

THE ENTROPY TRAP



THE ENTROPY TRAP
What Physics Knows that Markets Don't

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The Solstice Laboratory

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FOREWORD

by James Rickards

The publication of Mickey Maini's book *The Entropy Trap* marks a major milestone in the growing field of econophysics—the use of physics and other rigorous scientific disciplines to unravel the complexities of economics, banking and capital markets.

Econophysics draws from well-established branches of the hard sciences including complexity theory, the laws of thermodynamics, applied mathematics, power curves, fractals, scale invariance and quantum mechanics to understand the complex dynamic systems we know as capital markets. The field of econophysics is evolving quickly and none too soon given the dysfunction of modern economics.

The failures and false theories of economics today are too numerous to catalogue. Economists assume markets are efficient at receiving information and offering price discovery. They're not. Markets run on false narratives and adjust violently when they hit the brick wall of reality. Economists assume that market moves are distributed along a normal curve or bell curve. They're not. Market price charts are fractals. The degree distribution follows a power curve along which extreme events occur with far more frequency than

the bell curve suggests. If you have to pin a fat tail on a bell curve, it's not a bell curve. Economists assume a wealth effect in which rising asset values stimulate consumer spending. There's no empirical evidence for a wealth effect. Economists assume that inflation and unemployment are inversely correlated, the so-called Phillips Curve. There is no evidence for the Phillips Curve. Inflation and unemployment can both be high, both be low or stand in opposition all without material correlation. Milton Friedman assumed that real GDP could be optimized with little inflation merely by turning the money supply faucet on or off. Friedman ignored the role of velocity—the turnover of a given money supply—which is the most powerful variable of all and is driven by behavioral changes that are difficult to predict and mostly outside the reach of monetary policy. The list goes on. Astrology has a stronger claim to being hard science than modern economics.

If received theories don't explain economic behavior, what does? It turns out based on empirical evidence and successful predictive analytic results that econophysics has strong explanatory power when applied properly. Complexity theory offers concepts such as the critical threshold and phase transition where a system moves from one state space to another. It also explains how minute changes in initial conditions result in enormous differences in outcomes through exponential recursive functions as the system plays out. Complexity theory also offers the idea of emergent properties through which outcomes present that could not be predicted even with

perfect knowledge of the elements of a system. One learns to expect the unexpected.

Fractal mathematics discovered by Benoit Mandelbrot deals with phenomena that exist in dimensions greater than 1 but less than 2. A straight line is one-dimensional. A box is two-dimensional. A stock chart appearing as a jagged line on a typical graph is neither a straight line nor a box. It has a dimension of, for example, 1.357. What Mandelbrot's fractals reveal is scale invariance. This means a one-day stock chart closely resembles a ten-year stock chart on a different time-scale. Their fractal dimensions may be nearly the same. That's an invaluable forecasting and analytic tool.

The power curve degree distribution is supported by empirical market data unlike the bell curve. When you hear so-called experts refer to a "four standard-deviation event," they're referring to the x-intercept (x, 0) on a bell curve. Use of the phrase itself means they don't understand markets. Considering the one-day 22% crash of the Dow (1987), the Mexican Tequila Crisis (1994), the Asia-Russia-LTCM crisis (1998), the dot.com crash (2000), the Global Financial Crisis (2008) and the COVID pandemic (2020) it's intuitive that extreme events occur about once every 7 years instead of once every 126 years as the bell curve would predict.

Quantum mechanics are a useful tool for holding opposite outcomes in mind at the same time while considering interventions (observations) by policymakers. Bayes

Theorem is the best tool for updating forecasts based on new information when initial information was scarce. Outside the fields of physics and applied mathematics, behavioral psychology and history are excellent complements to the econophysics toolkit.

Into this fast-changing field of study comes Mickey Maini's new book. Maini's contribution is to take a particular facet of econophysics—The Second Law of Thermodynamics—and to explicate its application to markets.

The Second Law of Thermodynamics states that heat (created by energy) flows from hotter to colder parts of matter (or downhill on a temperature gradient). This happens spontaneously and does not go in reverse. Absent some intervention or new source of energy, the entire system will go cold. This process is entropy.

Capital markets are a system to which the Second Law of Thermodynamics can be applied. Capital markets continually require new inputs (energy) in order to keep producing outputs (higher stock prices). When the energy is depleted, the markets collapse. Money is a primary input or source of new energy.

The analysis begins with the understanding that money is stored energy. The classic definition of money includes the expression store of value but exactly what value is being

stored? Typically value is the output of labor and capital, both of which are energy intensive.

In the simplest case, a baker makes a loaf of bread using ingredients, equipment and her own labor, all of which use energy or are the product of other forms of energy. When the baker sells the loaf for money, the money represents the stored energy that went into making the bread. This energy can be unlocked when the baker purchases some goods or services, such as house painting, by paying the painter. The energy in the money is now released in the form of the time, effort, equipment and materials of the painter. Money works exactly like a battery. A battery takes a charge of energy, stores it for a period of time and rereleases the energy when needed. Money stores energy in the same way. As the lyrics of Cabaret attest, “Money makes the world go round.”

Maini’s highly original contribution to the field of econophysics is to apply thermodynamics and entropy to capital markets in ways that allow observers and analysts to ascertain if a financial system is running down and therefore headed for crisis. A system (which may be reflected in the value of currencies, commodities, stocks, bonds or monetary aggregates) naturally experiences entropy but may be sustained if new sources of energy (money) are available. Entropy can be accelerated through monetary debasement, war or lost trust. Entropy can be delayed with new energy inputs including sound money,

productivity, technology and policies that promote growth. These outcomes are the result of choices societies make through their governance and leadership.

In the end, the relationship between entropy and new energy inputs faces one insurmountable obstacle. As systems grow more complex, the energy required to maintain the system increases exponentially. If a system doubles in size and complexity, the energy needed by the system does not double; it may increase by a factor of ten. At some scale, the system will use all the energy on the planet. The only solutions are simplification or collapse.

Maini goes beyond the theory of entropy in capital markets to provide specific metrics and a dashboard with which the entropic process can be observed. The process creates stress, which Maini measures in a rigorous way. This analytic process is enlivened with historical case studies including the fall of the Han Dynasty and Roman Empire. He includes colorful profiles of Jesse Livermore, Bernard Baruch and Joseph P. Kennedy to illustrate how fortunes are made or lost by those attentive to the stresses. Maini is a maestro of stress measurement and a real-world pragmatist at the same time.

The tools of econophysics also lend themselves to the development of algorithms that can be turned loose on curated training sets (large language models) to produce new insights. Econophysics is ready for the world of AI.

Maini's work opens the door to a much-needed collaboration of physicists and economists. That's a conversation I've had many times over the past twenty years. When I meet with theoretical physicists in places like the Los Alamos National Laboratory, I suggest a joint effort among physicists, applied mathematicians, behavioralists, lawyers, economists and others to crack the code of market behavior using tools from all of their disciplines in new ways. The physicists are uniformly enthusiastic and encourage me to recruit top economists and practitioners from the other fields. Once a team is in place, proposals for grants and funding would be straightforward and a collaboration could be underway. When I approach economists with the same idea they react with disdain. They see no reason to work with physicists. Their posture says, in effect, "They have nothing to teach us."

Centers of excellence able to conduct this kind of collaboration are few. They include the Santa Fe Institute and ETH Zürich. Maini's new Solstice Laboratory, an independent research institute will make a fine addition to this list.

The Entropy Trap is an enlightening introduction for those new to the field of econophysics and offers expanded horizons for those already familiar with the core concepts. The morbid joke among economists is that their field advances one funeral at a time. Maini shows the field can actually advance one brilliant book at a time.

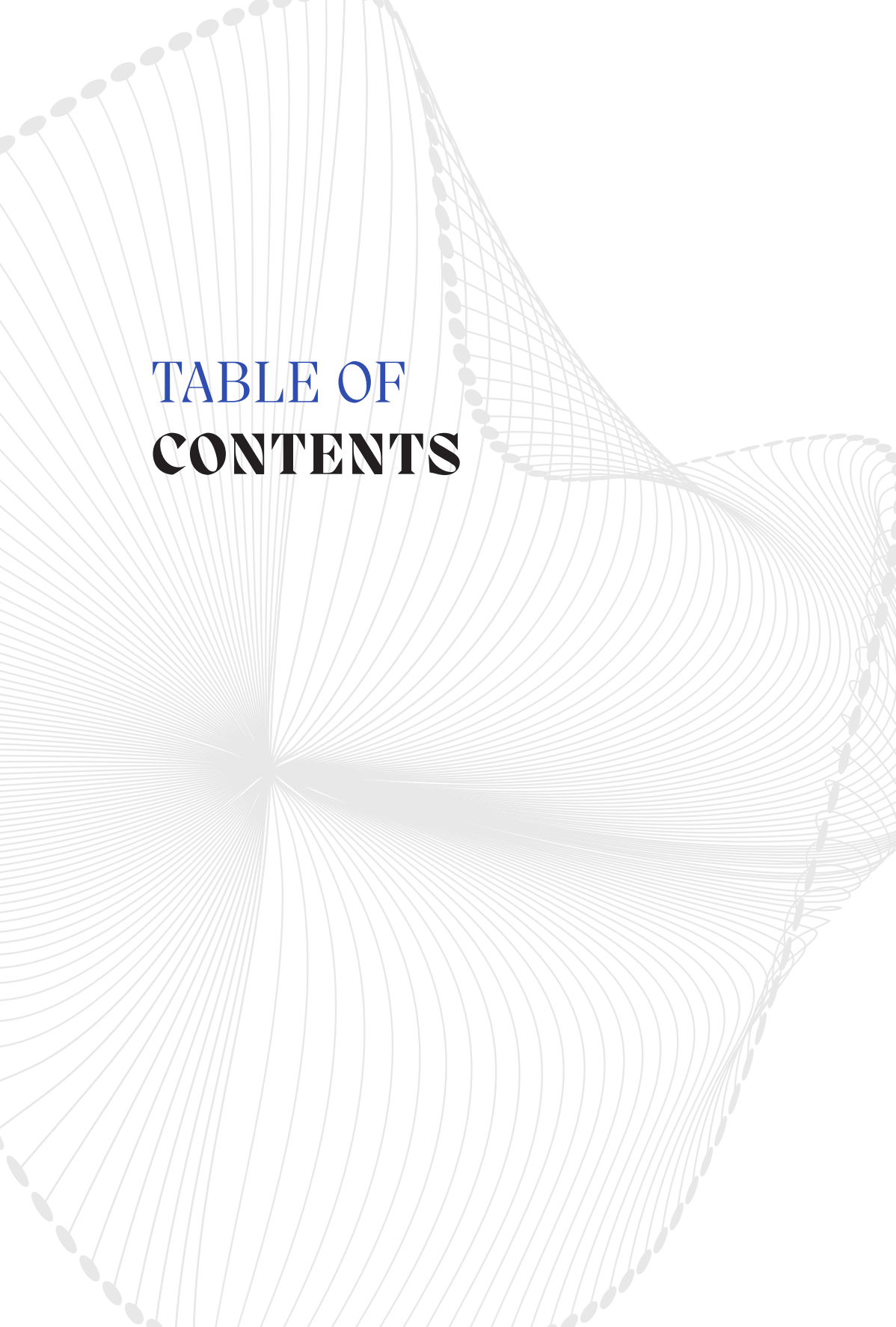


TABLE OF CONTENTS



Section One | ACCEPT_____4

Chapter 1 | The Entropy Trap_____10

Chapter 2 | The Phase Transition_____26

Chapter 3 | The Lethal Mistake_____44

Section Two | OBSERVE _____54

Chapter 4 | Motion _____62

Chapter 5 | The Map_____78

Chapter 6 | The Tide_____98

Section Three | REFLECT____112

Chapter 7 | The Solstice Dashboard_____119

Chapter 8 | The Proof_____130

Chapter 9 | But What If It's Different This Time?____151

Section Four | NAVIGATE____162

Chapter 10 | The Portfolio_____167

Chapter 11 | The Playbook_____186

Chapter 12 | The Bigger Picture_____197

Chapter 13 | Regeneration_____213

Prologue

Markets are at all-time highs.

Your portfolio is up. The economy is growing. Unemployment is low. The experts are calling for a soft landing. Everything the models measure says the system is working.

And yet.

Something does not sit right. You can sense it in the fractures: geopolitical tensions that keep escalating instead of resolving, debt numbers that have stopped making intuitive sense, technology that promises transformation while eliminating the jobs that pay for it. Each crisis arrives faster than the last. Each solution works a little less than the one before.

There is a gap between what the data says and what your gut knows.

You are not wrong.

Your instincts are detecting a pattern so large and so slow that it does not fit inside a quarterly earnings report or an annual forecast. The same pattern that preceded every major system change in recorded history—from the fall of Rome’s monetary system to the collapse of Bretton Woods. Not a pattern of prices falling, but of something deeper: the gradual exhaustion of the forces that hold the system together.

Economics cannot see it. Economics assumes systems return to balance.

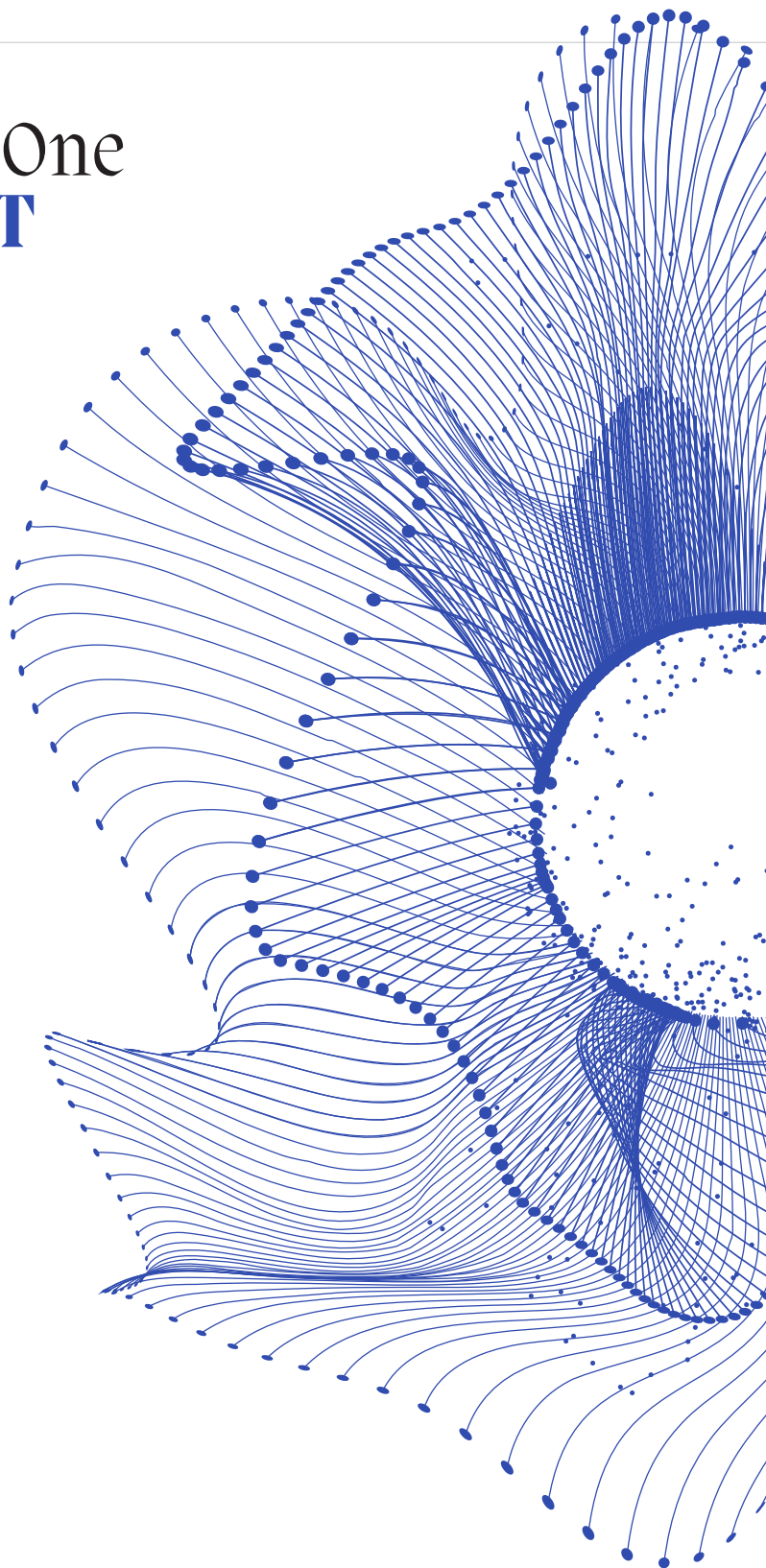
Physics can. Physics measures the forces underneath—speed, direction, acceleration—and it has been reading these transitions accurately for three thousand years. It does not just identify the pattern. It quantifies it. And the conclusion is short—change is coming. Navigating it will require a new instrument—this book is that compass.

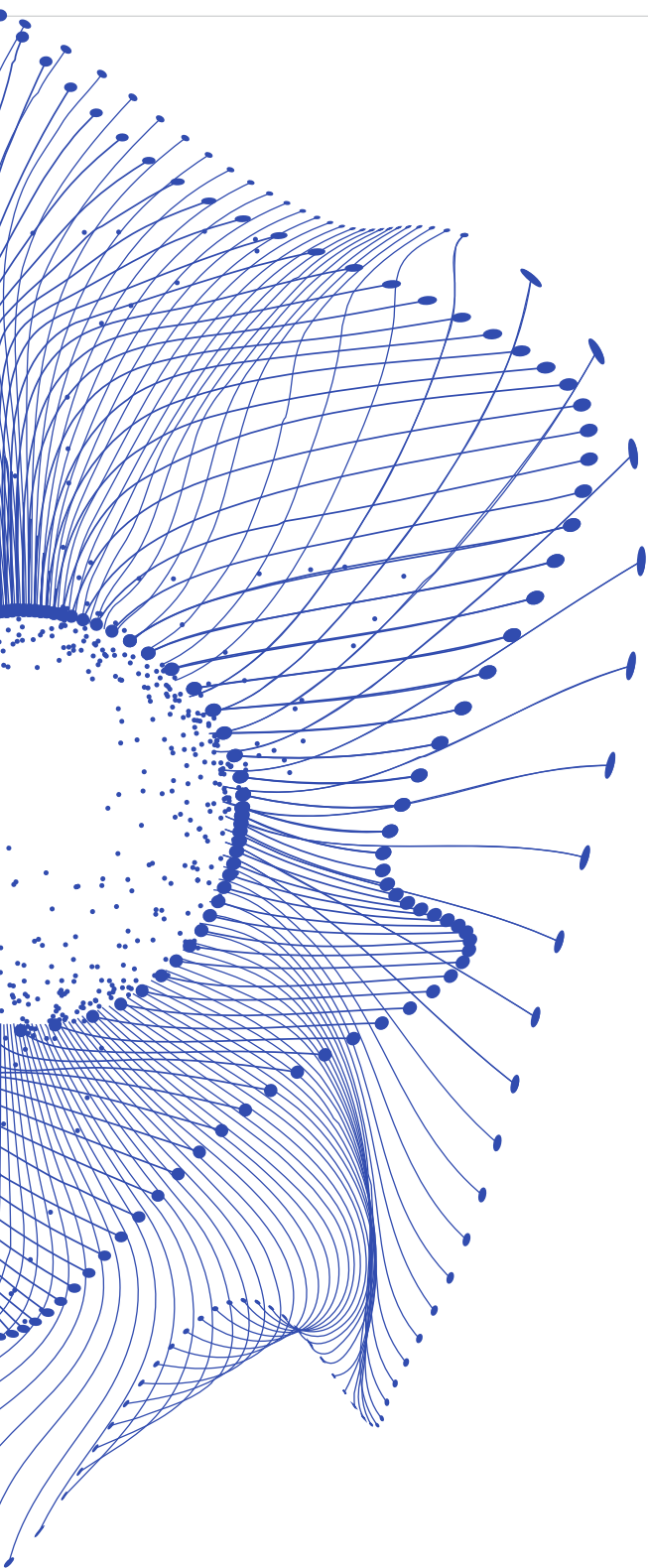
| *Welcome to the entropy trap.*

—M.M.

Section One

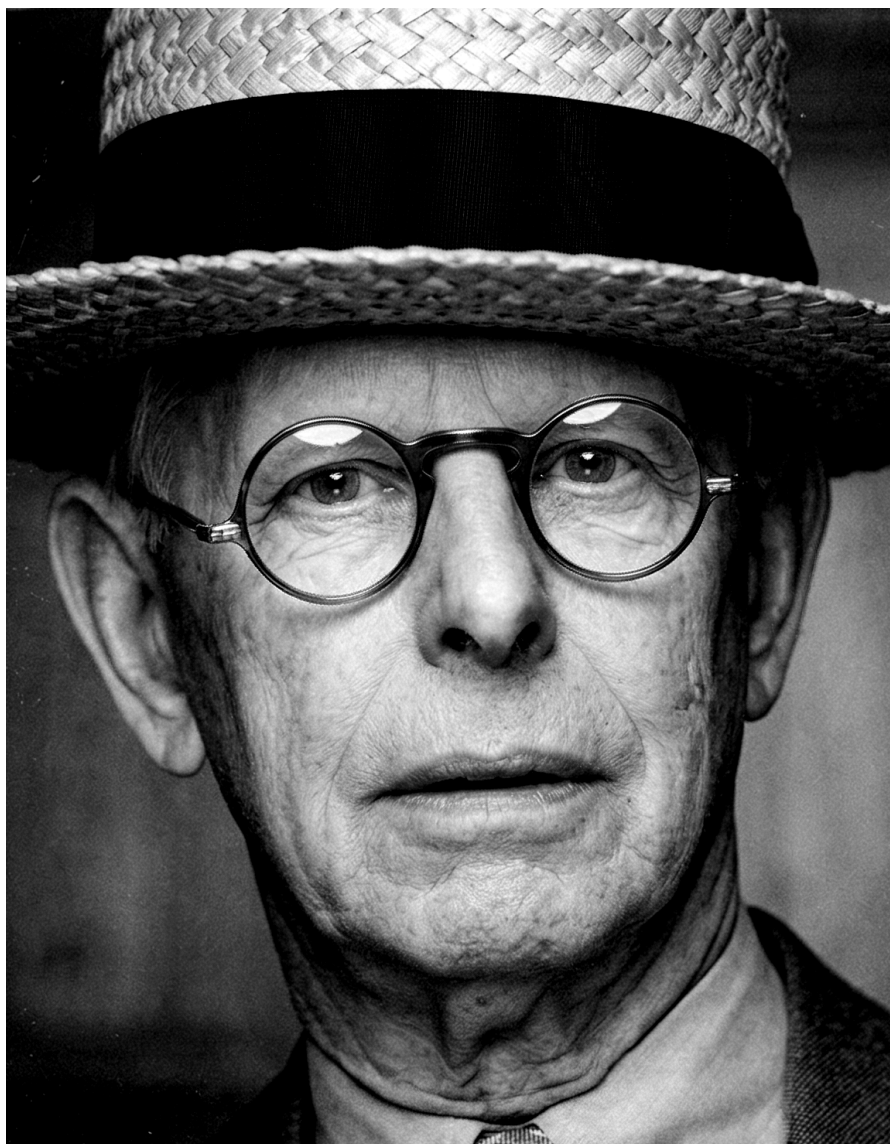
ACCEPT





THE TRAP

New York, April 1930



Jesse Livermore stood at the window of his office at 730 Fifth Avenue, watching the spring light fall across Manhattan.

Six months ago, the world had ended. The market had crashed 48% in two months.¹ Banks failed. Fortunes evaporated. Men who had been worth millions discovered they were worth nothing, or less than nothing.

But Livermore was not among them. He had bet against the market.

While others lost their fortunes, Livermore made one hundred million dollars by shorting the market.² In 1929, that was nearly two billion in today's money. He saw what others missed: the system was falling apart. He acted on that insight, and he was right.

Now the Dow had recovered from 199 to 294 (a 48% rally), the newspapers were saying the worst was over. The Harvard Economic Society said recovery was imminent.³ President Hoover declared that "the worst is behind us".⁴

And Livermore believed them.

He closed his short positions and started buying stocks, investing heavily. The same confidence that made him rich during the crash now convinced him the worst was over.

But Livermore was measuring the wrong thing. He was watching prices. Prices were rising. What he should have been watching was the rate at which the system was still deteriorating underneath those prices. The stress was still building. The recovery was not real.

| *It was a trap.*

Over the next two years, the Dow would fall from 294 to 41: an 86% decline from the point where Livermore had declared victory.⁵ His hundred million became nothing. Then less than nothing. Debts he could not pay and positions he could not exit.

Livermore believed he had survived the crisis. He believed he had mastered it. The crash had made him wealthier than ever.

What he did not realise was that the real test was still ahead.

Livermore was not alone that spring in 1930. As he stood at the window, ready to go long, two other men saw the same market rally but reached a different conclusion.

Bernard Baruch and Joseph Kennedy had both pulled back before the crash.⁶ They did not mistake rising prices for real recovery. They knew a rebound did not always mean things would return to normal.

The difference was not about intelligence, information, or bravery. It was about their posture. While Livermore measured price levels, Baruch and Kennedy measured structure. Livermore was one of the greatest traders who ever lived, but his method could not see the trap lurking inside the rally. That distinction produced radically different outcomes.

This book is about learning to see that distinction. And to do that, we must move beyond economics and into physics, where the real measurement begins.

¹ Dow fell from 381 (Sept 3, 1929) to 199 (Nov 13, 1929). Federal Reserve History.

² Smitten, Jesse Livermore: World's Greatest Stock Trader, 2001. The exact figure is debated; \$100M is the commonly cited estimate.

³ The Harvard Economic Society continued issuing optimistic forecasts through 1930. It disbanded in 1931–32. Friedman and Schwartz, *A Monetary History of the United States, 1867–1960* (1963).

⁴ Various public statements, 1930. See Galbraith, *The Great Crash 1929*, Chapter 7. Hoover's exact phrasing varied, but the sentiment was repeated throughout.

⁵ Dow peaked at 294.07 on April 17, 1930, and fell to 41.22 on July 8, 1932. ~86% decline from the rally peak. Federal Reserve History.

⁶ Grant, Bernard M. *Baruch: Adventures of a Wall Street Legend*, 1983; 1997 reprint. For Kennedy, see Nasaw, *The Patriarch*, 2012.