THE T E N D E N C Y TO DISCOVER: WHAT DOES IT MEAN ?

by

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FIRST DRAFT

The "tendency to discover profit opportunities" occupies a central role in modern Austrian economics; it is a role similar in its centrality to that exercised by the law of diminishing returns in classical economics. All of the main results of the Austrian approach depend in some way on this tendency. The market process is driven by the efforts of agents to pursue profits and avoid losses. Nevertheless, there is a great deal of unclarity about its precise meaning. Why is there only a *tendency* to discover? Shouldn't there be simply a *fact* of discovery? Why are we hedging? Some have argued that it is called a "tendency" because, at any point in time, a profit opportunity need not be discovered. If this is the case, what is the difference between those circumstances in which the opportunity is discovered from those in which it is not? The law of diminishing returns is a tendency, but we know what interferes with its manifestation in observable reality: viz., improvements in the state of agricultural production. But when an opportunity is not discovered, what stands in the way? Ignorance, uncertainty of the

future? Well, of course! Those are *always* operative, even when discoveries are made. In fact, we cannot conceive of discovery without ignorance and uncertainty, although we most certainly can conceive of diminishing returns without agricultural improvements. Clearly, discovery, if indeed it is appropriately called a "tendency", is very different from the of diminishing returns in the classical system. It is also, as we shall see, different from the tendencies (or comparative static propositions) of neoclassical economics. If terminology were the only issue at stake, clarification would be useful so that we would have a better or more efficient vocabulary – one that can more easily direct our minds to the underlying realities. More, however, is at stake. The lack of clarity attendant on use the term "tendency to discover" is symptomatic of underlying conceptual confusions that have implications for the extent to which we conceive of the market as an open system – one that endlessly generates new possibilities.

Tendency: The Source of Much Confusion

The *locus classicus* for the discussion of the ambiguity of the term "tendency" in political economy is Richard Whateley's *Introductory Lectures on Political Economy* [1966], originally published in 1832. Here he distinguishes two meanings:

> By a "tendency" towards a certain result is sometimes meant, "the existence of a cause which, if *operating unimpeded*, would produce that result." [1966:249]
>
> But sometimes, again, "a tendency towards a certain result" is understood to mean "the existence of a state of things that the

result *may be expected to take place*." [250]

These distinctions, while useful, unfortunately cut across some of the differences that are most important for our ultimate purposes. We must distinguish between tendencies that are static and those that are dynamic or processual. If we look at Whately's definitions, we might, at first glance, think that the first one refers to some isolated (i.e., ceteris paribus) dynamic process. But we must understand that in the classical system (and in early neoclassical economics as well) "dynamics" simply refers to the data changing: population, capital, techniques of production, etc.[Weintraub]. This has nothing to do with adjustment processes, per se. Whately gives as an example of a tendency of the first kind the Malthusian law of population. The problem with this law, however, is that it predicts that labor should remain at the level of subsistence on average, with temporary movements above and below. This prediction is, fortunately for humanity but unfortunately for the law, inconsistent with the historical record. How then can this failure be explained (away)? The law states what would happen, if there were no disturbing causes. Evidently, there were disturbing causes – possibly restraint of the passions, forms of birth control, or agricultural improvements outpacing the increase in population. Thus, the law, while still operative, is not evident in the historical record. The historical record is the result of several causes operating simultaneously. This argument has nothing to do with processes of adjustment; it simply amounts to a weighing up of conflicting tendencies (more on this later).

For our purposes, it is best to classify tendencies insofar as they embody the existence of processes in real time. Thus we shall distinguish among: (1) static tendencies; (2) pseudo-

dynamic tendencies; and (3) genuinely dynamic or processual tendencies. Only the third type embodies real-time processes. The tendency to discover is a tendency of the third kind. Let us briefly discuss the first two.

Static Tendencies [Hollander]

The degree to which the pecuniary motive is operative or dominant in economics was a subject of great controversy in the nineteenth-century. John Stuart Mill was anxious to preserve the great analytical power of the assumption of *homo economicus*, but he was also quite aware that "wealth maximization" was not the only motive people have. To accommodate both analytical and empirical demands, he argued that there was only a "tendency" to wealth maximization (subject to the "perpetually antagonizing"[Mill, 19 :] desire for leisure, and what we would call today, positive time preference). Why did he qualify his claim with the word "tendency"? He could have simply said that sometimes men seek wealth, and sometimes they don't. Such a claim, however, would not have given him the result he wanted, namely, the empirical relevance of the laws of political economy. For then it would be unclear when the laws of political economy applied and when they did not. Mill restricted the wealth maximization motive in a number of ways. First, it appeared mainly in a particular class of behavior, i.e., in business affairs. Second, it required a particular institutional-setting that exists primarily in countries like Britain, France, Germany. And, finally, even with these restrictions, wealth maximization was the motive only of the average or normal person. Thus, for example, the laws of political economy would apply to the average behavior of persons engaged in commerce in

Britain. Clearly, then, this is a straightforward use of the word "tendency" in the second sense of Whately above: " the existence of a state of things" in British commercial dealings such that "the result," wealth maximization, "may be expected to take place" on the average.

Pseudo-Dynamic Tendencies

The fundamental example of pseudo-dynamics is to be found in comparative static propositions, or more generally, in laws of covariation at a point in time, under (more or less carefully) stated conditions. Normally these are exceptionless generalizations: If interest rates rise, *ceteris paribus*, investment will fall. We do not say "investment might fall, or that it will fall in x-percent of cases, or that it will, on average, fall." No, it will fall, pure and simple. This is in sharp contrast with Whately's second meaning of "tendency" which requires only that the result be "expected" to take place. The difference between these two is that in the case of comparative static relationships the exceptions are hidden in the ceteris paribus clauses. In the empirical generalization of the relative frequency of wealth maximization, on the other hand, a number of behavioral motives are operative simultaneously (the *cetera* are not *paria*), and the high propensity to maximize

wealth, under certain conditions, is the overall or ultimate *result*. This is simply an outcome; no process is involved.

It may not be obvious why laws of covariation are also ultimately static even though they differ from the second form of tendencies described by Whately and used by Mill. This is because the former are always simply a pairing causes with "results", but results that are not observable to the technically unaided eye: they are the particular outcomes of partial causes in a world of multiple causes. They are cross sections along a multi-dimensional function that "completely" describes the phenomenon in question.

Comparative static relationships can sometimes give the impression of being applicable to dynamic situations. There are at least two reasons for this. The first is that the change in, say, investment that *accompanies* a rise in interest rates is often approximated as the change that temporally follows a rise in rates. The truth is, of course, that no time elapses in these mental experiments.

The second reason is a bit more subtle. It has to do with what Mill called the "composition of causes" [1936: 243]. Under certain conditions, real-world outcomes that are the result of a number of causes acting simultaneously may be analyzed in terms of the partial causes. Mechanical phenomena, which Mill believed to be an extensive class including the field of political economy, are characterized by a simplicity of causal interaction wherein "the joint effect of several causes is identical with the sum of their separate effects" [243]. The paradigm case is the vectorial addition of impressed forces

moving a body in different directions. “If a body is propelled in two directions by two forces, one tending to drive it to the north and the other to the east, it is caused to move in a given time as far in both directions as the two forces would have separately carried it; and *is left precisely where it would have arrived if it had been acted upon first by one of the two forces, and afterwards by the other*” [243,emphasis added]. There are two important points here. The first is that each partial cause (force) can simply be added to get the overall effect, that is, the movement of the body in the northeast direction. The second is that the order of time simply does not matter. Whether the movement to the north is first and that to the east is second, or the east first and north second, *or both simultaneously*, the result is the same. In physics this may be considered “dynamics” because of the movements involved .But for our purposes, the irrelevance of time and time order means that we are dealing with pseudo-dynamics.

The composition (or addition) of causes is possible because the individual causes “continue to observe the same laws when in combination which they observed when separate…” [243]. These partial causes are considered “tendencies” in the same sense of Whately’s first definition above. These tendencies are additive because we are dealing with a linear system: one which can be taken apart, reduced to its components and then put back together again, with no loss along the way. A relatively modern example from economics of the composition of causes is the Quantity Theory equation. In its differential form we have $dM + dV = dP + dQ$. Thus if there is simultaneously an increase in money and a decrease in velocity, the total effect on nominal income ($dP + dQ$) is simply the sum of the partial causes, the changes in money and velocity. It is

interesting to note, however, that in the special case where two antagonistic tendencies offset each other (as would be the case in the above example where dM = -dV), Mill claims that the two tendencies are still active, that the law of each is fulfilled.
"Each agent produced the same amount of effect as if it had acted separately, though the contrary effect which was taking place during the same time obliterated it as fast as it was produced" [244]. Strictly speaking, in a static context, this is incorrect because nothing is changing. There are simply "new" *levels* of money and velocity of circulation. The analyst has chosen alternative numbers to plug into the equation. Nevertheless, the claim is important because it shows that Mill's thinking is partially dynamic, that is, he has in mind real-world processes underlying the aggregate result.

In the final analysis, both of Whately's definitions of "tendency" – at least in the way there were applied – refer to phenomena of a static nature. The expectation of a certain result refers to a high relative frequency at a point in time. The operation of a cause, in unimpeded fashion, is simply a comparative static experiment, although we did see above some ambivalence in Mill and a thought, perhaps, that mechanical analysis could approximate processes.

On the Road to Dynamic Tendencies: A Lost Opportunity

The law of diminishing returns and the Malthusian population principle occupy a central position in classical economics insofar as most of its conclusions stem from the operation of these laws. Together they led to determinate results and, one might add, rather harsh

implications for the future of the laboring classes. The counteracting tendency that, in a sense, opened the classical system was improvement in the state of productive arts or, as we would say today, technical change. Mill [1987 :710-24] analyzed the effects of increases in population (and other key variables) on wages, rents and profits in some detail. His analysis follows the methodological precepts outlined above:

> The tendency of each cause in its separate state being thus ascertained, it is easy to determine the tendency of the actual course of things, in which the two movements are going on simultaneously, capital and population increasing with tolerable steadiness, while improvements in agriculture are made from time to time, and the knowledge and practice of improved methods become diffused gradually through the community [721].

Without any increases in capital or technology, an increase in population would usually lead to a fall in real wages (although a rise in unit labor costs) and a rise in rents, as both the intensive and extensive margins of cultivation increase to feed the additional laborers. So we could say that an increase in population *tends* to produce these effects. But, unfortunately for analytical simplicity, capital also will usually increase as will the state of productive technique. Therefore, consider now the case of population increasing and technical arts improving. If we imagine one factor (technique) to outstrip the other, the analysis would be the same, according to Mill, as if, say, technique were increasing and population were held constant. "To place the effect of improvement in a clear light, we

must suppose it to take place *suddenly*, so as to leave no time, during its introduction, for any [relative] increase in capital or of population" [716, emphasis added]. If we suppose the improvements in productive arts are both labor-saving and land-saving, then there will be great pressure on the price of agricultural products to fall as labor costs fall and the margin of cultivation recedes. Both of these factors will therefore lead to a fall in rents. Initially, before any effects on population growth, money wages would remain unchanged and laborers would reap the benefit of the fall in price of agricultural products (hence real wages would rise). So the effects of technological improvements, at least initially, are to counteract the effects of population growth.

From a contemporary perspective, one might have thought that the introduction of changes in knowledge and the consequent "falsification" of the standard classical predictions (thus, in a sense, opening up the model) would have lead to the introduction of dynamic tendencies. This did not happen for a number of reasons. The effect of changes in knowledge in the Millian system is purely commensurate with changes in capital and population. Each is reducible to changes in bushels of wheat per unit of land and thence to changes in various prices as determined by mechanistic laws. The entire system is one large machine with quantities of agricultural produce generating all outcomes in the final analysis. In addition, the simultaneous operation of sometimes counteracting and sometimes reinforcing tendencies does not change the structure of the relationships among these tendencies. This is the essence of the composition of causes.

Mill, however, did appreciate the limitations of the mechanical method in the study of nature. He believed that the emergence of new properties and relationships was quite common in chemistry, for example [1936: 243]. While the details of his view here may not be consistent with modern understanding of the physical basis of chemical reactions, it is consistent with the emergence of new possibilities chemical combination can engender. "[I]n the evolution of biochemistry, it is widely appreciated that every new compound creates new possibilities for further new compounds to synthesize: possibilities which previously did not exist" [Popper, 1990: 19]. Mill, understandably, had no inkling of this, and continued to hold out hope that the inapplicability of the composition of causes to the chemical realm was a function, in large part, of the primitive state of scientific understanding [1936: 245]. So, in the end, the growth of knowledge was treated as subject to the composition of causes and the role of emergence in nature was minimized.

On the Road to Dynamic Tendencies: The Mises – Mill Connection

Recall in the discussion above we pointed out that Mill believed in the fulfillment of the law of each tendency even in those cases where contrary tendencies apparently counteract each other completely. We asserted there that while this claim is wrong in a strictly static context, it could be true in a more dynamic or precessual model. If the latter is the case, it would show that the tendency-approach, as applied by Mill, was not inherently static. In fact, it would demonstrate a deep tension in Mill's thought arising out of the use of mechanical tools to understand dynamic phenomena. Consider the following:

> A stream running into a reservoir at one end tends to fill it higher and higher, while a drain at the other extremity tends to empty it. Now, in such cases as these, even if the two causes which are in joint action exactly annul one another, still the laws of both are fulfilled: the effect is the same as if the drain had been open for half an hour first, and the stream had flowed in for as long afterwards. Each agent produced the same amount of effect *as if* it had acted separately, though the contrary effect which was taking place during the same time obliterated it as fast as it was produced [244, emphasis added].

Our point here is that the individual operation of each cause is only possible in a temporal, sequential process and that the *instantaneous* obliteration of one cause by the other is, at best, a metaphor (hence the italicized "as if"). Therefore, for tendencies to be fully actualized in a world of conjunct or multiple causes, recourse must be had to process analysis. This is the direction pursued by Ludwig von Mises in his rendition of the effects of increases in the supply of money, on the one hand, and increases in the demand for money, on the other [1966: 414-415]. In a simple equation of exchange approach, the increase in money can be offset by the decrease in velocity (as we saw above). But when we are considering processes, Mises claims, "these two opposite tendencies do not neutralize each other. Both processes take their own course…" [415].

In a processual analysis it is difficult to see how there can be an increase in the supply of money, from, say, increased gold production and a *simultaneous and exactly offsetting*

increase in the demand for money. How does the increased money (realistically) enter the system? Does it get immediately "caught" by the increased demand to hold? If so, then the effective money supply does not increase. It would be equivalent in Mill's example to the reservoir not getting filled because the drain and point of entry overlapped, that is, because the water flowed into a drain directly. Therefore, a plausible scenario for the mutual interaction of an increase in gold production and an increase in the demand for money would have to be sequential. For example, gold production could increase somewhat and flow through the system, without their being a change in the demand to hold, and then prices would rise. Subsequently, there could be an increase in money balances and prices would fall. This process could continue until, in the final analysis, "[t]he new structure of prices may not differ very much from the previous one. But it is the resultant of two series of changes which have accomplished all inherent social transformations". Mises is careful to note, however, that the "two processes [must be] independent of each other" for the scenario outlined above to be plausible [Ibid.].

Thus, for "tendencies" to be something more than mere outcomes under stated conditions, there must be a process analysis, and processes must, of course, operate in time. "[T]here is no such thing as an instantaneous process" [Rescher, 1996: 38]. The idea of static tendencies points in the direction, however haltingly and imperfectly, of dynamic tendencies.

Still on the Road to Dynamic Tendencies: Hayek's Contribution

In previous work [Rizzo,1990], we distinguished between two forms of Whately's first meaning of "tendency" in the work of F.A Hayek. We described a "strong analytical tendency" and a "weak analytical tendency." In this view, the strength of the tendency depends on the degree to which there is appropriate or equilibrating learning in conditions of disequilibrium. While Hayek did not use these terms, he was very much aware of the differential likelihood of learning in different situations. Our task was to bring to the fore the implicit economic analysis and thus push forward the Hayekian project.

We can begin, as Hayek did, with individuals who are frustrated in the attempt to implement their plans. Something has gone wrong; the future did not turn out as the individuals' mental frameworks led them to expect. Let us investigate how the two approaches differ from this point onwards.

> **Strong Analytical Tendency**: It is inevitable that individuals will discover their coordination errors. It is also inevitable that they will discover the knowledge necessary for coordination to prevail.
>
> **Weak Analytical Tendency**: Individuals may discover their coordination errors. They may discover the knowledge necessary to achieve coordination.

What distinguishes the two tendencies is the background assumptions about the specific problem-situation faced by the agents and, derivatively, the particular kind of error involved in their existing mental frameworks.

In the first case, we can imagine the agents attempting to solve the problem of coordination of plans and actions with those of others with whom they interact. A tentative initial solution was found in the form of a framework that governed their expectations. This framework turned out to contain errors insofar as the expectations of the agents were wrong: they were lead to expect that they could make exchanges with certain other agents on particular terms, but they found that they could not. There was mutual incompatibility of plans. The discovery of these errors is presented as if it were "inevitable" [Hayek, 1948: 52]. But such inevitablity is only contingent on the existing framework having directed the attention of the agents in a specific way. They tried to make these specific exchanges, and not others. Now we move to the second stage of the scenario. The agents try to eliminate their errors with a new framework and new expectations. They must revise their expectations about what exchange-terms others will accept. Hayek's claim is that the are "bound" [Ibid.: 53] to discover the appropriate (equilibrium) terms. Nothing in Hayek's argument requires us to accept this assertion. It is clearly wrong.

In the second case the initial solution to the problem of interpersonal coordination reached by the agents led them to expect that the exchange opportunities they observed were the most favorable. The framework did not permit them to imagine or, more exactly, expect that there would be better ones – that is, better solutions to their general problem. Stated in this way, we can easily see that there is nothing permanent about this situation. There are *always* better solutions to problems. There are *always* better ways to

coordinate the plans of agents. There is *always* a better mousetrap "out there." In view of this, why does Hayek say that the agent "*may* learn of the new facts as it were by accident, that is, in away which is not a necessary consequence of his attempt to execute his original plan…" [Ibid.: 52, emphasis added]? In other words, why is there a weak analytical tendency? It is weak only insofar as any particular better opportunity will not inevitably be discovered. Certainly, all better opportunities will never be discovered even in infinite time. However, it is the continual aim of individuals to discover better solutions to the overall problem of coordination. Thus, the fundamental difference between the two cases is that the first is a story of the solution to a specific, limited problem. The second is the story of the unending quest for better sub-problems and better solutions.

The strong analytical tendency is pseudo-dynamic, not because of the limited-problem characterization, but insofar as error-detection and the discovery of a superior mental framework is considered inevitable. If the solution were indeed inevitable, then it should have been there all-along. Hence this collapses into the standard neoclassical case of pre-reconciliation because there is no reason for a process to take place. A process under these conditions is a purely ad hoc construction. The weak analytical tendency is truly dynamic because what is needed for a new tentative solution is not there already. Hence the process is real; discovery is genuine. As such, however, nothing is inevitable or final.

The Tendency to *be* Discovered: A Static Tendency

In the section and the next we shall discuss two forms of the tendency to discover. The first is most closely associated with the name of Israel Kirzner who has pioneered the development of this idea in economics and in Austrian economics, in particular. There is no gainsaying the fundamental importance of his contribution. It has the potential of transforming the face of economic science. Nevertheless, we submit that the concept of discovery, as he has developed it, remains too closely tied to its static roots to actualize fully its potential. For clarity, let us state in proposition form what we shall call Kirznerian or K-discovery for short. While, there is abundant textual evidence that this accurately renders his view, no author is completely consistent over a period of many years. So the main purpose of this section is not to "refute" Kirzner but to examine one form of the discovery-tendency and show why it is inadequate to our task of understanding the market.

> **K-Discovery:** Ceteris paribus, all profitable opportunities will eventually be discovered.

The Kirznerian formulation is qualified in two ways: first, the data underlying the profit opportunities is frozen (hence, "ceteris paribus"), second, the agents are given indefinite time to uncover them (hence, "eventually"). So, putting these qualifications together, the proposition is saying that if the opportunities are unchanged and if agents have an indefinitely large number of "trials" in which to discover these opportunities, they *will* be discovered. This is an exceptionless generalization, under the stated conditions, as in the Millian approach to static tendencies discussed above. From this proposition that all

opportunities will be discovered, it follows that *any given or any particular* opportunity will be discovered in indefinite time. Thus, in the modeling or depiction of a particular profit opportunity one is justified in saying, subject to the qualifications, that it will be discovered.

The K-tendency occupies an uneasy home in both Newtonian and apparent real time, depending on the perspective from which it is seen. While we should not be purists about conceptual tools, it does not seem that this particular mixed metaphor, so to speak, works. While the world of external profit opportunities is not allowed to change, the internal (mental or psychological) world of the agent is allowed to change. How else could he go from a situation of ignorance to a situation of discovery? This implies, however, that the opportunities are to be considered independent of the internal "theoretical" framework of the individual and its associated expectations. The opportunities exist in a separate static Newtonian world, while the mind of the individual changes, develops, and grows in a what appears to be world of real time.

Karl Popper [1990:19-20] examines a "law" of nature related to the K-tendency as we have stated it. Popper's law is: "All non-zero possibilities, even those to which only a tiny non-zero propensity is attached, will realize themselves in time, provided that they have time to do so; that is to say, provided the conditions repeat themselves sufficiently often or remain constant over a sufficiently long period of time." Popper recognizes that this law, if indeed it is a law, is undone once we realize the inherently dynamic nature of the realization of possibilities. Each possibility, when realized, creates new ones. As we

noted above, chemical compounds create opportunites for new compounds to be discovered. More importantly, for our purposes, the solving of a coordination problem (the discovery and seizing of a profit opportunity) gives rise to further opportunities. For example, the discovery of an opportunity to produce color computer monitors, even when successfully implemented, will have unintended consequences such as eye-fatigue problems from glare. This, in turn, will generate additional profit opportunities to solve the new problem, ad infinitum. This means that the realization of a possibility does not allow "the conditions [to] repeat themselves sufficiently often or remain constant over a sufficiently long period of time" for *all* opportunities to be discovered. New possibilities will replace old possibilities and change the likelihood of that those that persist will be realized. As we shall discuss further below, discovery must have a context (or a continuity of contexts); it is this very contextual continuity that makes the K-tendency impossible.

It should to be clear by now why we referred to K-discovery in the section heading as the "tendency to *be* discovered." In this formulation, opportunities "cry out"[Kirzner, 1973: 127] to be discovered. The population of potential discoveries will make itself manifest [Harper, 1996: 297], "sooner or later" [Kirzner, 1979: 32]. If this is true, then why does discovery take time at all? Why are not all opportunities *already* discovered, as in the neoclassical world? The truth is that K-discovery only appears to be in real time. There is no continuous growth of knowledge over the indefinite future. At some point, there is simply an instantaneous awareness of the problem and its solution. Thus the delay in any discovery is purely arbitrary. Nothing would be lost if its arrival had come one instant

earlier, or in the limit, immediately. Thus, K-discovery undermines itself in the sense that it can provide no argument against perfect knowledge ab initio.

K-discovery is thus an example of "radical finalism" [Bergson, 19]. The pre-existing opportunities exercise a pull on the pseudo-process that occurs in disequilibrium. There is a tendency for frozen opportunities to make themselves known in indefinite time. Since the "futurity" of this statement is purely arbitrary, finalism issues in the determination of knowledge by the existing data. So we come full-circle in the sense that finalism is really no different from "radical mechanism" in which a putative past determines the individual's state of knowledge. Since in mechanism also there is no non-arbitrary reason for the delay between determinants and knowledge, time is here too an illusion. So both finalism and mechanism have no defenses against the ideas of perfect knowledge and complete reconciliation.

The Dynamic Tendency to Discover

In this section we shall analyze a different form of the tendency to discover. This, we believe, captures the dynamic nature of discovery more effectively than the K-tendency. Since the formulation of this tendency takes its inspiration from the work of Karl Popper and the extensions thereof by David Harper [1996], we shall call it Popperian discovery or, for short, P-discovery.

P-Discovery: Individuals will discover problems and their solutions, that is,

they will discover profit opportunities.

The Popperian formulation is not qualified by a ceteris paribus clause and is not outside of real time. It is a generalization about human beings; it describes a fundamental evolutionary characteristic: People solve problems. These problems are not static. In fact, one of the leading characteristics of P-discovery is that the environmental background is continually changing. While agents may make numerous attempts to discover the solution to a problem, they do not have an indefinite number of occasions (or trials) precisely because the problem-situation is changing. Therefore, they will not discover every problem (opportunity) nor will they be able to solve every problem (or seize every opportunity). Some problems simply do not have solutions, even if an infinite amount of time were available.

The essence of P-discovery is that it is problem-oriented. A problem is seen through, and only through, the lenses of a mental framework. In the same way, a profit opportunity is perceived through a framework that directs us to look at particular behavior and to expect particular future developments. Sometimes the framework produces disappointed expectations. When this happens, losses may ensue. The agent then tries to find the source of the error and to generate a superior hypothesis that will enable him to have correct expectations about the environment next time. Thus, we begin with an initial problem situation defined in terms of a framework – here a perceived discoordination of plans – then we move on to a tentative solution – there a plan to seize the profit opportunity offered by the discoordination. Suppose that the solution fails, then the agent

may discover the source of the error. From there he may discover a new, better framework that defines a new problem – perhaps a more subtle form of discoordination – and a solution to that problem. Even if the solution to the initial problem is adequate, however, the likelihood of unintended consequences following upon the solution will produce new problems (frameworks) and tentative solutions.

The importance of the preceding analysis is that discovery can take place only within a dynamic framework, that is to say, an intellectual structure that specifies a problem, a tentative solution, the detection of errors in that solution, and a new problem. We could say that there is *discovery* at every stage in this process. This is true. But we must be careful not to think (except provisionally) of the process as broken down into parts. This is because unless the entire structure is in place there is no discovery at any point in the process. What does it mean to discover a problem without a mental framework? What does it mean to eliminate errors without a tentative solution? How can one perceive errors without the framework? How can one improve a framework and problem-situation except by reference to the previous? Discovery at one point presupposes discovery at all the others. Discovery is dynamically continuous.

This "simple" fact has many implications:

1. Discovery is not instantaneous. It can take place only in a temporally integrated process. There is no discovery about a single, isolated fact because there are no isolated facts.

2. Discovery is a *tendency* in the sense that arises out of previous problem-situations with their tentative solutions and possible errors. The previous problem-situation exercises "plastic control" [Popper] over future discoveries. While prediction, of course, is out of the question, ex post, the analyst should be able to construct a reasonable story – a rational reconstruction – of how one discovery leads, in a loose way, to another.
3. The process is literally unending because both satisfactory and unsatisfactory solutions give rise to new problems (opportunities) and new tentative solutions. Equilibrium can only refer to the solution of a particular problem, the seizing of a particular profit opportunity. Such an "equilibrium" is unstable in the sense we have been arguing in this Article.

The tendency to discover, properly understood, does not require the freezing of the underlying economic data. The *social* proposition is not qualified by a ceteris paribus clause. People discover because their survival, or less dramatically, their well-being is connected to it. Action, solving problems, and discovery are three main elements in the evolutionary process. Everyday and every way, the process of evolutionary trial and error and its selection pressures is operative and forms the context for the continual process of discovery. On the other hand, at the *individual* level no one can question all hypotheses simultaneously. Such a procedure is incompatible with discovery of any sort. An intellectual "ceteris paribus" is required insofar as, for example, the individual need not question the accuracy of his observations or the methods used to make those

observations. None of this, however, means that unquestioned hypotheses are taken as true. Not questioning may simply be a convenient way to proceed.

The dynamic tendency to discover is thus a continuous process firmly embedded in real time. This process is open-ended and unpredictable. The universe of possible discoveries is endlessly changing as a result of the discovery process itself. Thus it makes no sense mentally to freeze opportunities during discovery. Discovery can only be understood as a part of a process in which one discovery leads to another. It is an inherently dynamic idea.