

Hayek and Lachmann and the Complexity of Capital

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Introduction

Friederich Hayek was a scholar of uncommon breadth and depth whose work will be the subject of study and discovery for a long time to come. The span of his career makes it difficult, probably impossible, to account for all of the influences that the many scholars who crossed his path might have had on his work, or the influences that he might have had on theirs. No doubt this will motivate diverse contributions. Some of the usual suspects appear in other chapters of this volume. In this chapter I investigate the intellectual relationship between Hayek and his student and younger colleague Ludwig M. Lachmann. I begin at the beginning, the LSE years, during which Hayek and Lachmann both worked on the related topics of the trade-cycle and capital-theory. I follow with an examination of their diverging but related subsequent work. The capital-theory experience is pivotal.

The LSE Years – in close proximity

Though he could, with justification be described as a fellow ‘Austrian Economist,’ Ludwig Lachmann was born and educated in Germany, not in Austria. He became acquainted with and enamored of Austrian economics as a young student in his twenties, discovering the work of Joseph Schumpeter and Ludwig von Mises. (He met Mises for the first time in 1932.) He spent the rest of his long professional life working within and fighting for the causes of the ‘Austrian School’ as he saw them (Mittermaier 1992 ; also Grinder 1977b).

In 1933 he left Germany (with his future wife Margot) for England. He was unable to find an academic appointment and decided to go to the London School of Economics as a student, even though he already had a doctorate from Berlin (Mittermaier 1992: 9). This placed him at the very center of the vibrant new ‘Hayekian’ school of economics, together with such scholars as Lionel Robbins, John Hicks, Nicolas Kaldor, Abba Lerner, George Shackle and others, and at the very center of the fast developing battle between the Hayekians and the emerging Keynesians. He was already a Hayekian when he arrived (Mittermaier 1992: 9). As Mittermaier points out, being a ‘Hayekian’ at that time referred to an appreciative interest in the Austrian theory of capital and the business (trade) cycle.²

Thus, the first and strongest connection between Hayek and Lachmann grew out of these topical preoccupations with the Austrian version of the business cycle, deriving from Mises and from the Austrian theory of capital, which was a crucial building block for that theory. The Austrian Theory of Capital (ATC), originating with Carl Menger (1871) was the most well-known contribution of the Austrian school at that time, owing mainly to the extensive work of Eugen von Böhm-Bawerk on the subject. Böhm-Bawerk’s work had achieved world-wide recognition (1959, three volumes originally published during the period 1884-1912). In his influential work on the trade cycle (1933a, 1935a), Hayek had referred to, and made use of, a highly stylized version of the ATC. And much of his work in the 1930s was dedicated to the attempt to elaborate and make this theory more widely accessible, especially to English speakers. In the process, he was led to a thorough reexamination of the ATC, writing a number

¹ Thanks to Roger Garrison, Roger Koppl, Paul Lewis and Richard Ebeling for very helpful comments and editorial assistance, with the usual disclaimer.

² Hayek’s contributions to philosophy, politics and methodology were yet to come, and though Mittermaier claims correctly that Lachmann was never a Hayekian in this later and broader sense, I shall have some things to say about the relationships between Lachmann and the later Hayek. .

of important articles (some of which are collected in Hayek 1939a³) and culminating in *The Pure Theory of Capital* (1941). This body of work constitutes the greatest Hayekian influence on Lachmann. It was crucial to his own subsequent work on capital theory and also his enduring preoccupation with the topic of *expectations*.

Lachmann had for a while been troubled by the influence of people's expectations on their actions, and felt that in *Price and Production* (1935a) and *Monetary Theory and the Trade Cycle* (1933a⁴) and in his debate with Keynes subsequent to the publication of Keynes's *Treatise* (1930), Hayek had neglected to adequately address expectations in the trade cycle story offered as a counter-argument to Keynes's. Reading Keynes *General Theory* (1936) upon its publication he was surprised to find Keynes's extensive treatment of the subject.

Lachmann always maintained that the quarrel [the Hayek-Keynes debate] was unnecessary and that no important economic principles were at stake. It concerned empirical questions about how markets work in the modern industrial world (which were fix-price and which were flex-price, in Hicks's terminology) although there were also some political undertones. Keynes had won, he thought, partly because he had introduced expectations most effectively into his theory, at least where it suited his purposes, whereas neither Mises nor Hayek responded in like manner. In 1934 Paul Rosenstein-Rodan had said to Lachmann that the question of expectations was 'the major flaw in Hayek'. Keynes had not made the mistake. As Lachmann wrote once (unpublished): "I bought a copy of the 'General Theory' the week it came out (February 1936). At first I understood very little. But when I came to the definition of 'marginal efficiency of capital', I realized: Keynes too was bothered about expectations. Investment depended on expectations! As I had reached the same conclusion before, that was a great help." (Mittermaier 1992: 10)

Mittermaier's claim that Lachmann believed that the Austrians had inappropriately neglected expectations in the context of this debate is no doubt true. Indeed, the implications of subjectivism for expectations, was a theme that motivated his work for the rest of his life.⁵ Nevertheless, it is clear that in his work in the 1930's (subsequent to *Prices and Production*) Hayek too was much exercised about the question of expectations, and by the time the *General Theory* came out, Hayek had published a number of articles carefully examining their influence.⁶ His seminal article 'Economics and Knowledge' (1937a), which many see as a dividing line, presaging Hayek's work on the meaning and consequences of disequilibrium, was preceded by much in-depth investigation of similar issues in connection with the ATC and expectations. It is reasonable to assume that Lachmann was strongly influenced by this work. The nature of that influence is, however, somewhat ambiguous. Lachmann sees his view of expectations as being more fundamental than Hayek's. As he later wrote: "For in the general equilibrium perspective Hayek adopted in the 1930's it is convergence, and the nature of the economic processes promoting or impeding it, that must be of primary interest. The divergence of expectations appears in this perspective mainly as an obstacle to equilibrium, if not as a reflection of a temporary distorted view of the world" (1979: 314n). To investigate this further we should look at Lachmann's work on capital theory and expectations.

³ About the articles collected in the 1939 volume, Hayek says: they "are a selection from the various attempts made in the course of the last ten years to improve and develop the outline of a theory of fluctuations contained in two small books on *Monetary Theory and the Trade Cycle* and *Prices and Production*" (Hayek 1939a: vii).

⁴ Written originally in German in the late 1920's.

⁵ "Austrian economics reflects a 'subjectivist' view of the world. The subjective nature of human preferences is its root. But in a world of change the subjectivism of expectations is perhaps even more important than the subjectivism of preferences. The assumption of 'static expectations,' however, means not merely that expectations as autonomous forces causing economic change are ignored so that a mechanism of other forces may be exhibited in its 'pure form' but also that the diversity of expectations, the pattern of inconsistent expectations held by different individuals at the same time, which we find in the real world, cannot even come into sight." (Lachmann 1977a: 22).

⁶ The work at both the LSE and Cambridge was influenced by the writings of the 'Stockholm School' of economics, starting with Wicksell and including Lindahl and especially Myrdal on the effects of expectations.

Hayek and Lachmann on Capital Theory and Expectations

Lachmann's work on capital theory began in the late 1930's, continued into the 1940's and developed together with his work on expectations (Lachmann 1937, 1938, 1939, 1941, 1943, 1944, 1945, 1947, 1948).⁷ This work begins in the context of the Hayek-Keynes debate and the onset of the Great Depression, with Lachmann exploring the nature of 'secondary depressions' but soon develops beyond this. It culminates ultimately in his book *Capital and its Structure* published much later in 1956 (Lachmann 1978 [1956]) by which time he was far away and interest in capital theory had disappeared with the triumph of the Keynesian revolution.

Background

Lachmann's capital theory is clearly Hayekian in spirit and he acknowledges Hayek's important influence. "My greatest debt of gratitude is to Professor F. A. Hayek whose ideas on capital have helped me to shape my own thought more than any other thinker." (Lachmann 1978: xvi). It is, however, also closely connected to the work of Böhm-Bawerk, whose insights Lachmann sought to carefully and critically rehabilitate in a form applicable to modern real world production contexts.⁸ As such it bears an interesting relationship to Hayek's last and most extensive work on capital, *The Pure Theory of Capital* of which more later.

Lachmann's approach reflects what he saw to be the inextricable connection between capital, knowledge and expectations, the implications of which he clearly thought needed to be spelled out in order to provide a satisfactory answer to the Keynesian challenge. According to Lachmann:

The generic concept of capital without which economists cannot do their work has no measurable counterpart among material objects; it reflects the entrepreneurial appraisal of such objects. Beer barrels and blast furnaces, harbor installations and hotel room furniture are capital not by virtue of their physical properties but by virtue of their economic functions. Something is capital because the market, the consensus of entrepreneurial minds, regards it as capable of yielding an income. . . . [But] the stock of capital used by society does not present a picture of chaos. Its arrangement is not arbitrary. There is some order to it. (Lachmann 1978:xv).

The value of the capital-stock, being dependent on individual expectations and evaluations (time preferences included), is not an objectively observable phenomenon. Only in equilibrium, where all individuals' expectations were consistent one with the other, would such a value have any meaning. He thus offers a theory of the capital-*structure* rather than the capital-*stock* and emphasizes the heterogeneity of capital. The fact that capital goods are physically very dissimilar is significant precisely because of the existence of disequilibrium. Physical heterogeneity could be reduced to value homogeneity if the values of the various capital goods could be simply added together. Where disequilibrium means that individuals have different and frequently inconsistent expectations, one cannot simply add together individual valuations.

Expectations

On the matter of both expectations and heterogeneity, Hayek and Lachmann are clearly on the same page. Those familiar with Lachmann's work on expectations and his emphasis on their disparate, incompatible nature, will find the following similarity with Hayek's early pronouncement striking:

It is evident that the various expectations on which different individuals base their decisions at a particular moment either will or will not be mutually compatible; and if these expectations are not compatible those of some people at least must be disappointed. (Hayek 1933b:140)

Compare this with a typical statement of Lachmann's on expectations.

Different people may hold different expectations at the same time; the same person may hold different expectations at different times. These are quite insoluble problems as long as we regard expectations as independent of each other. Why should they be consistent with each other? (Lachmann 1978: 21).

⁷ During this time he was still in England (holding a variety of short-term positions), though he spent five months in the United States where he met Alfred Shutz and Frank Knight, both of whom had a lasting impression on him (Mittermaier 1992: 11-12).

⁸ In an important sense, Lachmann's capital theory is also Mengerian (see Lewin 2011 [1999]: chapter 8).

Hayek's preoccupation with expectations (influenced by his involvement in both the Hayek-Keynes debate and the Socialist-Calculation debate which occurred also in the 1930's) led him to develop some of his most important early insights as evident in his seminal 1937 and 1945 articles (Hayek 1937a and 1945). Lachmann seems to have picked up mostly from the work that preceded this.

Investment and the heterogeneity of capital

According to Lachmann, though the capital-stock is heterogeneous, it is not amorphous. The various components of the capital-stock stand in sensible relationship to one another because they perform specific functions together. That is to say, they are used in various capital combinations. If we understand the logic of capital combinations, we give meaning to the capital-structure and, in this way, we are able to design appropriate economic policies or, even more importantly, avoid inappropriate ones (for example Lachmann 1947, 1978:123).

Understanding capital combinations entails an understanding of the concepts of complementarity and substitutability. These concepts pertain to a world in which perceived prices are actual (disequilibrium) prices, in the sense that they reflect inconsistent expectations and in which changes that occur cause protracted visible adjustments. Capital goods are complements if they contribute together to a given production plan. A production plan is defined by the pursuit of a given set of ends to which the production goods are the means. As long as the plan is being successfully fulfilled, all of the production goods stand in complementary relationship to one another. They are part of the same plan. The complementarity relationships within the plan may be quite intricate and no doubt involve different stages of production and distribution.

Substitution occurs when a production plan fails (in whole or in part). When some element of the plan fails, a contingency adjustment must be sought. Thus some resources must be substituted for others. This is the role, for example, of spare parts or excess inventory. Thus, complementarity and substitutability are properties of different states of the world. The same good can be a complement in one situation and a substitute in another.⁹ Substitutability can only be gauged to the extent that a certain set of contingency events can be visualized. There may be some events, such as those caused by significant technological changes, that, not having been predictable, render some production plans valueless. The resources associated with them will have to be incorporated into some other production plan or else scrapped—they will have been rendered unemployable. This is a natural result of economic progress which is driven primarily by the trial-and-error discovery of new and superior outputs and techniques of production. What determines the fate of any capital good in the face of change is the extent to which it can be fitted into any other capital combination without loss in value. Capital goods are regrouped. Those that lose their value completely are scrapped. That is, capital goods, though heterogeneous and diverse, are often capable of performing a number of different economic functions.

Though Lachmann develops the theme of capital heterogeneity-complementarity-specificity-order in a way that Hayek never did (of which more below) it is clear that Hayek was very much aware of the importance of the heterogeneity of capital (and, surprisingly of labor¹⁰) in the work he did between *Prices and Production* and *The Pure Theory of Capital*.

There is every reason to believe that there are as great differences between the position of the different kinds of capital good industries as there are great differences between them and the consumer goods industries. ... [and refers to] the importance of the *specificity* of existing equipment to a particular method of production. (Hayek 1939b: 21, italics added).

Hayek's scattered remarks along these lines provided the impetus for Lachmann's development of his theory of the capital-structure. In his 1948 article Lachmann refers to Hayek (1937b) and says, "The ideas set forth

⁹ Lachmann uses the example of a delivery company (Lachmann 1947:199; and Lachmann 1978:56). The company possesses a number of delivery vans. Each one is a complement to the others in that they cooperate to fulfill an overall production plan. That plan encompasses the routine completion of a number of different delivery routes. As long as the plan is being fulfilled, this relationship prevails, but if one of the vans should break down, one or more of the others may be diverted in order to compensate for the unexpected loss of the use of one of the productive resources. To that extent and in that situation they are substitutes.

¹⁰ "[E]ven if aggregate demand for labor at the existing wage level ... continues to increase, it will be an increase in the demand for kinds of labor of which no more is available, while at the same time the demand for other kinds of labor will fall and total employment will consequently decrease" (Hayek 1939b: 26).

by Professor Hayek have been the main inspiration of this paper” (Lachmann 1948: 308n). This 1948 article entitled “Investment Repercussions” is a fascinating extension of the ideas found in his first articulation of the capital-structure-complementarity-specificity-substitutability story in 1947, inspired by Hayek’s 1937b article which is tantalizingly entitled “Investment that Raises the Demand for Capital.” In the light of Lachmann’s later work, this last mentioned article might be expected to be about capital-complementarity (as investment, by adding to existing heterogeneous and complementary capital items, increases the expected rate of return of the capital combination and, thus, the demand for capital), but it is not, at least not directly. It is mostly about how past-investment funds in diverse capital goods constitute a sunk-cost and thus raise the prospective rate of return of any investment going forward. This is relevant to the question of investment and Keynes’s marginal efficiency of capital (investment) and the trade cycle (never far from consideration during those times). Lachmann might have been expected to combine this with his capital-structure ideas to address investment policy questions, including the question of the trade cycle.

A simple example illustrates Hayek’s point. Consider an n period investment in which the revenue earned in the first two periods is (and is expected to be) zero while expenses are positive, so that

$$FV_1, FV_2 < 0$$

where FV_i refers to the expected net-revenue (future value) for period i. The rate of return expected for the n periods (from the perspective of period 1) can be computed as r in

$$\frac{FV_1}{(1+r)} + \frac{FV_2}{(1+r)^2} + \frac{FV_3}{(1+r)^3} + \dots + \frac{FV_n}{(1+r)^n} = 0$$

Assume that r marginally exceeds the variable interest rate at which the project is being financed. The project is financed with a series of loans. If after two periods the interest rate unexpectedly rises, it might be expected that the project would be abandoned, since the n-period investment is now earning a rate of return less than the cost of financing it. However, this is no longer an n-period investment. Instead it is an n-2-period investment. The expenditures incurred in the first two periods are sunk-costs and are irrelevant to the computation of the rate of return going forward (from the perspective of period 3). This can be computed using

$$\frac{FV_3}{(1+r)^3} + \dots + \frac{FV_n}{(1+r)^n} = 0$$

and r will clearly be higher and may well be substantially higher than when it was first computed. These considerations suggest that, with the passage of time, the rise in the rate of interest that is sufficient to deter the completion of any multi-period investment project may be significantly higher than the current rate at any period.¹¹

Anything which will lead people to expect a lower rate of interest, or a larger supply of investible funds, than will actually exist when the time comes for their utilization, will in the way we have suggested force interest rates to rise much higher than would have been the case if people had not expected such a low rate. But, while it is true that an unexpected decrease in the rate of saving, or an unforeseen appearance of a new demand for capital - a new invention for instance - may bring about such a situation, the most important cause practically of such *false expectations* probably is a temporary increase in the supply of such funds through credit expansion at a rate which cannot be maintained.¹² In this case, the increased quantity of current investment will induce people to expect investment to continue at a similar rate for some time, and in consequence to invest now in a form which requires for its successful completion further investment at a similar rate. It is not so much the quantity of current investment but the direction

¹¹ I am referring here to the (internal) rate of return because this affords easy comparison with the rate of interest and is equivalent to Keynes’s marginal efficiency of capital (investment). Strictly speaking one should judge the efficacy and attractiveness of a project (in financial terms) using the net present value criterion – HT: Roger Koppl.

¹² As current experience with the dot-com boom-bust shows both of these causes may exist. The arrival of a new technology, which leads to an unexpected increase in the demand for capital, may be underwritten by a very expansive monetary policy; and this would plausibly have the effects described by Hayek in this paragraph (see also Garrison 2011: 447; also chapter 7 in this volume).

it takes – the *type* of capital goods being produced – which determines the amount of future investment required if the current investments are to be successfully incorporated in *the structure of production*. ... [Thus] an increase in the rate of investment, or the quantity of capital goods, may have the effect of raising rather than lowering the rate of interest if this increase has given rise to the expectation of a greater future supply of investable funds than is actually forthcoming. (Hayek 1937b: 80 – 81, footnote removed, first and third set of italics added)

That these telling points were not more persuasive at the time in explaining the origins of the cycle, and in exposing the superficial nature of Keynes's analysis of investment behavior, must be attributed to the nature of the times and its preoccupation with the deep secondary depression in which the world economy found itself. But, it is clear that here, and in similar contemporaneous work, Hayek can hardly be accused of neglecting the importance of expectations. So by this point in time at least, Lachmann's criticism on that score had been forcefully answered. Indeed, we see here the building blocks for Lachmann's exploration of the implications of the heterogeneity of capital in a changing world in which disappointed expectations feature so prominently.

The modern theory of investment, set forth by Lord Keynes in *The General Theory*, has had its many triumphs these last twelve years, but it still has a number of gaps. Conceiving of investment as simple growth of a stock of homogeneous capital, it is ill-equipped to cope with situations in which the immobility of heterogeneous capital resources imposes a strain of the economic system. In particular, it can tell us little about the 'inducement to invest' in a world where scarcity of some capital resources co-exists with abundance of others. (Lachmann 1948: 131).

In this article (1948) Lachmann then proceeds to lay out a detailed analysis of the implications of capital heterogeneity, perhaps even more fully and clearly than in his earlier 1947 article on complementarity and substitutability. He links these concepts to the theory of investment (which he points out must contain an implicit theory of capital) and specifically to Keynes's marginal efficiency concept (which lacks any recognition of such a theory).¹³ The effect of an increase in investment on the demand for capital depends, in his account, on the shape of the already existing capital structure and the degree of its complementarity with the new investment. So he is, like Hayek, examining the implications of time and changes in expectations in response to experience (including the experience of the results of economic policy), but he does so from a much broader point of view and the importance of Hayek's narrower point concerning sunk costs and the change in the expected rate of return of any project as outlined above, does not feature prominently – though, it is, of course, implied.

Hayek's work on capital and the Pure Theory

With the completion of *The Pure Theory of Capital* Hayek's concentrated work on capital theory comes to an end. By his own admission he felt somewhat disillusioned with the project. Looked at retrospectively, this may have been an auspicious development. Hayek's experience in grappling with the intricacies of capital seems to have provided both motivation and insight for his later projects, in particular, for his "shift of methodological perspective from one that emphasized the dualism of the social and natural sciences to one that explored the distinction between 'simple' phenomena and 'complex' phenomena" (Horwitz 2008: 144).

Caldwell (2004) points to the period of the 1940's as the time when Hayek began to undergo this shift. Hayek's decision to revisit theoretical psychology and publish *The Sensory Order* (1952) brings together both this emphasis on complex phenomena and Hayek's attempts to provide a scientific underpinning for traditional Austrian subjectivism. (Horwitz 2008: 144).

¹³ Anticipating his future preoccupations he also explores the role of changing and inconsistent expectations and points out that this implies the enduring existence of disequilibrium. We find here also perhaps his earliest articulation of the nature and importance of the 'plan' in analyzing investment behavior. Perhaps the most important general implication of a disequilibrium approach to capital is the proposition that all capital accumulation entails technological change. Most technical change is embodied in new (improved) capital goods and/or involves the production of new consumption goods. It is very likely that government expenditure 'crowds out' not only private sector investment but also private-sector investment-induced technical progress. The shape of the capital structure will be different and, because capital assets are heterogeneous, specific, and durable, will remain different from what it would otherwise have been.

More specifically, Horwitz suggests, a “new framework for conceptualizing the relationship between the natural and social world” was the outcome, at least in part, of his work on capital theory in the late 1930’s that culminated in 1941’s *The Pure Theory of Capital*, along with similar contributions and extensions by Ludwig Lachmann It is striking how similar the Austrian theory of capital is to Hayek’s work on cognition. Many of the same underlying ideas of function, complementarity, and structure are present in both.” (Horwitz 2008: 144-145). We can explore this a bit further.

Hayek’s extensive work on capital, while involving many insights pertinent to a theory of capital in a dynamic world was never consummated in a fully-fledged ‘dynamic’ theory of capital (indeed, one may wonder if such a theory is even possible in the way in which ‘theory’ is usually understood). But it was his intention to produce one that was the original motivation for *The Pure Theory of Capital*, an intention he never fulfilled. His objectives are clearly stated.

The problems that are raised by any attempt to analyze the dynamics of production are mainly problems connected with the interrelationships between the different parts of the elaborate structure of productive equipment which man has built to serve his needs. But all the essential differences between these parts were obscured by the general endeavor to subsume them under one comprehensive definition of the stock of capital. The fact that this stock of capital is not an amorphous mass but possesses a definite structure, that it is organized in a definite way, and that its composition of essentially different items is much more important than its aggregate ‘quantity,’ was systematically disregarded.(Hayek 1941: 6)

Much of the book is, however, taken up with a discussion of how an economy directed by a central dictator might make decisions regarding the formation and use of capital goods in an environment devoid of change. This, of course, abstracts from any dynamic issues. There is, by assumption, no disequilibrium problem; heterogeneity is seen not to matter. Hayek does this as a foil, a relief against which to illuminate the real-world problems of heterogeneity and change. His method is first to get the abstract problem right. But, though the final section of the book does contain a valuable discussion of some dynamic issues, it is not the fulfillment of the project Hayek had originally envisaged.

There is some evidence to suggest that both Hayek and Lachmann saw Lachmann’s work as a continuation of Hayek’s project. From Lachmann’s side we know this to be true from his many references to Hayek’s work, some of which, as already indicated, are specific on this.

The notion of intertemporal equilibrium, ..., occupies a central place in Hayekian capital theory. All analysis in the *Pure Theory* is such equilibrium analysis. But Hayek also regards it as a means to an end, viz. causal analysis, and we shall have to question whether it is an adequate means to this end (Lachmann 1975: 200-201).

The means are not adequate, something which he worked to remedy.

From Hayek’s side the situation is less clear. When asked about the *Pure Theory* Hayek once remarked, “I think the most useful conclusions drawn from what I did are really in Lachmann’s book on capital” and he suggests that what Lachmann said is perhaps as much as could be said. Hayek continues: “Like so many things, I am afraid, which I have attempted in economics, this capital-theory work more shows a barrier to how these things I’ve stressed – the complexity of the phenomena in general, the unknown character of the data, and so on- really much more point out limits to our possible knowledge than [are] contributions that make specific predictions possible.” (quoted in Kresge and Wenar 1994:142). So it seems that Hayek’s often frustrating and exhausting experience working on capital-theory, provided an unintentional proving-ground for the later fundamental philosophical investigations that led him away from a preoccupation with theories that could make ‘specific predictions’ to those that, because of the essentially complex nature of the world, were suited to making only ‘predictions in principle’ or ‘pattern predictions.’

Capital theory is an area of inquiry that contains seemingly endless potential for further insight. Both Hayek and Lachmann were provoked to consider more general social issues - in Lachmann’s case most particularly it was action in disequilibrium. This has implications for both how we do economics (or any social science) and how the people we study are able to gain sufficient knowledge in order to act in a coherent manner – that is for methodology and epistemology. For both Hayek and Lachmann doing capital-theory implied considering the nature and limitations of social science, what can and can not be said or predicted, and the role that social

institutions play in orienting people's behavior. Both are led away from classical formal modeling to the consideration of 'complex phenomena,' Hayek very extensively and explicitly, Lachmann more by implication. Consider the following remarks that Lachmann made later in considering Hayek's capital theory:

There are two possible types of social process. (There may be more). We may describe the first as 'mechanical', the second (for want of a better term) as 'orientative'. In the first, whatever men do within a period depends on the position they have reached. A 'feedback' mechanism in which each subsequent step depends on 'distance from equilibrium' is a special instance of it. Actors, when in disequilibrium, plan to take their next steps in the direction of equilibrium. This is what Hayek must have had in mind. 'The direction in which an entrepreneur will have to revise his plans will depend on the direction in which events prove to differ from his expectations. The statement of conditions under which individual plans will be compatible is therefore implicitly a statement of what will happen if they are not compatible (Hayek: 1941: 23). But in a footnote to this passage we are warned 'This is strictly true only if we are thinking of a single deviation of a particular in a situation which is otherwise in equilibrium, that is on the assumption that all other expectations are confirmed. If more than one element turns out to be different from what was expected, the relation is no longer so simple.' (Lachmann 1975: 204).

For Lachmann this is his cue to explore the world of incompatible expectations writ large in which feedback mechanisms guiding action cannot be taken for granted. For Hayek one might wonder if it was one of those things that pushed him to the consideration of a world in which things are "no longer so simple," a world of complex phenomena.

From Capital Complementarity to Complexity

By the time Lachmann took up his post at the University of the Witwatersrand in 1950, both Hayek and the wider economics world had moved on from capital theory and the trade cycle, and, although he remained interested in capital theory, Lachmann gradually expanded his scope of inquiry to more abstract big-picture methodological issues (and, to a lesser extent, economic policy¹⁴). He and Hayek were never again to be working in close proximity.

What is complexity?

Capital theory forces us to focus on the elemental fact that all human action in society is embedded in *networks* of shared, but (by definition) subjective meanings that propel and arise from the interaction between individuals – in a nutshell, that all human action in society is human *interaction*. The 'data' that inform human decisions are not given 'objectively' in the sense that data on the physical world are, but, rather, include prominently the expected actions of others upon whom the success of our actions depend (Hayek 1937a; see also Lewin 1997). Planned actions need to be *coordinated* in order to succeed.

Both Hayek and Lachmann devote considerable effort to examining the consequences of this. For Hayek this leads him from an initial attempt to define, examine, refine and, if possible save, the concept of equilibrium (understood as the achievement of plan coordination), to his abandoning the notion of equilibrium in favor of the broader concept of "order" (see Lewis, chapter 9 of this volume). His later work on methodology, cognition, law and social institutions, anticipates and develops his ideas on the methods associated with the study of *complex adaptive (classifying) systems*. (Hayek 1952, 1967, 1978; McQuade and Butos 1999).

Complex systems are systems (networks, structures) with many elements that relate to one another in limited, but complicated and often numerous, multi-level (to be explained below), ways, that lead to outcomes that are essentially unpredictable (in their details, though the possible 'patterns' may be known). Complex *adaptive* systems are complex systems whose multiple interactions lead to outcomes that are in some significant sense 'ordered' or 'functional' or 'organized' (Hayek 1974: 26; also 1955 and 1964). In these systems, complex interaction leads adaptively to outcomes that are coherent and useful according to some scheme of action and evaluation. For example, evolution in nature is a complex adaptive system that works through some selection-

¹⁴ For example, both he and Hayek developed similar but different variations of the Austrian business cycle theory to apply to the world of their time. Both emphasized the role of labor unions. Lachmann considered the power of unions to be such as to have created a situation in which prices could no longer fall and in which unions were seen to be the main culprits for the occurrence of inflation. Referencing John Hicks, he suggested that the world had abandoned the gold-standard for a 'labor-standard.' (Lachmann 1967. See also Hayek 1959 and Baird chapter 8 of this volume).

replication process (constrained by the physical environment) to produce outcomes that are better adapted to the environment (Hayek 1964). The evolution framework is very generalizable and has been applied in multiple contexts, including, of course, to human societies (in which connection it was first conceived). As Hayek discerned very early on, the brain itself is a complex adaptive system (Hayek 1952, based on work done in the 1920s).

Though it is the subject of an increasing body of research effort, and though it has a clearly common-sense type meaning, there is no readily agreed-upon definition of the concept of 'complexity' (Page 2011: 24-32; Mitchell 2009: 94-111). For Hayek complexity is in essence a matter of 'too many variables.'

[W]hat we regard as the field of physics may well be the totality of phenomena where the number of significantly connected variables of different kinds is sufficiently small to enable us to study them as if they formed a closed system for which we can observe and control all the determining factors; we may have been led to treat certain phenomena as lying outside physics precisely because this is not the case. (Hayek 1955: 4, footnote removed)

The situation is different, however, where *the number of significantly interdependent variables is very large* and only some of them can in practice be individually observed. The position will here frequently be that if *we already know* the relevant laws, we could predict that if several hundred specified factors had the values $x_1, x_2, x_3, \dots, x_n$, then there would always occur $y_1, y_2, y_3, \dots, y_n$. But in fact all that our observation suggests may be that if $x_1, x_2, x_3, \dots, x_n$, then there will occur [some recognizable subset of $y_1, y_2, y_3, \dots, y_n$ and there may be a large unknown number of subsets; or that perhaps some relation P or Q could result from a x_1, \dots, x_3 or similar input]. There may be no possibility of getting beyond this by means of observation, because it may in practice be impossible to test all the possible combinations of the factors $x_1, x_2, x_3, \dots, x_n$. If in the face of the variety and complexity of such a situation our imagination cannot suggest more precise rules than those indicated, no systematic testing will help us over this difficulty. (Hayek 1955: 8, first set of italics added).¹⁵

It is not a question of *merely* too many variables. The difference in conceptual structures to which Hayek is referring is of a huge magnitude.¹⁶ It is in the first instance a practical matter, but it is most likely also more fundamental and elusive in that in order to successfully model essentially complex structures we would have to engage in a degree of complex classification that is *intrinsically* beyond the capacity of the human brain to

¹⁵ “[S]ocial sciences, like much of biology, but unlike most fields of the physical sciences, have to deal with structures of *essential* complexity, i.e. with structures whose characteristic properties can be exhibited only by models made up of *relatively large numbers of variables*” (Hayek 1974: 26, italics added). It is illuminating to view this problem in the context of statistical modeling and the well-known difficulty of inferring from the estimated reduced-form parameters the fundamental structural parameters of the model. The model is supposedly an ‘accurate’ depiction of reality. This is the ‘Lucas critique’ leveled at econometric practice. The response has been to try to find better (more easily identifiable) models. But, in the context of the discussion in the text, it may be seriously doubted that such a strategy is ever likely to be viable. The structural parameters of real-world complex processes are the result of multi-level interaction an order of magnitude far beyond the capacity of any statistical modeler to specify. For a ‘critical realist’ analysis of the ‘Lucas critique’ see Lawson 1995, which contains many (independently perceived) ‘Hayekian-type’ insights, but without reference to Hayek.

¹⁶ Hayek (1964: 25n references removed) quotes von Neumann 1951 “we are dealing here with parts of logic with which we have practically no experience. The order of complexity is out of all proportion to anything we have ever known.” Hayek continues: “It may be useful to give here a few illustrations of the orders of magnitude with which biology and neurology have to deal. While the total number of electrons in the Universe has been estimated at 10^{79} and the number of electrons and protons at 10^{100} , there are in chromosomes with 1,000 locations [genes] with 10 allelomorphs 10^{1000} possible combinations; and the number of possible proteins is estimated at 10^{2700} . C. Judson Herrick suggests that ‘during a few minutes of intense cortical activity the number of interneuronic connections actually made (counting also those that are actuated more than once in different associational patterns) may well be as great as the total number of atoms in the solar system’ (i.e. 10^{56}); and Ralph W. Gerard has estimated that in the course of seventy years a man may accumulate 15×10^{12} units of information (‘bits’), which is more than 1,000 times larger than the number of nerve cells. The further complications which social relations superimpose upon this are, of course, relatively insignificant. But the point is that if we wanted to ‘reduce’ social phenomena to physical events, they would constitute an additional complication, superimposed upon that of the physiological processes determining mental events.” See also Fiori 2009, HT: Paul Lewis.

accomplish, being that the brain itself is a classifying mechanism of lower complexity than the observed structures (a point that emerges from his 1952 work on cognitive psychology). In addition there are some systems that are *intrinsically* non-computable/decidable (see Koppl 2010) – the imputation problem in capital theory comes to mind.

The implications of complexity in a system (structure, network) are typically that, though intelligible, the outcomes that result from their operation do not provide us with precise value (quantitative) predictions. Instead, they are intelligible in that we are able to understand (comprehend the meaning of) the *types* of outcomes that are possible and are observed. Thus *patterns* rather than values are what can be predicted. As Hayek is anxious to point out, and as has perhaps been insufficiently emphasized, this does not preclude the possibility of an important type of (Popperian) falsification or refutation (a criterion taken by many scientists as the hallmark of acceptable ‘scientific’ investigation). Certain resulting patterns *are* ruled out by this type of investigation. The observation of a pattern of results not within the range predicted by a model of complex phenomena, would refute the model (Hayek 1964: 32-33; 1974: 30-32). Confirmed observations of inherited traits acquired in a Lamarckian manner would refute the Darwinian version of evolution. Observations of ‘stagflation’ lent credence to Monetarist and Austrian accounts of macroeconomic structure as opposed to the Keynesian story. The fact that such ‘refutations’ are hard to come by, or, indeed, to sustain, counts no more against the scientific nature of these methods (that lack quantitative predictive capacity) than do the same limitations in more traditional refutations based on deviant quantitative outcomes. The latter are also notoriously hard to come by.

I spoke earlier of multi-level interaction. Hayek’s description of complex phenomena implies the phenomenon of *emergence* (See Lewis 2012). Complex adaptive systems are (most) often hierarchical in nature, exhibiting ‘lower’ and ‘higher’ levels. Elements existing at the lower level interact in ways that result in the ‘emergence’ of *qualitatively different* (to be explained below) elements at a higher level. But interaction is not limited to any level. Elements at a lower level may be affected (in a ‘downward’ direction) by the emergent elements at a higher level – as when individual action is influenced by social structures (like institutions and standards) that are, themselves, the result of *prior* individual actions; hence multi-level interaction. The observation that the changes are ‘qualitative’ in nature is basically a recognition that they cannot be fully ‘accounted for’ by changes in the elements at the lower level. The new characteristics appear to ‘emerge’ in a not fully explicable way from the interactions that occur at a lower level. This is a discernible aspect of the ‘too many variables’ problem, one that is commonly found with complex phenomena. Indeed it, and the other typical aspects of complex systems, are clearly apparent in capital-structures as portrayed by both Hayek and Lachmann.

Heterogeneity and Complexity; Quality and Quantity

As we have seen, drawing on the work of Hayek, Lachmann made much of the fact that capital-goods are heterogeneous and built his theory of the capital-structure, based on complementary capital-good combinations, around this. Both Hayek and Lachmann emphasized that the heterogeneous nature of capital-goods precluded adding them up to obtain an overall aggregate capital stock. Capital goods cannot be measured by adding them up. There is no simple dimension along which this could be accomplished (for example Lachmann 1941, 1978: chapter 4; see also Hayek 1941: 36-39, 1935b 86-88). For reasons already explained, aggregation in terms of the money values of the capital-goods ignores the diverse subjective estimations of their ‘worth’ in terms of the prospective earnings they are expected to provide. The heterogeneity of capital-goods is a derivative of the heterogeneity of expectations surrounding them.

Until recently this point was mostly ignored by scholars and policy-makers. Lately, however, many aspects of heterogeneity have come to be considered very relevant – in the social and biological sciences, and, notably, in management studies, where ‘firm heterogeneity’ strikes at the core of the neoclassical microeconomic theory of production. It is frequently invoked also in ‘complexity studies’ (as ‘variety’) (see also Harper and Endres 2010, 2012). This growing literature, provoking more in-depth examination of the concept of heterogeneity reveals hitherto insufficiently appreciated connections between the early and later work of both Lachmann and Hayek. Most fundamentally, considering the concept of heterogeneity throws light on the relationship between *quantity and quality*.

All observation and explanation proceeds on the basis of classification (categorization). Phenomena are grouped into categories according to our perception of their essential similarity (homogeneity). The elements of any category (class) might be different in some respects, but in all respects that ‘matter’ to us they are identical. Items within a particular category can be counted, quantified. The ability to quantify is crucially dependent on

being able to count items in this manner. The number and type of categories (variables) is known and fixed. Thus, the arrival of a new category cannot be accommodated within a scheme of simple quantitative variation and must be considered to be a change in *quality*. Qualitative differences are *categorical* differences.

All quantitative modeling proceeds on the basis of the assumption that the individual elements of any given quantifiable variable are identical (homogeneous) and are different in some important respect from those of another variable. Variables are essentially distinguishable categories. In addition the elements of a quantifiable category do not interact with each other – else they could not be simply counted. Each element is an independent, identical instance of the class. (Most obvious is the case of ‘identical randomly distributed variables’). This does not preclude the elements themselves being complex – being the result of lower-level interactions, like identical molecules or biological cells, which are incredibly complex phenomena.

We may think of this in terms of *structure*. Structure implies connections/interactions. As indicated earlier, a structure is composed of heterogeneous items that are more than simply a list of those items. There is a sense of how the heterogeneous items work together to ‘produce’ something. (We see here how a *capital-structure is both a metaphor for and a particular case of the phenomenon of complex structures* in the world.) A structure is an ‘order’ in Hayek’s sense, in which it is possible to know something about the whole by observing the *types* and the ways in which they are *related*, without having to observe a totality of the elements. Structures are *relational*. Elements are defined not only by their individual characteristics but also by the manner in which they relate to other elements. These interactions are, in effect, additional variables.

Thus, though the elements of a quantifiable category may be unstructured, these elements may be *composed* of structured sub-elements. This is the basis of the phenomenon of *modularity*. Self-contained (possibly complex) modules may be quantified. This dramatically simplifies the organization of complex phenomena, as has been noted in a fast growing literature on the subject. Modularity is both a ubiquitous phenomenon in nature and in social organizations. It is an indispensable principle of hierarchically structured complex systems. The benefits of modularity in social settings include the facilitation of adjustment to change, and of product design, and the reaping of large economies in the use and management of knowledge (see for example Baldwin and Clark 2000, Langlois 2002, 2012) and it is clearly an aspect, perhaps the key aspect, of Lachmannian capital-structures. Capital-goods themselves are modules, which are creatively grouped into capital-combinations which constitute the modules of the (non-quantifiable) capital-structure.

Returning to the theme of the relationship between quantity and quality, quantitative modeling works when both the independent and dependent variables are meaningful, identifiable quantifiable categories that can be causally related. The model ‘works’ then in the sense of providing quantitative predictions. The inputs and outputs can be described in quantitative terms. But, when the outcome of the process described by the model is a new (novel) category of things, no such quantitative prediction is possible. Ambiguity in the type and number of categories in any system destroys the ability to meaningfully describe that system exclusively in terms of quantities. We have a sense then of the effects of heterogeneity. *Variation* applies to quantitative range. *Heterogeneity* (variety) applies to qualitative (categorical) range. *Diversity* incorporates both, but they are significantly different. Heterogeneity may not be necessary for complexity, but heterogeneity does militate in its favor. For example, compound interaction between *quantitative* variables (categories) can be an important characteristic of complex systems, but complex systems are likely to result from substantial heterogeneity, *especially where heterogeneity is open-ended, in the sense that the set of all possible categories of things is unknown and unknowable*. These considerations strongly suggest that the capital-structure of a market economy is a complex phenomenon (in the technical sense discussed above).

Heterogeneity rules out aggregation, which, in turn, rules out quantitative prediction and control, but certainly does not rule out the type of ‘pattern prediction’ of which Hayek spoke. In fact, as we have seen, erroneously treating heterogeneous capital as though it were a quantifiable magnitude has led to misunderstandings and policy-errors, such as the those associated with the connection between investment and interest rates - errors that could have been avoided with a better understanding of capital heterogeneity and its effects. The capital-structure is complex, but it is intelligible. We can understand and describe in qualitative (abstract) terms how it works and render judgment on economic policies that affect it. And, as a result of Hayek’s insights into complex phenomena, we have an enhanced appreciation of what is involved. Lachmann’s work on capital is thus enriched by this broader perspective, in a way that perhaps he had not yet come fully to appreciate.

Further observations on capital complexity – the importance of change

Lachmann reaches for the increasing number of productive stages as an indication of the growing complexity of the capital-structure. Though, not spelled out, considering the importance of complementarity (a form of interaction between elements) at multiple levels (capital-combinations, plans), complexity in this context seems to imply an increasingly complicated network of production linkages – a progressively expanding network of complicated, multi-level mutual dependencies between increasingly specialized elements. And the more complex the system the more complex the disparate expectations of the agents that operate within it. Disparate expectations implies error and uncertainty. Thus, capital complexity is related to the ubiquity of (unexpected) change. This is an important part of Lachmann's theory. It is in the connection between capital accumulation and technological progress that this is most evident.

Lachmann proposed a reinterpretation of a controversial aspect of Böhm-Bawerk's theory, his famous proposition concerning the superior productivity of roundabout production (i.e., of production processes that are more indirect, that take more 'production time') (Lachmann 1978: chapter 5). Like his contemporary Austrian School colleagues, Lachmann regarded Böhm-Bawerk's use of time as a unit of measurement for the capital-stock as untenable and seriously misleading, an indefensible attempt at quantification. He felt strongly, however, that Böhm-Bawerk's intuition about the sources of economic progress was correct. "[T]he intuitive genius of Böhm-Bawerk gave an answer [that], to be sure we cannot fully accept and which, moreover, is marred by an excessive degree of simplification, yet an answer we cannot afford to disregard" (1978:73). Therefore he suggests dispensing with the notion 'period of production' and replacing it with the notion 'degree of complexity.' Whereas Böhm-Bawerk argued that the period of production increased with capital accumulation, Lachmann argues that capital accumulation results in the *increasing complexity* of the production process. In this way he hoped to have given a new and more appropriate meaning to the notion of increased roundaboutness.

Lachmann argued that Böhm-Bawerk's ideas were closely related to those of Adam Smith (1978:79). Both were concerned about the sources of economic progress. Both lived in a world that was "neither a stationary nor a fully dynamic world" (1978:79). Our world is, however, *a dynamic world, one in which technical progress is an outstanding feature*. "For Adam Smith the division of labor was the most important source of progress. The same principle can be applied to capital. As capital accumulates there takes place a 'division of capital,' a specialization of individual capital items, which enables us to resist the law of diminishing returns." (1978:79). Böhm-Bawerk's thesis about the higher productivity of roundabout production is an empirical generalization. It can be applied, reinterpreted, to our own world. We have achieved, and will continue to achieve, greater productivity, that is, the production of more and (qualitatively) better consumption goods and services, by the continuing introduction of new indivisible production goods (which embody new production techniques) – in other words essentially qualitative changes. This can be cast in terms of Böhm-Bawerk's idea of 'stages of maturity.' Böhm-Bawerk argued that capital accumulation will take the form of an increase in the number of stages of production. "The richer a society the smaller will be the proportion of capital resources used in the later stages of production, the stages nearest to the consumption end, and vice versa" (Lachmann 1978:82). The increased number of stages is indicative of increased complexity, which, in turn, is indicative of increased productivity. Increased complexity implies "an ever more *complex* pattern of capital complementarity" (Lachmann 1978.:85, italics added).¹⁷

Capital accumulation (the progressive creation of capital-value over time) necessarily implies an evolving capital structure, that is, a capital structure that is becoming more 'complex.' Lachmann's theory is a theory of progress reflected in and achieved by a continuing specialization of economic activities, a growing division of function. Heterogeneity matters because heterogeneous capital goods perform qualitatively different functions in combination with other human and physical resources. New goods, new methods of production, new modes of organization, new resources (capital goods) (Schumpeter 1947: 84-85); all of these are part of the market process,

¹⁷ Mises points this out in a particularly graphic way. An increase in the number of stages of production, i.e. and increase in specialization, necessarily implies an increase in complexity in that those stages closer to the final product are more complex than those stages further from it. Complexity is related to specificity – the construction of artifacts for specialized purposes implies more internal structure, and more linkages between the stages. "Iron is less specific in character than iron tubes, and iron tubes less so than iron machine parts. The conversion of a process of production [to another purpose, in response to unexpected change] becomes as a rule more difficult, the farther it has been pursued and the nearer it has come to its termination, the turning out of consumers' goods." (Mises 1949: 500).

all this change is part of the 'information age' (understood more broadly to encompass modern industrial and post-industrial economies).

It is not the fact of changes in technology that is revolutionary, it is the speed with which it is occurring that is new. The pace of change is not only quicker, it is accelerating. Lachmann's considerations suggest, however, that *our ability to absorb and adjust to change has dramatically increased* – it must have, or else we would not be able to observe these changes occurring as they do within a well-ordered social framework, a framework that remains intact in spite of the ubiquity of change. So, during this period of his professional life, Lachmann turns his attention to the an investigation of the institutional setting within in which economic activity exists (1971, 1979), to be examined below.

The increasing complexity of the capital structure can now be understood in broader terms, especially if we include human capital (as we should). In some respects this is only the latest in a line of similar revolutions like the original emergence of language and the development of writing, accounting, and printing. The latest, and to date most profound, in this line of developments is electronic communication, of which the telephone, the computer, and the video and audio recorder, and, of course, the internet, are all part. Electronic communication in all of these aspects is responsible for the developments of global markets, of desktop publishing, of fuel injectors for automobiles, of computer aided design of everything from microchips to airplanes, and so on.

Thus to understand the phenomenon of accelerating structural change occurring together with our enhanced abilities to adapt to change, we must realize that the scope and pace of technological change itself is governed by our ability to generate and process relevant information. This means that the current pace of technical change is dependent on the results of *past* technical advances, particularly the ability to generate and process information. This is a complex process involving multi-level interactions over time.

If technological change is seen as the result of many trial-and-error selections (of production processes, of product types, of modes of distribution, etc.) then the ability to generate and perceive more possibilities will result in a greater number of successes. It will, of course, also result in a greater number of failures. Lachmann's proposition that capital accumulation, proceeding as it does hand in hand with technological change, necessarily brings with it capital-regrouping as a result of failed production plans, appears in this perspective to be particularly pertinent. "[E]conomic progress . . . is a process which involves trial and error. In its course new knowledge is acquired gradually, often painfully, and always at some cost to somebody" (Lachmann 1978:18). Today new knowledge acquisition is not so gradual.

Complexity and institutions

Many of the issues that arise in capital theory generalize readily to all social situations, such as the interaction of individual expectations. The most important bridging concept is the concept of the 'plan' the basis of all human action.

Lachmann sees the market process as tending to integrate the capital structure, in other words, rendering individual production plans more consistent, although he is careful to add that *the forces of equilibrium may be overwhelmed by the forces of change*. At the individual level, disparate elements of the production plan are brought into consistency by the planner. These elements are all present in a single human mind. There is no such mechanism guaranteeing consistency between different production plans. The market process does, however, tend to eliminate inconsistencies between plans in so far as not all of them can succeed. In this way plans that are consistent with (complementary to) one another tend to prevail over those that are not. So whereas the individual planner ensures the complementarity of all of the resources within a production plan, the market process tends towards a situation of overall plan complementarity. But there is absolutely no guarantee that in the face of continuing changes in the 'data,' that such a tendency will be the dominant one. Lachmann was clearly more skeptical than Hayek (or Mises or Kirzner) about the question of the predominance of equilibrating over disequilibrating forces. For him it was an empirical issue.

Professor Hayek and Mises both espouse the market process, but do not ignore equilibrium as its final stage. The former, whose early work was clearly under the influence of the general equilibrium model, at one time appeared to regard a strong tendency towards general equilibrium as a rear phenomenon of the market economy. Mises, calling the Austrians 'logical' and the neoclassicals 'mathematical' economists, wrote: 'Both the logical and the mathematical economists assert that human action ultimately aims at the establishment of such a state of equilibrium and would reach it if all further changes in date were to

cease' (Mises 1949: 352). In is this view of the market process as at least potentially terminating in a state of long-run general equilibrium that now appears to require revision.

... What emerges from our reflections is an image of the market as a particular kind of process, a continuous process without beginning or end, propelled by the interaction between the forces of equilibrium and the forces of change. General equilibrium theory only knows interaction between the former. (Lachmann 1976: 239).

Lachmann thus rejects the notion of the predominance of equilibrating tendencies even in 'theory.' He did not see it as legitimate to omit from the theory the undeniably disequilibrating effects of the inevitable change in knowledge that must occur with the passage of time. But this disagreement is not about whether or not equilibrium is ever reached. There is no disagreement that it is not. What emerges as an issue for all these economists then is the question of how people can act in a world which is always subject to changes in the 'data' so that it is always *de facto* in disequilibrium. And the answer they all give in one form or another is the existence of social institutions – the existence of rules, habits, customs, mores, etc. that serve to anchor people's expectations about the actions of others in such a way as to permit them to act coherently in anticipation of predictable consequences.

The problem is particularly acute for Lachmann the 'radical subjectivist.' For him expectations are autonomous. Though they may be influenced by events they are not wholly determined by them. All experience must be interpreted and may be interpreted differently by different individuals. This creates unavoidable uncertainty and error. It is the world in which there is work for the entrepreneur who pits his vision of the future against those of his rivals. It is a kaleidic world. This implies what Roger Koppl has called the "Lachmann problem" (Koppl 1998: 61). Action is by definition goal oriented, informed by knowledge of a causal mechanism that presupposes a tight connection between action and outcome. But if outcomes are radically uncertain why are people not debilitated? How is action possible in a radically uncertain world? Stated differently, on the one hand there are the undeniable facts of novelty and disequilibrium and the inability to foresee all consequences. On the other hand, there is the undeniable fact of order in society in which people seem able to act by relying on successfully predicting the actions of others. How is one to reconcile these apparently irreconcilable perspectives?

This issue has been the subject of some recent research (for example McMullen 2010: 114,131, Foss and Garzarelli 2007 and Lewis and Runde 2007) which turns to Lachmann's work on social institutions (mainly Lachmann 1971, see also Lachmann 1979) for a resolution. Compared to Hayek, Lachmann's work on institutions is tiny. Hayek's work is extensive and well-known, forming the basis for comprehensive analysis and defense of decentralized market economies. Yet, the inspiration for Lachmann on this is not Hayek, his former mentor, but rather Max Weber.¹⁸ In his analysis Lachmann does not even cite or refer to Hayek. Clearly he either was not sufficiently familiar with the later Hayek or else he was not enamored of this work but, given their history, was reluctant to engage on it – most likely the latter (see Mittermaier 1992: 10).¹⁹

It is not even as though their approaches are that different, though clearly Hayek's concerns range much wider and deeper. Both stress the role that institutions play in orienting individual action, in providing the 'rules of the game' that provide individuals with sufficient knowledge, about the possible range of actions of others, to be able to form reliable expectations. Both speculate about the origin and change of these institutions. Hayek has a full-blown theory of cultural evolution. Lachmann has a few pages on innovations in institutions and on how individual imitation of behavior may lead to the emergence of institutions (1971). Both agree that institutional change must be orderly and slow if it is not to disturb the institutional framework.

Concluding Remarks

I will conclude this chapter by offering a few, perhaps presumptuous, remarks on where I think Lachmann's, and maybe Hayek's, analysis might be augmented to provide further insight into how action is possible in a kaleidic world (Lewin 1997, 2011, chapter 3).

The Lachmann problem revolves around the autonomy of expectations. Because they are autonomous they are likely to be disparate – hence the unavoidability of substantial numbers of errors. Of the disparate expectations of any given future only one (at most) can be correct. If, indeed, this were all there was to it, action

¹⁸ Though, as Roger Koppl suggests, Weber was no doubt an inspiration for Hayek (as for Mises) as well.

¹⁹ This is a genuine puzzle, since Lachmann showed no reluctance to part company on the issue of equilibration.

would be impossible. It is no answer to say that institutions provide points of orientation that enable action unless we can somehow explain how institutions act to reduce the spread of expectations or render the consequences of that spread harmless. Both solutions emerge from a different way of looking at it.

We need to unpack the concept of ‘expectations’ and ask the question ‘expectations of what?’ Obviously individuals have expectations about many different things. Only some of these are likely to differ much across individuals. Those that form the basis of institutions, expectations about the ‘rules of game’ are likely to be very uniform across individuals. We may say that these expectations are informed by knowledge of the ‘social laws’ concerning how others will (almost) invariably behave in given situations²⁰ analogous to their knowledge of natural laws (like the law of gravity). Those expectations that are informed by these two kinds of knowledge are likely to be very congruent. By contrast those expectations relating to the outcomes of introducing a new product, a new advertising approach, a new technology, a new competitive strategy, are *not* informed by such ‘hard’ knowledge. These are likely to be all over the place. Yet, such actions will not be deterred on account of the spread of expectations. The entrepreneur acts precisely because he believes he is different and he knows better than the rest, absent which there would be no profit in it. Thus, somewhat paradoxically, *predictability in one sphere is the necessary ingredient for coping with its absence (novelty) in another sphere.* (Loasby 1991, 1994). To invoke once again the analogy of a sports game, the fact that the outcome (the score, and the details of the action) cannot be predicted with any degree of certainty does not prevent the game from being played. On the contrary, it is the very unpredictability that adds to its attraction. What is predictable are the consequences of any infringement of the rules of the game, the fact that the losers will probably accept the result peacefully and so on. And it is the latter that allows the game to be played.

Finally there is the question of the origin of these institutional frameworks within which action can take place. Lachmann tries to invoke the idea of a process like a market process to explain how functional institutions win out. He was, like Hayek, looking to some kind of evolutionary selection process. He also appeals to individual imitation of successful action (1971). No doubt both forces are at work. But, it seems to me he misses a key element. An individual walks across the mall full of snow and leaves a trail of footprints. Someone following him finds it helpful to walk in his footprints (pun intended). Those who follow do the same and eventually they make a path through the snow that is of benefit to all who walk it (Kirzner 1992: Introduction). The original trailblazer is an *unintentional institutional entrepreneur*. The general principle is the operation of *network effects* – the more people use the network the greater the benefits for *each* (Liebowitz & Margolis 1994). Social institutions are complex phenomena and they are networks. A network of this kind is one in which the individuals who participate benefit from a shared (frequently tacit) understanding of how to proceed – a common standard (like a telephone technology, a language group, a religious group, a commonly accepted means of payment, a system of commercial laws, etc.). These ‘external benefits’ are the network effects that imply that there is *feedback from individual action to other individuals, in the direction of producing uniform expectations regarding each other’s behavior (choices)*. We can provide plausible choice-theoretic arguments showing how individuals perceive the benefits of choosing common modes of behavior. In other words, social institutions are likely to emerge spontaneously from individual action and to grow spontaneously to an optimum size. They have exactly the properties whose absence Lachmann emphasized in dynamic market processes. They produce a convergence of individual expectations. There are many examples of convergent social processes, perhaps the most familiar being the emergence of money (Menger 1871).

Convergence and permanence are no doubt relative. Nevertheless they are necessary in some degree for the existence of, and for the understanding of, dynamic economic processes. The hectic procession of new products and productive processes—the result of the activities of a multitude of individuals organized as firms, operating within the constraints of contract and property law, some of whom succeed in their endeavors, many of whom do not—is dependent on underlying social institutions. Experience suggests that while we cannot predict who will succeed and who will not, while we cannot predict which products will emerge and be popular, while we cannot foresee the nature of future technologies, *we strongly believe that the process will be peaceful and will be orderly*; we confidently expect those who are unsuccessful to accept their losses peacefully and perhaps try something else, those who lose their jobs to move on in the hope of greener pastures, and those who do succeed to continue to try to do so. *The fruits of this dynamic process depend crucially on our (predictable) willingness to accept the*

²⁰ They will drive on the right hand side, they will mark time in the same way, they will not resort to violence if their business fails, etc.

consequences of its unpredictability. That willingness is the vital predictable part. Indeed, as with other complex adaptive orders, we have the emergence of 'order' and we are able to explain the process in a readily accessible and intuitive way as deriving from human action.

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