F. A. Hayek and the “Economic Calculus”

Bruce Caldwell

Introduction

I begin with two puzzles in Hayek interpretation, one longstanding, the other prompted by some recent discoveries in the Hayek archives.

The longstanding puzzle involves the relationship between Hayek’s writings on complex structured orders (spontaneous orders, as he would put it) and his work in economics. Though the claim that the economy is an example of such an order was made very early by Hayek, usually after invoking Scottish enlightenment precursors like Hume, Smith, Josiah Tucker, and Adam Ferguson, or the Austrian Carl Menger (see, e.g., Hayek [1933] 1991, pp. 26-28; [1945] 2010, pp. 52-54), few details were provided beyond the assertion. When he began writing explicitly about complex orders in papers like “Degrees of Explanation” ([1955] 2014), “The Theory of Complex Phenomena” ([1964] 2014), and “Notes on the Evolution of Systems of Rules of Conduct” ([1967] 2014), he would mention economics but also other fields like linguistics, cybernetics, general systems theory, and communication theory. When he provided an example, it was the Darwinian theory of evolution.\(^2\)

\(^1\) An early version of this paper was prepared for a conference on Friedrich Hayek and the Liberal Tradition, held at the University of Richmond, Richmond, VA, on April 13, 2013. I received helpful comments there, and from participants at the Historical and Philosophical Perspectives Seminar at the London School of Economics, at the European Society for the History of Economics meeting in London, and at the History of Recent Economics meeting in Cergy, all in May 2013. Paul Lewis and Craig Smith provided particularly helpful comments. All are absolved responsibility for remaining errors. I offer this paper in memory of Hayek’s host in 1961 at the University of Virginia and fellow Nobel Laureate, James Buchanan (1919-2013). Permission to quote from unpublished material was granted by the estate of F. A. Hayek.

[A number of the papers by Hayek referenced in the present paper are listed as 2014 because they will appear in The Market and Other Orders, a new volume in The Collected Works of F. A. Hayek.]

\(^2\) When dealing with complex phenomena, our ability to predict is limited, and often the best we can do is to explain the principles by which such phenomena operate. Thus with evolutionary theory, we can explain the
The second puzzle involves some items I recently came across in the Hayek archives. A standard account of the trajectory of Hayek’s research career is that, with a few exceptions, he stopped concentrating on economics after 1945 or so, turning instead to such fields as psychology and philosophy of mind, intellectual history, political philosophy, and methodology of the social sciences. He only returned to economics in the 1970s, when he became concerned about monetary policy and, in particular, the renewed fear of inflation.

But the new archival material suggests that, far from turning away from economics, from the late 1940s through the early 1960s Hayek was in fact planning to do more work in the field. And much of this planned work focused on something Hayek referred to as “the economic calculus.”

Thus in an exchange of letters with John Nef at the University of Chicago in fall 1948 Hayek outlined some of the projects he would undertake if he gained an appointment on the Committee on Social Thought, and one of these had to do with economics: “I have still a good deal to say on economics proper, particularly in connection with more recent ‘Keynesian’ developments and on what I like to call the logic of choice or the economic calculus.”

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principle by which it operates (as Hayek put it in [1964] 2014, p. 267, “a mechanism of reduplication with transmittable variations and competitive selection”), but we cannot make precise predictions, we cannot predict the course of speciation. The closest we can come regarding prediction is to make a “pattern prediction,” one that rules out certain changes.

In the last chapter of my book Hayek’s Challenge (Caldwell 2004) I offered the conjecture that what I there called “basic economic reasoning,” that is, standard introductory level microeconomics, is what Hayek had in mind when he talked about complex phenomena. My argument hinged on the notion that the use of the ceteris paribus clause meant that all of the predictions that flowed from standard microeconomic theory took the form of “pattern predictions” or “explanations of the principle,” phrases that Hayek used when he talked about what could be said about complex orders. In what follows, it will become evident that my conjecture was partly right, but also partly wrong.

For his contributions to those fields, see, e.g., Hayek 1951; 1952; [1952] 2010; 1954; [1960] 2011; 1973-78. A notable exception is Vaughn 1999, who argued that Hayek’s later work on political philosophy, which contained an “implicit economics,” helped to solve the problems first raised in “Economics and Knowledge.”

Both letters may be found in the F. A. Hayek Collection, box 55, folder 1, Hoover Institution Archives.

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years later, it appears that he was planning to write a book, one that was to be titled *A Grammar of the Economic Calculus*. We may infer this from the picture that he sketched of its cover, complete with date and publisher information⁵

[Insert book cover picture here]

Hayek began permanently teaching at Chicago in fall 1950. In 1955, and again in 1959, Hayek prepared a “Memorandum for Plans of Work.”⁶ In both of them he again mentioned (without describing what he meant by the term) the economic calculus. In the earlier memo it is left to the end of the document, and it looks like he had a popular treatment in mind:

Finally, I do hope not completely to abandon my work on technical economics. I had long thought that the next book in that field would be “A Grammar of the Economic Calculus” – a sort of rigorous introduction into the basic logic of economics intended mainly for scientists and people with a scientifically trained mind. But although I have collected a good deal of material for this, it still proves very refractory to shaping in a book…⁷

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⁵ The book cover may be found in the Hayek Collection, box 129, folder 5. In box 139, folder 5, is a student notebook of Hayek’s from 1920. On one page he has a crude cover for a book based on his student essay on psychology, a book to be titled “Versuch einer Theorie der Entwicklung des menschlichen Bewusstseins.” In a letter of 7 October 1951 Hayek tells his friend Karl Popper that he spent part of the summer collecting notes for the “Grammar of the Economic Calculus” project; see the Popper Collection, box 305, folder 14.

⁶ The terms of his appointment on the Committee included the provision that the William Volker Charities Fund would reimburse the University of Chicago for the amount of his salary for a period of ten years. The memoranda Hayek prepared were to inform the Volker Fund trustees of his planned work. They may be found in the Hayek Collection, box 93, folder 11.

⁷ Some of the material he collected may be found in his notes in the Hayek Collection, box 129, folders 5 and 6. Topics and problems to be covered included such things as economics and engineering, choice, equivalence, and opportunity cost, as well as their “Corresponding Fallacies,” among them objective value, energetics, and the Just price.
THE GRAMMAR OF THE ECONOMIC CALCULUS

BY

F.A. HAYEK

1952

University of Chicago Press, Chicago

Routledge & Kegan Paul, London
Hayek notes that another project, a popular book on money titled “Money as an Intellectual Adventure” and for which he had “a fairly clear outline” might need to come first. In 1959, though, he wants to combine the two economics projects into one:

I intend in the first instance to try and combine the two economic studies mentioned...in the earlier memorandum in a volume to be called A New Look at Economic Theory. This would hardly provide the rigorous introduction into the basic logic of economics which I then contemplated but merely an outline of the economic calculus followed by an examination of the working of the money economy.

These archival finds give rise to further questions. What exactly was the economic calculus, and how did it fit into the rest of Hayek’s work on economics and in other fields? Why was he so keen to express his views on it that he would draw a picture of a book cover? Why did he end up not developing these ideas in print, a point that is particularly important given that Hayek so seldom used examples from economics when he was developing his ideas about complex phenomena in the 1950s and 1960s? Finally, how does all of this affect our views of the development of Hayek’s thought?

This paper will explore those (as well as other questions) while documenting Hayek’s unsuccessful attempt return to economics in the 1950s and 1960s. We will see that two crucial sets of unpublished documents – lectures he gave to undergraduates in Cambridge in 1943-44, and a set of public lectures he gave at the University of Virginia in the spring of 1961 – will help to answer our questions.

I will begin with the second puzzle, by describing the economic calculus and showing how it helps us better to understand Hayek’s work. We will then turn to the first puzzle, and show how he struggled to bring together his ideas about economics with the theory of complex

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8 I have not been able to locate the outline that Hayek mentions.
phenomena. He was unsuccessful, not least in his own mind, and that is why he never published anything. But the journey very much influenced the trajectory of his thought.

The Cambridge Lectures and the Economic Calculus

Hayek taught at the London School of Economics (LSE), which was evacuated to Cambridge when World War II started, eventually setting up at Peterhouse. The notes from one of his courses, "Economic Analysis," which he delivered during the 1943-44 academic year, survive. It is basically a course in microeconomics. They are one of only two sets of notes in English that Hayek preserved, so he must have thought them important. Many of the topics Hayek covered would be familiar to anyone who has taught introductory microeconomics. In the first (Michaelmas) term, he handled the theory of production and consumer choice; in the second (Lent), market exchange and market structures; and in the third (Summer), the theory of distribution. Many of his diagrams would also be familiar.

But some of the diagrams decidedly are not. And as he admits to the students in his opening lecture, his decision to present the theory of production before consumer choice theory is also "rather unusual." In discussing why he is approaching the course in what might seem an idiosyncratic way, Hayek makes clear what the economic calculus is, and how it fits into our understanding of economic phenomena.

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9 Hayek Collection, box 138, folder 10. The lecture notes are written out and run to over 100 pages. The pages are not numbered, so quotations in the text and footnotes will not make reference to a page. Two pages appear to have been rewritten, and were apparently inserted in a later (1945/46) academic year. These pages are headed, dramatically, The Economic Calculus, with the words centered and underlined, twice. It seems that Hayek wanted to restate the points that he made here with particular care and emphasis.

10 The only other set of notes in English that I have located were from Hayek’s "Development of Economics II" class, a history of economic thought course on the post-Smithian classical period. These included fairly detailed mini-biographies of major and minor figures, lists of the works they had written (including the more obscure titles), many of these typed out with handwritten supplementary material added. He probably kept these as much for their value as a research reference as for class notes. See the Hayek Collection, box 139, folder 6. Notes from courses he taught in German may be found in the Hayek Collection, box 139, folders 11 and 12.
The economic calculus is another term for the “Pure Logic of Choice,” a phrase he had used in his 1937 “Economics and Knowledge” paper. In his notes he also sometimes calls it “the theory of simple economy.” The economic calculus is used to analyze the actions that follow from a single coherent plan. The plan may be that of an individual, a firm, a community, a nation, and so on. The two prime examples of the economic calculus that he will deal with are the theory of production and the theory of consumer choice. (He notes that capital theory could also be included, but because of its difficulty, he doubts he will say much about it.) When employing the economic calculus one can deduce, logically, what will happen in a given choice situation because of the key assumption that “all the data are always facts that are given to the individual.”

Another way of thinking about the economic calculus is that it analyses the various ways that means-ends relationships may be structured: “In a way all the economic calculus is concerned with is the classification of goods according to their economically relevant characteristics; not concerned with their physical characteristics but with position in the means-end order.” The means-ends structures reveal the economically relevant characteristics of objects. At one point Hayek promises that the classification system will be an exhaustive one.\(^\text{11}\) He will present production theory before the theory of consumer choice (which is the opposite of the usual order in a standard microeconomics class) because in that application, choices about the best means (factors of production) to obtain a given end (output) present a more concrete example of a specific means-ends structure.

Before putting up the familiar sorts of diagrams that are associated with production theory (e.g., total, marginal, and average product curves; isoquants), Hayek draws some

\(^{11}\) “In brief the purpose of this economic calculus is no more than to provide an exhaustive classification of the objects of economic activity according to their economically relevant attributes....” Hayek Collection, box 138, folder 10.
diagrams that are meant to reveal the "General structure of means-ends relationship." He represents situations in which there are many ends and one means; one end and multiple possible means; multiple means and ends; means that are substitutes and complements; means that can only be used for a particular purpose; ends that themselves are means into another choice situation, and so on. Here are some examples.

[Insert picture]

Hayek will use these pictures again, in his Virginia lectures. They appear to be (almost) unique to him. The rest of the Michaelmas term was devoted to explicating the theories of production and consumer choice, for the most part using, if not always standard, at least recognizable diagrams.

In his opening lecture for the Lent Term, Hayek made clear how the topics in the economic calculus that had been explored in the first term were going to fit in with what was to come, the study of "multiple economy," in which the plans of many individuals interact. His introductory remarks are worth quoting at length:

In describing the decisions of an individual from the desires and the knowledge presumed to be possessed by him we were merely making explicit a conclusion implied in our assumptions. We were playing at pure logic - that is why I called it the Logic of Choice...or the Economic Calculus. No questions of cause and effect arose in this sphere; the relations with which we dealt were all of that "tautological" character which mathematics or logic have, and had nothing to do with the way in which events follow each other in time and affect each other.

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12 The reason for the caveat "almost" will become clear at the end of the paper.

13 Some of the diagrams are not used today, and Hayek was not always careful in labeling his axes, but one can still usually see what he was doing.
General structure of means and relationships

- Means are alternatives, one
  - Means of the same means are not
    - Equally capable of being
      - Satisfied in the same degree

- Counterpart forms given as examples of
  - Being satisfied by many different means.
  - Other means, with or without substituting
    - Perfect substitutes, are expected to lead to
      - Different results.

- Strictly speaking, equality would necessarily be found proportionally,
  - And similarly, in reverse proportion, being perfect substitutes.

- Why should we expect all means which are perfect substitutes with
  - A and B to be different?

  Because they will have different alternative uses

  e.g.

  although each means only a limited use
  and through means (e.g., M1 and M2) cannot be used at all for some;
  they still form part of some interconnected system,
  e.g., mortality of M3 may have affected M4; M5 will have
  to be used differently because M6 has replaced M7;
  simple regression rather than by interdependence of whole
  could enumerate of no person having to deal with both
  recommending:

  separate systems, different economic systems, forgetting one
  of the means in one group will be over liable for other
  (not least in fact because of lead time between, with changing markets)
  but useful to consider.

  This sort of diagram representation seems to work very far.
Now we shall, of course, still be using this technique insofar as we have to deal with any of the separate plans of the different individuals. But as these plans are separate and not necessarily known to the other individuals, as soon as the people begin to act upon them, a new and different problem arises.

In a multiple economy dealings with other people will necessarily form part of the plans of each individual. But he will not know beforehand what the other people intend to do, and will learn this only as time goes on. Every such experience he will have, if it is not precisely what he has expected, is a new datum to him. Once we assume he has learnt a new fact, we can then derive his reaction from the new datum (to him) and all the other facts. But with his learning about new facts which may possibly lead him to alter his plan, we meet for the first time a true cause bringing about a change. If he learns the new fact, the rest just follows from our assumptions. But in assuming he does learn about it we bring in a new empirical assumption (emphasizes in the original).

In discussing interaction in situations in which there are multiple agents, then, we must take into account the learning that takes place. Hayek speaks next of the confusion that results from the tacit assumption (“common particularly among mathematical economists and theorists of perfect competition”) that “everything is automatically known to everybody.”

It is important that from the beginning we look at competition not as a state of affairs in which everybody knows everything but as a process by which knowledge is dispersed and acquired – how effectively this happens under different conditions we shall gradually see (emphases in the original).

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The introductory lectures with which Hayek began the Michaelmas and Lent terms were methodological clarifications for how to view the theoretical structures that were about to be
presented. That part of standard microeconomics that deals with the allocation of resources is constructed on the assumption that a plan exists and that the decision-maker has all the information necessary to pursue the plan. Given that these assumptions are met, they are simply exercises in logic. But if we ask how the decision-maker comes to learn that information, we introduce a new empirical assumption, one that involves causes and causal processes. Agents find out new information as they interact with one another in competitive markets. As an illustration, we might consider the way that Hayek had put it a few years earlier, in a critique of Oskar Lange’s claim that socialist managers could be instructed to set prices so as to reflect minimum costs:

…the question is frequently treated as if the cost curves were objectively given facts. What is forgotten here is that the method which under given conditions is the cheapest is a thing which has to be discovered, and to be discovered anew sometimes almost from day to day, by the entrepreneur, and that, in spite of the strong inducement, it is by no means regularly the established entrepreneur, the man in charge of the existing plant, who will discover what is the best method. The force which in a competitive society brings about the reduction of price to the lowest cost at which the quantity salable at that cost can be produced is the opportunity for anybody who knows a cheaper method to come in at his own risk and to attract customers by underbidding the other producers (Hayek [1940] 1997, p. 130).

Market competition is a continual process: as one person learns new information and adjusts his actions, that provides new information to others, who adjusts their actions, and so on. Crucially, the theory of perfect competition, by assuming “everybody automatically knows everything,” obscures (by assuming away) this vital role.
The lectures were delivered in 1943-44, that is, between the time of the publication of Hayek’s “Economics and Knowledge” (1937) and two later related papers, “The Use of Knowledge in Society” (1945) and “The Meaning of Competition” (1948). Hayek placed these three papers after one another in his 1948 collection, *Individualism and Economic Order*, for good reason, for they fit together perfectly.

“Economics and Knowledge” is where Hayek first poses what would be come to be known as “the knowledge problem” and he would later refer to it as a seminal piece.\(^ {14}\) The paper is about the assumptions that economists make in their models about the knowledge that agents are presumed to possess, and the implications that these have for equilibrium analysis. He asserts that the notion of equilibrium has a clear meaning when applied to an individual: the agent is assumed to have a plan, and to know her own tastes and preferences and constraints, and if these are all known and do not change, the choice made is simply a matter of logic.\(^ {15}\) In

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\(^ {14}\) Perhaps the first time was in his Cambridge lectures, where he wrote that it was “the only original contribution to economics I have in my own opinion ever made, although even there, of course, I have done no more than to make explicit what was implicit in other people’s reasoning” (emphasis in the original). Interestingly, this statement is crossed through in the notes, but Hayek would continue to refer to the paper as a key contribution. In 1964 he wrote,

Though at one time a very pure and narrow economic theorist, I was led from technical economics into all kinds of questions usually regarded as philosophical. When I look back, it seems to have all begun, nearly thirty years ago, with an essay on “Economics and Knowledge” in which I examined what seemed to me some of the central difficulties of pure economic theory (Hayek [1964] 2014, pp. 49-50).

Hayek also mentions “Economics and Knowledge” in interviews in the late 1970s.

...it was really the beginning of my looking at things in a new light. If you asked me, I would say that up till that moment I was developing conventional ideas. With the ’37 lecture to the Economics Club in London, my Presidential Address, which is “Economics and Knowledge,” I started my own way of thinking.

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And it was with a feeling of sudden illumination, sudden enlightenment, that I ---- I wrote that lecture in a certain excitement. I was aware that I was putting down things which were fairly well known in a new form, and perhaps it was the most exciting moment in my career when I saw it in print (Hayek 1983, pp. 425-26).

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\(^ {15}\) Of course, if the agent was wrong about some element of the plan, the choice may bring new knowledge, and hence plan revision.
the paper Hayek calls this the Pure Logic of Choice, and, as we now know, it is the same thing as the economic calculus.

When one discusses equilibrium for a society, what Hayek would call in his lectures the "multiple economy," one enters into a wholly different sphere. For society to be in equilibrium, the plans of all the agents must be compatible with one another. The usual assumption made about knowledge in equilibrium theory – namely, that all agents have access to the same, correct information – automatically brings about such compatibility, in which all expectations are met. But if agents have access to different bits of knowledge – if knowledge is "divided," as Hayek puts it – then how does such a compatibility, how can equilibrium, ever come about? We may talk about a "tendency towards equilibrium," but such talk is meaningless unless we can shed some light on how the coordination of plans takes place. This is the essence of "the knowledge problem." Hayek does not solve the problem in the paper, but he states that its solution will require further analysis of the kinds of knowledge that are relevant for agents to possess, the conditions under which people are likely to acquire such knowledge, and the process by which they do so.

Hayek answers these questions in "The Use of Knowledge in Society." Regarding kinds of knowledge, Hayek argues that it is not scientific knowledge, but rather, "knowledge of the particular circumstances of time and place" that individual market participants possess that matters most.

The shipper who earns his living from using otherwise empty or half-filled journeys of tramp-steamers, or the estate agent whose whole knowledge is almost exclusively one of temporary opportunities, or the arbitrageur who gains from local differences of commodity prices – are all performing eminently useful functions based on special
knowledge of circumstances of the fleeting moment not known to others (Hayek [1945],
2014, p. 96).

The knowledge of the “man on the spot” is therefore critical. But there is an additional problem,
that of “communicating to him such further information as he needs to fit his decisions into the
whole pattern of changes of the larger economic system” (ibid, p. 98). Luckily, it is not
necessary that he know everything about all the other markets that might affect him. The ever-
changing relative scarcities of goods in such markets are reflected in the ever-changing array of
market prices that he faces, as Hayek demonstrates with his celebrated “tin example.” The
conditions and process by which knowledge is acquired is through participation in a competitive
market process. The price system thus conceived is a vast communication system (ibid., p.
100).

“The Meaning of Competition” (Hayek [1948], 2014) is a companion piece, for in it Hayek
argues that the theory of perfect competition used by economists fundamentally fails to capture
the rivalrous competition that exists in the real world and that brings about social coordination. It
fails precisely because it assumes that all market participants have full information, missing the
fact that competition in the real world is the very process that allows market participants both to
gain and to transmit knowledge about market conditions through space and time. The existing
theory of perfect competition, in short, is a category mistake. Economics requires a different
theory of competition, one that captures the dynamic process by which it transmits knowledge.

This was hinted at in “Economics and Knowledge.” Hayek had stated there that “the
empirical element in economic theory…consists of propositions about the acquisition of
knowledge” (Hayek [1937], 2014, p. 57), but at the end of the article he also insisted, in a
sentence that has baffled many readers, that:
...in stressing the nature of the empirical propositions of which we must make use if the formal apparatus of equilibrium analysis is to serve for an explanation of the real world, and in emphasizing that the propositions about how people will learn, which are relevant in this connection, are of a fundamentally different nature from those of formal analysis, I do not mean to suggest that there opens here and now a wide field for empirical research. I very much doubt whether such investigation would teach us anything new (ibid., p. 77).

It seems probable that this sentence was directed against people like Wesley Clair Mitchell and the American institutionalists who were, indeed, calling for more empirical investigations in economics. But it is also meant to emphasize that the study of the competitive market process as an information generating, processing, and distributing mechanism could (or perhaps should) be handled theoretically. Hayek would wrestle with how to do that in the years to come.

The Second Puzzle – Complex Orders and Economics

A Return to the Economic Calculus?

The idea that freely-adjusting competitively-formed market prices promote social coordination and cooperation on a global scale in a world of dispersed (and sometimes tacitly held) knowledge is perhaps Hayek's most important intellectual legacy. A market system, when embedded in the appropriate set of other institutions, is a marvelous mechanism for solving the knowledge problem. This is the contribution for which Hayek will most be remembered.

But what about the other part of Hayek's conceptual schema: the economic calculus? He never stopped thinking about it, as the book cover and memoranda to the Volker Fund reveal. It appears that throughout the 1950s he struggled to shape a more popular book, intended for a
Scientifically literate audience, about the basic economic reasoning that someone who has studied microeconomics learns. As late as 1959 he was thinking of including something about it in a book he would call *A New Look at Economic Theory*. Then, in 1960, he was invited by James Buchanan to give a series of lectures the following spring at the University of Virginia. Hayek decided to title the lectures *A New Look at Economic Theory*, and to devote one of them to an exposition of the economic calculus.

Though James Buchanan had seen Hayek speak at the University of Chicago in 1946 when Buchanan was still a graduate student, it was not until the summer of 1955 that they appear to have had their first real period of interaction, this at a Volker Fund seminar at Wabash College, Indiana. This apparently led to an invitation to Buchanan to attend the 1957 Mont Pèlerin Society meeting in St. Moritz. In 1959 they met again at another Volker Fund seminar on political economy, held at UNC-Chapel Hill and hosted by the monetary economist Clarence Philbrook, and the next year came the invitation to Virginia. The lectures were sponsored by the newly established, and later controversy-ridden, Thomas Jefferson Center for Studies in Political Economy and Social Philosophy. They were given at 8 p.m. and spread over three months.

[insert picture of program of lectures]

Hayek discussed what he hoped to do in the lectures in a letter to his old friend the philosopher Karl Popper, written about a year before he was to give them. The letter is significant because in it we can see another change of plans, for now Hayek wanted to restate

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16 For details, see Buchanan 1992. A personal aside: I took the last graduate class that Clarence Philbrook taught, in spring 1976.

17 For more on the controversies surrounding the Center, see Buchanan, 1988.
A New Look at Economic Theory

FOUR LECTURES

I. The Subject of Economic Theory
   March 20, 1961

II. The Economic Calculus
   Thursday, March 21, 1961

III. Economic and Technology
   Thursday, April 4, 1961

IV. The Coordinating Function of the Market
   Thursday, April 25, 1961

All lectures will be held in the South Meeting Room, McCormick Hall.

The public is cordially invited to attend each of these lectures.

THOMAS JEFFERSON CENTER FOR STUDIES IN POLITICAL ECONOMY

UNIVERSITY OF VIRGINIA
his ideas on the nature of economic theory using "the conception of higher level regularities," an
idea that he felt would be "fruitful far beyond the field of economics." He went on to say,

I suspect it is really what Bertalanffy with his General Systems Theory was after and the
conception itself was of course already implied in my "Degrees of Explanation." It
continues to become clearer, though I have not yet got an altogether satisfactory
formulation of what I am after.\textsuperscript{18}

So in his final formulation, it look like Hayek hoped to integrate some of his more philosophical
work on complex phenomena, research that had also occupied him through the 1950s, with his
earlier-formed ideas on the nature of economic theory. That was the formidable task that he set
for himself in Charlottesville.

The Virginia Lectures\textsuperscript{19}

The first lecture takes as its topic, "The Objects of Economic Theory." Hayek's initial
important claim is that many economic phenomena are in fact examples of organized but
undesigned complex orders. What is the best way to theorize about such phenomena? Hayek
proposes that we reflect on the approach taken by microeconomics. This will be helpful not only
because "the exact scientific character of the older micro-analysis was always a little obscure,"
but also because of his hope that "certain aspects of the technique of analysis of microeconomic
theory should apply also in other fields which deal with phenomena of comparable complexity"
(Hayek [1961] 2014, p. 375). He mentions biology and psychology as two fields parts of which
also deal with such phenomena. So Hayek thought that the approach taken in microeconomics

\textsuperscript{18} Letter, Hayek to Popper, 27 February 1960, Hayek Collection, box 44, folder 2. A founder of general systems
theory, the Austrian-born biologist Ludwig Bertalanffy (1901-1972) was a friend of Hayek's, and had offered him
comments on \textit{The Sensory Order} when it was in manuscript form. "Degrees of Explanation" was published in 1955,
and is Hayek's first statement of the problems that arise when one studies phenomena of "organized complexity"
and the implications for scientific method.

\textsuperscript{19} The lectures have now been published in Hayek [1961] 2014.
might shed light on (or perhaps even provide a model for the study of) other fields that deal with complex phenomena.

The patterns exhibited by complex orders are typically abstract, and when dealing with them scientists often must employ abstract schemata, such as those provided by mathematics. The recurring patterns that exist in society are particularly hard to identify, so that often the best we can do is to identify patterns that may involve relations, or relations among relations (and so on to higher levels), of elements, rather than specifying their detailed interactions. For example, mathematical economists have described the behavior of a market system using systems of equations. These are of no help in making predictions; they are only meant to illustrate structures of relations or provide explanations of the principle by which the phenomena behave. But that is not something to worry about; precise prediction is impossible when dealing with complex orders.

In the second part of the lecture Hayek states that the role of the economic calculus is to provide an abstract, deductive method for describing or classifying the sort of order that we sometimes see in economic phenomena in the real world. Recognizing the existence of the order is important, for though it was not designed by men, it is essential for realization of human ends. Market interaction may under certain conditions bring about at least an approach to such an order. But the economic calculus can tell us nothing about how that happens or what those conditions are. To give “an account of the causal mechanism which produces the order is clearly the task for an empirical science and can never be solved by the deductive methods of pure logic” (ibid., p. 384). As such Ludwig von Mises (Hayek identifies him by name) is wrong to overlook that this logical groundwork does not yet provide an explanation of how things actually happen but stands to such an explanation of real events in about the same relation as

\[\text{20}\] He even notes that “Much of what we know as the pure theory of utility and of production indeed proves on closer inspection to be no more than such a logical scheme, a description of a significant type of order which, once we know it, we then can indeed discover to exist in the real world.” See Hayek [1961] 2014, p. 383.
mathematics stands to physics" (ibid.). At the end of the lecture, Hayek notes that, because prediction and control are difficult or impossible when we deal with complex phenomena, we should avoid the temptation that we can undertake social policy that has that as a goal: “the pretence to more knowledge than we possess or can obtain has certain dangerous consequences” (ibid., p. 386).

In this lecture, then, Hayek tries to link up his earlier work on the economic calculus to his then developing work on the study of phenomena of organized complexity, just as he had told Popper he would do. The economic calculus is a powerful logical tool for helping people allocate resources, but it requires full information to be applied. No one has full information. But certain economic environments can help to approximate the conditions that would need to be met for such orders to exist.

Those who know Hayek’s 1964 paper, “The Theory of Complex Phenomena,” which first appeared in a Festschrift for Popper, will recognize in this first lecture not only many themes, but indeed whole passages that appeared in that later work. Though “The Theory of Complex Phenomena” was first published in 1964, it was actually written in 1961.21 Soon after giving the lectures, Hayek apparently decided to lift his ideas about complex phenomena out of the economics context in which they originally appeared, and put them into a more general paper dealing with complex orders.22

It is also of some interest that Hayek criticizes Mises by name in this lecture, asserting that his mentor did not understand the proper relationship between the economic calculus and

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21 Note the first footnote to the paper, Hayek [1964] 2014, p. 257, where he states that he “completed the manuscript in December 1961.”

22 Intriguingly this is not the first time this happened with regards to Hayek’s work on complex phenomena. Sections of his first statement of these ideas, in his 1955 paper “Degrees of Explanation,” may be found in an unpublished contemporaneous fragment, “Within Systems and About Systems,” which may be found in the Hayek Collection, box 104, folder 22, and which will be reproduced in the Collected Works volume of The Sensory Order.
the study of causal processes. Mises was then still alive. The other times that Hayek criticized
Mises on this point all occurred in interviews or in articles published after Mises had died. Of
course, given that the Virginia lectures were not published, the criticism, like the declamations of
Adam Smith’s actors, perished in the instant of its production (Smith [1776] 1981, p. 331).

It should finally be noted that reference to a pretence of knowledge appears not once but
three times in this lecture. The actual phrase “pretence of knowledge” also appears in the notes
Hayek made for his book on the economic calculus. That phrase would finally find its way into
print as the title of Hayek’s Nobel lecture (Hayek [1975] 2014), though then he would apply it
primarily to issues of macroeconomics.

In the second lecture Hayek examines the economic calculus in more detail. He notes
that his first interest in the subject was sparked by considering the difference between people he
considered to be good economists and those (either economists or people in other fields) who
seemed not to understand economic reasoning. His answer was that the good economists
shared “a capacity of discovering and refuting certain kinds of fallacies of reasoning”23 (Hayek
[1961] 2014, p. 388). Hayek wonders aloud, can the reasoning that allows them to do this be
taught?24 If so it would be very valuable, because fallacies in reasoning by well-intentioned
people cause them to make costly policy errors, for example, by viewing as examples of
obvious waste developments that economists would see as the normal workings of the system.
What is the nature of the logic that economists employ?

Of course, his answer is that the logic is given by the economic calculus, which he
describes as that “general representation of the problems faced by any person who has to

23 As Henry Simons, 1983, p. 3, put it in his economics syllabus, “Economics is primarily useful, both to a student
and to the political leader, as a prophylactic against popular fallacies.”

24 This was perhaps what Hayek had in mind in his 1955 memorandum when he described a book on the economic
calculus that would be a “sort of rigorous introduction into the basic logic of economics intended mainly for
scientists and people with a scientifically trained mind.”
allocate scarce means between alternative uses” (ibid., p. 389). Hayek notes that this definition of the specifically economic task – choice under conditions of scarcity – came to be widely accepted just as he first began thinking about these problems.²⁶ He also tells us why he now prefers “economic calculus” to “pure logic of choice.” “Choice” can occur when there is no scarcity: a person deciding which jewelry to wear for a night out, or a surgeon deciding which scalpel is best for a particular operation, each makes choices, but there is no economic side to it. Economic calculation requires scarcity (ibid., pp. 389-90).

Hayek next draws the same general schema that he did for his undergraduates at Cambridge to illustrate and emphasize the general structure of the connections between means and ends. The next step is to rank the different ends quantitatively – and to do this, later in the lecture he draws the more familiar diagrams of production and utility theory.

Though the economic calculus is simply an abstract deductive classifying system, it is also an important aid to thinking about the relationships between means and ends. Hayek demonstrates this with an example in his concluding remarks, in which he alludes to his old nemesis Otto Neurath’s idea that, in a planned society, one could forgo market prices and use in natura calculation instead.²⁶ Neurath’s recommended approach ignores the importance of the framework of the economic calculus for making rational decisions about resource allocation:

If we remember that as recently as thirty years ago it was contended by serious thinkers that the phenomenon of value was peculiar to the capitalist organization of society and that socialist society would be able to dispense with it by relying entirely on what was called calculation “in natura” or in real terms, it is rather remarkable that this contention can be so clearly disproved by a purely deductive argument (ibid, p. 401).


²⁶For more on Neurath and Hayek, see Caldwell 1997, pp. 5-10; Hayek [1952] 2010, chapters 5, 10.
Given the important place that Hayek gave to the economic calculus in his second lecture (after all, understanding it thoroughly is, according to him, what divides the world between good economists and everyone else), the third is devoted, appropriately, to an extended illustration of its power. The topic discussed is the use of technology, and especially its relation to policy decisions in less developed countries. Hayek argues that it is a mistake to think that the economic conditions facing the developed nations of the West (conditions that determine the best uses of capital and labor resources there) are the same as those that less developed countries face. Simply put, different sorts of technology are appropriate to different sorts of economic settings. The efforts by certain less developed countries to mimic the West, efforts that are often supported by policy advisors from developed countries who have little appreciation for local conditions, inevitably result in a waste of resources. Less developed countries typically have a surplus of labor and a scarcity of capital when compared to developed ones. To build large state-of-the-art factories there may be a source of pride, but it also often wastes scarce resources. As Hayek put it, "...better ploughs and carts and draft animals and farm buildings and not combines or even tractors will probably be what is needed" (ibid., p. 214).

If what Hayek says seems obvious today, it was much less so when he was writing. One of the people he cites in the lecture is C. P. Snow, who in his widely-read book The Two Cultures had claimed that all China and other less developed countries needed to do to catch up with the west was to have us train more scientists and engineers (Snow [1959] 1998, p. 44ff.) 27

Hayek's final lecture is titled "The Communication Function of the Market." He reiterates that treating the allocation problem separately is important because it makes us aware of the

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27 Snow writes (pp. 44-45): "It is simply that technology is rather easy.... For the task of totally industrializing a major country, as in China today, it only takes will to train enough scientists and engineers and technicians. Will, and quite a small number of years."
highly unrealistic character of the assumption of perfect knowledge. In using the empirical
science of economics to explain how a particular pattern might come about, the assumption of
perfect knowledge has no place. As he noted in his Cambridge lectures, in the world of action,
means are different sets of data that are known to different people, who have different opinions,
and the same may be said for ends. There are literally as many unconnected hierarchies of
ends as there are people. How can they coordinate their actions?

In “The Use of Knowledge in Society” Hayek had illustrated how freely adjusting market
prices in the tin market accomplishes that coordination. He provides a similar though more
detailed example in the Virginia lecture, one involving an American string manufacturer who
begins substituting sisal for jute, not due to any change in demand for string or in the production
of sisal or jute, but to more remote circumstances that nevertheless affect him. The point of
the example is that the American string manufacturer is not likely to be informed about changes
in markets that are far removed from his own. But he does not have to be. All he needs to know
is that the price of jute went up relative to sisal, and that causes him to adjust his plans “in the
right direction.” The constant process of adjustment is what gives rise to a structure in the world,
a set of relationships that approximates the structure of the economic calculus. Though it is a
world of constant change and adjustment, there is likewise a constant tendency to move in the

For much of the rest of the lecture, Hayek addresses other aspects of the knowledge
problem. He notes that in addition to prices, a market participant generally must know a host of
other things: the social and legal framework of the society in which she lives, technological
possibilities, and the particular circumstances of the environment, which would include the

28 These might be, for example, a reduction in Indian grain imports that then reduces the available return shipping
space for jute, driving up its shipping costs, or perhaps the fact that some other industry had substituted artificial
people with whom one is interacting (ibid., p. 418). As regards prices, things become very
difficult theoretically when one realizes that current prices are much less important than
expected future prices: if prices go up, do people expect them to come back down, keep going
up, or stabilize at the new higher level, and can anything be said in general about that? The
numbers of people participating in the market also evidently has effects, but it is difficult to
define how dense the network must be to work well, though generally, the more, the better.  

These are all interesting questions. But Hayek does not provide what was supposed to
have been his main contribution, a new theoretical framework. At the end of the lecture he
admits as much, saying that when he chose the topic for his final lecture he had hoped to have
been able to present a more well worked out theory of the market process. What he says in
admitting defeat is worth noting at length:

But I have not only not succeeded in working out such a more precise theory but have
also become rather doubtful whether there is much more to be said and whether the
taking account of this process of the communication of knowledge does not necessarily
mean a sort of retreat from the kind of precision achieved by a theory based on the
assumption of given and perfect knowledge to something inevitably more vague and
indefinite. This may be very disturbing to some people, but I am not sure whether this
retreat from pseudo-precision does not in fact bring a gain in realism and
usefulness....The only point I feel unhappy about is that, though even an imprecise
answer might be very valuable, the chance of persuading others that so far as it goes it

29 This was a point that Ludwig Lachmann, the radical subjectivist who chastised Mises and Hayek for failing to
incorporate subjectivism into the analysis of expectations, repeatedly made; see, e.g., Lachmann 1976. It implies
that the speed of adjustment in specific markets is an empirical question about which very little may be said
theoretically. Hayek seems to be acknowledging the point in his discussion.

30E.g., "...what seems necessary is that there should exist a sufficiently pervasive inter-connection by each seller
knowing a number of buyers which are also known to other sellers which in turn know other buyers and so on" (Hayek [ 1961] 2014, p. 418).
is right, and therefore that it will in fact be used as a guide for political action, is very small (Hayek [1961] 2014, pp. 422-23).

Thus Hayek felt that he had not really advanced the discussion in the way that he had hoped when he had written to Popper. His statement above probably is what caused James Buchanan, Hayek’s host at Virginia, later to reflect on the talks as follows:

These lectures were failures, at least by Professor Hayek’s own standards. Those who listened to them were, of course, rewarded by a careful review of the earlier analysis of knowledge in relation to economic interaction. But Hayek was unable to go beyond that which he had developed two decades before; no new insights emerged as he reviewed the earlier thought processes. His announced ambitions were thwarted (Buchanan 1992, p. 131).

Buchanan’s post-mortem is not quite right. In his lectures Hayek had clarified and made public his ideas about the economic calculus, and had tried to link his earlier economic writings to his then developing ideas about how to study complex orders. Nonetheless, it is true that he had not developed a theory, but only provided a description, of how the competitive market process operates.

Concluding Remarks

Hayek would continue to develop that which was most new in the Virginia lectures, his ideas about complex orders, in future work. He would also frequently point out that orders could be represented by mathematical structures, always with the caveat that care had to be used in
interpolating them.\textsuperscript{31} But he would never return to the economic calculus as another exemplar of such a structure. Why not?

One reason, certainly, is that the economic calculus basically refers to the sort of exercises that one presents in an introductory microeconomics class. If this was considered advanced economic theory in the 1930s, it was no longer so in the 1950s and 1960s. Hayek recognized this; he more than once apologized to the economists in the audience at Virginia for putting up such basic diagrams. Hayek did not have the mathematical preparation to go beyond that level of mathematics to try to update what he was saying using more recent developments. And in any case the assumption of perfect information would itself soon begin to disappear in economics, if one got beyond the introductory level. Ironically, his own work (especially “The Use of Knowledge in Society”) was one impetus for the creation of the economics of information that would move economics into wholly new directions.

That said, Hayek’s distinctions certainly provide food for thought for anyone who has ever taught an introductory microeconomics course. In teaching that course, it is evident that the basic tools provide one with a way of understanding the trade-offs that exist in a world of scarce resources and competing ends. Many of the tools seem simply to involve deductive mathematical relationships. How does one get from working with them to saying anything meaningful about the world? Hayek’s bifurcation between a logical calculus that would hold if one had full information and that reflects structures we sometimes see roughly exhibited in the social world, and the market process that is instrumental in creating those structures in the world, has a certain appeal. In any event, many economists would share his observation that our most important role \textit{qua} economists is to poke holes in popular fallacies, or, to put it in the

vernacular, to point out that there is no such thing as a free lunch, for which the economic calculus is an essential tool.

The narrative above causes certain revisions in our understanding of the development of Hayek’s thought. One of these concerns the role of Mises in contributing to Hayek’s initial insight in “Economics and Knowledge.” Hayek would later say that the paper contained a gentle criticism of Mises, who had insisted that the axioms of the science of human action, or praxeology, are a priori true, and further that the theorems of economics could all be derived from the fundamental category of action and therefore carried the same apodictic certainty.32 This claim was roundly attacked by another Viennese intellectual, the mathematician Karl Menger, in a workshop paper presented in December 1935.33 Hayek’s distinction would allow Mises’ claims about the a priori or tautological nature of the basic axioms to be retained, but would drop the idea that they carried over with the same necessity to the world – for that one needed to make additional empirical assumptions regarding knowledge. I think that Hayek never emphasized this for the same reason that he never criticized Mises on this point until after Mises had died.34 Mises continued to make the claim that Hayek had criticized in his magnum opus,

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32 Hayek 1983, pp. 57-58: “...It was in that same article on economics and knowledge where I made the point that while the analysis of individual planning is in a way an a priori system of logic, the empirical element enters in people learning about what the other people do... That was a gentle attempt to persuade Mises to give up the a priori claim, but I failed in persuading him.” Mises’ claims regarding a priorism can be found in, e.g., Mises 1933 1981, chapter 1. See Caldwell 2004, pp. 220-23 for more on Mises, Hayek, and a priorism.

33 The paper was later translated and published, see Menger 1936 1979, pp. 279-302. For an account of the episode see Leonard 2010, pp. 161-68. Leonard (p. 165, note 50) points out that Hayek had heard about the dispute from his friend Alfred Schütz, and wrote to Oskar Morgenstern that he thought that there was confusion on both sides. “Economics and Knowledge” may be read in part as Hayek’s attempt to clear up the confusion, to find a middle ground between Menger and Mises.

34 At least not in print! But recall the first Virginia lecture.
Had Hayek insisted on pressing the point, it probably would have led to a break of the sort that people like Haberler and Machlup had experienced with Mises.\textsuperscript{36} Next, the narrative that Hayek turned away from economics after the war needs to be modified. He clearly initially wanted to do a popular book that would explicate the "economic way of thinking" to the intelligent layman. Part of the goal was to challenge what he saw as fallacious reasoning. But he also wanted to talk about the economic calculus as a structure that reflects things we perceive in the world. This concern with the relationship between the world and the abstract structures we use to theorize about it has resonances elsewhere in his work.

Recall that in his Cambridge lectures Hayek claimed that the economic calculus would provide "an exhaustive classification of the objects of economic activity," of the means-ends structure. The word "exhaustive" resonates. In "The Facts of the Social Sciences," written around the same time as the Cambridge lectures, Hayek asserts that in trying to make sense of the behavior of others, we use a classification system based on our knowledge of our own mind:

\ldots\text{we can derive from the knowledge of our own mind in an \textit{a priori} or \textit{deductive} or \textit{analytic} fashion, an (at least in principle) \textit{exhaustive} classification of all the possible forms of intelligible behavior (Hayek [1943] 2014, p. 86, emphasis in the original).}

After the war Hayek took seven years to turn what started out as a paper ("What Is Mind?") into his 1952 book on psychology, \textit{The Sensory Order}. In that book Hayek described the brain as an immensely complicated, inter-connected and hierarchical classification system. In the concluding chapter of the book, where Hayek explores the "Philosophical Consequences" of his

\textsuperscript{35} In correspondence with the author Richard Ebeling challenged my claim, stating that "Mises would (and did agree) that once beyond the 'economic calculus,' empirical content had to be added to the analysis to put 'flesh' on the 'a priori' skeleton to analyze and understand the workings of markets" (e-mail, Ebeling to Caldwell, 19 May 2013). Ebeling notes that this means that Mises did not hold the views that Hayek accused him of holding, and further, that many self-identified "Misesians" who believe Mises held such views are also wrong.

work, he asserts that the brain as a classifying system will continue to readjust relations until “in the end the system of explicit definitions becomes both all-comprehensive and self-contained or circular” (Hayek 1952, p. 171), that is to say, exhaustive. I must confess I never really understood these and similar passages in Hayek’s writings. But it would seem that as early as 1943 Hayek was beginning to see analogies between the structure of the brain and the ways that we structure our own understanding of the economic system, and indeed other complex systems. We can see evidence in other parts of Hayek’s work.

Thus we find Hayek describing the human mind as a classifying system that cannot explain itself; all we can understand are the principles by which it operates. Our brain in turn allows us to classify and structure our phenomenal experience. The economic calculus is the classifying system that we use to understand structures that we see in the economy, which includes such things as the capital structure. The structures get created, but we cannot use the classifying system to account for where the structures came from, for that we need something from the outside. In *The Sensory Order* Hayek described the process by which the neuronal networks that give rise to consciousness developed, just as he described the competitive market process which gives rise to the structures that we see in the economy. We might finally note that even his earlier work on monetary theory complements this vision. In *Monetary Theory and the Trade Cycle*, Hayek first described the closed system of equilibrium relations. To generate a business cycle, one has to introduce into that system an outside disequilibrating force: Money. The market process gives rise to a structure of prices that, by reflecting relative scarcities, operates as a vast communication system. Money is another causal factor that sometimes causes the system to malfunction.

Whenever we might date Hayek’s first insights on these matters, certainly by the early 1950s Hayek was trying to develop these hypotheses: the theme of his unfinished "Within Systems and About System" is that the human brain is a hierarchical system that interacts with
other similar systems in a larger system (the economy). He lacked the mathematical background to formalize his ideas, a fact that he recognized and which clearly frustrated him, as it kept him from publishing his ideas in the form in which he originally developed them. That it continued to be a strong interest is evident from his interactions with people like Bertalanffy and von Neumann in the 1950s, and his organization of the Analogy Symposium in the 1960s.\footnote{For more on Hayek’s increasing interest in the 1950s in fields like cybernetics, systems theory, and the like, see Caldwell 2004, pp. 306-10. For some examples of work that treats the economy as a complex adaptive system, see Kochugovindan and Vriend 1998, Vriend 2002.}

This would explain, too, why Hayek would create a book cover that featured prominently the economic calculus. It is hard to imagine him doing that for what would be a popular book about common fallacies. It is much easier to imagine him doing it for a book that would reveal commonalities in theorizing about such different entities as the brain and the workings of the economy.

I will leave the reader with a final puzzle. In 1962 James Buchanan and Gordon Tullock published \textit{The Calculus of Consent}. The use of the term “calculus” in the title intrigues, does it not, given Hayek’s lectures the year before, and especially given the strange diagrams that decorate the cover of the 1965 paperback edition?\footnote{I became aware of the cover through pure serendipity. Georg Vanberg and I both participated in a workshop for students in January 2013. Georg was talking about the public choice movement, and included a picture of the cover in a slide. I was working on this paper at the time and was immediately struck by it. I plan to explore the Buchanan archives and, if necessary, those of the publisher to see if I can discover the origins of the cover design.}

[insert picture of cover]
James M. Buchanan & Gordon Tullock

the calculus of consent
LOGICAL FOUNDATIONS OF CONSTITUTIONAL DEMOCRACY

AA100 Ann Arbor Paperbacks
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