoli (2005):

[3] From this point of view, McNulty's interpretation is akin to those of Hollander (1973) and Eatwell (1987). The former claims that "the Smithian conception of competition must be carefully distinguished from the modern conception which envisages sellers (and consumers) as "price-takers" rather than "price-makers"." (p. 126); while the latter points out that "the characteristics of 'perfect' competition (notably the conditions which ensure price-taking) are often read back, illegitimately, into Classical discussions of competition." (p. 63). See also Machovec 2005, Chapter 8.

According to the system-of-forces (SOF) view, economics is a discipline whose main subject is the analysis of the economic processes generated by market and not-market forces, including - but by no means exclusively - the processes leading the system to an equilibrium. According to the system-of-relations (SOR) view economics is a discipline whose main subject is the investigation of the existence and properties of economic equilibria in terms of the validation and mutual consistency of given formal conditions, but that has little if anything to say about the meaningfulness of these equilibria for the analysis of real economic systems. (Giocoli 2005, p. 180)

According to Giocoli (*ibidem*), the SOF view is the dominant vision up to the years between the two World Wars, while the SOR view becomes popular only in the second postwar period when many intellectual efforts were devoted to the project of a fully axiomation of economic science.

In our view, the distinction between the Classical notion of competition and the neoclassical one and a careful analysis of the theoretical domain of the latter has not simply a historiographical worth. And this for at least two reasons:

a) the neoclassical theory of perfect competition carries with it some theoretical difficulties alien to the Classical notion of free competition.

b) the Classical notion of competition can be made analytically precise so soon as the modern concept of mixed strategies equilibrium is introduced into the picture.

The following Section is devoted to substantiate point a) above while we defer the analysis of the point b) to Section 6.

3. Some problematic aspects of the neoclassical theory of perfect competition

As pointed out by Green (1974), every market equilibrium concept requires the specification of a consistent set of behavioural postulates that prescribe what happens in equilibrium and what happens outside equilibrium. In the Walrasian framework, the behavioural postulates that define the situation of equilibrium differ from the behavioural postulates that define the mechanism of adjustment in disequilibrium. In fact, as it regards the situation of equilibrium, the behavioural postulate is that every agent assumes market prices as a parametric datum and, on the basis of such prices and other constraints, maximizes her own objective function; while in disequilibrium, the behavioural postulate is that a meta-agent, the auctioneer, determines market prices according to market excess demands. Moreover, no transactions among the agents are allowed to take place during the adjustment process.[4] As a consequence, the price-taking

[4] From this perspective Edgeworth' concept of equilibrium (*core*) and his adjustment process in disequilibrium (*recontracting*) are superior to the Walrasian ones: "The recontracting process … is based on the same behavioral postulate, blocking by coalitions, that is used to define the solution concept, the core [The core is defined to be the

behaviour assumption implies that each individual firm in a given market has no incentive to set a price different from the ruling market price and has no incentive to carry on transactions at a price different from the Walrasian market-clearing price. Thus, such an assumption drastically reduces the theoretical domain of the theory to equilibrium, market-clearing situations. To clarify this point, let's distinguish three notions of price in a partial equilibrium setting: p_{wx}, p_{mx} and p_{ix}.

p_{wx} is the Walrasian, market-clearing, equilibrium price of a given commodity *X*.

p_{mx} is the unique market price ruling all transactions in the market of commodity *X*.

p_{ix} is the price set by the *i-th* firm present in the market of commodity *X*.

Assume, as in standard textbook presentation of the perfect competition model, that the commodity *X* is homogeneous, that there is perfect information, common technology and that all the firms in the market under scrutiny are characterized by 'small' productive capacity.

Now consider two different scenarios. In the first scenario p_{mx} equals p_{wx}. In this case, the *i-th* firm, when choosing its own price policy, has three mutually exclusive options:

1) to set $p_{ix} = p_{mx} = p_{wx}$

2) to set $p_{ix} > p_{mx} = p_{wx}$

3) to set $p_{ix} < p_{mx} = p_{wx}$

In the first case, the *i-th* firm forms the expectation to sell all of its production; in the second case, to sell nothing; while in the third case, the *i-th* firm forms the expectation to be able to sell all of its production but, at the same time, not to be able to cover its average cost or not to be able to satisfy the whole demand in correspondence of such price. Therefore, in the $p_{mx} = p_{wx}$ scenario the *i-th* firm has no incentive to set a price p_{ix} different from p_{mx}.

In the second scenario p_{mx} is different from p_{wx}. That such a situation involves some difficulties to the neoclassical theory of perfect competition is acknowledged also by current textbooks:

> Strictly speaking, it is *equilibrium* market prices that [consumers and producers] will regard as unaffected by their actions. (Mas-Colell *et al*. 1995, p. 314, fn 1, authors' emphasis)

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set of all unblocked allocations. That is, it is the set of all allocations such that no subset of the participants can improve the position of all its members by withdrawing from the system and using only resources of its members]. This seems to be a desirable property. It is, however, not shared by most studies of disequilibrium price dynamics because these involve price changes brought about by a market manager or other artificiality. Prices do not vary as a consequence of the maximizing behavior of individuals." (Green 1974, p. 22)

In the $p_{mx} \neq p_{wx}$ scenario, individual firms do have an incentive not to behave in a passive way in their price decisions and do have well-grounded reasons to believe that their individual price decisions will have sensible effects on market price:

> For the price-taking assumption to be appropriate, what we want is that [consumers and producers] have no *incentive* to alter prices that, if taken as given, equate demand and supply (we have already seen that [consumers and producers] *do* have an incentive to alter prices that do not equate demand and supply). (*idem*, p. 315, authors' emphasis)

Such a conclusion reveals the existence of a more general problem for the neoclassical theory of perfect competition concerning the logical compatibility between *a*) the individualist thesis (methodological individualism) and *b*) the price-taking behaviour assumption. To put it in a nutshell, *a*) and *b*) constitute a sort of incompatible duo. The individualist thesis is violated if a meta-agent, such as the Walrasian auctioneer, is assumed to set p_{mx} according to market excess demand. Conversely, the price-taking behaviour assumption is violated if the agent setting p_{mx} is assumed to be an agent like all the other agents in the market under scrutiny. Therefore, outside the $p_{mx} = p_{wx}$ scenario, the neoclassical theory of perfect competition goes into serious troubles.

To our knowledge, Arrow (1959) is the first who has highlighted the logical difficulties besetting the neoclassical theory of perfect competition:

> the Law [of Supply and Demand, Arrow's equation 3: $dp/dt = h(S - D)$ with $h' < 0$ and $h(0) = 0$] is not on the same logical level as the hypotheses underlying equation 1 [$D = f(p)$ and $S = g(p)$]. It is not explained whose decision it is to change prices in accordance with equation 3. Each individual participant in the economy is supposed to take prices as given and determine his choices as to purchases and sales accordingly; there is no one left over whose job it is to make a decision on price. (Arrow 1959, p. 43)[5]

In short, for Arrow in the perfect competition set-up there is no place left for "a rational decision with respect to prices" (*idem*, p. 41) thus implying the conclusion that "perfect competition can really prevail only at equilibrium" (*ibidem*). The solution proposed by Arrow (1959) to study market price dynamics outside market-clearing equilibrium consists of turning to the theory of the monopoly:

> when supply and demand do not balance, even in an objectively competitive market, the individual firms are in the position of monopolists as far as the imperfect elasticity of demand for their products is concerned. (*idem*, p. 46)

[5] D (S) is the quantity demanded (supplied) of a given commodity X, p its price, $f(p)$ and $g(p)$ the demand and supply functions, respectively, while $dp/dt = h(S - D)$ is the time derivative which formalizes the law of motion of market price in relation to market excess demand.

However, Arrow claims that standard monopoly theory must be modified in the sense to remove the assumption that the monopolist perfectly knows her own demand curve (besides her own costs curves):

Uncertainty [as to the demand curve] is a crucial consideration in the theory of monopolistic price adjustment. (*idem*, p. 44)

In such circumstances, the monopolist will vary her own price, in a process of trials and errors, since she finds out the price that maximizes her expected profits.

To our goals, the salient points of Arrow's analysis are the following:

1) Jevons' Law of Indifference, that states that there is only one price ruling in a competitive market, ceases to be valid in disequilibrium:

Although the broad tendency will be for prices to rise when demand exceed supply, there can easily be a considerable dispersion of prices among different sellers of the same commodity (*idem*, pp. 46 – 47).

2) By assuming that competition takes place on the two sides of the market, that is, competition among producers and competition among consumers, it is possible to distinguish a market of the buyers from a market of the sellers:

By a parallel argument each buyer on a market with an inequality between supply and demand can be regarded as a monopsonist […] *In disequilibrium, the market consists of a number of monopolists facing a number of monopsonists*. The most general picture is that of a shifting set of bilateral monopolies […] In general, it is reasonable to suppose that if the selling side of the market is much more concentrated than the buying side, the main force in changing prices will be the monopolistic behaviour of the sellers […] Similarly, if the buying side of the market is the more concentrated, as in non-unionized labor markets, the dynamics will come from that side (*idem*, p. 47, emphasis added).

In the following two Sections we will make clear how these two elements of Arrow's contribution may be found in Smith's and, even more explicitly, in Marx's treatment of market prices, thus paving the way for a restatement of the Classical notion of competition by means of contemporary game-theoretic analysis.

4. The Classical notion of free competition: Adam Smith

Richardson (1975, pp. 350 – 351) has convincingly argued that "competition features within *The Wealth of Nations* in two different contexts; first, in the account given of the balancing of supply and demand in particular markets, and, secondly, in the explanation of structural and technological development. Smith offers us in effect both a theory of economic equilibrium and a theory of economic evolution; and in each of these competition has a key role to play." In what

follows we concentrate on the static aspect of the Smithian notion of market competition, concerned with market price determination, leaving aside its dynamic aspect (see Lavezzi 2003).

As far as the Classical notion of market competition is concerned, the *locus classicus* is Book I Chapter VII of Smith's *The Wealth of Nations*.[6] Smith's working assumption is that it is possible to classify the economic forces in action in a given moment into two broad categories, i) those erratic and short-lived that determine the market values both of commodity prices and the distributive variables and ii) those systematic and persistent that determine the natural values of the same magnitudes. Only for these latter Classical theorists hold to be able to say something formally precise.[7]

The data from which the Smithian argument starts are the natural values of wages, rent and profits which, sectorial specificities apart, depend on the conditions of prosperity of the economic system under scrutiny. The latter depend on the state of capital accumulation and on the share of productive workers on the total working population. From the summation of these three elements the natural price of (re)production of the various commodities comes down. The natural price is, therefore, a magnitude that is not formed in the market, but that, given some appropriate conditions, may come true in the market. The natural price, in fact, constitutes a sort of a floor for the market price in the sense that the latter cannot remain for long below the former without put into a serious hazard the reproduction of the commodity in question:

> The competition of the different dealers obliges them all to accept of [the natural price]; but does not oblige them to accept of less. […] The natural price, or the price of free competition … is the lowest which can be taken, not upon every occasion, indeed, but for any considerable time together … is the lowest which the sellers can commonly afford to take, and at the same time continue their business. (*WN* I.vii.11)

The natural levels of prices and distributive variable, therefore, constitute a kind of satisfactory level that, once reached, induce the economic agents to perform their economic activity in unchanged way.

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[6] As is well-known, Ricardo devotes to the distinction between natural and market magnitudes just a short Chapter, the IV, of his *Principles* where he explicitly refers to Chapter VII of *The Wealth of Nation*s where "all that concerns this question is most ably treated" (Ricardo 1951, p. 91).

[7] Ricardo clearly states that the *focus* of his analysis are natural magnitudes only: "Having fully acknowledged the temporary effects which, in particular employments of capital, may be produced on the prices of commodities, as well on the wages of labour, and the profits of stock, by accidental causes, without influencing the general prices of commodities, wages or profits, since these effects are equally operative in all stages of society, we will leave them entirely out of consideration, whilst we are treating of the laws which regulate natural prices, natural wages and natural profits, effects totally independent of these accidental causes" (Ricardo 1951, pp. 91 – 92).

The theoretical importance of natural prices consists of providing a guide to the theorist with the purpose to explain the dynamic path followed by market prices:

> The natural price, therefore, is, as it were, the central price to which the prices of all commodities are continually gravitating. Different accidents may sometimes keep them suspended a good deal above it, and sometimes force them down even somewhat below it. But whatever may be the obstacles which hinder them from settling in this center of repose and continuance, they are constantly tending towards it. (*WN* I.vii.15)

To study the genesis of market prices and the existing relations between market prices and natural prices Smith introduces the concept of *effectual demand* that is "the demand of those who are willing to pay the natural price of the commodity". It is to be stressed that the relationship between the quantity brought to the market and the effectual demand determines only the market price of a commodity and not also its natural price.[8] Moreover, "demand" and "supply" are treated by Smith as given quantities and not as functional relationships between price and quantity characterized by well-defined formal properties, as it will be in the neoclassical theory (Garegnani 1983).[9]

Given the unplanned nature of market economies, at the end of a productive cycle, entrepreneurs may not face in the market a demand able to absorb the whole of their production (at least) at the natural price. This fact requires for the specification of an adjustment mechanism powerful enough to realize the effective convergence to a situation in which the produced quantity coincides with the effectual demand: in the absence of such a mechanism, natural prices could not constitute a reliable guide to explain the movements of market prices.[10]

To put it briefly, the adjustment mechanism envisaged by Classical authors is as follows. At the end of a productive cycle, the entrepreneur brings to the market a given stock of produced commodity resulting from the production decisions taken at the beginning of the cycle just

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[8] See Ricardo's rejection of the opinion that price depends solely from the proportion between these two quantities (Ricardo 1951 vol. I , p. 382).

[9] Differences between the classical and the neoclassical theories of value and distribution have been emphasised by authors such as Bharadwaj (1978), Roncaglia (1978) and Garegnani (1984). Needless to add, historiographical controversies are still well alive: see Blaug (1999) *vs* Kurz and Salvadori (2002).

[10] This consideration may explain Ricardo's emphasis on the effectiveness of the adjustment mechanism: "When we look to the markets of a large town, and observe how regularly they are supplied both with home and foreign commodities, in the quantity in which they are required, under all circumstances of varying demand … without often producing either the effect of a glut from too abundant a supply, or an enourmously high price from the supply being unequal to the demand, *we must confess that the principle which apportions capital to each trade in the precise amount that is required, is more active than is generally supposed*" (Ricardo 1951 vol. I, p. 90, emphasis added)

concluded. Of course, she cannot modify such stock for adjusting it to the demand she actually meets on the market. Thus, the adjustment variable is constituted by the selling price of the commodity. Smith assumes that, in presence of a gap between production and effectual demand, a sort of auction starts among the agents that happen to be on (what we today would call the) long side of the market: such agents are prepared to offer higher and higher prices (in case of excess demand) or lower and lower prices (in case of excess supply).

Once the market price of any commodity happens to be different from its natural price, this fact provokes an unbalance in the distributive sphere in the sense that the remunerations of those people that have contributed to the production of the commodity turn out to be different from their respective natural values. In the absence of entry/exit barriers and in the presence of market transparency this fact provokes i) an intersectorial reallocation of economic resources in the search of the highest market remuneration and ii) a variation of the produced quantity of the commodity in the following periods. Such process comes to a halt only when produced quantity and demanded quantity balance in correspondence of the natural price and the market values of wages, profits and rent equal their respective natural values.[11] Therefore, the unbalance in the sphere of circulation (discrepancy between natural price and market price of a commodity) spill over in the sphere of distribution (discrepancy between natural values and market values of wages, profits and rent) and, finally, in the sphere of production (intersectorial reallocation of the productive resources and variation of the produced quantities in the following periods).

The assumed tendency of the market values to their respective natural values is based on two assumptions: 1) economic agents consider, besides the outlay costs, also the opportunity-costs in their decisions as to where to allocate their economic resources and 2) there are but negligible barriers to the intersectorial mobility of the economic resources:

When the price of any commodity is neither more nor less than what is sufficient to pay the rent of the land, the wages of the labour, and the profits of the stock employed in raising, preparing, and bringing it to market, according to their natural rates, the commodity is then sold for what may be called its natural price. The commodity is then sold precisely for what it is worth, or for what it really costs the person who brings it to market; for *though in common language what is called the prime costs of any commodity does not comprehend the profit of the person who is to sell it again, yet if he sell it at a price which does not allow him the ordinary rate of profit in his neighbourhood, he is evidently a loser by the trade; since by employing his stock in some other way he might have made that profit*. […] Though the price, therefore, which leaves him this profit is not always the lowest at which to dealer may sometimes sell his goods, it is the lowest at which he is likely to sell them for any considerable time; at

[11] However, Classical economists were perfectly aware of the existence of profit and wage rate differentials. For a modern treatment see Kurz and Salvadori 1995, Chapter 11.

least where *there is perfect liberty, or where he may change his trade as often as he pleases*. (*WN* I.vii.6, emphasis added)

The above shows that Smith devotes much care to the issues of natural values determination and to the gravitation process of market magnitudes to their natural counterparts. The same may not be maintained as far as the issue of market prices determination is concerned, particularly when the market is not in a situation of long-period equilibrium. Taking stock of Smith's sparse hints on this subject it is possible to point out what follows:

1) In those markets in which competition is not free (e.g., because of legal monopoly and/or the presence of a guild, a collusive agreement, a law or a rule that, someway, prevents economic agents to allocate their resources in the sector they prefer) or where are industrial secrets, entrepreneurs voluntarily limit the produced quantity so that the market is left understocked and the market price stays artificially high:

The exclusive privileges of corporations, statutes of apprenticeship, and all those laws which restrain, in particular employments, the competition to smaller number than might otherwise go into them, have the same tendency, though in to less degree. They are a sort of enlarged monopolies, and may frequently, for ages together, and in whole classes of employments, keep up the market price of particular commodities above the natural price, and maintain both the wages of the labour and the profits of the stock employed about them somewhat above their natural rate. (*WN* I.vii.28)

Conversely, where competition is free and industrial secrets absent, a process of price-undercutting starts so soon as at least two competitors are present in the market. This process is amplified by increasing the number of competitors since this fact makes the establishment of a collusive agreement more unlikely:

The quantity of grocery goods, for example, which can be sold in a particular town is limited by the demand of that town and its neighbourhood. The capital, therefore, which can be employed in the grocery trade cannot exceed what is sufficient to purchase that quantity. If this capital is divided between two different grocers, their competition will tend to make both of them sell cheaper than if it were in the hands of one only; and if it were divided among twenty, their competition would be just so much the greater, and the chance of their combining together, in order to raise the price, just so much the less. (*WN* II.v.7)

2) Smith's explanation concerning the determination of market prices in situations of short-period equilibrium includes both elements apparently fruit of a casual observation and that he doesn't analyse in greater detail (the wealth of the buyers and their desire to get the commodity *vs* the necessity of the sellers to free themselves from their own commodities) and elements that he instead systematically applies in his analysis of the various markets. Of these latter the most meaningful is the relative number of sellers and buyers and their relative ability to make a binding agreement. The market price will be high or low whether the buyers are more numerous

than the sellers (and viceversa): the buyers "bid against one another" offering higher and higher prices, the sellers "bid against one another" offering lower and lower prices. The relative number of the buyers in relation to the sellers is therefore the crucial element: every time that the agents on one side of the market are few and are able to communicate (e.g. because they operate in the same place such as a town) while the agents on the other side of the market are many and are not able to communicate (e.g. because they are isolated and scattered in the countryside) the bargaining from which the market price springs will obviously be more favorable to the former. This is particularly evident in Smith's analysis of the labour market:

> What are the common wages of labour, depends every where upon the contract usually made between those two parties, whose interests are by no means the same. The workmen desire to get as much, the masters to give as little as possible. The former are disposed to combine in order to raise, the latter in order to lower the wages of labour. It is not, however, difficult to foresee which of the two parties must, upon all ordinary occasions, have the advantage in the disputes, and force the other into to compliance with their terms. The masters, being fewer in number, can combine much more easily; and the law, besides, authorises, or at least does not prohibit their combinations, while it prohibits those of the workmen. […] When in any country the demand for those who live by wages; labourers, journeymen, servants of every kind, is continually increasing; when every year furnishes employment for to greater number than had been employed the year before, the workmen have no occasion to combine in order to raise their wages. The scarcity of hands occasions a competition among masters, who bid against one another, in order to get workmen, and thus voluntarily break through the natural combination of masters not to raise wages. (*WN* I.viii.11-12 and 17)

In the following Section we show how Marx draws on and develop these elements of Smith's treatment of market prices.

5. The Classical notion of free competition: Karl Marx

In Chapter 3 of *Wage-Labour and Capital* (Marx [1847] 1933) it is possible to find a vivid description of the determination of the short-period price in the market of a raw material, cotton. We think that such a description provides a clue to the young Marx's view of the competitive process. The Chapter bears the title of "By what is the price of a commodity determined?" and Marx's answer is the quite conventional one: "By the competition between buyers and sellers, by the relation of the demand to the supply, of the call to the offer." (*idem*, p. 21) Yet, immediately after, he adds that "[t]he competition by which the price of a commodity is determined is *threefold*. (*ibidem*, emphasis added) The first element highlighted by Marx is competition among the sellers:

Whoever sells commodities of the same quality most cheaply, is sure to drive the other sellers from the field and to secure the greatest market for himself. […] [It is competition among the sellers] which forces down the price of the commodities offered by them. (*ibidem*)

The second element is competition among the buyers which "causes the price of the proffered commodities to rise" (*ibidem*). These two aspects of competition are *not* considered by the young Marx sufficient to fully determine the outcome of the competitive process. In fact, Marx adds a third and last element:

Finally, there is *competition between the buyers and the sellers*: these wish to purchase as cheaply as possible, those to sell as dearly as possible. The result of this competition between buyers and sellers will depend upon the relations between the two above-mentioned camps of competitors – i.e., upon whether the competition in the army of sellers is stronger. Industry leads two great armies into the field against each other, and each of these again is engaged in a battle among its own troops in its own ranks. The army among whose troops there is less fighting, carries off the victory over the opposing host. (*ibidem*, Marx's emphasis)

We claim that the metaphor of the two armies which, at the one and the same time, are engaged into fightings against each other and into internal fightings within their own camp coupled with the hint that the result of the battle is eventually determined by the interplay of these two levels of fight pave the way to an interesting analytical intuition. In our view, in fact, Marx's rethorics foreshadows the modern notion of price determination in a mixed strategies equilibrium: the outcome of market competition needs not to be univocally determined, even if optimal (mixed) strategies are.

To clarify his thought Marx goes on by providing a concrete example. Marx's choice of a raw material market for this didactic purpose is illuminating. In the market of a consumption good it is quite obvious to assume a multitude of atomistic buyers. In such a case competition among buyers would be reduced to their reservation prices and, eventually, described by means of a demand curve. It may not be so in the case of a market of a raw material, where buyers may be larger than sellers and it is possible to reverse the image of atomistic buyers to that of atomistic sellers. Marx's example starts with the analysis of what, in modern terminology, is called a sellers' market:

Let us suppose that there are 100 bales of cotton in the market and at the same time purchasers for 1,000 bales of cotton. (*ibidem*)

The fact that the demand is many (ten!) times greater than the supply is very likely to be intentional: if there were 100 bales and purchesers for 110, conditions would have not been, in Marx opinion, those of a sellers' market. On the contrary 100 to 1,000 is considered enough to have that

The cotton sellers, who perceive the troops of the enemy in the most violent contention among themselves, and who therefore are fully assured of the sale of their whole 100 bales, will beware of pulling one another's hair in order to force down the price of cotton at the very moment in which their opponents race with one another to screw it up high. So, all of a sudden, peace reigns in the army of sellers. They stand opposed to the buyers like one man, fold their arms in philosophic contentment and their claims would find no limit did not the offers of even the most importunate of buyers have a very definite limit. (*idem*, p. 22)

Obviously, the ratio between 1 to 10 is, in itself, neither a necessary nor a sufficient condition. It can be easily proved that the necessary and sufficient condition is that all buyers but the largest one are willing to buy *more* than the existing amount of cotton. Since the largest buyer could be excluded from the purchase, any other buyer could be excluded too. Therefore, the best strategy for each buyer is to express a demand for cotton at her reservation price. If, on the contrary, all buyers but the largest one are willing to buy *less* than the existing amount of cotton, the largest buyer knows that she will certainly buy some cotton. In the limiting case in which all buyers but the largest one have purchased their desired amount of cotton, the largest buyer is a monopsonist with respect the sellers who have not sold their cotton. This simple fact is sufficient to prevent also the other buyers from buying at their reservation prices. Therefore, sellers cannot "stand opposed to the buyers like one man" and "fold their arms in philosophic contentment": they must fight each other to sell at an higher price. As a consequence, both armies, to use Marx's metaphor, are engaged into intestine fights. The best strategies for both buyers and sellers are not single (that is, deterministic) prices, but distributions of probability within a set of prices.

Going back to Marx example, he continues by introducing the buyers' market:

It is well known that the opposite case, with the opposite result, happens more frequently. Great excess of supply over demand; desperate competition among the sellers, and a lack of buyers; forced sales of commodities at ridiculously low prices. (*ibidem*)

Marx's text reveals that, for him, buyers' market and sellers' market are not strictly contiguous in the sense that between them there must be something, but apart from the metaphor of the two armies, his readers are just left with the obvious remark that

In the same proportion in which [competition among the sellers] decreases, the competition among the buyers increases. Result: a more or less considerable rise in the prices of commodities. (*ibidem*)

Following the same argument used above, we can argue that a necessary and sufficient condition for a buyers' market to hold is that all sellers but the largest one can offer *more* than the amount of cotton that buyers are willing to buy. This is also enough to clarify that in between there is room for the mixed strategy equilibrium.

The Marxian text continues by introducing long-period considerations that is, the gravitation of market prices towards prices of production (here Marx uses the expression "costs of production")

as a consequence of capital migration from (into) those sectors where market prices are below (above) costs of production. Yet, in Marx' view, long-period analysis is no way to be priviledged in relation to the short-period one and market prices are not be dismissed lightly as theoretically insignificant. Marx, in fact, goes so far as to claim that the typical market outcome is market price above or below costs of production while the equality between the two should rather be considered as an exception:

> The determination of price by the cost of production is not to be understood in the sense of the bourgeois economists. The economists say that the average price of commodities equals the cost of production: that is the law. The anarchic movement, in which the rise is compensated for by a fall and the fall by a rise, they regard as an accident. We might just as well consider the fluctuations as the law, and the determination of the price by cost of production as an accident – as is, in fact, done by certain other economists. But it is precisely these fluctuations which, viewed more closely, carry the most frightful devastation in their train, and, like an earthquake, cause bourgeois society to shake to its very foundations – it is precisely these fluctuations that force the price to conform to the cost of production. In the totality of this disorderly movement is to be found its order. In the total course of this industrial anarchy, in this circular movement, competition balances, as it were, the one extravagance by the other. (*idem*, p. 24)

The reader might think that the elder Marx, equipped with an improved understanding of the Classical notion of prices of production and with a more mature version of his own theory of labour-value, would have not endorsed the foregoing analysis by the young Marx. We think that is not the case, as witnessed by Book III, Chapter X of *Capital* (Marx [1894] 1909).

This Chapter, bearing the title "Compensation of the Average Rate of Profit by Competition. Market Prices and Market Values. Surplus-profit", is located in Part II, where Marx is confronted with the (insurmountable) problem of conciliating the origin of profit from surplus-value with an uniform rate of profit and an uniform rate of surplus-value among sectors. This is not the place to provide a thorough assessment of this Chapter. It suffices to note the following.

After having identified in II.X.14 the conditions which need to be met in order that "the prices at which commodities are exchanged with one another may correspond approximately to their values", in II.X.15 Marx adds:

> [The fact that] the commodities of the various spheres of production are sold at their value implies, of course, only that their value is the center of gravity around which prices fluctuate, and around which their rise and fall tends to an equilibrium.

This sentence has been often quoted in modern literature on the gravitation. However, it is not clear whether Marx think that the price is unique at each moment of time or, rather, there is a constellation of prices at each moment of time. The difference is substantial. If sellers and buyers follow mixed strategies instead of pure strategies, there is clearly a constellation of prices at each

moment of time. Marx identifies also two simple cases. In the first "demand is so strong that it does not let up when the price is regulated by the value of commodities produced under the most unfavorable conditions" (II.X.16); in this case these conditions determine the market-value. In the second "the mass of the produced commodities exceeds the quantity which is ordinarily disposed of at average market-values" and, as a consequence "the commodities produced under the most favorable conditions regulate the market value" (*ibidem*). Marx is more interested into to the result of this process than into the analysis of less simple cases.[12] However, in II.X.51, he claims:

> That side of competition, which is momentarily the weaker, is also that in which the individual acts independently of the mass of his competitors and often works against them, whereby the dependence of one upon the other is impressed upon them, while the stronger side always acts more or less unitedly against its antagonist. If the demand for this particular kind of commodities is larger than the supply, *then one buyer outbids another*, within certain limits, and thereby raises the price of the commodity for all of them above the market-price, while on the other hand *the sellers unite in trying to sell at a high price*. If, vice versa, the supply exceeds the demand, some one *begins to dispose of his goods at a cheaper rate* and the others must follow, while the buyers *unite in their efforts to depress the market-price as much as possible below the market-value*. The common interest is appreciated only so long as each gains more by it than without it. And common action ceases, as soon as this or that side becomes the weaker, when each one tries to get out of it by his own devices with as little loss as possible. (*ibidem*, emphasis added)

Here we find a clear echo of the argument used by the young Marx in *Wage, Labour and Capital*. It is also clear that the price is *not* unique at each moment of time: on the contrary, there is a constellation of prices at each moment of time. This fact supports our claims that the process need to be analyzed under the assumption that buyers and sellers follow mixed strategies instead of pure strategies.

6. Classical competition and Bertrand competition

In the previous Sections we have outlined the Classical notion of competition with a particular concern to the issue of market prices determination. In this Section we try to answer to the following question: Has the Classical notion of competition percolated within modern theory? A

[12] "No matter what may be the way in which prices are regulated, the result always is the following: 1) The law of value dominates the movements of prices, ... 2) The average profit which determines the prices of production must always be approximately equal to that quantity of surplus-value, which falls to the share of a certain individual capital in its capacity as an aliquot part of the total social capital" (§§ 17-18).

positive answer to such a question would allow us to make use of some recent results in order to extend the analysis of market competition within Classical economics.[13]

As is well known, in 1883 the then famous mathematician Joseph Louis François Bertrand wrote a highly critical review of Walras' *Théorie mathématique de la richesse sociale* and Cournot's *Recherches sur les principes mathématiques de la théorie des richesses*.[14] As concerns Walras, Bertrand focused his scorn on the meta-agent, the auctioneer, and the process of *tatonnement* towards equilibrium. As concerns Cournot, Bertrand stigmatized the latter's use of quantities as the strategic variables in his duopoly model. By contrast, Bertrand sketched a model in which firms compete each other by means of price undercutting. He described how price competition would lead to a downword spiral of prices. This is not the place to discuss whether Bertrand's views, particularly as concerns Cournot, are well-grounded or not (see Magnan de Bornier 1992 and 2001, Dimand and Dore 1999, Morrison 1998 and 2001). From our perspective, it is interesting to note that a mathematician, with no much training in economics, suggested a concept of competition which was far away from the concept of competition which was going to be developed in those years and much closer to the concept of competition used by Classical economists.

Sixteen years later, another contribution came from a distinguished economist, Francis Ysidro Edgeworth. He wrote a paper, originally published in Italian in 1897 and translated with some modifications into English in 1925, in which he argued that, *pace* Cournot, duopoly equilibrium is indeterminate:

> [The case of two identical articles] is treated by Cournot as the first step in the transition from monopoly to perfect competition. He concludes that a determinate proposition of equilibrium defined by certain quantities of the articles will be reached. Cournot's conclusion has been shown to be erroneous by Bertrand for the case in which there is no cost of production; by Professor Marshall for the case in which the cost follows the law of increasing returns; and by the present writer for the case in which the cost follows the law of diminishing returns. In the last case there will be an indeterminate tract through which the index of value will oscillate, or rather will vibrate irregularly for an indefinite length of time. (Edgeworth 1925, pp. 117 − 118)

To defend this claim, Edgeworth produced a numerical example in which two firms compete on prices, but they have capacity constraints. Edgeworth showed there is no (pure strategy) equilibrium in his example and formulated a sort of dynamical solution: firms undercut each other

[13] In a series of papers Kurz and Salvadori (1993, 1998, 2000) have employed a similar analytical strategy in relation to von Neumann model, endogeneous growth models, and input-output models.

[14] An English translation of Bertrand's text, originally in *Journal des Savants*, vol. 48, pp. 499 − 508, is provided in the Appendix of Magnan de Bornier (1992).

until price becomes so low that it is convenient for a firm to quote an high price and sell only the residual demand instead than to undercut the price quoted by the rival. As Edgeworth wrote:

> [A]t every stage in the fall of price, and before it has reached its limiting value $1/4$, it is competent to each monopolist to deliberate whether it will pay him better to lower the price against his rival as already described, *or rather to raise it to a heigher, perhaps the initial*, level for that remainder of customers of which he cannot be deprived by his rival (owing to the latter's limitation of supply). Long before the lowest point has been reached, that alternative will have become more advantageous than the course first described. (*idem*, p. 120)

With the devolepment of game theory and its application to economics, the kind of duopolistic, price-based, competition depicted by Bertrand, and then revisited by Edgeworth, became a fruitful and extensively studied alternative to the atomistic, price-taking agents, competition of the standard perfect competition model (see Baye and Kovenock 2008). Yet, the so-called Bertrand competition, as formulated by contemporary game theorists, is somewhat different from the original formulation. First, it is a one-shot game with a mixed strategy equilibrium and not a dynamical process of price-undercutting. This feature magnifies the problem of firms quoting the same price: in the case of a tie the firms charging the lowest prices must share total demand in a way or another. This requires the introduction of a specific assumption at this regard, assumption absent in Smith's and Marx's writings. Second, it is necessary to model how demand is rationed when a firm's quantity demanded exceeds its capacity. Thus, another assumption, lacking in the Classical authors, is needed.

A comparison between modern Bertrand competition and Smith's notion of competition and even more the story told by Marx in *Wage-Labour and Capital*, shows clearly these differences. First of all, in the former there is a multitude of atomistic buyers described by means of a demand curve confronted with a given number of sellers, each defined by its costs (generally marginal costs are constant and uniform) and its capacity. On the contrary in Marx we find a sort of simmetry between sellers and buyers. It is certainly not difficult to extend the Bertrand competition model to investigate the case in which there is multitude of atomistic sellers described by means of a supply curve confronted with a given number of buyers, each defined by its reservation price (possibly constant and uniform) and its capacity. Generalization to a symmetrical case in which a number of sellers with their costs and selling capacities are confronted with a number of buyers with their reservation prices and buying capacities is certainly less obvious. Second, Bertrand competition theorists have analyzed quite extensively the case of duopoly and, in the presence of constant and uniform marginal cost, have determined three areas of the capacity space: one in which in equilibrium price equals the marginal cost (buyers' market), one in which in equilibrium price equals the demand price corresponding to the

sum of capacities (sellers' market), one in which there is a mixed strategy equilibrium where distributions of probability and supports of the strategies are uniquely determined. In Marx we may find a hint of these three cases specification, but the limit between them is not exactly determined and mixed strategies (obviously, a concept totally unknown at that time) are substituted by a metaphor of two armies which are engaged into fightings against each other and into internal fightings within their own camp. However, in the light of the modern theory of oligopoly, we have pointed out a clear congecture of the limits among these three cases (all buyers but the largest one willing to buy *more* than the existing amount of a given commodity for a sellers's market and all sellers but the largest one willing to offer more than the amount of a given commodity buyers are willing to purchase for a buyers's market). Obviously, a formal analysis is required.[15]

7. Final remarks

In this paper we have attempted at an assessment of the Classical notion of free competition in comparison with the Walrasian notion of perfect competition. We have shown that the latter is plagued with some logical difficulties which drastically reduces its explanatory power to equilibrium situation. Such difficulties are absent in the Classical notion of competition which, contrary to the Walrasian one, is not based on any kind of price-taking assumption. Yet, also the former displays some unsatisfactory aspects. In particular, we refer to the fact that Classical authors, while they have extensively investigated long-period, natural, values and the subject of gravitation, have been more sketchy as concerns market prices determination in short-period disequilibrium. To fill this lacuna we have analysed Smith's and Marx's (both the young Marx of *Wage-Labour and Capital* and the mature Marx of *Capital*) views on competition between buyers and sellers. We claim that, taking inspiration from the modern theory of Bertrand competition, it is possible to render formally precise Smith's and Marx's hints.

[15] De Francesco and Salvadori (2010) have investigated the Bertrand-Edgeworth model in the case of a oligopoly, with a complete analsis of the triopoly (see also the literature there referred to). When competing firms are more than two many changes are needed. In the case of two firms, any firm can either undercut the other or avoid to do so. In the case of three or more firms any firm can either undercut all other firms or just some of the firms and not others or none of them. For example in the case in which there are two (not equal) large firms and a smaller firm, this last one can avoid high prices so that the two large firms are not interested in undercutting it when they undercut each other at higher prices. Some small firm can take advantage of this protection from competition of larger firms (at high prices) to obtain a larger rate of profit. A further problem is that in some special conditions the mixed strategies of some firms (but not all) may be undedetermined (but all profits are uniquely determined).

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Abstract

We compare and analyse two different conceptions of market competition: the walrasian notion of perfect competition and the Classical notion of free competition: while the former may be described as an equilibrium state in which atomistic agents treat prices parametrically, the latter is a situation in which agents, endowed by market power, fix prices strategically. We show that

price undercutting or outbidding are the typical phenomena that, for the Classical authors, may be observed in a market characterized by free competition. We investigate some problematic aspects of the neoclassical notion of perfect competition and we reconstruct the Classical theory of free competition, as developed, in particular, by Adam Smith and Karl Marx, in the light of the modern notion of mixed strategies equilibria.

Keywords

Classical and neoclassical notions of competition, Adam Smith, Karl Marx, mixed strategies.