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THE ECONOMICS OF ANTOINE AUGUSTIN COURNOT \*  
(1801 - 1877)

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I. INTRODUCTION

The impact of traditional economists, among whom the first position is held by the Classics, may be considered responsible for «hibernation» of Cournot's ideas. The «traditionalists» were non-mathematical economists and those like Cournot who attempted broad use of mathematics, paid for it with long anonymity and disregard.

Cournot's important book «Researches»<sup>1</sup> was translated into English in 1897, quite a long time for such a book to be unnoticed by a large segment of important economists. The price of disregard was also paid by Stanley Jevons. It was the work of Alfred Marshall and the difficulties it encountered that revealed the need for more drastic use of mathematics.

Politica Economy according to Cournot deals with «the hygiene and pathology of the social system» but fails in its theoretical progress towards improvement of mankind, first because it cannot reduce the relations it studies into fixed terms, and second because these relations are too complicated «for our powers of combination and analysis»<sup>2</sup>.

To say that Cournot as an economist created a «system» would be exaggeration but to admit that he introduced ideas which for decades became the center of economic analysis is the scientific duty of any historian of economic thought.

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1. *Researches sur Les Principes Mathématiques de la Théorie des Richesses*; By Antoine Augustin Cournot, published in 1838; Translated into English by N. J. Bacon (1897); for the preparation of this paper I used the English translation, 2nd edition (1927).

2. *Ibid.*, p. 13.

On the concept of value Cournot did not introduce any innovations except that the vigour of mathematical treatment made the concept and its distinctions more precise. His mathematical approach help him to clarify not only the several distinctions of value but also the changes in value and the causes of these changes.

He established clearly the concept of an international clearing house and thus freed us from the complexities of bimetalism, even though certain aspects of his analysis are antiquated today as dealing exclusively with the needs of his period. In addition he was handicapped with insufficient analytical apparatus. He was a pioneer, and while his ideas are new because of the reasons stated, they by necessity are incomplete.

Cournot gave us a crude process of price analysis in the search for profit maximization and his concept of the cost of production is quite inadequate and vague. He also investigated the process of achieving price equilibrium and the role of taxes in cost analysis.

He begins his anatomy of the market with a surprisingly new set of analytical distinctions and presents us with the fundamentals of the theory of monopoly and his work became what Schumpeter calls the backbone of the Marshallian theory on the subject<sup>3</sup>. Cournot followed his monopoly theory with what today we call duopoly, oligopoly, monopolistic competition by increasing the number of producers. In all this we have in Cournot the backbone of the monopoly theory and a rather good idea of duopoly which became so fashionable after *The Theory of Monopolistic Competition*.

As Schumpeter puts it Cournot was the first, the second was von Thünen, «to visualize the general interdependence of all economic quantities and the necessity of representing this cosmos by a system of equations»<sup>4</sup>. It was mainly L. Walras who developed this point to a complete, even though static, system, but on this elsewhere.

It is clear that Cournot associates the cost of living with rising or falling prices but this point is not clearly demonstrated. He seems to agree with Malthus on the importance and the role of consumption and also gives us an explanation of cyclical fluctuations. We have, furthermore, indications on the role of the principle of substitution.

Finally, we see in Cournot an attempt towards macro-economic ana-

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3. *History of Economic Analysis*; by J.A. Schumpeter, Oxford University Press; New York (1954) p. 960.

4. *Ibid.*, p. 467.

lysis but due to the intricacy of the subject he approached it on a partial basis and dealt only with a crude theory of distribution and part of macroconcepts, especially the social income.

In the study of economic problems Cournot came to the conclusion that the use of mathematics is not a matter of caprice but of necessity since other media fail to disentangle the complexity of the factors involved.

Irving Fisher in this introduction to the English translation of «*Researches*» gives us a technical analysis of Cournot's work and a more or less complete list of the literature on mathematical economics up to the time of the translation's second edition. Today Cournot's attempts and the work of his successors on the role of mathematics in economic analysis have gained general acceptance and the necessity of a rigid mathematical education for economists has become the *sine qua non* of our serious work.

## II. A CLOSER LOOK AT COURNOT'S ECONOMIC IDEAS

Cournot is a theoretician; at least he emphasizes the role of theory as a scientific discipline, but he cannot understand theory without the help of mathematics. Theory without mathematics is weak; to be effective it «must be strengthened by mathematical analysis»<sup>5</sup>. But as a whole he is offering us not a complete body of economic analysis but a group of exercises on economic problems in the solution of which mathematics plays predominant role. Cournot explains that no use of mathematics has been by the great economists of his day due to their unfamiliarity with the subject.

One of his economic exercises is the theory of wealth which he considers as the subject matter of economics. The theory of wealth is the outcome of the progress of commercial relations and «the gradual reaction of these relations on civil institutions»<sup>6</sup>.

We apply the concept of wealth to objects which are not easily obtainable; thus, his definition of wealth is rather narrow because it includes what are considered as exchangeable values. Wealth and its theory would be idle speculation if they did not refer to actual objects from which wealth is made up.

The ideas of wealth or value in exchange, according to his defi-

5. *Researches*, op. cit. p. 1.

6. *Ibid.*, p. 5.



dition, must be distinguished from ideas like utility or scarcity which, on the one hand are variable and on the other indeterminate. Such ideas «are questions of valuation, and not soluble by calculation, nor by logical argument»<sup>7</sup>.

The shortcomings of the traditional economists as far as value is concerned consist in their inability to clarify value and the essence of the distinction between relative and absolute value. They are working with a fuzzy concept. Motion must be considered first as a change of position or second as displacement or relative movement. In the same way motion is connected to position, a commodity is assigned value by reference to other commodities. Thus we establish the meaning of relative value, the value of one commodity compared with the value of another. But this relative value, or any relative value for that matter, changes because of absolute changes occurring to the one or the other commodity or to both of them. If the absolute value of all other commodities remains the same, but their relative value changes; this change is due to the change of the absolute value of one commodity alone.

Relative variations of value are due to absolute variations and because of this it is important to know the laws which govern the variations of these values and this is what Cournot calls the theory of wealth.<sup>8</sup> To have a consistent theory of exchange we must have only «relative values» the changes of which can be explained only by absolute changes. While we have no absolute values because the absolute has no reference, we have «movements of absolute rise and fall in values»<sup>9</sup>.

Every commodity may be subject to absolute variation; in such a case we have no invariable commodity with which we can compare all other commodities and it is not easy to derive absolute variations from relative ones. But the absence of such a perfectly stable commodity does not prevent us from assuming one. We can, for instance, investigate what causes absolute variations in the value of monetary metals, correct these variations and reduce the values of all other commodities to units of the corrected monetary values. It is true that the relative value of monetary instruments changes, but this change is due to the increase in the value of most articles which is the result of an increase in population and «the progressive development of industry and labour»<sup>10</sup>.

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7. Ibid., p. 8.

8. Ibid., p. 19.

9. Ibid., p. 19.

10. Ibid., p. 31.

We assume that we establish one and the same monetary unit and we assume that its ratio to a constant quantity of a precious metal is constant; on this basis, in the case of exchange between commercial centers, each center determines its monetary unit in terms of the constant quantity of the precious metal. In this way a rate of exchange is established among the different commercial centers and the amounts to be paid each way as a result of exchange is easily established. In addition this mechanism will lead to «clearing» processes and there will take place one final shipping of actual species<sup>11</sup>. This eliminates the need for governments to establish internal ratios between the monetary metals.

Cournot's basic assumption is the economic principle of «maximization» that is «each one seeks to derive the greatest possible value from his goods or his labour»<sup>12</sup>. Traditional economists, according to Cournot, have failed to present this point in a meaningful way. The general principle that traditional economists have followed is that «the price of goods is in the inverse ratio of the quantity offered, and in the direct ratio of the quantity demanded»<sup>13</sup>. The difficulty rests in that we do not have statistics on the matter and also the meaning of the proposition is not clear. Does it mean that if the quantity is doubled the price will be  $\frac{1}{2}$  at the same place and time? It is assumed that sales are a function of price; this function depends on the utility of the article involved and utility depends on many other factors. If the function  $F(p)$  is continuous then demand variations will be proportional to price variations as long as price variations are small fractions of the original price and the signs in variations will be opposite. What we have to determine is whether the function  $pF(p)$  is increasing or decreasing for increasing values of  $p$ .

A monopolist, on the assumption that the demand function is  $F(p)$  will try to establish a price that will maximize his profit, that is  $pF(p)$ ; if the annual production of the monopolist is  $\Delta$ , then from the equation  $F9p) = \Delta$  we obtain the price per unit which will be finally fixed by the competition of customers.

Up to this point no cost production is involved. If cost is involved it is not the expression  $pF9p)$ , gross receipts, which the monopolist will try to maximize but the net receipts, that is  $pF(p) - \varphi(D)$  where

11. Ibid., p. 36.

12. Ibid., p. 36.

13. Ibid., p. 36.

$\varphi(D)$  is the cost which is necessary to produce  $D$  units; that is, the cost is a function of the quantity produced.

If we denote by  $\Delta$  either production or the limit of demand, then the price of the product will be fixed by the relation  $p(F) = \Delta$  as in there was no cost of production. The cost function  $\varphi', (D)$  is a decreasing function when  $C$  increases. This is the result of internal (organization, volume, discount, general expenses). But in the process beyond a certain point  $\varphi', (D)$  again begins to increase with  $D$ <sup>14</sup>. Between the two cases, one where  $\varphi', (D)$  is increasing and the other where it is decreasing we have the case where the function is reduced to a constant, and this is the case where the cost is proportional to production.

When the cost of production increases the monopolist's price will also increase, but this increase is sometimes much greater and sometimes much smaller than the increase in cost and therefore «there is no equality between the reduction in cost and fall in the price of the commodity»<sup>15</sup>. This applies only if the producer can meet the demand that will give him the greatest net return.

A tax on the income of the monopolist (producer) «is an obstacle to the creation of new investments ...»<sup>16</sup>. Taxes of this kind become more onerous the higher the cost of production or the smaller the proportion of the profit.

If we abandon the case of monopoly and we assume two competitors, each one of them will try to make his income independently from the other and make it as large as possible. The alternative of *i n d e p e n d e n t l y* would be an agreement which would lead to the same results as in the case of monopoly. If each of the competitors has gone away from the point that will give him the maximum result, then, the reaction of the other will bring him back to his equilibrium position by a series of reactions. The successive reactions «far from bringing both producers nearer to the original condition (of monopoly) will separate them further and further from it»<sup>17</sup>. This is not a condition of stable equilibrium, eventhough by a formal agreement the competitors may maintain the most favourable position for both producers. For the same production «the costs will always be greater for competing producers than they would be under monopoly»<sup>18</sup>.

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14. *Ibid.*, p. 49.

15. *Ibid.*, p. 53.

16. *Ibid.*, p. 57.

17. *Ibid.*, p. 68.

18. *Ibid.*, p. 72.

After monopoly and duopoly Cournot takes over what he calls the case of unlimited competition or what has been called pure competition. The effects of competition reach their limits if the production of each competitor is not significant. In the case of the monopoly the effect of the monopolist's action does not disappear and the variations in the amount produced «affects the total production of the article, and its price, to a perceptible extent»<sup>19</sup>.

In the case of vertical utilization of resources the profits made by all producers are distributed among the several participating producers of the same article. Complementarity of two commodities leads to equal distribution of profits between the participating producers.

The communication of the markets leads to reduction of total production; not only the total quantity produced is reduced but also the «total value of the quantity produced»<sup>20</sup>.

From the study of the law of demand on the one hand and supply on the other we arrive at price determination and income regulation of the producers. This seems to be the most important mission when we study the two laws as well as the derivative price determination. The study was made under the assumption of given prices of other commodities and given incomes. But this is an unrealistic set of assumptions. What happens to the «given» factors must be taken under consideration. But this problem is extremely complex and because of its complexity, the question is raised how this difficulty can be overcome, as much as possible, with the help of mathematics.

The broader aspect of the social income involves not only property and capital «but also the wages and annual profits which come to them in their capacity as workers and industrial agents»<sup>21</sup>. It also involves salaries which writers in economics have characterized as unproductive.

The price at which a commodity is sold is made up of shares representing the incomes of landlords and capitalists who furnished the raw materials and the instruments for handling them; also of profits and wages of the different industrial agents who have cooperated in producing the commodity and in bringing it to market<sup>22</sup>. Thus the price may be decomposed to the various branches of the social income;

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19. *Ibid.*, p. 76.

20. *Ibid.*, p. 102.

21. *Ibid.*, p. 109.

22. *Ibid.*, p. 109.

the shares to these branches fluctuate in consequence of price fluctuations and variations in the quantity of the commodity. The increase in the price of the commodity decreases the value of the social income. The decrease in social income will be differently subdivided among the various productive factors which co-operate in the creation of the commodity through the use of property or personal work.

Decrease in income will lead to less money for consumption which will affect the demand for other commodities, diminish the income of many other classes of productive agents and by reaction lead to a new decrease of the social income.

Because of the rise in the price of a commodity, the consumers who will continue to buy it, will withdraw from other commodities; this will lead to saving of part of their income which is equal to the difference between the price they paid for all commodities before the rise and the income they now spend by not buying a part of the commodities they were buying before but continue to buy commodities at a higher price<sup>23</sup>. «A variation occurring in the incomes of the producers of A, while modifying the distribution of the remainder of the social income among the producers of B, C, D, E, etc., does not alter the total value of it», or it modifies it by a negligible amount.

Consumers who do not buy commodity A after the increase in its price, transfer to commodities B, C, D, E, etc., and in so doing experience a loss because they make a different use of this section of their income than before, but this kind of loss cannot be estimated numerically.

In the case of monopoly of a product, if the control of the product is divided among several producers, the price of the commodity will fall because of competition «the consumption will go on increasing and the social income, although nominally decreasing will experience an actual increase»<sup>24</sup>. An increase in the cost of production decreases the real value of the social income; if we increase or decrease the nominal income, depending on the circumstances, a cost decrease will always increase the real value of the social income<sup>25</sup>. What is lost because of an increase in cost is called the actual decrease of the social income, but when order and not size is involved we talk about nominal decrease<sup>26</sup>.

Cournot has made the assumption that a rise or fall in the cost of production causes an increase or fall of price and therefore reduction

23. *Ibid.*, p. 111.

24. *Ibid.*, p. 115.

25. *Ibid.*, p. 116.

26. *Ibid.*, pp. 113-14.

or expansion of production; this may occur when the relation between demand and price has remained the same. The same argument can be applied if variations in price and the quantities produced were the outcome of a change in tastes and of the needs of consumers as well as of changes in the methods of distribution of the social wealth <sup>27</sup>.

The causes which tend to reduce the inequalities in the distribution of wealth will tend to cause variations in the economic system the average effect of which will be an actual increase in the social income <sup>28</sup>.

If the economic system is modified in a way that leads to increase of the laboring class through increase in production, the outcome will also be an increase in the value of the social income the wage portion of which constitutes an important part <sup>29</sup>.

New commodities would on the average have a tendency to increase the social income by an amount equal to the value of the quantity of the annually produced commodities <sup>30</sup>. But this is not always the case because the outcome depends on the nature of the commodities responsible for the change. In the field of foreign trade, the value of the social income fluctuates in both the importing and exporting markets.

### III. CONCLUSION

It is clear that Cournot's economics constitute an effort of an inquiring mind to remove the ambiguities of the developing science of economics. His contribution consists in the demonstration of improvements in the analytical process with the help of Mathematics which, as it was pointed out above, for Cournot is not a matter of caprice but a matter of necessity.

Cournot's work is spatial; he may be considered as a constructive critic but did not present us with a treatise on economics. He considers the problem of wealth as the basic problem of economics; he discusses and tries to improve the theory of value; he develops a rather elementary theory of cost analysis and cannot escape the orbit of the classical theory of exchange. This theory of utility, for him, cannot be brought down to positive measuring.

In the theory of price formation he is able to escape the clutches

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27. *Ibid.*, p. 118.

28. *Ibid.*, p. 119.

29. *Ibid.*, p. 119.

30. *Ibid.*, p. 122.

of pure competition and open the way towards what later became the theory of monopolistic or imperfect competition with his clear definition and analysis of the case of duopoly.

Another element of originality in Cournot's work we find in the field of international trade with the development of a clear cut picture of an international clearing house for international payments which later was used in the establishment of international monetary parity by the International Monetary Fund.

In general, Cournot's work is not a system of analysis but an expression of dissatisfaction with the sufficiency of analytical tools used by the economists of his time. He, like Jevons, was not satisfied with the «perfection» of the Classical System and investigated the causes of imperfection; In this attempt he gives us hints on what later became the backbone of micro-economic theory and introduced the use of mathematics as the *sine qua non* of economic analysis.

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