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WHAT DON’T ECONOMISTS KNOW NOW THAT MARSHALL KNEW A CENTURY AGO?

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In the twentieth century economics has been dominated by the idea that rigorous thinking is limited to the natural sciences. This belief has gotten in the way of contemporary economists' understanding of Marshall's legacy. Marshall conceived of economics as a science of complexity. Hence he considered essential to take into account the institutional and behavioral peculiarities that often require the close attention to empirical details that the Walrasian approach neglected. Marshall held that the appropriate style for economics to deal with economic complexity should be made of different languages. Classical mathematical language alone cannot grasp the complexity of the real economy by itself because it plots precisely defined conceptual borders where in the real world the borders are uncertain and the concepts ill-defined and unable to be captured in one precise definition.
Introduction

According to Schumpeter, Alfred Marshall’s work represents “the classical situation that emerged around 1900” (Schumpeter 1954, p. 834). Vast changes in economic ideas and methodology took place in the hundred years that followed. These changes can be evaluated by using Marshall’s *Principles* as the standard against which twentieth-century economics is to be measured. Some outstanding economists have recently expressed their critical evaluations of the past hundred years of economics on the pages of the *Quarterly Journal of Economics* and taken the question - “What do economists know now that Marshall at his time did not?” (Baumol 2000, Bowles and Gintis 2000, Stiglitz 2000). They agree that there is quite a significant difference in concepts, theories and tools between the twentieth-century economics and the economics of Marshall’s times. However, they differ in the interpretation of Marshall’s thought and its significance for the economists of our times.

William Baumol emphasizes that “there is surprisingly little beyond Marshall in the micro sections of our textbooks apart from the theory of oligopoly and monopolistic competition” (Baumol 2000, p. 8). This is traditionally considered Marshall’s orthodox neoclassical side. Nevertheless, twentieth-century economic science has gone beyond Marshall in relating theory and empirical research: “Our century produced a new integration, or at least brought to a far higher level, the integration of theory, empirical investigation and application” (ibid., p. 10). In contrast to Baumol, Samuel Bowles and Herbert Gintis emphasize the ‘heterodox’ side of Marshall missing from the classic microeconomic textbooks. Marshall paid attention to the particularities of human motivations and institutions; to non-selfish motives and to other preferences unknown to *Homo economicus*; he touched on increasing returns; he had a preference for biological analogies. Bowles and Gintis acknowledge that there is a great divide between Marshall and later twentieth-century economics, but this divide is mainly attributed to the general adoption of Walrasian approach in modern economics, which is considered the antithesis of Marshall’s. Joseph Stiglitz upholds a similar view. He stresses that Marshall anticipated many of the insights of the economics of information, even though he “observed the consequences of information imperfections …, but [he] neither pursued the logical implications … not even traced the source of the observation … to a problem of information” (Stiglitz 2000, p. 1442).

What is important to stress in these articles is, first of all, that they present two Marshalls: Baumol’s ‘orthodox’ neoclassical Marshall on the one hand, and Bowles and
Gintis’s and Stiglitz’s ‘heterodox’ Marshall on the other. This is an interpretative dichotomy that is well known in the history of economics. Secondly, the articles identify two different ways of dividing the Marshall from the post-Marshall era - the relation theory-empirics and the adoption of a Walrasian approach. This difference in perspective and emphasis needs to be considered more deeply.

Certainly, we have to recognize that Marshall’s conception of economics contrasts with the one that prevailed after the Second World War both in its theoretical framework and its approach to empirical work. Marshall adopted loose definitions and generic concepts; he did not make extensive use of mathematics as “an engine of inquiry”; he thought that pure theory has a limited scope; he undervalued the general economic equilibrium analysis; he did not support his opinion with the aid of systematic statistical analysis. Nevertheless, Bowles, Gintis and Stiglitz maintain that the Walrasian model was a detour which turned out to be a wrong way and that contemporary economics is moving towards a return to Marshall. This position emphasizes Marshall’s modernity and our fascination with him. It is not new and has been supported over the past decades by a small number of economists. They have held that these characteristics of Marshall’s economics do not make his thought obsolete but rather testify to his live sense of the complexity of the interrelation between economic phenomena and to the role of history and institutions in their evolution. Coase (1972) for example, expressed this view. He asked whether Marshall’s fears can be considered well founded “in our days”, in which “the mathematical method rides triumphant in economics”. Coase answered that “it would be hard to deny that the extensive use of mathematics has encouraged the tendencies that he thought its probable consequence” (p. 415) - the neglect of factors not easily be dealt with in mathematical form and the engagement in “mathematical diversion”. According to Coase the development in economics since the 1940s would have hardly shook Marshall's belief that the extensive use of formalism would lead us away from what he considered to be constructive work. Viner (1941) in United States, and authors like Andrews (1951), Richardson (1960), and Loasby (1989) in Europe, expressed quite similar views. Positive references to Marshall's methodology increase in the 1990s. Solow (1997) recognizes the relevance of using Marshallian biological analogies. McCloskey (1997) makes an appeal for a return to a Marshallian style of economic discourse. Krugman (1998) makes two cheers for formalism, and a cheer for Marshallian “sophisticated informality”. This goes to prove that the Marshallian question of the appropriate style for economics does matter even in our time. The statements and analyses offered in the QJE articles lead us to consider the following questions:
- What is the 'true' Marshall or what is the relationship between the orthodox and the heterodox side of Marshall? Do these opposite sides simply represent the contradictions of an author who was unable to offer an adequate analytical translation of his insights?
- Why did Marshall refuse to seek a real integration of theory and empirics, despite his liking for mathematical reasoning and his interest in concrete economic phenomena and statistics? Why did a fine theoretician like Marshall adopt a loose attitude towards empirical work?
- What did twentieth-century economics refuse to follow the Marshallian path and take the Walrasian one instead? If Marshall was right and Walras wrong, as Bowles and Gintis maintain, why was Marshall substantially abandoned?
- Finally, is Marshall to be considered a precursor of contemporary post-Walrasian economics, and, if so, in what way? More generally, is Marshall’s legacy useful to contemporary economists?

To answer the first two questions we have to deal with a subject not considered in the QJE articles - Marshall’s conception of the nature of economic thinking and its method (Section II). To answer the third question we have to make a brief excursus into ‘the years of high theory’ - the 1920s and 1930s -, when old and new ideas clashed and the orientation of economics was completely altered as a result of an extraordinary creative intellectual effort (Section III). The question raised in the fourth point will have an answer in the concluding remarks (Section IV).

Marshall on method

On the occasion of the 50th anniversary of the Principles Schumpeter wrote that "the discovery that there is a thing as a general method of economic analysis" was not Marshall's, "but no economist before Marshall ever grasped the meaning of this so fully" (1941, p. 101-2)\(^1\). Marshall's interest in economics began in a period when this discipline faced an identity crisis that came out of theoretical, ideological and political problems with classical economists' apparatus. One of the key questions at stake was the scientific status of

\(^1\) To Marshall we should add Vilfredo Pareto who in the same period developed a methodological anti-Walrasian reflection with many points of similarity with Marshall, particularly in the emphasis on the limitation of deductive reasoning unsupported by specific experience. See (Marchionatti-Gambino 1997) and (Marchionatti 1999a).
economics. Is economics a science? If so, what type of science is economics? What is its method? Marshall took up the task of answering these questions. He stressed his continuity with Ricardo and the classical economists as founders of economics on a scientific basis. However, Marshall pointed out that "Ricardo and his followers neglected a large group of facts" because "they regarded man as, so to speak, a constant quantity" and did not allow for "human passions, instincts and habits" (Marshall 1885, p.155). For Marshall, economics is "a study of men as they live and move and think in the ordinary business of life" (Marshall 1961, p. 14). He countered the 'excessive' abstraction of theoreticians like Ricardo and Walras, by emphasizing that economics deals with man as he is - not with an abstract or 'economic man'; but a man of flesh and blood" (ibid., p. 27).

Economics is a science, Marshall maintained. However, he thought that economics differs from 'hard' sciences, basically in that their simplicity and precision cannot be reached because human actions are varied and uncertain. The subject matter of economics is the "living and ever-changing economic organism" (ibid, p. 769). Hence "economics ‘proper’" is a science of "human motives" that "could not be better grouped than with the other Moral Sciences" (Marshall 1897) – namely a science of human and social complexity. This complexity has several facets: as regards the forces that cause movement, they are more "numerous", not well definite, scarcely known, diverse in character than those of mechanics; as regards the material under exam, it is uncertain, heterogeneous, constantly changing (Marshall 1961, p. 772). In other words, economic material belongs to a class of objects with uncertain borders, or fuzzy in the sense of contemporary logic. It should be stressed that this characteristic is not the result of our incomplete knowledge of this material (as if were transparent and exactly describable per se), but of the fact that it cannot be captured in one precise definition. According to Marshall, therefore, the nature of economic laws is such that they have some limitations as regards exactness, certitude and precision. For this reason, Marshall thought that economics resembles natural sciences like biology, which deal with the complex action of many heterogeneous and uncertain causes.

This raises the problem of how to deal with economic complexity - i.e. the method of economics as a science of complexity. The classical mathematical approach cannot be considered adequate because it succeeds only when a mathematical description of a subject 2.

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2. For Marshall economics’ domain has to be considered more complex than that of biology. Nevertheless, it remains a linguistic ambiguity in Marshall’s use of the biological analogy and the likeness-difference between economics and natural sciences. This ambiguity was overcome by Keynes who, following the philosopher Alfred N. Whitehead, preferred the term ‘process’ to ‘organism’.
can be expressed in a relatively simple equation system relating to a precisely defined small numbers of input and output variables. According to Marshall the economist must use “the reason” - i.e. deductive or abstract reasoning. However, this is not enough: "The work to be done is so *various* that much of it must be left to be dealt with by *trained common sense*, which is the ultimate arbiter in every practical problem” (ibid, p 38, my italics). It follows that “economic science is but the working of common sense aided by appliances of organized analysis and general reasoning, which facilitate the task of collecting, arranging, and drawing inferences from particular facts” (ibid., p. 38). Consequently, deductive reasoning is essential in dealing with economic questions but is by no means *the* economist’s type reasoning.

Marshall maintained that economists should cope with complex problems by first dividing them into parts in order to reduce them to simple, precisely definable problems. They assume static or stationary conditions and proceed step by step through successive approximations. This is the field of abstract reasoning in economics. This procedure is effective for the earlier stages of economic reasoning. In fact, “there is a fairly close analogy between the earlier stages of economic reasoning and the devices of physical statics”. However, “in the later stages of economics better analogies are to be got from biology than from physics” (Marshall 1898, p. 39). Consequently, “economic reasoning should start on methods analogous to those of physical statics, and should gradually become more biological in tone” and “the method will become ever more remote from the physical and more akin to the biological” (ibid.). In fact, he wrote in the *Principles*:

\[\text{The catastrophes of mechanics are caused by changes in the quantity and not in character of the forces at work: whereas in life their character changes also. ‘Progress’ or ‘evolution’, industrial and social, is not mere increase and decrease. *It is organic growth, chastened and confined and occasionally reversed by decay of innumerable factors, each of which influences and is influenced by those around it; and every such mutual influence varies with the stages which the respective factors have already reached in their growth* (Marshall 1898, p. 42-3, my italics).}\]

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3. Marshall emphasized that common sense must be ‘trained’ to carry out its task. In fact he distinguished (see Marshall 1885) between “untutored common sense or public opinion” and trained common sense: the first is knowledge based on surface phenomena unconcerned with the complexity of reality, the second is a sort of conscious common sense, that is concerned with complexity, which gives flexibility to reason and contextualizes theoretical models and avoids the risks of abstract reasoning.

4. As he wrote to Edgeworth on 28 August 1902: “In my view ‘Theory’ is essential. No one gets any real grip of economic problems unless he will work on it. But I conceive no more calamitous notion than that abstract, or general, or ‘theoretical’ economics was economics ‘proper’”. 
Therefore the use of abstract reasoning alone seemed “calamitous” to Marshall. He thought that the role of deductive reasoning in economics “it is not to forge a few long chains of reasoning, but to forge rightly many short chains and single connecting links” (Marshall 1890, p. 773). It is illusory, Marshall maintained, to think that there is room for long trains of deductive reasoning in economics, because economic material is often inadequate to bear the strains of the mathematician’s machinery. The mathematical engine used in physics, which “work out large volumes full of mathematical formulae and figures”, cannot be applied to economics, because it cannot help represent the “endless complexities” of the economic movement (Marshall 1898, p.39).

Hence, it is the nature of economic material – its essential resistance to pure reduction by means of mathematical treatment – that limits the use of mathematics in economics. We cannot construct long trains of deductive reasoning because the variables at stake increase in number and intensity in relations to external circumstances as we move from one determined situation to another. Synthetically Marshall said that the problem does not consist in manipulating more givens but in widening the connections. In theoretical terms, it is impossible to characterize few predominant causes to render practicable the hypothesis of ceteris paribus. Moreover, Marshall identified another problem connected with mathematical modelling, which has to do with the realism of models. The omission of certain factors or their ‘embellishment’ in order to render them mathematically manageable provokes “a tendency towards assigning wrong proportions to economic forces” (p. 850-1). This “reduction” of the model can be correctly made only after “a sufficiently realistic study of … statistics”, so that economists can find out the relation involved roughly and without calculation (see the letter to Bowley of February 21, 1901).

Hence, in Marshall approach, trained common sense is a necessary characteristic of the economist’s work. It brings the experience of life and history, which allows one to

5. Curiously, Paul Samuelson (1952), in a well known discussion of the relation between economic theory and mathematics, misunderstood the meaning of Marshall’s warning of the dangers involved in the application of long chains of logical reasoning. Samuelson supposed that what Marshall had in mind was a human limit, the “psychological problem of making correct deductions .. of that biological biped .. called homo sapiens” (p. 578), whereas, as it is clear from my quotations, Marshall referred to a characteristic of economic material.

6. Erroneously Marshall’s objections to formalism in economics are often considered only as a claim for more realism of the models, forgetting that they are in primis a question of the methodology to be applied to a very complex subject, realistic claims being a consequence of the adoption of the appropriate approach.
understand that theoretical notions must be taken broadly. So trained common sense ‘explains’ what theory, with its “few, long-drawn-out and subtle reasonings”, is unable to do by itself. In his biographical essay on Marshall, Keynes brilliantly expressed this conception of economic research when he wrote that economic interpretation in its higher form requires an “amalgam of logic and intuition and [a] wide knowledge of facts, most of which are not precise” (Keynes 1972, p.186n). According to Keynes, Marshall possessed the gifts necessary for reaching this goal.

The criticism of Marshall and the beginning of the Walrasian detour.

A short trip in the years of high theory

Bowles & Gintis (2000) write that the Walrasian detour was made essentially because mid-century neoclassical economists thought that factors as transaction costs, asymmetric information and endogenous preferences were of minor importance in a competitive economy and therefore they could be omitted from their models. Unemployment, inertial prices, the business cycle, credit rationing, and similar phenomena were treated as disequilibrium phenomena explicable by Keynesian and other short-term models. This theoretical behavior was certainly a crucial component of the Walrasian view, but I think that it is hardly an explanation of its overall achievement. The genesis of the radical change in the theoretical and methodological approach in economics in the post-Marshall era lies in two major intellectual events in 1920s and 1930s: the criticism of Marshall in the 1920s and the Econometric Society movement in the 1930s. They introduced the two fundamental divides that are emphasized by *QJE* papers. In these events the Walrasian approach established itself as ‘the economic theory’, and the relationship theory-empirics was re-defined.

*The criticism of Marshall in the Twenties*

In the Twenties Marshall's approach was increasingly seen as an inextricable mixture of statics and dynamics and the expression of a vague and inaccurate theory based upon a loose use of assumptions and a looser application of conclusions, as well as the unclear separation between the theoretical and empirical portions of economics. Marshall's attitude was considered anti-theoretical in Knight’s *Risk, Uncertainty and Profit* (1921), the book
which represented the most comprehensive and representative (at least in the American world) criticism of Marshall in the name of rigor (see Marchionatti 2002). Actually, he was anticipated by a practically un-known (in the English-speaking world) book written by the young Schumpeter in 1908, *Das Wesen und der Hauptinhalt der Theoretischen Nationalökonomie* (*Nature and Main Content of Theoretical Economics*) (see Leontiev 1950 and Schneider 1951). This first great work of the Austrian economist was essentially a study in methodology. It sought to set forth the principles that should govern the pursuit of theoretical economics as such and it came into being against a background of Walrasian thinking. In fact, Schumpeter expressed the necessity of abandoning the Marshallian path, which turned out to be fruitless. He exposed the canons of pure economics along Walrasian lines in the faith that “the new day in science ... is beginning to dawn” (Preface, p. xxii). Knight (1921) heeded this book message. He maintained that pure economics must be the field of the application of exact logic. Hence, a static method was to be adopted to examine the problem of equilibrium, whose core is the theory of price. He identified static method and equilibrium as the two key concepts of pure theoretical analysis, because they are inherent in the methodology of science, as he emphasized. He identified the progress of economics in a clearer formulation of premises and sharper separation of theory - considered the same as theoretical mechanics in physics - from empirical work. Consequently, he criticized Marshallian theory as eclectic and incapable of achieving the clarity and unity of Walras’ work. Marshall, Knight said, insisted on sticking as closely as possible to concrete reality, but suffered negative consequences from theoretical point of view:

> The gain in concreteness and realism is in our opinion much more than offset by the obscurity, vagueness and unsystematic character of the discussion, the inevitable consequence of burying fundamentals in an overwhelming mass of qualification and detail (Knight 1921, p. 15)

Knight took on the much discussed problem of the supply curve in the long run. He maintained that the Marshallian argument for a long-run tendency towards decreasing costs with increasing aggregate output had to be refused because it was incompatible with competitive equilibrium and involved a confusion between static and dynamic considerations. On this point, Knight joined Piero Sraffa’s (1926) and Lionel Robbins’s (1928) criticism in the ‘cost controversy’ on the pages of the British *Economic Journal* a few years after (see Marchionatti 2001). Sraffa’s and Robbins's critiques emphasized the deficiencies of the Marshallian approach from the analytical point of view in relation to the 'representative firm',
a concept that Marshall considered as an example of his approach to complexity. Marshall used the argument of ‘increasing returns and competition’ to exemplify the difficulty of using the hypothesis of ceteris paribus. In the note XIV of the “Mathematical Appendix” of the Principles, Marshall treated the case of commodities whose production expenses diminish rapidly with every increase in the amount produced. He wrote that "the causes that govern the limits of production are so complex that it seems hardly worth while to attempt to translate them into mathematical language" (Marshall 1961, p. 849). According to Marshall, this is the point of complexity where economic reasoning must abandon the mechanical method and become “more biological in tone”. He observed that the tendency of a commodity price to fall as a result of a gradual development of the industry by which it is produced, is “quite a different thing from the tendency to rapid introduction of new economies by an individual firm that is increasing its business” (ibid.). The reason is that a firm grows and decays. This fact must be taken into account to avoid falling into what he defined ‘Cournot’s error’. According to Marshall, the device of the ‘representative firm’ (representative of the average life cycle of the firm in the industry) permitted us to avoid this methodological error. Unfortunately, the solution of the difficulty of complexity in economics offered by Marshall in relation to the problem of the co-existence of increasing returns and competition was unsatisfactory from the analytical point of view because it did not analyze the path to equilibrium and seemed to be indeterminate, as the critics emphasized. Marshall's solution was rejected by Knight, Sraffa, Schumpeter and Robbins and by most of the economists of new generations then, who joined Knight in following a line of rigorous conceptualization. Consequently, they were also favorable to a clear separation between statics and dynamics as different fields of inquiry - respectively, the field of equilibrium phenomena and the field of disequilibrium phenomena. What is important to stress is that most of Marshall's critics also rejected the idea of economics as a science of human and social complexity when they rejected such Marshallian concepts as the representative firm. They pursued the idea of economics as a natural science along Walrasian lines. This change marked the passage into the post-Marshallian era in microeconomics.
The Econometric Society movement

The idea of economics as a natural science strongly connects the critique of Marshall to another major intellectual event, the Econometric Society program.\(^7\) From the methodological point of view the development of econometrics in the 1930s was a major event in the twentieth century and determined “the radical change during our century in the position of empirical research” that Baumol pointed out. In a Walrasian vein, a new generation of applied mathematical economists aspired to reproduce the methods of the natural sciences in economics. They held that it was needed to acquire the rigor of natural sciences methods in empirical economic research as the means for delivering exactness and certainty. In the editorial of *Econometrica*, the journal of the Econometric Society, Ragnar Frisch states its program:

to promote studies that aim at a unification of the theoretical-quantitative and the empirical-quantitative approach to economic problems and that are penetrated by constructive and rigorous thinking similar to that which has come to dominate in the natural sciences (Frisch 1933, p.1)

The unification of statistics, economic theory and mathematics was considered a necessity “for a real understanding of the quantitative relations in modern economic life”.\(^8\) In this new approach the concept of complexity changed his meaning. In Marshall, complexity referred both to the numerousness of the variables to be considered - the “complexity of mechanical type”, as Viner (1941) defined it - and, above all, to the impossibility of capturing some uncertain and heterogeneous material in one precise definition.\(^9\) On the contrary, in the econometric approach the complexity of economic life is of the mechanical, or Walrasian,

\(^{7}\) In my short discussion I consider the Econometric Society’s and the Cowles Commission’s programs as a unique thing: as it is well know, shortly after its birth in 1932, Cowles Commission was associated with the Econometric Society, founded in 1931.

\(^{8}\) The unification was also considered “more necessary today than at any previous stage in economics”: the troublesome international experience of world crisis and great depression, explains the sense of urgency expressed in many comments by these economists at that time.

\(^{9}\) Viner (1941) grasped the idea of complexity in Marshall as connected to mechanical and biological aspects. He wrote: “It must have been the complexities of the biological as distinguished from the mechanical aspects of economic problems which Marshall had in mind, for I cannot see how he could have intended to deny that, whatever the degree of complexity of the mechanical type economic problems may involve, they can be handled better with than without the aid of mathematics” (Viner 1941, pp. 232-3).
type - a “complex network of relationship operating in all directions”. Roughly speaking: ‘every thing depends on everything else’. This makes the mathematization of the economics not only possible but also “indispensable”. As Frisch (1933) wrote:

Many of the essential things in the new setting of the problems are so complex that it is impossible to discuss them safely and consistently without the use of mathematics ... So long as we confine ourselves to statements in general terms about one economic factor having an “effect” on some other factor, almost any sort of relationship may be selected, postulated as a law, and “explained” by a plausible argument. Thus, there exist a real danger of advancing statements and conclusions which .. are nevertheless thoroughly inadequate, or even misleading ... The full usefulness of a large and important group of our economic analysis will come .. only as we succeed in formulating the discussions in quantitative terms” (p. 2).

Hence the emphasis on the quantitative aspect of economic problems was considered a condition for enabling economists to “not tell stories, but make theories” (Tinbergen 1940, p. 80). On this basis, Marshall’s relationship between theory and empirical research could be bypassed. Marshall’s empirical approach had little concern for “anything that pretends to constitute analysis”, as Baumol writes, and so was viewed more and more as old-fashioned. Against the emerging mathematical economics, Marshall found a supporter in Keynes. Keynes was “frightfully afraid” of this tendency (see his letters to Harrod in 1938 and 1939 in Collected Writings, vol. XIII and XIV) and criticized it along Marshallian lines. Keynes thought that economics is not a natural science but “a moral science”. By moral science Keynes, like Marshall, meant that economics belongs to those disciplines that deal with human being in their social environment, because “the material to which it is applied is, in too many respects, not homogeneous through time” (letter of 4 July 1938, in Keynes 1973, vol. XIV). In examining this material, Keynes continued, economics uses introspection and value judgements to discover the relevant factors needed to build a model - or a sample, as he preferred to say (see his 1933 Cambridge lectures, in Rymes 1989). Due to the nature of economic material, a complete and exact generalization is not possible and the way of

10. On the other hand, a key element in the success of the econometricians’ movement is the fact that it appropriated the most significant economic contribution published in the twentieth century, Keynes’ General Theory. Hicks’ IS-LM model, as well as Harrod’s and Meade’s models, from which emerged the neoclassical synthesis based on the simultaneous equation model, was published in Econometrica and discussed in the meetings of the society. This interpretation of Keynes’ contribution became the dominant interpretation and caused the convergence of neoclassical synthesis with econometrics: “The heyday of Keynesian economics provides a wonderful example of the interplay among theory, the availability of data, and the econometric method” (Solow 1997, p. 47).
exposition must *often* be “quasi-formal”. On this basis Keynes criticized the statistical testing of business cycle theories, like that done by Tinbergen (1939). The central question was methodological: “the logic of applying the method of multiple correlation to unanalyzed economic material, which we know to be non-homogeneous through time” (Keynes 1973, p. 286). He maintained that there were not the conditions in order to pass from statistical description to inductive generalization, that is an adequate degree of homogeneity and stability in the environment. Keynes came out the debate with the econometricians a loser and was considered, from the methodological point of view, an old-fashioned economist like Marshall. Meanwhile, Tinbergen’s work laid the foundation for the advancement in macroeconomic model building (see Tobin 1997). In Solow’s (1997) words, this became “the standard intellectual exercise” that occupied econometricians for the rest of the century. As a consequence, the central methodological issue of causal inference, and the connected question of homogeneity and stability conditions, which Keynes raised, have remained forgotten by econometricians for over thirty years.

*After the thirties*

The two events that I have outlined caused the divides related in the *QJE* papers and gave rise to the Walrasian detour. Afterwards, the mathematical approach has played an increasingly dominant role in economics and unified its different parts. Paul Samuelson’s *Foundations* (1947), probably the most influential book in the second half of the century, represents the best example of the new mainstream of economics. More than other highly innovative contributions of the same period, such as those of Hicks, Allais, Leontief, or Koopmans, Samuelson’s *Foundations* are the symbolic example of the irresistible development of mathematical economics that characterized the second half of the Twentieth century. A bit ironically, the new mainstream appropriated Marshall on the basis of the analytical affinity between Marshall and Walras. As a consequence Marshall’s work was

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11. Keynes made a similar point on the un-stability of economic relations in his 1937 *QJE* article (see Marchionatti 1999b).

12. As, for example, Hicks (1934) wrote: “The modern reader of Walras’ *Eléments d’Economie Politique Pure* is struck by its affinity, not with the work of Jevons and Menger, but with that of Walras. For a quite considerable part of the way Walras and Marshall go together; and when they separate, it is a difference of interests, rather than of technique, that divides them. While Walras was seeking for the general principles
split into an orthodox and a heterodox part, the former to be incorporated in microeconomics textbooks.

Concluding remarks

In the twentieth century economics has been increasingly dominated by the idea that rigorous thinking is limited to the natural sciences, and that the Walrasian approach was economics *par excellence*. This beliefs have gotten in the way of our understanding of what it is now recognized as the most important and living part of the Marshallian legacy.

In my reconstruction of Marshall's thought, economics is conceived in the broad sense as a science of human and social complexity, where the 'orthodox' and 'heterodox' sides are inseparable. In dealing with complexity, economics cannot only consist of "abstract reasoning" because "abstract reasoning" alone is inadequate "to disentangle the interwoven effects of complex causes". "Abstract reasoning" may be "essential" for this but, as Marshall writes to Edgeworth, "a wide and thorough study of facts is equally essential". To do this, "abstract reasoning" has to be combined with "trained common sense" or, to use the term Keynes preferred, "practical wisdom". In addition to "abstract reasoning" the economist needs to have intellectual faculties like perception and imagination in order to study the specific cases. Marshall saw a limited scope for the fruitful use of mathematical language in economics. Instead he expressed a reasonable preference for a discursive, sophisticatedly informal and context-based style of exposition. In other words, Marshall felt that dealing with economic complexity fundamentally implies using different languages. From this point of view, mathematics must be considered nothing other than one of these languages.

In their attempts to imitate natural sciences, twentieth-century economists have approached economic questions with the myth of precision. As Samuelson (1952) proposed, they have reduced Willard Gibbs’ statement that “mathematics is a language” – quoted by Samuelson himself on the title page of his *Foundations* – to the statement that “Mathematics is language”. For Marshall this approach is unable to grasp the complexity of the real world which underlie the working of an exchange economy, Marshall forged an analytical instrument capable of easier application to particular problems” (p. 338).

13. Samuelson’s statement was challenged at the time he was formulated. Fritz Machlup (1952) refused the idea that mathematics is a superior language: “Mathematics ... for some purposes is superior to English or German. But for other purposes it is inferior or even altogether unsuitable. There are things that ought to be said but cannot be said in mathematical language ... There are definite limits to translatability into
essentially because it neglects complexity and traces precisely defined borders where in the real world borders are uncertain, the concepts ill-defined and unable to be captured in one precise definition.

The mathematics to which we have referred is, of course, classical mathematics. The limitations of the traditional mathematical approach in economics based on linearity and systems of differential equations are well known today. The classical mathematical approach is successful when the models can be given as simple equations relating a small number of input and output variables. But many economic processes do not yield to such an approach because nobody actually understands how they precisely work and the number of variables involved make it impossible to specify all their complex interrelations with mathematical precision. Complexity and precision bear an inverse relation to each other. Indeed, as the complexity of a problem increases, the possibility of analyzing it in precise terms diminishes.

A concept, however, need not be rigorously precise to be meaningful. Today we have new ways to deal with the complexity of the real world through the so-called mathematics of complexity. This kind of mathematics can deal with situations characterized by the interactions among heterogeneous agents, with limited cognitive resources who continually revise their behavior as they accumulate experience (see Barkley Rosser Jr.). From these new approaches we have the confirmation that the dynamical behavior of even simple economic

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mathematics ... The basic human attitudes that underlie economic conduct ... cannot be described and analyzed exclusively in mathematical language ... Those who talk only one language are probably barred from the appreciation and understanding of some problems. On the other hand, a problem is sometimes recognized as a mere pseudo problem when its analysis is translated into other languages. All this, I think, adds strength to the argument for polylinguistic scholarship” [p. 66-7]. Before Machlup, in a long review of Samuelson’s Foundations, Kenneth Boulding [1948] wrote that it was “an overstatement to say that mathematics is a language, for, while is probably true that all mathematical expressions can be translated into literary language if we are prepared to be sufficiently long-winded, it is not true that all literary expressions can be translated into mathematics ... These limits are set by the fact that the ‘universe of discourse’ of mathematics consists essentially of relationship between internally homogeneous variables and the operations which may be performed upon them ... Mathematics operates at the level of abstraction where any homogeneity or complexity in the structure of its basic variables may be neglected. This fact constitutes at once the strength and the weakness of mathematics as applied, say, to economics – strength because, by abstraction from the internal structure of variables, certain basic relationship may be seen more clearly and inconsistencies exposed; weakness because mathematical treatment distract attention from the actual complexity of the internal structure of the variables concerned and hence is likely to lead to error where this structure is important” [Boulding 1948, pp. 188-9].
systems is surprisingly complex and therefore that Marshall was probably right in warning economists to use simply the mathematical language.

Marshall was able to touch on many of the aspects now considered important for post-Walrasian economics because he did have a conception of economics as a science of complexity that considered essential to account for institutional and behavioral peculiarities. This often calls for the close attention to empirical details neglected in the Walrasian approach. In this sense Marshall was certainly a precursor of contemporary post-Walrasian economics. What is more, he had an idea of economic complexity which makes economics a science not reducible in the straight jacket borrowed from the natural sciences. For Marshall the capability to constantly amalgamate “logic and intuition and wide knowledge of facts”, in Keynes’ words, is the crucial factor in economic discourse and more languages or approaches can be used to reach this goal. Skeptical contemporary economists may feel that Marshall’s approach appears now a bit childish. However they would appreciate the importance of Marshall’s insights if they recall that after all, as James Duesenberry wrote in a discussion on mathematics in economics in the fifties, “it was a child who saw the king had no clothes” (1954, p. 363).


