Alphanomics: The Informational Underpinnings of Market Efficiency

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Boston — Delft

Foundations and Trends® in Accounting

Published, sold and distributed by:
now Publishers Inc.
PO Box 1024
Hanover, MA 02339
United States
Tel. +1-781-985-4510
www.nowpublishers.com
sales@nowpublishers.com

Outside North America:
now Publishers Inc.
PO Box 179
2600 AD Delft
The Netherlands
Tel. +31-6-51115274

The preferred citation for this publication is

C. M. C. Lee and E. C. So. *Alphanomics: The Informational Underpinnings of Market Efficiency*. Foundations and Trends® in Accounting, vol. 9, nos. 2–3, pp. 59–258, 2014.

This Foundations and Trends® issue was typeset in LaTeX using a class file designed by Neal Parikh. Printed on acid-free paper.

ISBN: 978-1-60198-893-5

Foundations and Trends® in Accounting
Volume 9, Issue 2–3, 2014

Editorial Board

Full text available at: http://dx.doi.org/10.1561/1400000022

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Foundations and Trends® in Accounting, 2014, Volume 9, 4 issues. ISSN paper version 1554-0642. ISSN online version 1554-0650. Also available as a combined paper and online subscription.

Foundations and Trends® in Accounting
Vol. 9, Nos. 2–3 (2014) 59–258

DOI: 10.1561/1400000022

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Contents

Abstract

This monograph is a compact introduction to empirical research on market efficiency, behavioral finance, and fundamental analysis. The first section reviews the evolution of academic thinking on market efficiency. Section 2 introduces the noise trader model as an alternative framework for market-related research. Section 3 surveys the growing literature on the causes and consequences of investor sentiment. Section 4 examines the role of fundamental analysis in value investing. Section 5 contains a survey of the literature on arbitrage costs and constraints, and Section 6 discusses research methodology issues associated with the need to distinguish between mispricing from risk.

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DOI: 10.1561/1400000022.

Foreword

Assumptions matter. They confine the flexibility that we believe is available to us as researchers, and they define the topics we deem worthy of study. Perhaps more insidiously, once we've lived with them long enough, they can disappear entirely from our consciousness.

Mainstream accounting and economic thought is shaped by classical information economics — the study of normative behavior under full rationality assumptions. While this powerful paradigm has proved highly instructive, it has also engendered an unfortunate tendency for economists to attribute unlimited processing ability to decision makers. We view this tendency as unfortunate, because it can inhibit the development of other potentially promising avenues of research.

In the area of market-based research, the assumption of unbounded rationality has produced a deep-seated faith in market efficiency that, for many years, detracted from potentially fruitful inquiries along alternative paths. As economists, we tend to take for granted the efficacy of the arbitrage mechanism, generally assuming that it involves few constraints, and little cost or risk. Faith in the arbitrage mechanism has stunted the development of research in mainstream economics on the dynamic process of information acquisition, analysis, and aggregation. Market prices are often presumed to be correct, as if by fiat, and the process by which they become correct is trivialized.

The depth of our collective faith in market efficiency is evident from our course offerings. At most top business schools today, investment classes are taught by financial economists trained in equilibrium thinking. In these classes, the efficient market hypothesis (EMH) is typically offered as the intellectual high ground — an inevitable outcome of rational thinking. Students are taught that market-clearing conditions require prices to reflect all currently available information. This line of reasoning persists, despite the fact that it conforms neither to logic nor to evidence.

This research monograph is intended to be a compact introduction to academic research on market efficiency, behavioral finance, and fundamental analysis. In the first two sections, we review the evolution of academic thinking on market efficiency, and introduce the noise trader model as a rational alternative. In the next four sections, we expand on several concepts introduced in the first two sections. Specifically, in Section 3, we survey the literature on investor sentiment and its role as a source of both risks and returns. In Section 4, we discuss the role of fundamental analysis in value investing. In Section 5, we survey the literature on limits to arbitrage, and in Section 6, we discuss research methodology issues associated with the need to distinguish mispricing from risk.

Some of the questions we will address include: Why do we believe markets are efficient? What problems have this belief engendered? What factors can impede and/or facilitate market efficiency? What roles do investor sentiment and costly arbitrage play in determining an equilibrium level of informational efficiency? What is the essence of value investing? How is it related to fundamental analysis (the study of historical financial data)? And how might we distinguish between risk and mispricing-based explanations for predictability patterns in returns?

The degree to which markets are efficient affects the demand for accounting research in investment decisions, regulatory standard-setting decisions, performance evaluations, corporate governance, contract design, executive compensation, and corporate disclosure decisions. One's belief about market efficiency also dictates our research

design, and in particular the role played by market prices in the analysis. Perhaps most importantly, given the intended audience of this volume, one's view about market efficiency will have a profound effect on the shape of one's research agenda. In fact, what a researcher chooses to study in the capital market area is, we believe, largely a function of her level of faith in the informational efficiency of these markets.

It has been 35 years since Michael Jensen famously proclaimed at a *Journal of Financial Economics* (JFE) symposium: "I believe there is no other proposition in economics which has more solid empirical evidence supporting it than the Efficient Market Hypothesis." [Jensen, 1978, p. 95]. Less often quoted, but perhaps even more on the mark, were Jensen's remarks at the end of the same article. Commenting on the evidence presented at the symposium about market-pricing anomalies, he wrote: "I have little doubt that in the next several years we will document further anomalies and begin to sort out and understand their causes. The result will not be abandonment of the 'efficiency' concept, nor of asset-pricing models. Five years from now, however, we will, as a profession, have a much better understanding of these concepts than we now possess, and we will have a much more fundamental understanding of the world around us." This monograph is an attempt to summarize what we have learned since, and what we as a profession have to look forward to in the future.

The 2013 Nobel Memorial Prize in Economics was shared by three Americans — Eugene Fama, Lars Peter Hansen, and Robert Shiller. For many of us who have followed the EMH debate over the years, the decision to honor Fama and Shiller together is not without irony, given the radical differences in their views on the subject. Fama was honored for his work in the 1960s showing that market prices are accurate reflections of available information. Shiller is honored largely for circumscribing that theory in the 1980s by showing that prices can deviate from rationality. In awarding them the prize, the Royal Swedish Academy of Sciences notes that collectively the three professors' work "laid the foundation for the current understanding of asset prices." In characterizing this contribution, the committee said their findings "showed that markets were moved by a mix of rational calculus and human behavior."

Markets are moved by a mix of rational calculus and human behavior. We have certainly come a long way since the days of the 1978 JFE symposium! As Jensen predicted, financial economists have not abandoned rational calculus or the concept of 'efficiency.' The power of equilibrium thinking is alive and well. At the same time, 35 years later, we have also come to acknowledge the importance of human behavior and arbitrage costs in asset-pricing. As a profession, many more of us are now willing to entertain, and wrestle with, the limitations and problems of an imperfect market. In this sense, we have indeed come to a much better place in terms of our understanding of the world around us.

In recent decades, the focus of academic research on market efficiency has gradually shifted from the general to the more specific. While earlier studies tended to view the matter as a yes/no debate, most recent studies now acknowledge the impossibility of fully efficient markets, and have focused instead on factors that could materially affect the timely incorporation of information. An extensive literature in finance has developed that examine the effect of "noise trader demand", or "investor sentiment" (broadly defined as price pressures of a non-fundamental origin). There is now substantial evidence that investor sentiment can affect asset-pricing, as well as real economic decisions, such as corporate finance, investments, dividend policies, and disclosure decisions. At the same time, increasing attention is being paid to how regulatory decisions could either impede or enhance market efficiency through their effect on information arbitrageurs.

Whatever one's view is of market efficiency, few scholars today deny the fact that active asset management, with "beating the market" as its central mandate, is today a large and thriving business. The reason our financial markets are even remotely efficient is because sufficient resources are being spent each day on keeping it so.[1] The agents who acquire and process new information aspire to make a profit from their

[1] As discussed in more detail in Section 1, we estimate the amount of asset-under-management (AUM) controlled by professional *active* managers across asset classes to be at least $60 trillion USD as of the end of 2012. The U.S. mutual fund market alone exceeds $6 trillion, and the hedge fund market is at least $2 trillion (See the 2013 Investment Company Factbook, available at http://www.icifactbook.org/).

investment. Their continued survival speaks powerfully to magnitude of the aggregate mispricing in equilibrium. At the same time, these purveyors of information face a complex production function, with multiple costs and risks, including: time-varying capital constraints, moral hazard problems, risk management issues, security lending costs, and various practical implementation challenges. Market efficiency is inevitably a function of the cost constraints faced by information arbitrageurs.[2]

In our view, a naïve form of efficiency, in which market prices are assumed to equal fundamental value, is a grossly inadequate starting point for much of today's market-related research.[3] To us, this is an oversimplification that underweights the role of costly information and fails to capture the richness of market-pricing dynamics and the process of price discovery. Prices do not adjust to fundamental value instantly by fiat. In reality market prices are buffeted by a continuous flow of information, or rumors and innuendos disguised as information. Individuals reacting to these signals, or pseudo-signals, cannot easily calibrate the extent to which their own signal is already reflected in price. This noisy process of price discovery requires time and takes effort, and is only achieved at substantial cost to society.

When information processing is costly, research opportunities abound. Given noisy prices and costly arbitrage, academic research can add value by improving the cost-effectiveness of the arbitrage mechanism. Some of this research will lead to superior techniques for identifying arbitrage opportunities. Other research will focus on sources of systematic noise, exploring behavioral and non-fundamental reasons why prices might diverge from value. Still others, such as work on earnings quality or fundamental analysis, will help to narrow the plausibility bounds around the value estimates of traded securities.

Thus it clearly takes a great deal of capital and resources to attain the level of pricing efficiency we currently enjoy.

[2]We define arbitrage as information trading aimed at exploiting market imperfections. As discussed later, this definition is broader than the definition found in some finance textbooks.

[3]Throughout this discourse, fundamental value is defined as the expected value of future dividends, conditional on currently available information. See Section 1 for a more detailed definition of the efficient market hypothesis (EMH).

Finally, research into arbitrage constraints and market design issues can help us to better understand and manage the costs faced by those who seek to acquire information and make markets more efficient. How might the incentives of these agents be affected by changes in security market regulations and mandatory corporate disclosure rules (such as fair value accounting or the adoption of IFRS)? How is the information acquisition and alpha extraction process being impacted by Big Data? To us, a wide world of research opportunities opens up once we are willing to lift the hood, and peer behind the assumption of market efficiency.

Much of this research has a utilitarian focus. It is decision driven, interdisciplinary, and prospective in nature. It assumes a user, rather than a preparer, orientation toward accounting information. It does not assume that the market price is equivalent to fundamental value. Rather, it produces independent estimates of firm value that may be used to challenge, and perhaps discipline, prices. Its end goal is to improve the allocation of scarce resources through more cost-effective usage of information in solving significant problems in financial economics.

This monograph is dedicated to the kind of decision-driven and prospectively-focused research that is much needed in a market constantly seeking to become *more* efficient. We refer to this type of research as "Alphanomics", the informational economics behind market efficiency. The "Alpha" portion refers to the abnormal returns, or financial rewards, which provide the incentive for some subpopulation of investors to engage in information acquisition and costly arbitrage activities. The "Nomics" refers to the economics of alpha extraction, which encompasses the costs and incentives of informational arbitrage as a sustainable business proposition.

We caution the reader on two caveats. First, the evidence we survey here focuses primarily on publicly traded equity securities. We acknowledge that in finance, an extensive literature explores related topics across multiple asset classes in a more global setting. Although we cover this literature only tangentially, many of the same principles discussed here apply across other asset classes. Second, we are focused

on market efficiency in an informational sense — that is, whether and how prices incorporate available information. Tobin [1984] entertains a broader definition of economic efficiency that we find intriguing, particularly his views on the "functional efficiency" of free markets. For parsimony, our monograph does not tread in that direction, but interested readers are encouraged to include Professor Tobin's work in their list of must-read references.

This work is made up of six sections. The first two sections draw heavily from the writings of financial economists. In Section 1, titled "The Magic of Markets," we revisit the theoretical foundations of the EMH, and discuss some of the limitations and biases it engenders. Some have compared the EMH to "Newtonian physics" in the sense that while we know it does not hold precisely, the theory is a safe operating assumption for practical purposes. We critically evaluate this claim, and discuss situations where the EMH falls particularly short.

Section 2 introduces a simple *Noise Trader Model* ("NTM") first featured in Shiller [1984]. A particularly appealing aspect of the NTM is its explicit recognition of the role played by information costs. In contrast to the EMH, which assumes information costs are trivial, the role for information arises endogenously in the NTM and the cost of information acquisition and analysis has direct implications for equilibrium pricing.

Section 3 expands the discussion of *Investor Sentiment*. In this section, we survey the extensive literature on noise trading and investor sentiment that has developed over the past three decades. We show that evidence in favor of a role for human behavior and investor sentiment in asset-pricing is now extensive. We also discuss the implications of these findings for the future of accounting research.

Section 4 examines *Equity Valuation*. An independent estimate of firm value is needed if information arbitrageurs are to challenge and discipline price. We discuss the role of historical accounting information in the formulation of such an estimate. Using the residual income model (RIM) as a framework, we integrate the investment approaches advocated by such legendary investors as: Ben Graham, Warren Buffett, and Joel Greenblatt. This analysis shows that the strategies espoused by

these investors actually dovetail nicely with the recent evidence from academic research on the predictability of stock returns.

Section 5 examines *Limits to Arbitrage*. In the NTM, the extent to which prices may wander away from fundamentals is a function of the costs faced by informed arbitrageurs. Thus reducing arbitrage costs will lead directly to greater pricing efficiency. We dissect the major components of these costs and discuss how each component might impact common investment strategies employed by hedge funds. We also discuss academic studies that shed light on the cost constraints faced by arbitrageurs.

Section 6 focuses on *Research Methodology*. In this section, we review research design issues for academics interested in working on questions related to market efficiency. Specifically, we discuss techniques for distinguishing between whether a predictable pattern in prices is due to risk or mispricing. We also speculate on future research directions in this area, using recent studies as illustrations.

In sum, this monograph presents and promotes a more nuanced view of market efficiency. It may be viewed as our attempt to reconcile the *theory* of market efficiency, so popular among academics, with the *practice* of active investing, so prevalent in industry. Active investing is big business, and it is rooted in the basic premise that the search for information not yet reflected in prices can be a worthy pursuit. It is difficult to begin serious academic analyses of this industry without an economic framework that accommodates, and even anticipates, the continued existence of mispricing in equilibrium. We offer such a framework.

1

The Magic of Markets

In this section, we trace the progression of economic thought on market efficiency.[1] We discuss what is meant by the efficient market hypothesis (EMH), and some of the most pressing problems that have resulted from the profession's undue reliance on market efficiency. Beginning with Hayek [1945], we review the informational role of markets in free enterprise systems. We then discuss the untenable case for perfectly efficient markets [Grossman and Stiglitz, 1980] and argue for a broader research agenda that recognizes the importance of the market for information.

1.1 The value of markets in society

In his justly famous treatise on the subject of knowledge aggregation in society, Hayek [1945] contrasted centralized-planning with a market-based economy based on decentralized decision making. Hayek noted that economic planning involves two types of knowledge: (1) scientific knowledge (knowledge about theoretical or technical principles

[1] For other survey studies that cover overlapping themes, see Lee [2001], Richardson et al. [2010], Asness and Liew [2014], and Campbell [2014].

and rules), and (2) specific knowledge (knowledge of particular circumstances of time and place). Recognizing that even the best central planner does not have adequate access to knowledge of the second type, Hayek argued that market-based economies in which resource allocation decisions are decentralized will always dominate centralized planning. This is because in a rational economic order, efficient social planning will always depend on "the utilization of knowledge not given to anyone in its entirety" (p. 520).

With the benefit of hindsight, the genius of Hayek is clear. After WWII, multiple country-level, paired-experiments emerged that offered a remarkable glimpse into the power of market-based planning: North and South Korea; East and West Germany; Taiwan and Communist China. In each case, holding constant cultural and genetic factors, decentralized economies dominated centrally-planned ones. This dominance is seen not merely in terms of personal economic wealth (that is, per capita GDP). On almost every conceivable metric of social wellness (education; opportunity; nutrition and healthcare; life expectancy; and basic human needs), the market-based systems dominated.[2] As Margaret Thatcher, champion of the free market gospel, once quipped: "capitalism *is* humanitarianism." In short, markets work and there is little wonder that the 20th century has been called "the Hayek Century" [Cassidy, 2000].

But what then gives the market-based economies their magic? It boils down to better resource allocation through decentralized decision making. As Hayek observed, the essential planning problem of society involves rapid adaptation to changing circumstances. It is an information game that the central planner cannot hope to win. It follows then that "the man (woman) on the spot" is the best person to make resource allocation decisions.[3]

[2] A good resource for those interested in broad measures of social progress is: www.socialprogressimperative.org.

[3] Hayek argued that due to this information game, planning must be decentralized. Government intervention in a free market only serves to forestall economic ailments and could lead to political oppression. In the *Road to Serfdom*, Hayek [1944] warns ominously: "the unforeseen but inevitable consequences of socialist planning create a state of affairs in which, if the policy is to be pursued, totalitarian forces will get the upper hand."

And what role do *prices* play in all this? Consider what the "man (woman) on the spot" needs to make resource allocation decisions. At a minimum, she needs to know the relative scarcity of things — the value of the inputs and outputs relevant to her decision. This information is quickly and succinctly summarized by prices. The pricing system is a vital knowledge aggregation mechanism in free markets. To the extent that market prices are meaningful indicators of relative scarcity, they help facilitate decentralized planning. Price, in short, is a *public good* that is essential in enabling decentralized decision making.

Given these basic tenets of free market economics, the efficiency with which market prices assimilate new information assumes an importance beyond academic debates over the size of the abnormal returns earned by hedge fund managers. If asset prices drive decentralized decisions and decentralized decision making drives free enterprise systems, then prices play a key informational role in free market economies. This is because such economies depend on their markets to set prices, which in turn determine resource allocation throughout the system.

We thus draw two key lessons from Hayek: (1) the informational role of markets in knowledge aggregation is of great value to society, and (2) asset prices that reflect the value of goods (and services) are central to the development of free market systems.

Notice, however, that neither Hayek , nor the broader Austrian school of economics to which he belonged, was focused on the specifics of *how* markets become efficient, or *when* the knowledge aggregation process might fail. These earlier works were focused on the central battle of their day: whether market systems are better than centrally planned ones. They are largely silent with respect to the economics of information acquisition and analysis, and the factors that might cause markets to become more or less price efficient. These issues were not their primary concern.

The idea that markets serve as powerful aggregators of knowledge, first proposed by Hayek, has in our day morphed into what we refer to as the EMH. In the next subsection we discuss why this turn of events has led to some inevitable problems.

1.2 The joint equilibrium problem

Some economists today believe the EMH is the "moral high ground", arguing that the existence of mispricing necessarily implies off-equilibrium (thus non-economic) thinking. In fact, the exact opposite is true. In terms of equilibrium thinking, it is the simplistic and naïve form of EMH that is conceptually flawed and intellectually untenable.

Statements regarding the efficiency of market prices must first recognize the existence of two interrelated but distinct markets. First, there is the market for the assets themselves — what people will pay for fractional ownership of various assets. In addition, if it is costly to evaluate asset and assign fair values, there will exist another market on information about these assets. Participants in this second market buy and sell information about the underlying assets. These participants incur costs to 'buy' (that is, acquire) information with the expectation that they can 'sell' (that is, profit) from this information, either through trading (in the case of investors) or other means (for example, sell-side analysts). A more complete view of equilibrium requires both markets to clear. In other words, supply must equal demand in *both* the asset market, and the market for information about these assets.

In discussing the impossibility of perfectly efficient markets, Grossman and Stiglitz make the following observation:

> *We have argued that because information is costly, prices cannot perfectly reflect the information which is available, since if it did, those who spend resources to obtain it would receive no compensation. There is a fundamental conflict between the efficiency with which markets spread information and the incentives to acquire information.* Grossman and Stiglitz [1980, p. 405]

Their point is simple. When information costs are non-trivial, some amount of mispricing must remain in equilibrium. This must be the case if informed traders are to be sufficiently compensated. In other words, market clearing conditions in this joint equilibrium (when supply equals demand in both markets) require asset prices to bear the marks of inefficiency.

Given the inextricable link between these two markets, focusing on either in isolation would be foolhardy. If we focus solely on the asset market, for example, we will observe "pricing anomalies", whose roots lie in the market for information. These asset-pricing aberrations can only be understood in the context of supply and demand in the parallel market for information. Larger mispricings will remain, for example, when the cost of acquiring and exploiting information about a firm is higher. This might be the case if the company's operations are more complex, its accounting is more opaque, or if informational extraction costs, such as market liquidity, and short-selling costs (that is, the costs of profitably exploiting value-relevant information) are higher.[4]

A central problem with the EMH is the assumption that the costs associated with informational arbitrage are trivial or unimportant. Both theory and evidence suggest that financial economists need to pay more attention to the costs and incentives in the market for information. The reason *most* individuals in society can rely on market prices to make their everyday decisions is because *some* individuals in society do not. While it might be alright for most (even the vast majority of) individuals in society to assume "the price is right" — that is, to free ride on the efforts of information arbitrageurs — economists who study how markets operates should not be counted among them.

Most people can assume a car will run each time the key is turned, however their auto mechanics cannot afford to do so. In fact, auto mechanics remain in business precisely because cars do not always operate as intended. Likewise financial economists interested in the informational role of markets need to understand how the market for information operates, and how frictions in that market can lead to pricing anomalies in the asset market. They need to look under the hood. It would be an abdication of responsibility for them not to.

[4]Blocher et al. [2013] provide an excellent example of the joint equilibrium problem in the context of short-selling constraints. Empirically, Beneish et al. [2015] link this phenomenon to nine well-known pricing anomalies in the equity market.

1.3 What do we mean by market efficiency?

Stripped down to its core, the efficient market hypothesis (EMH) is the simple proposition that market prices incorporate all available information. The original EMH literature is careful to condition this statement on a particular set of available information (see, for example, Fama [1965, 1970, 1991]). Different forms of the EMH (strong, semi-strong, and weak) are then defined in terms of the rapidity and accuracy of price adjustment to news, conditional on different information sets. Early applications of the EMH in accounting also acknowledged that the speed and accuracy of price adjustment to new information is a continuous process, and does not occur instantaneously (see, for example, Dyckman and Morse [1986, p. 2]).

Most empirical tests of market efficiency have focused on the predictability of returns. The idea is that if current market prices incorporate all available information, then future returns should be largely unpredictable. Or, at least any patterns of predictability that we observe in future returns should not be easily exploited after transaction costs. This version of the EMH is often evoked, for example, in deriving equilibrium conditions in asset-pricing models. It has been variously referred to as the "competitively efficient markets" hypothesis [Rubinstein, 2001], or the "no arbitrage condition". An even more descriptive moniker, we think, is the "No Free Lunch" assumption. Markets that are in equilibrium should rarely, if ever, offer a free lunch.

Tests of the "no free lunch" hypothesis run quickly into a serious challenge, which Fama [1970, 1991] famously refers to as the "joint hypothesis problem".[5] To make any statement about market efficiency, we need to assert how the market *should* reflect information — in other words, we need an equilibrium asset-pricing model. For example, the Capital Asset Pricing Model (CAPM) states that the expected return on any security is proportional to the risk of that security as measured by its sensitivity to market returns, referred to as 'Beta', and

[5] See Asness and Liew [2014] for a good discussion of the work by Fama and Shiller from the perspective of former academics who are now active fund managers. Campbell [2014] provides a more academic review of their work.

nothing else should matter. Suppose we find evidence against the predictive power of Beta for cross-sectional returns. One possibility is the EMH holds, but CAPM is a poor model of how investors set prices. Perhaps prices do reflect all information, but there are other risk factors besides market returns that investors are being compensated for bearing. Another possibility is that the CAPM is in fact how investors *should* set prices, but they are failing at it because of some sort of behavioral error or bias. Yet a third possibility is that the EMH and the CAPM are both wrong. It is difficult to sort out where the problem lies.

It has been argued that the joint hypothesis problem renders the EMH impossible to conclusively reject [Fama, 1970, 1991]. Indeed, this problem does limit what researchers can say about market efficiency on the basis of return predictability alone. However, there are now multiple methods for evaluating the reasonableness of a claim about market mispricing besides returns prediction. Some of these involve examining ancillary evidence about firms' future cash flows, operating profits, short-window earnings announcement returns, analyst forecast revisions, probability of distress or delisting, or short-sale activities, etc. Other studies [for example, Daniel and Titman, 1997, Hirshleifer et al., 2012, Ohlson and Bilinski, 2015] rely on common sense "reasonableness" tests to distinguish mispricing-based from risk-based explanations for returns predictability. The main point being as researchers, we now have at our disposal a large set of holistic, "weight of evidence," approaches that can help us to discriminate between risk and mispricing (this is the main subject of Section 6; we also touch on it in this section, in Section 1.7.3).[6]

As difficult as it might be to disprove the "No Free Lunch" hypothesis, this version of the EMH is not the main problem. As capital market research has evolved over time, a much stronger and more insidious form of the EMH has gained currency. It is what we refer to as the "Price is Right" hypothesis. Applied to equity markets, this view of market efficiency asserts that a company's stock price is an

[6] Also see Richardson et al. [2010] for a discussion of non-price-based tests that can help discriminate between risk and mispricing-based explanations for returns predictability.

optimal forecast of the present value of its expected future dividends ($P_t = V_t, \forall t$). Notationally, this view is often expressed in the following form:

$$P_t = V_t \equiv \sum_{i=1}^{\infty} \frac{E_t(D_{t+i})}{(1+r)^i}, \tag{1.1}$$

where V_t is defined as the stock's fundamental value at time t, $E_t(D_{t+i})$ is the expected future dividend for period $t+i$ based on information available at time t, and r is the appropriate risk-adjusted discount rate for the expected dividend stream. Equation (1) asserts that P_t, the stock price at time t, is equivalent to the expected value of future dividends, V_t.

Over time, the Price is Right view of markets has acquired the status of an operating assumption among many researchers. For example, in the information content literature in accounting (including both short-window event studies and long-window association studies), price is commonly interpreted as a de facto proxy for the expected value of future dividends, and stock returns are deemed to reflect changes in the present value of expected future dividends. In the extensive value-relevance literature [Holthausen and Watts, 2001, Barth et al., 2001], price is deemed to be a normative benchmark for firm value. The assumption that price is equivalent to the present value of expected future dividends appears more explicitly in valuation studies, typically as the first assumption in the paper (see, for example, Feltham and Ohlson [1999], Zhang [2000], and Dechow et al. [1999]).

In finance, this assumption has become a cornerstone of empirical asset-pricing, particularly when interpreting realized returns. For example, highly influential work by Campbell [1991] and Vuolteenaho [2002] decomposes realized returns under the assumption that movements in stock prices mirror movements in V_t. In a zero-sum attribution exercise where price equals value, what is not attributable to cash flows is, of necessity, attributed to discount rates. Thus, due to an uncritical application of the EMH, the unexplained volatility in stock prices is now widely interpreted in the empirical asset-pricing literature as evidence of time-varying expected returns.[7]

[7]Some may argue that Equation (1) is itself too naïve, as it does not allow for time-varying expected returns. In our view, this argument is a red herring. Of course,

The problem is that "No Free Lunch" does not imply "The Price is Right". In his seminal study on the role of mass psychology in markets, Shiller made the following observation:

> Returns on speculative assets are nearly unforecastable; this fact is the basis of the most important argument in the oral tradition against a role for mass psychology in speculative markets. One form of this argument claims that because real returns are nearly unforecastable, the real prices of stocks is close to the intrinsic value, that is, the present value with constant discount rate of optimally forecasted future real dividends. *This argument for the efficient market hypothesis represents one of the most remarkable errors in the history of economic thought. It is remarkable in the immediacy of its logical error and in the sweep and implications of its conclusion.* [Shiller, 1984, pp. 458–459] (emphasis is ours).

With a little thought, Shiller's point becomes obvious. If price is equal to value at all times, then indeed returns will be unforecastable. In other words, if the price is always right ("A"), then there will indeed be no free lunch ("B"). However, the reverse does not follow — it is possible for prices to vary far from fundamental values without presenting any easy money (that is, although "A" implies "B"; "B" does not imply "A").[8]

Equation (1) is predicated on the fact that we can derive an ex ante estimate of the cost-of-capital (risk-adjusted) appropriate for a firm's risk level. It would make no sense otherwise. However, irrespective of how a firm's expected return varies over time, at any given point in time one should be able to provide a point estimate for its expected return (a constant equivalent discount rate for its expected cash flows) based on currently available information. Our point is that given *any* reasonable estimate of r, Price should not be viewed as equivalent to Value. We discuss related issues in more detail later. Specifically, in Section 1.7.2, we cover the evidence on the excessive volatility of market-wide stock prices. In Section 5, we examine how funding constraints on arbitrage capital could give rise to time-variation in expected returns. Finally in Section 6, we revisit the issue of time-varying expected returns as an explanation for cross-sectional stock market anomalies.

[8]Consider the simple example where Price = Value + ε, and ε follows a random walk, or long-term mean reverting process. If the investment horizon of the typical arbitrageur is longer than the time it takes for ε to make significant progress toward zero, then arbitrageurs will not be able to profit from the mispricing.

The relevant point for capital market research is that just because returns are difficult to forecast, we should not jump to the conclusion that price is equal to intrinsic value. As we discuss below, much of the mess we find ourselves in today in empirical asset-pricing comes from a failure to heed Shiller's warning. But first, let's revisit the root arguments for market efficiency.

1.4 The conceptual case for efficiency

The traditional defense for market efficiency boils down to a visceral faith in the mechanism of arbitrage.[9] Most economists who believe markets are efficient view it as an inevitable outcome of continuous arbitrage. If a particular piece of value-relevant information is not incorporated into price, there will be powerful economic incentives to uncover it, and to trade on it. As a result of these arbitrage forces, price will adjust to fully reflect the information. Individual agents within the economy may behave irrationally, but we expect arbitrage forces to keep prices in line. Faith in the efficacy of this mechanism is a cornerstone of modern financial economics.

In fact, moving from the mechanics of arbitrage to the efficient market hypothesis involves an enormous leap of faith. It is akin to believing that the ocean is flat, simply because we have observed the forces of gravity at work on a glass of water. No one questions the effect of gravity, or the fact that water is always seeking its own level. But it is a stretch to infer from this observation that oceans should look like millponds on a still summer night. If oceans were flat, how do we explain predictable patterns, such as tides and currents? How can we account for the existence of waves, and of surfers? More to the point, if

[9] Some finance textbooks define arbitrage as "the simultaneous purchase and sale of the same, or essentially similar, security in two different markets for advantageously different prices" (see, for example, Sharpe and Alexander [1990]). This definition is too narrow for our purposes, because it implies an undertaking that requires no capital and entails no risk. In reality, almost all arbitrage requires capital, and is risky. Therefore, throughout this discourse, we will define arbitrage as information trading aimed at profiting from imperfections in the current price. Under this definition, arbitrage is based on costly information, and typically involves some risk.

we are in the business of training surfers, does it make sense to begin by assuming that waves, in theory, do not exist?

A more measured, and more descriptive, statement is that the ocean is constantly trying to become flat. In reality, market prices are buffeted by a continuous flow of information, or rumors and innuendos disguised as information. Individuals reacting to these signals, or pseudo-signals,[10] cannot fully calibrate the extent to which their own signal is already reflected in price. Prices move as they trade on the basis of their imperfect informational endowments. Eventually, through trial and error, the aggregation process is completed and prices adjust to fully reveal the impact of a particular signal. But by that time, many new signals have arrived, causing new turbulence. As a result, the ocean is in a constant state of restlessness. The market is in a continuous state of adjustment.

In this analogy, market efficiency is a journey, not a destination. Therefore, the pertinent questions about market efficiency are not yes or no, because strictly speaking the answer is always no. Price discovery is an on-going process and the current price of a security is best regarded as a noisy and incomplete proxy for a security's true fundamental value. In this context, the research focus should be on deriving an independent measure of fundamental value, and on understanding the dynamics of market price discovery. Rather than assume market efficiency, our research efforts are better focused on how, when, and why prices adjust (or fail to adjust) to information.

1.5 Can mispricing exist in equilibrium?

The descriptive validity of the above analogy depends on the continued existence of mispricings. Is it possible for mispricing to exist in equilibrium? Certainly. In fact, it strikes us as self-evident that arbitrage cannot exist without *some* amount of mispricing. Arbitrageurs are creatures of the very gap created by mispricing. Therefore, either both mispricing and arbitrage exist in equilibrium, or neither will. If by

[10] Pseudo signals have the appearance, but not the substance, of news. Trading on the basis of pseudo signals is one source noise trading, as described by Black [1986].

some mystical force, prices always adjust instantly to the right value, we would have no arbitrageurs. Therefore, if we believe that arbitrage is an equilibrium phenomenon, we must necessarily believe that *some* amount of mispricing is also an equilibrium phenomenon.

It may be useful to frame this discussion in terms of Hayek [1945]. Hayek addresses the vital role of markets in aggregating information across heterogeneously informed traders, but his work does not focus on the incentives for information acquisition and arbitrage. We argue that in order for the price discovery process featured in Hayek [1945] to operate effectively, sufficient incentives must exist in equilibrium to incentivize the information acquirers. In effect, the very reliability of prices depends on a sufficient level of mispricing to ensure that arbitrage continues to function. Because sustained arbitrage depends on the continued existence of exploitable opportunities, a free and competitive market is almost necessarily inefficient to some degree. This is part of the price we pay for the benefits offered by the market mechanism.[11]

Much is made of the evolutionary argument that noise traders (naïve investors) cannot survive in a competitive market place.[12] To us, the best evidence in favor of the long-term viability of noise traders is the continued existence of active professional arbitrageurs. Ecologists coming upon the African Safari encountered large prides of lions. From the abundance of these predators, they inferred an abundance of gazelles, zebras, and other forms of lion prey. In the same spirit, the massive arbitrage apparatus we observe today attests powerfully to the continuing presence of substantial market imperfections. We cannot at once believe in the existence of lions, and reject the existence of the creatures that are essential to their survival.

Some believe that active asset managers are merely clever marketers, shysters who play no role in making markets more efficient (see, for example, Rubinstein [2001]). But we would then be hard pressed to explain the billions of dollars spent, year after year, in this futile pursuit. Index funds are not a new idea. Why should it take so long for

[11] Shleifer [2000] makes this argument, and contains a good discussion of the origins of the efficient market hypothesis.

[12] See Friedman [1953] for the original argument. DeLong et al. [1990a] offer a defense for the survival of noise traders in equilibrium.

investment money to flow to these funds? The same evolutionary forces that are used to argue for the extinction of noise traders, argue also for the extinction of active money managers. Both seem equally puzzling. Either our financial markets have a persistent need to be corrected every year, the magnitude of which runs into the billions of dollars, or the labor market for investment talent is absurdly inefficient.

The fact that active managers do not beat their benchmarks after management fees is often cited as evidence in favor of the efficiency of financial markets. But this evidence has little bearing on the market efficiency debate. The average performance of active managers tells us more about the state of labor markets than about the efficiency of financial markets. If active managers consistently under (over) perform their benchmarks after management fees, capital would flow to passive (active) investment instruments. In equilibrium, the fees they charge should equal the amount of mispricing they remove through their arbitrage activities. We should therefore expect the *after-fee* performance of active managers to approximately equal their benchmark.

How large is the market for active asset management? The answer is not straightforward. It needs to be estimated through multiple sources, and is dependent on fluctuating market prices. As of the end of 2012, a reasonable estimate of the total assets under management (AUM) controlled by professional managers across all asset classes is around 90 trillion USD.[13] Although not all of this AUM is actively managed, multiple sources indicate that the vast majority (at least 70%) resides with active, not passive, managers.[14] Assuming just a flat 1% active

[13]Estimates of AUM vary depending on source. A Boston Consulting Group study [Shub et al., 2013] estimates the conventional publicly traded assets managed professionally for fees (pension funds, insurance funds, and mutual funds) to be around US$62.4 trillion at the end of 2012. The City UK Fund Management Report Hines [2012] uses a broader AUM definition, and estimates conventional assets under management to be $85.2 trillion at the end of 2012. This report also provides an estimate of alternative assets (managed by sovereign wealth funds, hedge funds, private equity funds, exchange-traded funds, and wealthy individuals or family offices). Taken together, the CityUK report estimates total assets under global fund management to be $120 trillion.

[14]See for example, Chart 23 in the Hines report, which details the breakdown between active versus passive management by industry sector in the UK.

management fee (not counting performance fees), a conservative estimate of the first-order costs of informational arbitrage is over 600 billion USD per year. This is simply the management fee paid to active managers, who are part of a much larger ecosystem that also includes various other information intermediaries (for example, the prime brokers, sell-side analysts, financial consultants, providers of analytical software, and trading platforms), as well as data vendors (for example, Bloomberg, Thompson-Reuters, Factset, and S&P Capital IQ). Clearly informational arbitrage is big business. Whatever you may think about market efficiency, one thing is certain — the current level of efficiency that we enjoy is the result of a costly price discovery apparatus.

It is difficult to understand how an industry of this size can survive unless, on average, the amount of mispricing extracted by these active managers is on the same order of magnitude. Even if *part* of what we pay for active managers is excessive, it's unlikely that *all* of this expenditure is non-productive. If a significant proportion of active asset managers earn their keep (that is, match or beat their benchmark *after* expenses), their continued survival implies that equilibrium arbitrage costs are huge. We might argue about the speed and precision with which prices incorporate information, but we should not forget the price we pay to achieve it.

1.6 Costly informational arbitrage

Once we view informational arbitrage as a technology, the focus shifts from a macro view of market equilibrium to a micro view of how and when we might recognize mispricings, and what it would take to exploit them. In recent years, a controversial new technology known as "fracking" has revolutionized the energy industry. By allowing trapped natural gas from shale formations to be extracted at much lower costs, fracking has changed the economics of global energy production. Like energy production, active management involves a technology, and all technologies are subject to continuous improvement. Thus a proper understanding of market efficiency can only come when we are willing to examine, and to challenge, the current state of technology for alpha extraction. This is the study of the costly informational arbitrage.

Accounting researchers can contribute to this process by developing lower cost techniques for market arbitrage. For example, our research might lead to better techniques for spotting arbitrage opportunities, thus allowing prices to assimilate the information faster or in a more unbiased manner. Our work might also help to deliver the same level of arbitrage service at a reduced cost. In either case, we improve the efficiency of financial markets by enhancing the cost-effectiveness of the arbitrage mechanism.

Our point is that to improve informational efficiency, we do not need to beat the market *before* active management fees. We can also contribute to the process by reducing the costs of arbitrage. A number of academic studies in accounting have had a substantial impact on the trading behavior of professional arbitrageurs.[15] Perhaps market prices are adjusting more quickly and in a more unbiased fashion as a result of this research. But even if this research has not resulted in more efficient prices, it has almost certainly reduced search costs for arbitrageurs.[16] In this sense, accounting research has directly contributed to the allocation efficiency of financial markets.

Less directly, our educational endeavors also help facilitate this process. Through our classroom efforts, we supply the market with a group of more informed investors. As the level of sophistication improves among market participants, prices also become more efficient. Traditionally, we have in mind the notion that prices are set by the mystical "marginal investor." We do not know who this marginal investor is, but we presume she is quite sophisticated. Yet the evidence on noise trading (discussed in Sections 2 and 3) suggests that relatively unsophisticated investors can also affect returns in market segments they dominate. If

[15]For example, Bernard and Thomas [1990], Sloan [1996], Frankel and Lee [1998], Richardson et al. [2005], and Piotroski [2004]. All these studies have been analyzed and used by quant funds, and indeed seem to be reflected in the trading patterns of short sellers — a particularly sophisticated segment of the investing populous [Drake et al., 2011]. See Richardson et al. [2010] for a survey of recent literature in accounting anomalies.

[16]As a testimony to the usefulness of academic research, today hedge funds routinely receive monthly reports from sell-side firms that scour academic sources and summarize key findings for the investment community. One such provider claims to read and filter over 500 studies per month [DBEQS Global, 2014].

we regard price as a capital-weighted consensus of investor opinions, an improvement in the overall sophistication of the investing public results in better markets.

1.7 The "As If" defense of market efficiency

A common assertion is that even if the EMH is not strictly true, it is sufficient to serve as a starting point for research purposes. Like Newtonian physics, it is more than good enough for everyday usage. This is sometimes referred to as the "as if" defense for market efficiency. Unfortunately, it has becoming increasingly more difficult to accommodate what we know about the behavior of prices and returns within this traditional framework. In this subsection, we discuss some of the main practical problems with assuming that price is equal to value.

1.7.1 Trading volume

One immediate problem is trading volume. If we assume price fully reflects all information about future dividends (that is, if equilibrium price is fully revealing), the rational expectations literature suggests that we should have no trading in individual stocks (see, for example, Grossman and Stiglitz [1980]). Black observes:

> *A person with information or insights about individual firms will want to trade, but will realize that only another person with information or insights will take the other side of the trade. Taking the other side's information into account, is it still worth trading? From the point of view of someone who knows what both traders know, one side or the other must be making a mistake. If the one who is making a mistake declines to trade, there must be no trading on information. In other words, I do not believe it makes sense to create a model with information trading but no noise trading.* [Black, 1986, p. 531]

On a typical day, many billions of shares exchange hands at the New York Stock Exchange (NYSE), the Nasdaq, and the NYSE MKT

(formerly AMEX). The vast majority of this trading is in individual securities. This enormous appetite for trading individual securities is a challenge for the traditional model, in which price fully reflects information about future dividends.

1.7.2 Volatility

If volume is difficult to explain, volatility is even more problematic.[17] In the classical framework, it is impossible for events that have no information content about future fundamentals to affect prices. Yet empirically, we find that news about fundamentals explains only a fraction of the volatility in returns (see, for example, Roll [1988], Cutler et al. [1989], and Chen et al. [2013]; for anecdotal evidence, witness the October 1987 crash or the daily volatility in internet stocks). In Cutler et al. [1989], for example, macro-economic news variables from past, present, and future periods (for example, innovations in production, consumption, and interest rates) collectively explain less than 50% of the annual variability in stock returns. The same message is echoed in many cross-sectional studies that attempt to explain stock returns with accounting-based fundamentals (see, for example, Easton et al. [1992] and Richardson et al. [2012]).[18] Throughout this literature, we find stock prices seem to move for reasons that have little to do with fundamental news. The weight of this evidence behooves us to adopt

[17] Using a variance bound test, Shiller [1981a,b] examined the proposition that stock prices are too volatile and concluded in the affirmative. This study precipitated a debate over the correction needed for variance calculations when both dividends and stock prices follow highly persistent processes with unit roots [see Kleidon, 1986, Marsh and Merton, 1986, Campbell and Shiller, 1987, 1988a,b]. In particular, Campbell and Shiller [1987] tested a form of the dividend discount model that modifies the variance calculation for the unit root case, and once again found excessive volatility. See Campbell [2014] for a good discussion of this topic.

[18] In Easton et al. [1992], fundamental accounting variables explain 15% and 5% of the cross-sectional returns for two- and one-year horizons, respectively. Even when using a 10-year window, the authors find the adjusted r-square between stock returns and accounting measures to be only 62%. In a more recent study, Richardson et al. [2012] include both firms' expected returns and forward-looking fundamental news (using analyst forecasts of earnings), and find that collectively these variables explain less than 40% of the variance in annual stock returns.

a broader view of asset-pricing, and to entertain the possibility that other forces are at work in shaping prices and returns.

1.7.3 Return predictability

Third, the evidence on the predictability of stock returns is increasingly more difficult to reconcile with the efficient market framework.[19] With risk-averse investors, all tests of potential trading strategies are a joint test of an asset-pricing model. If the asset-pricing model is misspecified, it is always possible that the abnormal returns are some form of compensation for yet another unknown risk factor. However, with many of the more recent pricing anomalies, the risk-based explanations are becoming less plausible because of the ancillary evidence associated with these findings.

We find particularly compelling the evidence that *healthier* and *safer* firms, as measured by various measures of risk or fundamentals, often earn higher subsequent returns. Firms with lower Beta, lower volatility, lower distress risk, lower leverage, and superior measures of profitability and growth, all earn higher returns (see, for example, Dichev [1998], Piotroski [2000], Lakonishok et al. [1994], and Asness et al. [2013]). If these firms are riskier, it is odd that they should exhibit future operating and return characteristics that suggest the opposite. We discuss this evidence in more detail in Sections 4 and 6.

The finding that a substantial portion of the abnormal returns is earned around subsequent earnings release dates is also extremely difficult to explain in a risk context.[20] Asset-pricing models do not predict these short-window price moves. Finally, the so-called momentum studies, that document subsequent price drifts to various corporate news releases (including earnings surprises, dividend announcements, and stock splits), are particularly difficult to reconcile with risk-based

[19] Much of this evidence has been discussed in prior survey work (see, for example, Fama [1991], Shleifer [2000], Kothari [2001], and Richardson et al. [2010]).

[20] Bernard and Thomas [1990] was perhaps the first and best-known study to use this technique in distinguishing between risk and mispricing explanations. Richardson et al. [2010] contain a good discussion.

explanations.[21] The fact that these events predict subsequent earnings surprises and the direction of analyst earnings revisions suggests that they are related to market misperceptions of earnings rather than risk (see, for example, La Porta [1996], Chan et al. [1996], and Richardson et al. [2010]).

It might be worthwhile to note the evolving nature of the evidence in this literature over time. Initially, much effort was focused on *documenting* apparent pricing anomalies (see, for example, DeBondt and Thaler [1985, 1987]). More recent efforts have been focused on *explaining* these anomalies and testing various behavioral models (see, for example, Arif and Lee [2015]), sometimes using experimental techniques [Libby et al., 2002]. We believe that future studies along these lines will not merely document new anomalies, but will also help to explain them. The literature is still at an early stage of development, but what we know is sufficient to convince many that risk-based explanations alone are not enough.

1.7.4 Cost-of-capital

Finally, one of the most elemental challenges to the efficient market paradigm is spawned by the cost of capital dilemma. Historically, asset-pricing models have been tested using average realized returns to proxy for expected returns. This practice is based on the assumption that market prices are unbiased in large samples. Yet even this weaker form of market efficiency has been questioned in recent times. As Elton [1999] observes in his presidential address to the American Finance Association, "(t)here are periods longer than 10 years during which stock market realized returns are on average less than the risk-free rate (1973 to 1984). There are periods longer than 50 years in which risky long-term bonds on average underperform the risk free rate (1927 to 1981)."

In other words, historical realized returns do not appear to be an appropriate proxy for expected returns, even averaged over decades.

[21] Ikenberry and Ramnath [2002] summarize the evidence on post-event drifts. Asness and Liew [2014] provide a good discussion of value and momentum strategies, as well as a practitioner's take on the market efficiency debate.

Changing risk premiums and conditional asset-pricing theories are likely to explain some time-series variations, but these explanations cannot account for risky assets earning persistently lower returns than the risk-free rate. Indeed, growing discontent with the noisy nature of average realized returns is the main impetus for the move toward valuation-based techniques for estimating expected returns (see, for example, Claus and Thomas [2000], Gebhardt et al. [2001], or Fama and French [2002]). Once again, we find that the "price equals value" assumption fails the Newtonian test of practical usage.

Summary

The main point of this section is that, as researchers, we need to think about fundamental ("intrinsic") value and the current market price as two distinct measures. This is because the problems engendered by the naïve view of market efficiency expressed in equation (1) are simply too pervasive to ignore. In fact, we believe the unshackling of price from value is a key conceptual step toward a better understanding of many long-standing puzzles in empirical financial economics, including: excessive trading volume, excessive return volatility, the pervasive evidence on returns predictability, the cost of capital dilemma, and the continued existence of a large active asset management industry.

At each point in the information aggregation process, Price is informed by, but not confined to equal, Value. In fact, the possibility of mispricing is what gives market participants the incentive to uncover news about firm value. This is an extremely important concept to get across to researchers working in the capital market area. Indeed, we view it as the "watershed" shift in thinking needed to bridge academic researchers with most asset managers.

A second central point made in this section is the need to focus on the market for information, and not merely the market for the assets themselves. The size of the active asset management industry speaks powerfully to the importance and complexity of the information market. In our view, the market for information deserves at least as much attention as the market for the assets themselves. Economic incentives,

behavioral biases, and other frictions in the market for information are keys to better understanding of the pricing problems in the market for the underlying assets. In short, informational arbitrage is a costly and complex process that deserves more academic attention. This is a recurrent theme throughout the book.

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