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Leaders in the Economics of Uncertainty



PROFILE

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NEW ECONOMIC PARADIGMS – AN APPRAISAL

- The True Meaning of “Market Risk”
- Confusions about Investor “Irrationality”
- A New Perspective on Behavioral Finance

ALSO

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The True Meaning of Market Risk and Investor Irrationality – And an Appraisal of New Economic Paradigms –

This **PROFILE** seeks to clarify the interrelated concepts of “market risk” and “investor irrationality.” In doing so, we place the discipline of Behavioral Finance and other new paradigms into a new and better perspective. There are two reasons for publishing this essay. First, much of what is written about market risk and investor irrationality is either badly confused or simply wrong. Second, important new progress has recently been made in clarifying exactly what these concepts *do* mean, and how they are mutually interrelated at a deep level. Of particular importance was the discovery in 1994 of the role of “endogenous risk” in generating market volatility. Since the Global Financial Crisis of 2008–2009 offers a textbook example of the role and importance of endogenous risk, it seemed timely to expand upon these issues.

An additional reason for this report is to announce the release of a new **On-Demand** lecture entitled “Reconceptualizing ‘Market Risk’ from Scratch.” This verbal lecture sets forth at a somewhat mathematical level the exact meaning of market risk. In particular, it shows the relationship between classical exogenous risk and modern endogenous risk. In this context, we review the four necessary and sufficient conditions required for a Perfect Financial Storm to occur—conditions that we identified back in 2006 utilizing the theory of endogenous risk. We show how the Global Financial Crisis of 2008–2009 satisfied *all four* of these. The fit here is quite remarkable, and we believe clients will find this discussion very enlightening.

This new **On-Demand** should be viewed as complementary to the more informal material in the first part of this essay. While the **On-Demand** exhibits a number of equations introduced for the sake of clarity, no math *per se* is involved, and the accompanying verbal lecture makes the presentation intuitively clear. We suggest listening to this new lecture after reading the Memo.

NOTE: These “**On-Demand**” lectures can be found on our website, www.sedinc.com. On the home page, go to “Client Log-In,” and log-in using your email address and password. Click on the menu item, “Lectures On-Demand.”

1. The Discovery of Endogenous Risk in 1994

One of the more remarkable discoveries within economics during the past half century was the discovery that *total observed market risk* is the sum of two very different kinds of risk: *exogenous risk versus endogenous risk*. This discovery — with both types of risk explained and quantified from first principles — was made by Professor Mordecai Kurz at Stanford University in 1994.¹ Previously, risk in economics (including within the theory of finance) had been limited to classical exogenous risk. This meant that all risk (fluctuations) in asset prices stems from the risks of exogenous events (e.g., the risks about the weather, or war, or anything “exogenous” to the economy itself). But when this hypothesis was tested by Yale’s Robert Shiller and others during the 1980s, it turned out that only 20% of total observed risk in the real world could be explained by “news” about exogenous events alone. [Had these economists focused on those sub-periods now known as “fat tails,” which they did not, they would have found that news could only explain about 4% of the observed fluctuations of asset prices during such episodes.]

The great question in the Economics of Uncertainty and in finance then became, “Where does the other 80% of total observed risk come from if not from uncertainty about the news?” Kurz discovered that the extra risk stemmed from the *interaction* of the news once learned with the prior distribution of expectations about the news *and* about the impact of such news on asset prices. The extra risk that resulted from these interactions — *in particular, those asset price gyrations due to investor efforts rectify mistakes that become apparent once the news is announced* — is now known as Endogenous Risk. It bubbles up from inside the system, and does not come from outside.

The True Accomplishment: All of this is common sense, at once level. Thus, I can give intuitively appealing speeches in which I state: “The extra (endogenous) risk originates in how wrong investors’ expectations about the future can prove to be once the news comes out (i.e., in the distribution and correlation of investors’ *ex post* mistakes). More specifically, the more *correlated* investors’ mistakes are — that is, the more they are all wrong in the *same* direction as in the recent US mortgage default debacle — then the greater the resulting price overshoot. Additionally, the more leveraged investors are when they discover their bets were wrong, the still greater the resulting volatility of asset prices will be (i.e., the greater the magnitude of endogenous risk.)”

I can press on further and assert that, “in classical pre-Kurz economics, a *given* news announcement (‘earnings of ABC Inc. were down 11% this afternoon’) will always give rise to *one and the same* change in an asset’s price — a change known by and agreed upon by all investors.” That is, no “Pricing Model Uncertainty” arises. But in a post-Kurz world, one and the same news announcement can cause completely *different* asset price changes depending upon **(i)** how many investors had prior expectations that were disappointed by the news, and **(ii)** how many of those mistaken investors were leveraged.

¹ “On the Structure and Diversity of Rational Beliefs,” *Economic Theory*, Vol. 4, pp. 877-900, 1994.

Yet, regardless of my own ability to make such matters sound obvious, years of hard work and conceptual genius were required to put all this (and much more) together, and to arrive at a logically consistent, testable model of General Equilibrium.² In particular, a new and quite difficult mathematical structure had to be developed in order to integrate all the ideas in a coherent manner, a structure that Kurz himself developed starting in the late 1980s.³ But it should not be surprising that this was required. After all, as Einstein put this matter so well years ago, the price paid for great advances in realism and in conceptual simplicity is typically the development of a more complex mathematical language (e.g., Newton's need for the new differential calculus, and Einstein's need for the new Riemannian differential geometry of "curved" space time.) Such can be price of the pursuit of truth in science.

Additionally, it proved very difficult for scholars to solve numerically the economic equations required to predict future levels of risk and return in a quantitative manner. But using advanced computer and econometric techniques, Kurz and his assistants have now done so and have shown that, with the introduction of endogenous risk, we can finally explain where almost *all* of the observed risk and risk premia of the real world actually come from, and why.

Regrettably, the econometric and mathematical difficulties involved in the new Stanford theory partly explain why Kurz's work is little known to date. His articles are quite difficult to read, but so were Kenneth Arrow's original articles on the Economics of Uncertainty, and so was Einstein's 1916 paper on General Relativity which most physicists found incomprehensible. The emergence and acceptance of powerful new paradigms often takes time.

2. Some Important Recognition – At Last

Happily, this latter situation is now changing for the better. First, in the 2009 *Handbook in Finance*, the editors invited Professor Kurz to write up a lengthy and definitive survey article on the true origins of market risk, and on the role of diverse beliefs in generating market dynamics.⁴ The interested reader will find this essay both readable and replete with references documenting all that his Theory of Rational Beliefs has accomplished to date. And what he has

² General Equilibrium models are the most general and powerful of all economic models of the workings of the Invisible Hand. In such models, multiple markets are modeled jointly, with everything allowed to depend upon everything else. In other words, "other things" are *not* held constant.

³ For the interested reader, it was necessary to characterize a new class of stochastic processes now known as "stable" processes (think of these as a half-way house between "stationary" and "non-stationary" processes in the ergodic sense of these terms). Additionally, advances in applied topology were required to make it possible to carry out General Equilibrium analysis in a setting where investors' mistakes and hence endogenous risk play a central role. Kurz's doctoral student, Carsten Nielsen, played an important role in this latter research.

⁴ *Handbook of Financial Markets: Dynamics and Evolution* (Handbooks in Finance Series), editors Thorsten Hens IV and Klaus Reiner Schenk-Hoppe, Chapter 8, pages 440-502, North Holland, 2009.

achieved is remarkable, both theoretically and empirically. Second, in a penetrating new article in the 2010 book *The Irrational Economist*, the legendary economist Kenneth Arrow weighs in on all that has been accomplished in the last half century since his landmark 1953 paper that created the Economics of Uncertainty in the first place.⁵ The editors of this new book call Arrow's essay "the jewel in the collection" of papers contributed by many of the foremost economists alive today. Not surprisingly, it is. The only new research Arrow cites in his review of General Equilibrium with Uncertainty is Kurz's work on endogenous risk, and in particular, Kurz's discovery that the value of financial assets depends upon both exogenous and endogenous events.

The reason for Arrow's citation is that Kurz's work *is* of fundamental importance. This is not true of those more fashionable theories du jour that include "Evolutionary Economics," "Neuro Economics," "The Adaptive Market Hypothesis," George Soros' concept of market "reflexivity," and Heaven knows what else. These proliferating theories will probably fall by the wayside over time, just as did those proliferating theories of the Ether developed by the Best and the Brightest of physicists around 1900. Recall that in 1905, Einstein demonstrated that there could be no Ether at all. The topic was henceforth moot. But what is exactly wrong about these new economic paradigms?

Failing Two Notable Tests: To be sure, these recent perspectives on economics contain very interesting insights. *But they all fail two very important tests.* First, they do little to resolve the *true* problem besetting classical economics: Exactly where does all the extra risk come from, and why? Second, they are pseudo-theories in that they fail to produce what is required of any epistemologically defensible theory of economics according to the philosophy of science: an integrated model that generates *falsifiable predictions* of the sequence of future prices and quantities over time. Kurz's Theory of Rational Beliefs (RB) passes both these tests, and the predictions it makes are very impressive in their accuracy as is documented in his new *Handbook of Financial Markets* review article. In contrast, the Chicago school models passed the second test above, but completely flunked the first test. What of the other less formal theories that fail both tests?

Interestingly, Kurz's theory is surprisingly compatible with most of these new perspectives on economics. To wit, Kurz's emphasis on the role of ongoing structural changes that cause investors to be wrong, and markets therefore to be turbulent, is fully compatible with the "evolutionary" and "adaptive" dimensions of economics stressed by Andrew Lo and others. Additionally, his theory embodies Soros' reflexivity concept but does so in a rigorous manner. Finally, his theory is surprisingly compatible with the new field of Behavioral Finance, as we now show in some detail.

⁵ *The Irrational Economist: Making Decisions in a Dangerous World*, editors Erwann Michel-Kerjan and Paul Slovic, Chapter 21, pages 183-191, Public Affairs, 2010.

3. Alleged Investor Irrationality, and a New Perspective on Behavioral Finance

In dismissing several new economic paradigms above, I intentionally failed to cite Behavioral Finance (BF). This is because very serious people have worked in this field, and they have shed many insights into the inability of the Chicago School economics to explain or predict many real-world outcomes, in particular the high level of observed market risk. I am personally sympathetic to many BF results, even if there are now so many versions of the theory that it hard to know what it really stands for. That being said, however, the deeper reality is this discipline too has failed to pass *both* of the two tests required for a theory to qualify as a *good* theory in this context (the two tests cited just above).

What I want to demonstrate now is how Kurz's theory of Rational Beliefs can help clarify what BF is all about, and can replicate many of its results in a different yet complementary manner. In particular, RB theory permits and indeed encourages the incorporation of "psychological factors" at the right point of entry into economic theory. To sum up, I believe that Kurz's theory can be viewed as BF done right. And do not forget that Kurz's theory passes both tests cited above.

Origins of Behavioral Finance: BF arose as a reaction to the empirical failure of Chicago School Efficient Market models. Since one principal assumption of EMT models was that all investors act completely "rationally," BF scholars chose to attack the assumption of rationality as their main problem. Specifically, the basic tenet of BF was that the extra market risk that classical theory could not explain was due to agents' *irrationality*.⁶ Yet there was another fundamental assumption of Chicago School models that they *could* have attacked instead, and which Kurz chose to relax in his theory. This was the assumption that agents' beliefs about the future were "rational" in the Chicago School sense of that term. More specifically, all agents possessed so-called Rational Expectations about the future.

To be sure, BF scholars *did* attack this assumption *along with* that of rational behavior, but in doing so they conflated and confused these two very different modes of rationality: rational actions (behavior) versus Rational Expectations (beliefs). Kurz on the other hand distinguished between these two modes of rationality, and restricted himself to attacking the doctrine of Rational Expectations alone. In short, his disagreement was with the Chicago School's assumption about investors' belief structures. Some historical background here will help clarify matters, and this is needed because of widespread confusion about this whole debate.

Classical Economics: In the early pre-Chicago economics of uncertainty, "rational" was an adjective that modified the noun "action." That is, actions, not beliefs, were supposed to be rational. And an action was said to be rational if it is consistent with an agent's personal beliefs and preferences, including his preference for risk. It was taken as obvious that beliefs were

⁶ Those "noise-trading models" of Lawrence Summers et. al. pursued the same track, albeit in a somewhat different manner.

“heterogeneous,” (i.e., that different agents held *different* probabilistic forecasts of future events.⁷) This conception of rationality that placed no restrictions on agents’ beliefs dominated economics up until the advent of Chicago School theories. In particular, agents in Arrow’s pioneering 1953 model of General Equilibrium with Uncertainty were assumed to possess different subjective probabilities as to all future states of the world.⁸

Advent of Rational Expectations Economics: All this changed with the advent of Rational Expectations (RE) economics associated with Sargent, Lucas, and others of the Chicago School in the late 1960s and early 1970s. The new theory required not only that all agents acted rationally in the sense above, but in addition possessed one and the same probabilistic forecast of all future events — the “perfect conditional foresight” assumption of finance textbooks. *Moreover this forecast was assumed to be the correct one.*⁹ This assumption always struck me and many others as ridiculous. Yet it did serve the purpose of making it quite easy to build testable models of market equilibria, and that did mark an important advance. Regrettably, once RE was introduced, the concept of “rational behavior” largely became synonymous with this later and highly restrictive concept about agents’ *beliefs*. Total confusion has reigned since!

In my own view, the failure of BF to create falsifiable models that could explain the true magnitude of real-world risk stems from the confusion between the early and the later conceptions of rationality just discussed. By conflating and rejecting *both* rational behavior *and* rational expectations, BF scholars would never be able to create the kind of testable model needed to forecast and explain risk, for quite technical reasons discussed in the footnote below.¹⁰

⁷ Two very subtle issues arise here. The first concerns the nature of people’s probabilistic beliefs about the future. The mathematical statistician L. J. Savage at Yale originally proved that agents’ beliefs would almost always be necessarily *subjective*. Indeed, modern decision theory was predicated upon the fact that all agents possessed subjective probability distributions, and it was even discovered how to quantify these probabilities. The second issue concerns the exact meaning of an *action* that is rational. The great breakthrough here occurred in 1947 when the mathematician John von Neumann proved that an action is rational (i.e., is maximally consistent with a person’s subjective probabilistic beliefs, his preferences, *and* his risk tolerance) if and only if it maximizes the agent’s so-called “expected utility.” In English, expected utility is the expected risk-adjusted payoff associated with any action giving rise to uncertain outcomes. This theorem marked the beginning of everything to do with uncertainty in economics.

⁸ Strictly speaking, this was true of Arrow’s 1953 contingent claims model of stated-and-dated commodities. But it was not true of his Arrow securities model that *did* require Rational Expectations in the later sense of the Chicago School. Arrow expands upon this point in his 2010 article cited above.

⁹ Kurz would later show that this assumption will only be justified if the environment is “stationary,” that is, if no structural changes occur. Thus there can be no global warming, no rise of China, no advent of derivatives, etc.

¹⁰ The reason why is that, devoid of a maximizing principle (e.g., the assumption that people maximize expected utility when they make a choice), it is mathematically impossible to construct the testable model that is required. For in such a setting, neither a variational principle nor a fixed point framework will be available for the required characterization of a dynamic equilibrium. I know of no formal proof that this is the case, but I think one is possible.

How the Kurz Theory Differs: Kurz, for his part, *retained* the assumption of rational behavior (i.e., utility maximization). But he *rejected* the assumption of Rational Expectations, substituting for it the much weaker assumption that agents merely possess Rational Beliefs. The very subtle meaning of this concept is described in some detail in the footnote below.¹¹ In his theory, agents do endeavor to maximize their risk-adjusted payoff (i.e., expected utility) when they make decisions, even though they may later admit that their probabilistic beliefs about the future were wrong. And the more wrong investors are in the same direction (i.e., the greater the correlation of investor mistakes), then the greater market volatility will be. And so on, as discussed above and in past essays. To sum it all up, Kurz was the first to argue that agents act rationally, but hold wrong beliefs. *Mistakes—not irrationality—are the true source of market risk.*

Towards a Reconciliation Between the Two Theories: Consider the following BF appraisal of Kurz's RB theory. This will help reconcile the two approaches: "Agents in Kurz's RB theory are not rational at all in the Chicago School sense. They have probabilistic beliefs that are divergent, that are usually wrong, and that are often correlated as the blind follow the blind in sequences of bull and bear markets. They are only rational in the weaker sense that, *given* their beliefs and preferences, they do the best they can in making decisions consistent with these beliefs and preferences. All in all, RB theory is far more realistic than the Chicago School theories of which we BF types are so critical. *But does this new model allow for the utilization of psychology where it is appropriate?* We believe that psychological variables play an important role in determining economic outcomes."

Proper Role of Psychology within Economics: Psychological variables actually enter very naturally into the Kurzian paradigm. As for *beliefs*, what explains the dynamic patterns of people's beliefs so pertinent to Kurz's theory? What, in particular, explains the scope of belief correlation (e.g., "herding")? What causes regimes of collective optimism to shift towards pessimism? As for *preferences*, what explains people's preferences, in particular swings in their "taste for risk" and for one asset class over another? Psychology can help explain *all* these issues. I personally have never seen any conflict between the concept of "rational economic behavior" on the one hand, and the importance of psychology on the other hand. That having been said, there is in fact little need for psychology in Chicago School theories where all agents'

¹¹ Whereas Rational Expectations are homogeneous and correct, Rational Beliefs are diverse and invariably wrong in the following precise sense: Agents look back after the fact and state, "I wish I had had different and better betting odds than I did when I acted." Aristotle certainly would have changed his betting odds that the sun goes around the Earth after the Copernican Revolution! What makes Kurzian beliefs "rational" is that they are required to be *non-contradictable* by such data as is available in a world of structural changes and thus of "stable" but not stationary stochastic processes. [Yes, I know this is very difficult, but I have written about this point in the past.] The important point here is that *many* divergent probabilistic beliefs are compatible with what we can learn from the data, and thus the set of RB will usually contain *many* elements. In this sense, agents reasonably disagree about the future within Kurz's theory. This leads to his emphasis on the correlation of *ex ante* investor beliefs, and on the resulting *ex post* distribution of mistakes after the news is learned.

beliefs are *assumed* to take the form of “correct” probability assessments of all future events. The axioms of RE theory render psychological considerations largely irrelevant in this case. But this is not true within Kurz’s more general theory.

The Fundamental Map—And the True Domain of Economics Proper: There is one task that lies in the domain of economics alone, and where psychology plays no legitimate role. This is the General Equilibrium logic whereby the diverse beliefs and preferences of people are mapped into testable predictions of the future evolution of prices and quantities. As the late Paul Samuelson often stressed, *this and this alone is the proper task of economics*. And it is in this sense that Kurz’s new theory goes way beyond BF and most new paradigms, and actually delivers the true goods. Finally, as for the much criticized role of mathematics in economics, try constructing this: **BELIEF • PREFERENCE → PRICE • QUANTITY** mapping without advanced math. Good luck! Arrant nonsense about such topics is widespread.

4. A Personal Note – Looking Back Eighteen Years Later

It was eighteen years ago when my longstanding friend Eugene Lancaric (then a grad student, now with ING in New York) brought me a draft of Kurz’s first paper on Rational Beliefs. “Read this!” he said. Kurz’s emphasis on the key role of structural changes paralleled the reasons why I had created SED nearly a decade before, and the brilliance of his analysis was arresting.¹² Having known of Kurz’s work in game theory, and having read his book (co-authored with Kenneth Arrow) on *Public Investment*, I was not surprised.¹³ Rather than remaining silent on this new advance and not discussing it with SED clients since it was “too difficult,” I devoted ten years to describing it, and to documenting its evolution and success in resolving all manner of paradoxes. These paradoxes include why there is a “forward premium” in Forex markets, why market volatility is as high as it is, what explains the spectrum of risk premia in asset classes, and why GARCH phenomena (e.g., time-varying variances) exist.

¹² My own view on structural change was initially quite different from Kurz’s. I had realized that the existence of structural changes explained how an investor could outperform the market, even when everyone possessed the same information at the same time. All that was required was for the investor to be willing to spend the time and money needed to *better interpret* generally available information than others do. The existence of structural changes made this logically possible. But I could not make formal sense of this point, much less prove it, without Kurz’s positive theory of General Equilibrium under Rational Beliefs. Even so, it took me fifteen more years to develop a theoretically satisfactory *normative* theory of the three logically compelling ways for an investor to outperform the market and add alpha *when all investors possess the same information*. Please see my recent essay, “The Ability to Outperform the Market: Logical Foundations Based Upon the Theory of Rational Beliefs,” by H.W. Brock, *Revista Internazionale di Scienze Sociali*, 2007, number 3, pp. 365-402. For a copy, please email WoodyBrock@SEDinc.com.

¹³ *Public Investment, the Rate of Return, and Optimal Fiscal Policy*, by K.J. Arrow and M. Kurz, Resources for the Future Press, 1971.

I predicted that this new theory of General Equilibrium with endogenous risk would likely emerge as *the* fundamental model of economics, suitably generalizing and dispensing with the classical Efficient Market Theory. As a separate matter, I worked quite closely with Kurz on an *ad hoc* basis in proposing generalizations and extensions of the new theory, and contributed a bit to the development of the theory, in particular my theory of Pricing Model Uncertainty.

It is thus a source of personal satisfaction that this new body of research is finally gaining the recognition it deserves, as in the two new articles cited above. I hope that clients reading this essay have noticed that I always talk *up* to you about new theories when they arise — *no matter how difficult* — and never down to you. I do not shy away from inculcating important advances in knowledge because “they are too difficult for the unwashed,” or because “they are not widely known or fashionable.” What matters to me is quite simply whether there is a new and useful *truth* to be told. Such has been my nature since I read Plato’s *Dialogues* in classical Greek at age 14, and absorbed his message about the need for a dialectic of the thoughtful in escaping the flickering shadows of his Cave of Ignorance.

5. TWO FUTURE RESEARCH PROFILES

During the next month, I shall publish a new strategy for solving America’s current triad of distress: low GDP growth, structurally high unemployment, and fiscal distress. This effort is consistent with other recent efforts (e.g., our two health care articles) to demonstrate that there are *constructive solutions* to all current problems. Thereafter, Dietmar Meyersiek of Dusseldorf (formerly of McKinsey and Co.) and I will publish new research on how a host of political and sociological variables play an important role in determining high versus low levels of economic growth. This study will quantify many of our past assertions about the true determinants of growth rates and the role of Incentive Structures in particular. *This research should be of particular interest to clients assessing the risks of emerging market investments.*

REMINDER! THE NEW ON-DEMAND LECTURE: Please now access our new **On-Demand** lecture, “Reconceptualizing ‘Market Risk’ from Scratch” in the password protected section of our website, www.sedinc.com, under the tab “Lectures On-Demand.”