Economics
The Open-Access, Open-Assessment E-Journal

Vol. 9, 2015-24 | August 18, 2015 | http://dx.doi.org/10.5018/economics-ejournal.ja.2015-24

Knightian Uncertainty and Stock-Price Movements: Why the REH Present-Value Model Failed Empirically

Roman Frydman, Michael D. Goldberg, and Nicholas Mangee

Abstract

Macroeconomic models that are based on either the rational expectations hypothesis (REH) or behavioral considerations share a core premise: All future market outcomes can be characterized ex ante with a single overarching probability distribution. This paper assesses the empirical relevance of this premise using a novel data set. The authors find that Knightian uncertainty, which cannot be reduced to a probability distribution, underpins outcomes in the stock market. This finding reveals the full implications of Robert Shiller's ground-breaking rejection of the class of REH present-value models that rely on the consumption-based specification of the risk premium. The relevance of Knightian uncertainty is inconsistent with all REH models, regardless of how they specify the market's risk premium. The authors' evidence is also inconsistent with bubble accounts of REH models' empirical difficulties. They consider a present-value model based on a New Rational Expectations Hypothesis, which recognizes the relevance of Knightian uncertainty in driving outcomes in real-world markets. Their novel data is supportive of the model's implications that rational forecasting relies on both fundamental and psychological factors.

(Published in Special Issue Radical Uncertainty and Its Implications for Economics)

JEL E44 G12 G14 B40

Keywords Knightian uncertainty; structural change; fundamentals; psychology; present-value model; stock prices

Authors

Roman Frydman, ✉ Department of Economics, New York University, New York, NY 10012, USA, and INET Program on Imperfect Knowledge Economics (IKE), rf3@nyu.edu

Michael D. Goldberg, Peter T. Paul College of Business and Economics, University of New Hampshire, Durham, NH 03824, USA, and INET Program on IKE

Nicholas Mangee, Department of Economics, Armstrong State University, Savannah, GA 31419, USA, and INET Program on IKE

Citation Roman Frydman, Michael D. Goldberg, and Nicholas Mangee (2015). Knightian Uncertainty and Stock-Price Movements: Why the REH Present-Value Model Failed Empirically. *Economics: The Open-Access, Open-Assessment E-Journal*, 9 (2015-24): 1—50. http://dx.doi.org/10.5018/economics-ejournal.ja.2015-24

Received May 19, 2015 **Published as Economics Discussion Paper** May 29, 2015
Revised August 3, 2015 **Accepted** August 6, 2015 **Published** August 18, 2015

1 Introduction

In his classic book *Risk, Uncertainty, and Profit,* Frank Knight introduced a distinction between measurable uncertainty, which he called "risk," and "true uncertainty," which cannot "by any method be reduced to an objective, quantitatively determined probability" (Knight, 1921, p. 321).

Over the last four decades, macroeconomists and finance theorists have developed models that assume away Knightian uncertainty and represent the process underpinning outcomes over an indefinite future with a single probability distribution. A vast majority of these models rely on the rational expectations hypothesis (REH) to represent the forecast of the market (an aggregate of its participants). They do so by imposing consistency between this forecast and the probability distribution of outcomes implied by the model (Muth, 1961). Lucas (1995, 2001) pointed out that once models that characterize outcomes with a probability distribution are upheld as "the relevant economic theory," REH represents how a rational participant understands and forecasts market outcomes.

Many studies have found REH models inconsistent with time-series data, most notably in asset markets. But tests of an REH model always involve a joint hypothesis: the process underpinning future outcomes can be represented *ex ante* with a probability distribution and market participants are rational and profit-seeking. Empirical rejection of the model could thus stem from either the model's probabilistic specification of outcomes or the presence of irrational participants in the market.

Proponents of REH maintain the premise of market participants' rationality and continue to search for alternative probabilistic representations of outcomes. Indeed, the rejection of one REH model does not preclude the possibility that another, either existing or yet to be invented, might be able to account for time-series data. Although progress has been made, this search has not yet resolved the main long-standing empirical puzzles in financial economics.

The key question is whether the economics profession should continue to devote considerable resources and talent to searching for empirically relevant REH models. In answering this question, we build on Knight's distinction between risk and "true uncertainty." If uncertainty in markets cannot "be reduced to an objective, quantitatively determined probability," economists should consider redirecting their

research to develop an alternative class of models that recognize the importance of "true," or Knightian, uncertainty in real-world markets.[1]

In this paper, we provide evidence that Knightian uncertainty underpins outcomes in asset markets. We focus on the process driving stock prices.

For Knight, true uncertainty arises from "our imperfect knowledge of the future, the consequence of [unforeseeable] change, not change as such" (Knight, 1921, p. 198). There is ample evidence that the process driving outcomes undergoes quantitative structural change, especially in asset markets. The key question is how to ascertain empirically whether this structural change is, at least in part, unforeseeable. Knight (1921, p. 231-232) provides the answer,

> Business decisions... deal with situations which are far too unique ... [to rely solely on] statistical tabulations. The conception of objectively measurable probability is simply inapplicable.

Here we examine whether historical events that are not exact repetitions of similar events in the past are important in driving stock prices. Because of their uniqueness, these events give rise to structural change that could not have been foreseen with a probability distribution.

We provide evidence that a wide range of such historical events drives stock-price movements. Some large-impact events—for example, 9/11 or the invention of breakthrough technologies—could not even have been imagined in advance. Moreover, stock prices are frequently moved by moderate-impact events that are also to some extent unique, from announcements by central banks to quarterly company reports containing news about current developments and future plans. The quantitative impact of these events on the process underpinning stock prices

[1] Our argument here is related to the distinction between "uncertainty outside and inside economic models" advanced by Hansen (2014) in his Nobel lecture. "Outside" uncertainty is inherent in an economist's choice of his model's specification. Uncertainty "inside economic models" refers to the model's representation of the uncertainty faced by market participants. Recent approaches to formalizing model uncertainty—for example, robustness (Hansen and Sargent, 2008) or ambiguity (Chen and Epstein, 2002)—represent this uncertainty in probabilistic terms. However, in his Nobel lecture, Hansen recognizes that economists may have to move beyond probabilistic representations of uncertainty.

depends on the extent of their novelty and the particular historical context in which they occur. Thus, *ipso facto*, the structural change that they trigger is unforeseeable.

Our evidence comes from *Bloomberg News* market wrap reports from January 4, 1993, through December 31, 2009. *Bloomberg* journalists monitor the U.S. stock market throughout the day. They also speak in real time to market participants about the factors that they consider relevant and how these factors influence their forecasts. At the end of each trading day, *Bloomberg* posts a wrap that summarizes the intraday news reports. *Bloomberg*'s real-time reporting about news and market developments gives us confidence that these wraps are far from *ex post* rationalization of a day's stock-price movements.[2]

Mangee (2011) converts the information that comprises the wraps into a numerical data set according to a strict set of rules.[3] This data set contains an extensive record of historical events as they occur and their impact on the market's forecasts and stock prices. As such, Mangee's data set provides direct evidence concerning the relevance of Knightian uncertainty during the 17-year sample period. Notably, 20% of the news that is reported by *Bloomberg* as driving daily stock-price movements involves historical events that are to some extent unique. We also provide much other evidence that the price process undergoes structural change at times and in ways that no one could have fully foreseen.

These findings pose a direct challenge to the core premise of existing macroeconomics and finance theory. The empirical relevance of Knightian uncertainty implies that REH models' *ex ante* probabilistic representations do not represent the process underpinning future outcomes.

To be sure, REH models are internally consistent. But their inconsistency with how market outcomes actually unfold undercuts the widespread belief that REH represents rational forecasting. Indeed, once we recognize that unforeseeable change drives outcomes, REH's presumption that participants ignore this change implies that they forego profit opportunities, and thus are irrational (Frydman and Goldberg, 2015).

It is unsurprising, therefore, that REH models have given rise to many long-standing anomalies, most notably in financial markets. One such anomaly is the

[2] See Section 4 for a discussion and empirical evidence on this important issue.

[3] For a description of how Mangee constructs his data set, see Section 4 and Data Appendix A.

failure of the REH present-value model of stock prices, which relates these prices to the market's forecast of stocks' fundamental value (the discounted value of all future dividends). REH's presumption that future dividends and the discount rate can be characterized with a probability distribution implies that—save for a mean-zero error term uncorrelated with available information—the market's forecast equals the actual values of outcomes. If this were the case, stock prices would be less volatile than their fundamental value.

In a ground-breaking paper, Shiller (1981) found the exact opposite: stock prices are more volatile than their *ex post* fundamental value. In computing this value, Shiller used time-series data on dividends and interest rates. One of his measures of this value assumed that the risk premium is constant. He also used *ex post* data on consumption and the REH consumption-based capital asset pricing model to account for the time-varying risk premium in measuring the fundamental value.

Fama (2014) argues that Shiller's "excess volatility" finding stems from the misspecification of the risk premium. However, more than three decades after Shiller published his paper, attempts to explain this "excess volatility" with an REH risk-premium model still encounter considerable difficulties.[4]

The empirical relevance of Knightian uncertainty explains why. As with dividends, interest rates, and stock prices, how the risk premium in a market populated by rational participants unfolds over time cannot be represented with an REH model.

Shiller and other behavioral-finance economists did not relate the failure of the REH present-value model to the importance of Knightian uncertainty in the stock market. Instead, they followed their REH counterparts and retained the premise that a probability distribution can be used to represent outcomes. Behavioral-finance theorists, therefore, continued to rely on REH as the way to represent how a rational, profit-seeking participant forecasts outcomes in terms of fundamental factors.

[4] For an authoritative review of REH risk-premium models and their empirical difficulties, see Campbell *et al.* (1997). The search for an empirically relevant REH risk-premium model continues. As John Cochrane put it in an interview for the New Yorker, "That's the challenge. That's what we all work on" (Cassidy, 2010, p. 3).

This belief led behavioral-finance economists to interpret the findings of excess volatility as evidence that the market is dominated by individuals who are not "fully rational" (Barberis and Thaler, 2003, p. 1056). Their "bubble" models suppose that these individuals' forecasts—and thus stock prices—are driven by "psychological biases" and momentum trading that are largely unrelated to fundamental factors.

This irrationality-based explanation of the REH present-value model's empirical failure is, however, an artifact of behavioral-finance models' reliance on probabilistic representations of outcomes. Frydman and Goldberg's (2015) New Rational Expectations Hypothesis (NREH) shows how the relevance of Knightian uncertainty accords psychological factors an important role in how a rational, profit-seeking participant forecasts outcomes in terms of fundamental factors.

NREH models are open to unforeseeable change, but only partly so. They impose *ex ante* constraints on this change, for example, that it will be moderate for protracted intervals.

Frydman and Goldberg (2015) rely on NREH to derive the present-value model. Like REH, NREH represents the market's forecasts of dividends and the discount rate by imposing consistency between these forecasts and its partly open representation of the process underpinning these outcomes.

This consistency implies that fundamental factors underpin stock prices. But, because an NREH model recognizes the relevance of Knightian uncertainty, it can account for the diversity of ways in which a rational market participant may forecast outcomes.[5]

A participant cannot rely solely on statistical analysis or other calculations to ascertain which forecasting strategy he should use. Ultimately, a market participant is guided by the confidence that he has in choosing one strategy over others to relate available information on fundamental factors to future outcomes. Intuition and emotions (such as optimism and fear) inevitably also play a role. Consequently,

[5] This implication of Knightian uncertainty stands in sharp contrast to the premise that underpins every REH model. To be sure, there are many different REH models. However, in formulating an REH model, an economist presumes that the probability distribution implied by his particular model provides the only "objective" way to understand and forecast outcomes. As Sargent (2005, p. 566) acknowledged, "The fact is that [one] cannot talk about...differences [among people's models] within the typical rational expectations model...All agents inside the model, the econometrician, and God share the same model." See Frydman and Goldberg (2011) for further discussion and references.

we would expect that whenever market participants rely on psychological considerations in driving their forecasting, they relate these considerations to their understanding of the influence of news about fundamental factors.

Bloomberg's reports provide a particularly rich source of information about the role that market participants attach to psychological and fundamental factors in driving outcomes. Our analysis of Mangee's data set reveals that, as the NREH present-value model predicts, fundamental factors are the main driver of stock prices. Psychological factors also play an important role in participants' forecasting. But, in sharp contrast to the bubble models, these considerations are not unrelated to fundamental factors. We find that psychological factors matter in ways that are consistent with NREH: market participants rely on them almost entirely to help them interpret the impact of news concerning fundamental factors on future stock prices.

Direct evidence concerning factors driving market participants' forecasts of dividends and discount rates enables us to assess the empirical relevance of the NREH present-value model, regardless of the particular partly open specification for these outcomes chosen by an economist. Our approach requires neither a specification of the time-varying risk premium nor an assumption that this premium does not change over time.

Frydman and Goldberg (2015) show that recognizing Knightian uncertainty does not alter one of the main qualitative predictions of the present-value model: when news about fundamental factors raises (lowers) the market's forecast of dividends, or lowers (raises) its forecast of the discount rate, the market bids stock prices up (down). We find that news about fundamental factors moves prices through the present-value model's two main channels—the market's forecast of dividends and its forecast of the discount rate—in ways that are remarkably consistent with the model's predictions.

Taken as a whole, our findings point to the root cause of REH models' empirical difficulties: no one can specify *ex ante* how outcomes will actually unfold with an overarching probability distribution. More important, our analysis points to a way forward for economics that builds on the insights of both REH and behavioral approaches. Accounting for the roles of fundamental and psychological factors in rational forecasting requires economists to recognize the relevance of Knightian uncertainty. Empirical support for an NREH present-value model holds promise

that opening models to unforeseeable change might enable economists to resolve long-standing empirical puzzles without jettisoning market participants' rationality.

The remainder of the paper is structured as follows. In Section 2, we consider both the REH and NREH versions of the present-value model, and discuss how Knightian uncertainty leads to an additional term in the model. In Section 3, we consider Shiller's (1981) volatility tests of the REH present-value model and argue that uncovering evidence of Knightian uncertainty rejects the entire class of REH models. In Section 4, we examine Mangee's (2011) novel data set and discuss why the reporting on which it is based is not *ex post* rationalization of stock-price movements. The remaining sections consider the qualitative predictions implied by both the REH and NREH versions of the present-value model. Section 5 presents our empirical findings concerning the importance of both fundamental and psychological factors in driving daily stock-price movements, whereas Section 6 presents evidence of unforeseeable structural change and Knightian uncertainty. In Section 7, we use Mangee's data set to assess the present-value model's main qualitative implications concerning how the market relies on news about fundamental and psychological factors in forecasting dividends and interest rates. We also present indirect evidence that news about fundamental and psychological factors influence stock prices through its impact on the market's risk premium. Section 8 provides concluding remarks. A Data Appendix discusses Mangee's (2011) data and provides examples of his rule-based scoring of market wraps.

2 The Present-Value Model

The present-value model represents the price of stocks in terms of the market's forecast of their fundamental value. Both REH and NREH versions of the model rest on an equilibrium condition for the one-period return on stocks, whereby prices at each point in time are equal to the market's forecasts of the discounted value of the next period's dividends and prices. Both versions also assume that internal consistency can be used to represent the market's forecasts. However, REH and NREH models differ sharply in how they represent the process underpinning dividends, the discount rate, and prices.

A vast majority of existing REH macroeconomic and finance models are time-invariant. They characterize outcomes at each point in time with the same reduced-form relationship and probability distribution. Sometimes, REH theorists allow for structural change in this process.[6] However, because REH models constrain all future changes in the process underpinning dividends, the discount rate, and prices to conform to an *ex ante* probabilistic rule, they in effect represent this process over an indefinite future with a single overarching probability distribution.

REH represents the market's forecasts in terms of fundamental factors by imposing consistency between these forecasts and the distribution implied by an economist's model. REH's *ex ante* probabilistic characterization of the market's forecasts, together with the assumption that market participants have access to the same information, implies that the Law of Iterated Expectations (LIE) can be used in deriving the present-value model from the equilibrium condition.

Like its REH counterpart, an NREH model specifies the set of quantitative structures and constrains them to share certain qualitative features—for example, that the impact of a particular causal factor on outcomes will be positive at each point in time. However, a partly open model does not constrain *ex ante* how these structures change over time with a probabilistic rule.[7] As a result, the model represents outcomes with a sequence of probability distributions that cannot be reduced *ex ante* to an overarching distribution. Consequently, LIE does not hold.

Frydman and Goldberg (2015) show that in this case, stock prices differ from the market's forecast of stocks' fundamental value by a term that arises from

[6] Hamilton (1989) has developed a seminal class of such models. He supposes that there are several different regimes in which prices are related to a set of factors. Hamilton represents these factors (and the error terms) in each regime with a different probability distribution and supposes that the timing of switches between regimes is governed by a Markov rule.

[7] Instead, the model hypothesizes that there are protracted intervals during which the economy will undergo moderate structural change, in the sense that this change will fall between a lower and upper bound. A partly open model also recognizes that structural change sometimes will not be moderate (it will fall outside the bounds); but, again, it does not specify the timing of such changes with a probabilistic rule *ex ante*.

Knightian uncertainty. The NREH present-value model for stock prices can be written as follows:

$$p_t = \sum_{j=0}^{\infty} \rho^j \mathscr{F}_t^{\mathrm{M}} \left[(1-\rho)\, d_{t+1+j} - r_{t+1+j} | v_t \right] + ku_t \tag{1}$$

where p_t and d_{t+1} denote the log price of a stock or a basket of stocks in period t and next-period's log dividends, respectively, r_{t+1} is the discount rate (which typically is the sum of the interest rate and a premium for potential capital losses), and $0 < \rho < 1$ is a parameter of linearization.[8] $\mathscr{F}_t^{\mathrm{M}}(\cdot|v_t)$ represents the market's time-t point forecast conditional on the information about the factors that it considers relevant, denoted by v_t. The t subscript on the $\mathscr{F}_t^{\mathrm{M}}(\cdot)$ operator recognizes that the strategy underpinning the markets' point forecast changes over time. The Knightian uncertainty term, ku_t, follows from a simple decomposition of the market's iterated forecasts at each iteration of the equilibrium condition. For example, at t+1, we have:

$$\mathscr{F}_t^{\mathrm{M}} \left(\mathscr{F}_{t+1}^{\mathrm{M}} \left[x_{t+2} | v_t \right] \right) = \mathscr{F}_t^{\mathrm{M}} \left(\left[x_{t+2} \right] | v_t \right) + ku_{2,t} \tag{2}$$

$$ku_{2,t} = \mathscr{F}_t^{\mathrm{M}} \left(\mathscr{F}_{t+1}^{\mathrm{M}} \left[x_{t+2} \right] | v_t \right) - \mathscr{F}_t^{\mathrm{M}} \left(\left[x_{t+2} \right] | v_t \right) \tag{3}$$

where $x_{t+2} = (1-\rho)\, d_{t+2} - r_{t+2}$. As such, $ku_t = \sum_{j=2}^{\infty} ku_{j,t}$. We note that with internal consistency, the market's time-t forecast of its $t+1$ forecast of outcomes in Equations (2) and (3) depends on information available at t concerning the fundamental factors that the market considers relevant.

Standard REH models characterize $\mathscr{F}_t^{\mathrm{M}}(\cdot|v_t)$ with the conditional expectation of the probability distribution implied by the model. The assumption that market participants have access to the same information implies that LIE holds, and thus $ku_{j,t} = 0$ for all j and all t.[9] Although $ku_{j,t} \neq 0$ in NREH models, this term does

[8] This formulation makes use of Campbell and Shiller's (1988) log-linear specification. For ease of exposition, we ignore a constant term arising from linearization.

[9] However, Allen *et al.* (2006) show that with asymmetric information, LIE does not hold, even with REH. In these models, stock prices differ from the market's forecast of stocks' fundamental value by a term that arises from the asymmetry of information.

not affect their qualitative predictions concerning how news about the fundamental factors, v_t, impacts the market's forecasts of dividends and the discount rate at a point in time or how these forecasts and stock prices co-move with v_t over time.

In an NREH model, an economist formulates his own understanding of how available information is related to future dividends and the discount rate with a partly open representation. This representation supposes that particular fundamental factors are relevant and imposes qualitative constraints *ex ante* on the impact of these factors at each point in time on all future outcomes, for example, that current earnings impact future dividends positively at all forecasting horizons. Frydman and Goldberg (2015) show that internal consistency imposes the same qualitative constraints on the representation of the market's iterated forecasts and its forecast of outcomes in terms of the fundamental factors at every forecast horizon.[10] Consequently, the NREH model's qualitative implications concerning the impact of news about fundamentals at a point in time on stock prices are unaffected by the presence of the ku_t term.

The ku_t term also does not affect the NREH model's predictions concerning co-movements in time-series data. The reason is that the model generates *only* qualitative predictions concerning these co-movements. For example, that stock prices co-move positively with earnings for protracted intervals during which unforeseeable change is "moderate" (falling within upper and lower bounds) (Frydman and Goldberg, 2015).

The REH present value model also yields qualitative implications concerning the impact of news on stock prices. Researchers typically assess these implications with time-series data. The probabilistic constraints imposed by REH imply *ex ante* quantitative predictions concerning co-movements in the data, which are given by the conditional moments implied by the model's probabilistic representation.

[10] Of course, the quantitative impact effects of news on the market's iterated forecasts and the market's forecast of outcomes, in general, differ. Allen *et al.* (2006) provide an REH example with asymmetric information.

3 Shiller's Findings

Shiller (1981) examined the quantitative prediction of the REH present-value model concerning time-series co-movements between stock prices and their fundamental value. Reliance on REH enabled him to carry out his test without specifying the particular probabilistic representation of the processes underpinning dividends and the discount rate. Shiller exploited REH's key implication: regardless of the particular probabilistic characterization of outcomes implied by the model, the actual future values of dividends and the discount rate differ from the market's forecast of these outcomes by a mean-zero error that is uncorrelated with all available information. This decomposition implies that stock prices should be less volatile than their fundamental value, p_t^{F}:

$$p_t^{\mathrm{F}} = E\left(p_t^{\mathrm{F}} | v_t\right) + \varepsilon_t = p_t + \varepsilon_t \tag{4}$$

where

$$p_t^{\mathrm{F}} = \sum_{j=0}^{\infty} \rho^k \left[(1-\rho)\, d_{t+1+j} - r_{t+1+j}\right] \tag{5}$$

In computing the fundamental value in (5) at each point in time, Shiller used time-series data on the actual values of dividends and the interest rate at future dates. One of his measures of p_t^{F} relied on the consumption-based capital asset pricing model (CAPM) and *ex post* data on consumption to account for the time-varying risk premium.

Shiller's test of (4) involved a joint hypothesis: the particular CAPM specification that he used and the REH present-value model's characterization of how the market forecasts stocks' fundamental value. Thus, his finding that prices are more volatile than their fundamental value implies rejection of either the specific risk premium specification underpinning his *ex post* measure of stocks' fundamental value or the entire class of REH present-value models.

In Section 6, we present evidence that unforeseeable structural change and Knightian uncertainty underpin the process driving stock-market outcomes. As with dividends and interest rates, this evidence is inconsistent with REH's characterization of the market's forecasting, and thus stock prices, regardless of the

chosen specification of the risk premium. Consequently, like Shiller, we interpret the excess-volatility finding as a rejection of the empirical relevance of *all* REH representations—including those yet to be invented—of how market participants forecast the risk premium, as well as dividends, interest rates, and prices.

Rejection of the quantitative predictions of the entire class of REH present-value models leaves open the question of whether the model's qualitative implications—that stock prices depend on fundamental factors and that these factors drive outcomes through their impact on the market's forecasting of future dividends and the discount rate—are empirically relevant. In order to assess these predictions we rely on direct evidence concerning how participants in markets relate stock-price movements to fundamental and other factors. This evidence also enables us to assess the competing qualitative predictions of the REH and NREH versions of the present-value model.

4 Uncovering Direct Evidence

Mangee's (2011) *Bloomberg News* data set provides such direct evidence. He manually reads *Bloomberg* market wraps and converts textual information in them into numerical data without the aid of a content-analysis program.[11] This enables him to identify only those factors that are explicitly reported as having driven stock prices on a given day. A strict set of rules ensures that the wraps are scored consistently over the 17-year period.[12]

This rule-based manual approach is not constrained to search for words or phrases from a pre-specified list: any factor—whether fundamental, psychological, or technical—that is reported in a market wrap as a main driver of prices is recorded. Mangee also records whether a fundamental factor was mentioned as affecting prices positively or negatively. For example, if a rise (fall) in oil prices was

[11] Most other textual-data studies rely on such a program to convert narrative information into numerical data. See Frydman *et al*. (2015) for a discussion of why this approach is not suitable for assessing the relevance of Knightian uncertainty or the qualitative implications of the present value model.

[12] See Data Appendix A for a list of these rules.

mentioned as underpinning a rise (fall) in stock prices, he would record in his data set a +1 (–1) for oil prices on the date of the report.

Herein lies one of the principal advantages of Mangee's approach over those that rely on automated textual analysis: Rule-based manual reading enables us to rely on the wrap reports themselves, rather than on econometric analysis, to uncover the factors that market participants consider relevant and how they interpret news about these factors in forecasting outcomes. Moreover, Mangee's rule-based reading enables us to uncover the influence of historical events that are to some extent unique, from central-bank announcements and trade agreements to mergers and management shake-ups. *Bloomberg*'s real-time reporting of these historical events is important to ascertain the relevance of Knightian uncertainty.

Understanding the context in which a factor is considered relevant enables Mangee to address a central problem inherent in all news-impact studies: what often matters for markets is not the actual change in a fundamental factor, but its change relative to what the market expected. *Bloomberg* journalists report the influence of such expectations when they are relevant for explaining market movements.[13]

In Data Appendix B, we consider excerpts from several *Bloomberg* market wraps to specify the information about the process underpinning stock prices that these wraps provide and help clarify how Mangee constructs his data set. The excerpts also show how the influence of expectations is incorporated into *Bloomberg*'s reporting of the impact of fundamental factors.

4.1 Real-Time News Reporting

To be sure, there is reason for skepticism regarding the scientific value of the information contained in *Bloomberg*'s market wraps. After all, these wraps could merely reflect end-of-day rationalizations based on journalists' *a priori* conceptions,

[13] *Bloomberg* journalists rely largely on polling conducted by their firm's parent company, *Bloomberg* L.P., of the expectations of professional economists working at more than a hundred financial institutions and forecasting companies. These surveys often involve dozens of participants and are regularly conducted before the announcement of a broad range of key macroeconomic indicators. *Bloomberg* journalists sometimes also rely on *Thompson-Reuters* and other companies that regularly conduct surveys of professional participants' expectations.

which may have little connection to the developments and factors that actually drove market participants' forecasts and stock prices.

Other textual-data studies also face this problem. Tetlock (2007), Tuckett *et al*. (2015), and others rely on regression analysis to address it. They report that their narrative-based sentiment measures have some ability to predict future asset-price movements. This finding suggests that the news reports that underpin these measures are not *ex post* rationalizations.

We follow an analogous approach and examine whether a monthly index based on Mangee's (2011) data can predict future stock-price movements. This data set tracks the importance of a wide range of factors and how news about them affects the market's forecasting. Here, we focus on the historical events that, according to *Bloomberg News*, underpinned market participants' forecasting and stock-price movements. These events play a key role in our argument that unforeseeable change and Knightian uncertainty drive market outcomes.[14] We categorize a historical event as positive (negative) if *Bloomberg News* reported it as contributing to a rise (fall) in stock prices on a given day. We construct a net unforeseeable change index (UCI) which tracks the number of positive events relative to the number of negative events.

The relevance of Knightian uncertainty poses considerable difficulties for quantitative testing of net UCI's predictive power; for example, a linear regression model would miss structural changes.[15] We thus examine the question in qualitative terms: does our index of historical events predict the direction of change of the Standard and Poor's (S&P) 500 price index? Table 1 reports our results at the one-, three-, six-, and 12-month forecast horizons.

While the net UCI does not have predictive power at the longer forecast horizons, it does at the one-month horizon; it predicts correctly the qualitative movement in prices roughly two out of every three months, on average, over the

[14] We discuss the events that comprise our net UCI in Section 6.2.

[15] Most textual-data studies do not consider the structural stability of the regressions that underpin the results of their tests of predictive power. However, the problem of structural change is well known in the news-impact literature, which finds that the quantitative impact of news about overall economic activity depends on the business cycle. See Pearce and Roley (1985), McQueen and Roley (1993), Fair (2002), Boyd *et al*. (2005), and Andersen *et al.* (2007).

Table 1: The Predictive Power of Historical Events

Full Sample: 1993:01–2009:12	
Forecast Horizon[a]	Net UCI[b]
1	65.7*
3	49.7
6	51.1
12	52.7

Notes: *a* : Forecast horizon in months; *b* : percentage of months in the full sample for which the net UCI index and the direction of change of the Standard and Poor's (S&P) 500 price index are the same sign, * denotes statistical significance at the 1% level based on a standard binomial distribution.

entire sample.[16] With a sample of 178 months, we can reject the null hypothesis of no predictive power at the 1% significance level.[17]

Beyond this result, the process by which *Bloomberg News* market wraps are produced creates confidence that they contain valuable information for understanding stock markets. The crucial feature of this process is that *Bloomberg* journalists monitor developments in the US stock market throughout each trading day. As earnings announcements are made or policy decisions become known, they and everyone else can see the market react. *Bloomberg*'s journalists report these developments as they occur. Their intraday reports thus provide direct observation of the major pieces of news and market movements, rather than *ex post* rationalizations. Moreover, these reports regularly draw on interviews with hedge- and equity-fund managers and other professional participants. The market wraps summarize the intraday reports.[18]

Bloomberg's market wraps thus provide a uniquely rich source of information about market participants' decision-making and the key factors that they consider

[16] There were some months for which the net UCI was zero. Because these observations provide no forecast concerning the direction of change of the future stock price, we omitted them from our measures.

[17] We are using the binomial distribution.

[18] The market wraps provide a rather extensive summary of a day's developments and are thus generally much longer than reports from other news sources. The wraps in our sample averaged 1,122 words, whereas a sample of recent *Associated Press* reports averaged 120 words.

relevant in driving stock-price movements.[19] Indeed, the demand for *Bloomberg* reports suggests that market participants themselves consider them relevant, if not indispensable, for understanding such movements.[20]

4.2 The Factors Behind Price Movements

Mangee (2011) finds that 115 factors were mentioned as driving market movements on at least one day in the sample. We categorize these factors into three major groupings: fundamental, psychological, and technical factors, respectively.

Table A1 in the Data Appendix groups 85 fundamental factors into 16 broad categories. For example, the "macroeconomic activity" category includes 17 factors that are typically interpreted as measures of overall economic activity. Our empirical analysis in the next section focuses largely on these broader categories. Table A2 lists the psychological factors reported by *Bloomberg News.* Table A3 groups technical factors into two categories: those that involve some type of momentum or bandwagon behavior and those that are unrelated to such behavior.

5 Fundamentals and Psychology in Stock-Price Movements

Mangee's data set enables us to assess the empirical relevance of the REH and NREH present-value models' qualitative predictions at a point in time. In this section, we examine qualitative predictions concerning the impact of news about fundamental factors or psychological considerations on daily stock-price movements. Mangee's data set enables us to do so regardless of the particular specification of a model in either class. Thus, like Shiller (1981), who tested the quantitative

[19] As far as we know, Mangee (2011) is the first study to construct a numerical data set based on *Bloomberg News* market wraps. Other textual sources that have been used in the literature include *Dow Jones* newswire feeds (Tetlock *et al.*, 2008; Li, 2010; Cornell, 2013; and Boudoukh *et al.*, 2013), *Wall Street Journal* columns (Tetlock, 2007, and Sullivan, 2013), *Yahoo! Finance* message boards (Antweiler and Frank, 2005 and Das and Chen, 2007), and corporate earnings releases (Davis *et al.*, 2006; Engelberg, 2008 and Demers and Vega, 2010).

[20] *Bloomberg* L.P. is one of the largest financial news firms as measured by market share of financial professionals. Its subsidiary, *Bloomberg News*, is a major newswire service for more than 315,000 clients in 174 countries, including 450 newspaper and magazine outlets.

predictions of an entire class of REH models, we examine qualitative predictions of the entire classes of both REH and NREH models.

Both REH and NREH impose consistency in the model, thereby implying that market participants' forecasting strategies depend on fundamental factors. In Section 2, we pointed out that the Knightian uncertainty term, ku_t, in the NREH present-value model in Equation (1) does not affect the model's qualitative predictions. As this term is equal to zero for all t in standard REH models, both REH and NREH versions of the model in Equation (1) imply that news about the fundamental factors, v_t, influences stock prices at every point in time.

One gauge of the relevance of a factor in moving stock prices is the proportion of trading days in the sample on which this factor was reported as having done so. Column 2 in Table 2 reports these frequencies for the three major groups and broad categories of fundamental factors.

A frequency of 99.4% for the group of fundamental factors indicates that at least one of these factors was considered relevant on virtually every trading day in the 17-year sample. This evidence is strongly supportive of both REH and NREH models' implication that fundamentals are a driver of stock prices.

However, Mangee's data set provides evidence that psychological and other non-fundamental factors also underpin stock-price movements. As Table 2 shows, although psychological considerations were reported to underpin stock-price movements considerably less frequently than fundamental factors, they were mentioned on roughly half of the trading days in the sample as underpinning the market's forecasting. REH models' implication that psychological factors play no role in how market participants forecast outcomes is inconsistent with this finding.

The evidence in Table 2 also upends the raison d'être of behavioral-finance models, which assume that asset prices are driven by psychological and other considerations that are largely unrelated to fundamental factors.[21] Contrary to this claim, we find that nearly all of *Bloomberg*'s mentions of psychological factors (98.5% to be exact) were explicitly related to how market participants interpreted news about fundamental factors.[22]

[21] For an overview of behavioral-finance models, see Shleifer (2000).

[22] See Data Appendix C for examples of such reporting.

Table 2: Factors that Moved the Market

Factor Categories[a]	% Trading Days[b]	% Positive Impact[c]
Fundamentals	99.4	-
Dividends	42.7	99.5
Macroeconomic activity	35.4	69.2
Company variables	23.1	-
Sales	23.2	91.3
Oil	20.2	45.4
Interest rates	17.3	1.9
Rest of world	14.2	-
Benchmark valuation	12.4	5.7
Government	11.7	-
Central Bank	9.6	-
Housing	8.2	-
Inflation	7.5	1.8
Currency markets	6.1	66.2
Financial institutions	6.3	-
Geopolitical issues	2.2	-
Trade	1.4	-
Psychological	55.4	-
Psychology w/ fundamentals	54.6	-
Pure psychology	1.1	-
Technical	6.3	-
Momentum	1.9	-
Non-momentum	4.9	-

Notes: *a* : Each category includes factors that *Bloomberg News* reported in at least one market wrap moved daily stock prices. For category definitions, see Tables A1-A3. *b* : Each figure is the percentage of all trading days in the sample on which *Bloomberg News* reported that the factor moved stock prices. *c* : The percentage of all mentions from *Bloomberg* market wraps for which the qualitative impact of a factor was reported as positive.

Table 2 shows that technical factors played a small role in underpinning daily price movements. These factors were mentioned as a driver of the market on

only 6.3% of the trading days in the sample. There is also little evidence for the momentum trading emphasized by behavioral bubble models. Such trading was mentioned as driving the market on only 1.9% of all trading days in the sample.[23] Most of *Bloomberg*'s mentions of technical factors involved the January effect and other such non-momentum considerations.

Mangee's data is inconsistent with REH and behavioral-finance models' sharply different implications that either fundamental factors or behavioral considerations, respectively, underpin asset-price movements. This dualism is an artifact of the flawed premise underpinning both of these approaches: an *ex ante* overarching probability distribution can represent outcomes over an indefinite future (Frydman and Goldberg, 2011).

An NREH model jettisons this premise, which enables it to recognize that there are many rational ways to forecast dividends and the discount rate. A rational market participant, therefore, cannot rely solely on statistical analysis or other calculations to ascertain which forecasting strategy he should use. Ultimately, he is guided by the confidence that he has in choosing one strategy over others, as well as his intuition and emotions in deciding when and how to revise it. As we discuss in Section 7, we would also expect psychological factors to play a key role in how market participants assess the riskiness of holding open positions in the market.

Choosing a forecasting strategy entails selecting which fundamental factors are relevant and determining how to interpret the impact of news about them on future outcomes. Consequently, whenever market participants rely on psychological factors in driving their forecasting, they relate them to their understanding of the influence of news about fundamental factors. This connection is exactly what we find in *Bloomberg* market wraps. This evidence—that both psychological and fundamental factors underpin stock-price movements—is consistent with the NREH present-value model's qualitative predictions.

[23] There is evidence that momentum trading played a small role in the 1990s upswing in stock prices. But, this was not the case in the 2000s. For an empirical assessment of bubble models using Mangee's (2011) *Bloomberg* data, see Frydman and Goldberg (2011).

6 Unforeseeable Change and Knightian Uncertainty

Beyond providing evidence that a wide variety of fundamental factors underpin stock prices, Mangee's (2011) *Bloomberg* data contain direct evidence concerning how market participants interpret and forecast outcomes in terms of these factors. Although Mangee's data provide only qualitative evidence about such relationships, this evidence implies that the structure of the process underpinning dividends and interest rates, and thereby stock prices, often undergoes quantitative change.

These findings accord with econometric studies that also find structural change in the price process. But the central question for macroeconomics and finance theory is this: Could the structural change that these studies estimate on the basis of *ex post* data have been represented *ex ante* with a probabilistic rule?

Much hinges on the answer. As we discussed at the outset, the core premise of a vast majority of macroeconomics and finance models is that the answer is yes. However, a negative answer would not only undercut this core premise; it would also call for rethinking these models claim to be able to represent rational forecasting and how market outcomes actually unfold. In particular, it would support our argument that assuming away Knightian uncertainty lies at the root of Shiller's findings and other long-standing empirical puzzles.

6.1 Structural Change

Mangee's data set provides explicit evidence of quantitative structural change in equity markets. This evidence comes in part from reports of switches in the algebraic sign of the impact of news on stock prices.[24]

By far the most important among these factors are those in the macroeconomic activity category, which was mentioned as relevant on 35% of the trading days. We report in Section 7 that the market interpreted news on overall economic activity through both the dividend and discount rate channels, with positive and negative

[24] Evidence also comes from fluctuations in the proportion of days each month a fundamental factor was mentioned in a wrap report as driving stock prices. These fluctuations are suggestive not only of quantitative structural change, but that different fundamental factors were relevant for the market's forecasting during different subperiods in our sample. See Frydman *et al.* (2015) for a discussion of these findings.

impacts, respectively. Thus, whenever this news mattered positively (negatively) for stock prices, its impact through the dividend channel was greater (smaller) in *magnitude* than its impact through the discount-rate channel. Consequently, our finding (reported in Table 2) that good news about macroeconomic activity impacted stock prices positively on 69.2% of the days on which this news was mentioned and negatively on 30.8% of those days provides explicit evidence of *quantitative* structural change.

News-impact studies have uncovered a similar finding of structural change in the impact of macroeconomic news on stock prices, lending further support to the value of Mangee's evidence. These studies report that good news about macroeconomic activity impacted stock prices negatively during expansions and positively during contractions.[25] Table 2 shows that the impact of oil prices and currency-market factors also involved switches in sign over the period of the sample. These sign switches, as with those involving news about macroeconomic activity, provide explicit evidence of quantitative structural change in the process underlying stock prices.

6.2 Knightian Uncertainty

As any good forecaster of macroeconomic activity knows, shifts in the economic cycle are often triggered by events that, even in the best of cases, can be only dimly anticipated. We would therefore expect that the quantitative structural change documented by the news-impact studies and *Bloomberg News* market wraps would be all but impossible to foresee, even in probabilistic terms. Indeed, members of the NBER's Business Cycle Dating Committee often disagree on the timing of when a cycle begins or ends, even though they have access to *ex post* data.

To put it simply, structural change is often triggered by events that are not exact repetitions of similar events in the past. Thus, *ipso facto,* the quantitative effect of

[25] See Footnote 15 for references. Mangee (2014) also reports evidence from *Bloomberg News* that the qualitative impact of macroeconomic news is connected to the economic cycle. However, he finds that sign switches occur throughout his sample, indicating that the frequency of structural change is much greater and the connection to the business cycle much looser than reported by the news-impact studies.

these events on change in the economy's structure cannot be represented *ex ante* with a probabilistic rule.

The appointment of Paul Volcker to lead the U.S. Federal Reserve is just one of many examples. Few could have foreseen in 1978 that he would be appointed in 1979. In order to foresee fully the consequences of his appointment for the subsequent movement of stock prices, one would have had to come up with a precise estimate of the severity of the contractionary monetary policy that he ultimately implemented. One would also have had to estimate a model that related prices to the monetary-policy stance. The very fact that Volcker's change in policy was unusual, and that its impact was context-dependent, implies that there was no past data that one could have used to estimate the precise impact of his appointment *ex ante*.

Studies that allow for such change use Hamilton's (1989) Markov switching model and constrain its transition probabilities to be fixed *ex ante*.[26] However, events such as the appointment of a new Fed chair or a new CEO engender unforeseeable structural change and thereby render any *ex ante* specifications of Markov switching models inconsistent with how outcomes will actually unfold. In fact, in an early study of currency markets, Kaminsky (1993) finds that the transition probabilities estimated on the basis of *ex post* data are not only time-varying, but depend on who is Fed chair and the credibility of the incumbent's policies.[27] This unforeseeable structural change cannot be specified *ex ante*. Consequently, she finds that Markov switching models are inconsistent with the actual turning points in the data.

Indeed, *Bloomberg News* reports that many of the factors that move stock prices involve events that are to some extent novel and whose impact is context-dependent. In Table 3, we list the categories of fundamental factors from Table A1 that involve such historical events, which include appointment of a new CEO, mergers and acquisitions, wars, election outcomes, and other geopolitical developments.

[26] For example, in the stock market see Driffill and Sola (1998) and Gutiérrez and Vázquez (2004).

[27] For evidence that structural change in models of stock returns are related to historical events that are to some extent novel, see Pettenuzzo and Timmermann (2011) and Ang and Timmermann (2012).

Table 3: Historical Events that Moved the Market

Mergers and acquisitions (435)	Fed comments/Fed minutes/ other Fed communication (369)
Legal or Accounting Issues (286)	
Leverage/credit issues (159)	Communication by government officials (151)
Armed conflicts (143)	
Bailouts or nationalization of banks (90)	Business spending (63)
	Political conflict, instability, corruption (55)
Liquidity issues (59)	
Management Shake-ups (47)	Macroprudential policy (40)
Bankruptcy (45)	Purchases of large stake/ stock splits/share buybacks (38)
Fiscal policy/stimulus plan (40)	
Trade agreements (30)	Political elections (22)
Labor layoffs or strikes (25)	Financial reform (19)
Terrorism (21)	Natural disasters (11)
Initial Public Offerings (18)	Cabinet changes (3)
Healthcare policy (11)	Taxes or rules on CEO bonuses (1)
Tariff/quotas/subsidies (3)	Introduction of Euro (1)

Notes: The table lists the fundamental factors from Table A1 that involve historical events that are to some extent unique. Figures in parentheses denote the total absolute number of mentions for each factor.

We find that such events account for a substantial fraction (roughly 20%) of *Bloomberg*'s mentions of fundamental factors over the sample.[28]

7 The Present-Value Model's Two Channels

The empirical relevance of Knightian uncertainty and Shiller's remarkable excess-volatility finding imply that the REH present-value model's quantitative implications are grossly inconsistent with how stock prices actually unfold. Moreover,

[28] Liquidity issues largely involve central bank injections of liquidity into the banking system, which ease borrowing constraints. *Bloomberg* wrap reports indicate that these injections influence the market through the dividend or the discount rate channel.

the evidence that psychological considerations impact stock-price movements is inconsistent with the REH model.

Although the REH present-value model's quantitative predictions are rejected, the model shares with its NREH counterpart qualitative predictions concerning how news about fundamental factors moves stock prices at each point in time. First, this news impacts prices through two channels: the market's forecast of dividends and its forecast of the discount rate. Second, *ceteris paribus*, as the market raises (lowers) its forecast of dividends, or lowers (raises) its forecast of the discount rate, it bids up (down) stock prices. Mangee's (2011) *Bloomberg* data set provide much support for these predictions.

7.1 The Dividend Channel

Bloomberg's market wraps explicitly mention three broad categories of factors most often as influencing the market's forecast of dividends. The most frequently mentioned factors are in the dividend category, which includes mentions of firms' dividend and earnings announcements, as well as earnings forecasts by firms and analysts. The other two sets of factors fall within the company variables and sales categories. The former includes a variety of factors—such as CEO and CFO changes, IPOs, and mergers and acquisitions—that impact companies' future earnings and thus dividends. The sales category includes firm or industry revenues. Table 2 reports the proportion of trading days in the sample that factors in these and other categories were mentioned in a market wrap as having driven stock prices on a given day. Many of these mentions were explicitly related to the dividend channel.

Reports that earnings forecasts moved stock prices are *ipso facto* explicit mentions of the market's forecasting of dividends. Moreover, *Bloomberg*'s wraps often report the impact of news about factors in the dividend category in terms of the market's forecast of these factors. As such, these reports also are explicit mentions of the dividend channel. We find that 75% of the news concerning the dividend category involved earnings forecasts or was related to the market's forecasting of factors in this category.

Bloomberg's wraps also frequently mention the dividend channel explicitly in their reporting of other news, particularly about factors in the company variables

and sales categories. In Table 4, we report the share of trading days in the sample for which any piece of news was explicitly mentioned as underpinning stock-price movements through the dividend channel. We find that this channel was explicitly mentioned on 46.1% of all trading days in the sample.[29]

Table 4: Mentions of Dividend and Interest Rate Forecasts

	Explicit Mentions	Implied Mentions	Total
Dividend channel	46.1	20.7	61.9
Interest rate channel	25.8	17.8	38.6
Either channel	63.2	70.5	95.0

Notes: All figures represent the percentage of total trading days on which *Bloomberg News* implicitly or explicitly mentioned in the wrap reports dividend forecasts, interest rate forecasts, or either of the present value model's two channels.

The evidence of explicit mentions of the dividend channel suggests that news concerning the dividend, company variables, and sales categories is particularly relevant for forecasting dividends. Indeed, we would expect that most such forecasts would rely on this news.

We thus consider mentions of factors in these three categories that *Bloomberg News* does not explicitly relate to the market's forecasting of dividends or earnings as implied mentions of the dividend channel. Table 4 reports that implied mentions of the dividend channel occurred on 20.7% of all trading days in the sample. When we consider explicit and implied mentions together, we find that the dividend channel was mentioned at least once as underpinning stock-price movements on 61.9% of all trading days.

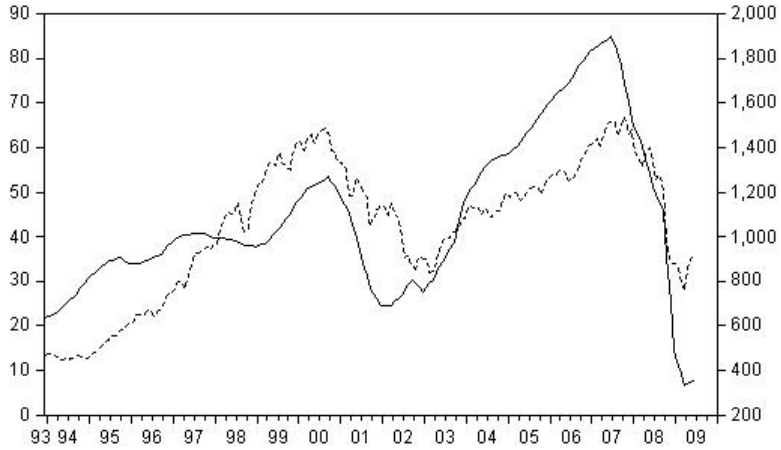
Table 2 provides corroborating evidence of the importance of the dividend channel. It shows that the most important fundamental drivers of stock prices were factors in the dividend, company variables, and sales categories; these factors, along with those concerning macroeconomic activity, were mentioned, respectively, on

[29] The proportions of explicit mentions of the dividend channel involving news about the dividend category and news about the other categories are 30.3% and 21.8%, respectively. The sum of these figures is larger than the 46.1% reported in Table 4 because on some days, factors in more than one category were mentioned.

43%, 23%, 23%, and 35% of the trading days in the sample. These are the factors that we would expect would be the most relevant for the market in forecasting earnings and dividends.

Time-series data on stock prices and earnings lend support to *Bloomberg*'s reporting on the importance of the dividend channel. In Figure 1, we provide simple time plots of the S&P 500 price index and underlying earnings over Mangee's (2011) sample period.

Figure 1: The S&P500 Price Index and Company Earnings



Notes: The figure plots the monthly S&P500 Price Index (dotted line) and a monthly index of company earnings (solid line). Data are from Robert Shiller's website: http://www.econ.yale.edu/∼shiller/.

The strikingly close co-movement of the two series clearly suggests the importance of the dividend channel in underpinning price movements. The fact that Mangee's data also show the importance of the dividend channel in actually driving stock prices provides another indication that *Bloomberg News*' wraps provide *bona fide* evidence concerning the process underpinning these prices.

7.2 The Discount-Rate Channel

In general, the market's forecast of the discount rate consists of its forecast of interest rates and a risk premium. But, although interest-rate movements are observable, those affecting the market's risk premium are not. Not surprisingly, *Bloomberg*'s mentions of the discount-rate channel consist entirely of news that is directly related to the market's forecasting of interest rates. We argue in Section 7.5 that, although the wraps do not explicitly mention the market's risk premium, they contain indirect evidence concerning key factors that underpin it.

Here we analyze Mangee's evidence of explicit mentions of the discount-rate channel, which pertain to the market's forecast of interest rates. Many of these mentions involve news about interest rates themselves, including news about short-term and long-term domestic rates. As with the dividend category, *Bloomberg*'s reporting often relates the impact of interest-rate movements to the market's forecast of these movements. This applies to 27.1% of its interest-rate mentions.

Bloomberg News also frequently mentions the discount-rate channel explicitly when it reports the impact on stock prices—again via the market's forecasting of interest rates—of news about the inflation rate and central-bank communications. Consequently, we consider mentions of factors in all three categories—interest rates, inflation rates, and central-bank communications—that *Bloomberg News* does not explicitly relate to the market's forecasting of interest rates as implied mentions of the discount-rate channel.

We find that this channel was mentioned explicitly and implicitly as underpinning stock-price movements on 25.8% and 17.8% of all trading days in the sample, respectively (see Table 4). When we consider explicit and implied mentions together, this channel was mentioned as driving stock-price movements at least once on 38.6% of all trading days.

7.3 Mentions of Either Channel

Table 4 reports the share of trading days for which news was explicitly reported to have influenced stock prices through either the dividend or the discount-rate channel. We find that at least one of these two channels was explicitly mentioned on roughly two-thirds (63.2%) of all trading days.

We reported that *Bloomberg News* explicitly mentioned news concerning macroeconomic factors as influencing stock prices through both the dividend and discount-rate channels. We thus include in our measure of implied mentions of either channel news about macroeconomic activity that *Bloomberg* did not explicitly relate to the market's forecasting of dividends or interest rates.

When explicit and implied mentions of both channels are considered together, we find that *Bloomberg*'s market wraps reported that news about fundamental factors influenced stock prices through either the market's forecast of dividends or interest rates on nearly every trading day (95%) in the sample.

7.4 Model-Consistent Impacts

Beyond providing supportive evidence that news about fundamental factors influences stock prices through the present-value model's two channels, the news constituting *Bloomberg*'s market wraps is remarkably consistent with the model's predictions concerning the direction of these impacts.

Bloomberg's market wraps contain information about how changes in a fundamental factor affected daily stock-price movements. For example, a fall in interest rates may have impacted stock prices negatively, or market participants revised their forecasts of future company earnings, and subsequently bid up stock prices, following an announcement that GDP grew at a higher-than-expected rate. For such usual fundamental factors, the last column in Table 2 provides the proportion of mentions in the sample involving a positive (and thus negative) impact on stock prices.

However, several of the categories in Table 2 include factors that are non-quantitative, heterogeneous, and to some extent unique; for example, Federal Reserve communications and new trade policies. News about these factors provides no way to measure their own direction of change. As a result, tracking whether stock prices rise or fall as news becomes available cannot provide evidence concerning the qualitative relationships underpinning stock prices. For these categories, we therefore use a "-".

According to the present-value model, news that the market interprets as influencing future dividends (interest rates) leads it to bid stock prices in the same (opposite) direction. Table 2 provides evidence for these qualitative predictions.

For example, the 99.5% figure for the dividend category reveals that these factors mattered positively virtually every time they were mentioned in a wrap as driving the market. The 1.9% figure for the interest-rate category shows that these factors mattered negatively nearly every time they were mentioned. This evidence is highly supportive of the present-value model's qualitative predictions.

Table 2 shows that factors in the inflation category also mattered negatively for stock prices nearly every time they were mentioned. This finding may appear inconsistent with the present-value model, given that a change in the expected inflation rate, *ceteris paribus*, implies that real interest rates move in the opposite direction. However, *Bloomberg* reporting reveals that the market understands inflation news largely through its impact on nominal interest rates: market participants explicitly relate 89% of inflation mentions to their forecasting of nominal rates.

The high proportion of factors in the company sales category that had a positive impact (91.3%) is also consistent with the present-value model's predictions. We would expect, for example, that the market would interpret expanding company or industry sales largely as positive news for future dividends. Indeed, *Bloomberg News* often mentions the dividend channel in reporting this news.

We saw in Section 6.2 that 69.2% (30.8%) of mentions of macroeconomic activity had a positive (negative) impact on prices. Consistent with the present-value model, Mangee's (2011) data set reveals frequent mentions of the dividend (discount-rate) channel when macroeconomic activity was reported as affecting prices positively (negatively).

7.5 An NREH Model of Uncertainty Premium

Bloomberg's reporting does not contain explicit mentions of news affecting stock prices through its influence on the market's risk premium. Standard REH models rely on expected utility theory to relate this premium to the *ex ante* variance of returns or the *ex ante* covariance of returns and consumption. *Bloomberg*'s market wraps contain no mentions of either measure of variation underpinning stock prices.

A Premium for Knightian Uncertainty

However, the wraps contain evidence that is consistent with an alternative NREH model of the market's premium. The model relies on endogenous prospect theory to model preferences under Knightian uncertainty and uses NREH to represent the market's forecasts.[30] According to endogenous prospect theory, participants hold open positions in the market only if they expect to earn a positive return—a premium—to compensate them for their extra sensitivity to potential losses. Frydman and Goldberg (2007) refer to this compensation as an "uncertainty premium," echoing Knight's (1921) distinction between "true" uncertainty and risk.

In the aggregate, the market's uncertainty premium, up_t, depends on the bulls' premium relative to the bears' premium:[31]

$$up_t = up_t^{\mathrm{L}} - up_t^{\mathrm{S}} \tag{6}$$

where the superscripts "L" and "S" denote the premiums of the bulls and bears, who hold long and short positions, respectively.[32] Each group's premium depends on participants' forecasts of the potential losses from holding long or short positions. Frydman and Goldberg (2007) build on Keynes (1936) and represent these forecasts in terms of the departure of the asset price from participants' assessments of the historical benchmark value:

$$up_t^i = \gamma_{0t}^i + \gamma_{1t}^i gap_t \tag{7}$$

where gap_t denotes the gap between the stock price and its historical benchmark value, and γ_{1t}^i and γ_{0t}^i, i =L,S, represent the influence of the gap on bulls' or bears'

[30] Endogenous prospect theory builds on Kahneman and Tversky's (1979) prospect theory (Frydman and Goldberg, 2007). It enables economists to model the "limits to arbitrage" solely on the basis of prospect theory.

[31] The market's uncertainty premium is defined as a forecast of the return to holding a long position in the market. It is equal to the bulls' premium relative to the bears' premium because a positive return on a long position implies a negative return on a short position. Consequently, a small uncertainty premium in the aggregate does not imply that bulls and bears require a small premium to take open positions in the market. A small market premium would asrise if the group of bulls' and bears' premiums were large but comparable.

[32] The market's unceratinty premium can be thought of as an expected return on holding a long position in the market. But, it is a weighted average of the expectations of bulls and bears, where the bears' expectations of the return are of course negative.

uncertainty premium and all other factors that influence this premium, respectively. The t subscripts on these parameters recognize that the relationship underpinning the market's premium changes over time.

In the NREH model, bulls' and bears' forecasts of the potential losses from speculating respond differently to changes in the gap. For example, as stock prices become more overvalued or less undervalued relative to perceived benchmark values (that is, as gap_t increases), bulls raise and bears lower their forecasts of the potential losses, that is, $\gamma_{1t}^{L} > 0$ and $\gamma_{1t}^{L} < 0$ in every time period. Consequently, a rising (falling) gap_t leads bulls to raise (lower) the uncertainty premium they require to hold long positions, whereas bears respond in the opposite fashion. Although the qualitative impacts of changes in gap_t on bulls' and bears' uncertainty premiums are hypothesized to be time invariant, the model is open to unforeseeable changes in the exact magnitudes of these gap effects.[33]

The aggregate uncertainty premium can be expressed as follows:

$$up_t = \gamma_{0t} + \gamma_{1t} gap_t \tag{8}$$

where γ_{0t} could take on a positive or negative sign, and γ_{1t} represents the aggregate gap effect, which the model constrains *ex ante* to be positive in all time periods, because $\gamma_{1t}^{L} > 0$ and $\gamma_{1t}^{L} < 0$.

A Gap Effect in the Market's Premium

Bloomberg's wraps provide evidence that participants pay attention to the divergence of stock prices from historical valuation levels. The benchmark valuation category in Table A1 includes all mentions of stocks' current valuation influencing stock-price movements.[34]

Table 2 reports that this gap category was mentioned as underpinning a day's stock-price movement on 12.4% of all trading days in the sample. It also shows

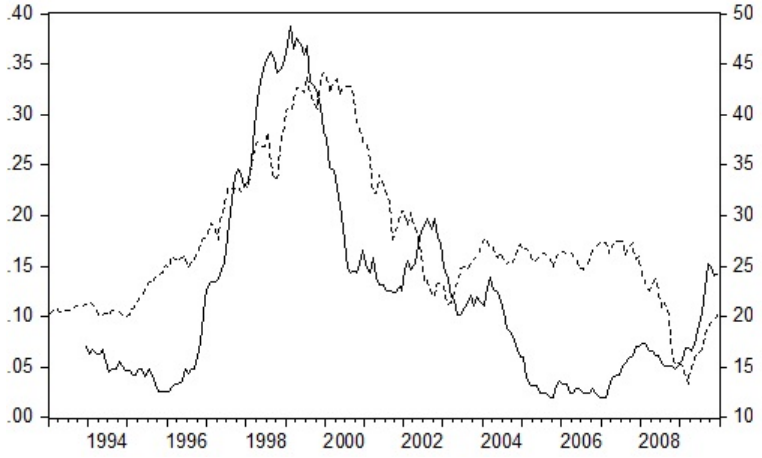
[33] The relevance of Knightian uncertainty implies that a market participant's uncertainty premium also depends on the confidence that he has in his choice of forecasting strategy. For example, a rise in confidence-related psychological factors leads him to lower his required uncertainty premium. Mangee's (2011) evidence on the connection between psychological factors and market participants' forecasting of fundamental factors is suggestive of a role for confidence in underpinning the market's forecast of potential losses and thus its uncertainty premium.

[34] See Data Appendix C for an example of such a mention.

that this factor affected stock prices negatively on 94.3% of all days on which it was mentioned as relevant. This finding is consistent with the NREH model in Equation (8), which implies that a higher gap leads the market to raise its uncertainty premium, and therefore its discount rate.

We would expect that the gap effect would grow with the magnitude of the gap. Figure 2 provides some support for this prediction, by plotting the S&P 500 price-earnings (PE) ratio against a 12-month moving average of the proportion of days in each month that this factor was mentioned as underpinning a day's stock-price movements.[35]

Figure 2: The S&P500 PE Ratio and Benchmark Valuation



Notes: The figure plots the monthly S&P500 Price-to-Earnings ratio (dotted line) and the monthly frequency with which *Bloomberg News* mentions benchmark valuation factors as moving stock prices (solid line). Data on the PE ratio are from Robert Shiller's website: http://www.econ.yale.edu/∼shiller/.

The figure shows that prior to 1997, benchmark-valuation considerations played a minor role in the market; they were mentioned in *Bloomberg* 's wraps on roughly 6% or fewer of the trading days each month. However, this frequency began to rise

[35] The PE ratio in the figure follows Campbell and Shiller (2001) and uses a 10-year moving average for earnings.

sharply in 1997, reaching a high of 38% by the end of 1998. During this period, stock prices also rose sharply, implying that the market's increasing focus on valuation issues did not outweigh the impact of bullish trends in earnings and other fundamental factors. The evidence from *Bloomberg*'s reporting and the NREH model imply that the market's uncertainty premium was rising during this period.

As the PE ratio fell from historic highs during 2000–2002, we would expect the market to focus less on valuation considerations. Figure 2 is consistent with this view, though the frequency of mentions of this factor began falling at the end of 1999, which was proximate, but before the sharp fall in stocks' PE ratio in early 2000.

Much of the large upswing in stock prices during the 2000s was not associated with a corresponding rise in stocks' PE ratio. However, at roughly 25, this ratio was historically high.[36]

Figure 2 shows that the frequency with which valuation considerations were mentioned began rising in 2007, some months prior to the sharp downswing in stocks' PE ratio. Interestingly, the sharpest increase in this frequency occurred after the collapse of Lehman Brothers in September 2008 and the subsequent sharp fall in stock prices. *Bloomberg*'s market wraps reveal that the market considered a PE ratio of 18 or below a negative gap and reason to begin buying stocks in 2009.

The evidence in Figure 2 is consistent with the NREH model sketched in this section: upswings in stocks' PE ratio are associated with upswings in *Bloomberg*'s mentions of the gap as driving market participants' forecasting, and thus, presumably upswings in its uncertainty premium.[37]

This evidence undercuts REH proponents' interpretation of Shiller's (1981) and others' findings that a countercyclical risk premium caused the volatility tests to miss the variation in stocks' fundamental value.

[36] Using monthly data from January 1881 through August 2014, the historical average PE ratio is 16.6. If we focus on the period beginning in January 1980, the average PE ratio is 21.3.

[37] We have also examined Mangee's data concerning the connection between the market's confidence in how it forecasts outcomes and its uncertainty premium. We found that an index of such confidence tends to rise during price upswings. According to the NREH model, such fluctuations should lead to an upswing in the market's uncertainty premium.

8 Concluding Remarks: Why the REH Present-Value Model Failed Empirically

The evidence that the process underpinning stock prices undergoes unforeseeable structural change leads us to a novel explanation of the REH present-value model's empirical failure: there is no overarching probability distribution that could characterize this process. Rational, profit-seeking participants cannot afford to ignore unforeseeable change and the Knightian uncertainty that it engenders. Consequently, they revise their forecasting strategies at times and in ways that no one could specify in advance with a probabilistic rule. These revisions render *any* REH present-value model's account of stock-price movements inconsistent with time-series data, as Shiller and many others have found.

Acknowledgements: The authors are indebted to the Institute for New Economic Thinking (INET) for supporting this research. We are also grateful to Dennis Snower for encouraging us to refocus an earlier draft of the paper on the central issue of Knightian uncertainty. We thank two anonymous referees and Romar Correa for their useful comments and suggestions. Both the refocusing and refereeing process have improved the paper considerably. The authors also thank Matt Winkler and *Bloomberg News* for providing access to the company's entire historical record of market wrap reports.

Data Appendix

This appendix consists of three sections. We first report the set of rules Mangee (2011) uses in extracting relevant information contained in *Bloomberg* market wraps and converting this information into numerical data. We then list the complete set of factors that underpinned stock prices during his sample. Finally, we consider several of *Bloomberg News's* market wraps to illustrate how they report on the importance of fundamental, psychological, and technical factors and how Mangee scores these wraps. In doing so, we provide examples of explicit and implied mentions of the dividend and discount-rate channels.

A. Rule-Based Reading

In what follows, we denote by Z a fundamental, psychological, or technical factor and by P either the Dow Jones Industrial, Standard and Poors 500, or NASDAQ price index.

Recording the Relevance of Z

Mangee records a 1 for Z and 0 otherwise on a given day if:

1. Z is mentioned as underpinning the day's P movement;
2. a forecast of Z is mentioned as underpinning the day's P movement;
3. Z is mentioned as underpinning a single firm's stock price and this movement is in the same direction as the overall market;

It is often the case that one fundamental factor is mentioned as underpinning a day's P movement because it influenced the market's forecast of another fundamental factor. For these mentions, a 1 is recorded for both factors according to rules 1 and 2.

Recording the Qualitative Impact of Fundamentals

The qualitative relationship between Z and P is determined by the following criteria:

A "+" is recorded for a fundamental factor for any of the following five cases:

a. Z increases(decreases) and P increases(decreases);
b. Z increases by more than expected and P increases;
c. Z decreases by more than expected and P decreases;
d. Z increases but by less than expected and P decreases;
e. Z decreases but by less than expected and P increases.

A "−" is recorded for a fundamental factor for any of the following five cases

f. Z increases(decreases) and P decreases(increases);
h. Z increases by more than expected and P decreases;
i. Z decreases by more than expected and P increases;
j. Z increases but by less than expected and P increases;
k. Z decreases but by less than expected and P decreases.

B. The Factors that Moved the Market

Table A1: Fundamental Factors

Macroeconomic Activity	Company Variables
GDP growth	Bankruptcy
Index of leading economic indicators	CEO or CFO changes
Industrial production	Legal or accounting issues
Productivity	Firm added to index
Personal income	IPOs
Service sector activity	Business spending
Employment	Mergers and acquisitions
Unemployment rate	Book-to-bill ratio
Jobless claims	Labor layoff or strike
Retail sales national level	Purchase of large stake
Manufacturing activity	Stock split/Share buyback
Factory orders	
Durables output	Central Bank Communication
Nondurables output	Minutes
Construction spending	Comments by officials
Consumer spending	Macroprudential policy
Consumer confidence	
	Oil
Interest Rates	Crude oil prices
Federal Funds	
Discount	Financial Institutions
Treasury bill	Leverage or credit issues
Treasury note	Liquidity issues
Treasury bond	Credit card defaults
	Credit ratings
Inflation Rates	Capital funding
Producer Prices	
Consumer Prices	Currency Markets
Manufacturing Prices	Exchange rates
GDP Deflator	Introduction of Euro
Employment Cost	
	Sales
Dividends	Firm or industry revenues
Earnings announcements	Auto Sales
Earnings forecast announcements	
Dividend announcements	International Trade
	Trade agreements
Benchmark Valuation	Tariffs
Gap from benchmark levels	Quotas
Overvalued	Subsidies
Undervalued	Current account balance

Table A1: Continued

Housing	Government/Fiscal
Housing starts	Fiscal policy/stimulus plan
Home sales	Comments by officials
Foreclosures	Taxes or rules on CEO bonuses
Home prices	Credit worthiness
Real estate prices	Bailout or nationalization of banks
Commercial prices	Health care issues
Mortgage rates	Budget surplus or deficit
Geopolitical Issues	Political elections
Armed conflicts	Political conflicts, instability or corruption
Nuclear testing	Financial reform
Terrorism	Cabinet changes
Rest of World	
All of the above factors as they pertain to the rest of the world	

Notes: Each category includes fundamental factors that *Bloomberg News* reported in at least one market wrap moved daily stock prices. GDP, Gross Domestic Product; CEO, chief executive officer; CFO, chief financial officer; IPO, initial public offering. See Mangee (2011) for more detail on factor definitions.

Table A2: Psychological Factors

Optimism	Concern
Pessimism	Euphoria
Confidence	Crowd psychology
Sentiment	Exuberance
Greed	Worry
Fear	Panic

Notes: Psychological factors that *Bloomberg News* reported in at least one market wrap moved daily stock prices. See Mangee (2011) for more detail on factor definitions.

Table A3: Technical Factors

Non-momentum	Momentum
Profit taking	Market rally
Firm added to index	Market momentum
Holiday effect	Momentum traders
January effect	Bandwagon
End of month effect	Price-to-price loop
End of quarter effect	Moving average
Friday effect	Chartism
End of year effect	
Giving back effect	
Triple witching	
Monday effect	

Notes: Technical factors that *Bloomberg News* reported in at least one market wrap moved daily stock prices. See Mangee (2011) for more detail on factor definitions.

C. *Bloomberg News'* Reporting

We first provide examples of how *Bloomberg News* reports on the importance of fundamental factors and how Mangee scores them.

The Dividend Channel

Consider the following excerpt from a market wrap:

> "U.S. stocks rose as $35 billion in acquisitions and Merck & Co.'s better-than-forecast earnings carried the Standard & Poor's 500 Index and Dow Jones Industrial Average to the steepest gains in a week...GlobalSantaFe Corp., the second-biggest offshore oil and gas driller, climbed to a record after agreeing to be bought by larger rival Transocean Inc. Merck, the third-largest U.S. drugmaker, had its biggest advance since April and accounted for almost a third of the Dow average's rally. " [July 23, 2007]

The dividend channel is explicitly mentioned since the excerpt reports the impact of earnings relative to what the market expected. According to scoring rules 1, 3 and b, a "+1" would be scored for both earnings and company variables on the given day.

The next explicit mention of the dividend channel involves news concerning a factor other than those in the dividend category:

> "The U.S. stock market posted its first advance in four days after a rally in oil prices improved earnings prospects for fuel producers and better-than-expected profit at Oracle Corp. ignited shares of software makers." [June 27, 2007]

According to scoring rules 1 and 2, a +1 would be recorded for both oil prices and earnings on the given day.

The last excerpt we consider involves disappointing news about macroeconomic activity that, as we discussed in Section 7.1, is an implied mention of the dividend channel:

> "U.S. stocks fell, dragging the Standard & Poors 500 Index down from a nine-month high, after reports on job losses and service industries were worse than economists estimated...Benchmark indexes opened lower after data from ADP Employer Services showed companies cut 371,000 workers from payrolls in July, more than the average estimate of 350,000 in a Bloomberg survey of economists...Equities extended losses as the Institute for Supply Management's index of non-manufacturing businesses, which make up almost 90 percent of the economy, fell to 46.4 from 47 in June. " [August 5, 2009]

According to scoring rules 1, a and c, a "+1" would be recorded for macroeconomic activity on the given day.

The Discount-Rate Channel

The following excerpt explicitly mentions news about interest rates as impacting stock prices through how the market forecasts interest rates:

> "U.S. stocks rose for a fourth day after the Federal Reserve cut its benchmark interest rate more than forecast to help revive the economy." [November 6, 2002]

Scoring rules 1 and i imply a −1 for interest rates.

The next explicit mention involves news concerning a factor other than those in the interest rate category:

> "U.S. stocks failed to sustain early gains as evidence of a pickup in manufacturing and raw-material prices suggested the Federal Reserve won't stop raising interest rates any time soon...The Dow average and the S&P 500 retreated from early gains after the Institute for Supply Management said its factory index showed unexpected expansion in manufacturing in September. The two indexes rose as much as 0.4 percent before the report..."Today it's all about rates," said Todd Clark, director of trading at Nollenberger Capital Partners in San Francisco. "That was a much better-than-expected ISM manufacturing number. That clearly caught people off guard." " [October 3, 2005]

For this excerpt, Mangee records a " −1" for macroeconomic activity and inflation rates (rules 1, f and h) and "−1" for interest rates (rule 2).

The next excerpt involves interest rate news without explicitly mentioning expectations. As we discussed in Section 7.2, it is an implied mention of the discount-rate channel.

> "U.S. stocks suffered their worst slide in more than six weeks as bond yields surged. Coca- Cola Co. and bank shares led the decline. "It's no longer a continuing flow of good news," said John Niedenberger, who helps oversee $3.5 billion as a money manager with Advanced Investment Management in Pittsburgh. "Any time rates go up stock investors get nervous, because higher rates cause investors to value stocks lower." [August 8, 1997]

Scoring rules 1 and f imply a −1 for interest rates.

This last excerpt shows how *Bloomberg* News reports on the impact of benchmark valuation factors, which we argued in Section 7.5, provides indirect evidence of the relevance of a market uncertainty premium:

> "US stocks fell in a volatile session whipped by concern that rising share prices aren't justified by corporate earnings prospects... "There is a sense that this just can't keep going the way it has been, so we see big swings," said Larry Aasheim, money manager at Corestates Investment Advisors with $17 billion in assets. . . . "Valuations are teetering," he said. " [November 26, 1996]

Scoring rules 1 and f imply a −1 for benchmark valuation factors.

Psychological Factors

The last two excerpts in the preceding section show how *Bloomberg News* often reports on the importance of psychological factors: they relate these factors to how market participants interpret the impact of news concerning fundamental factors. In scoring these wraps, Mangee recorded a "1" for "nervous" on August 8, 1997 (scoring rule 1) a "1" for "concern" on November 26, 1996.

The next excerpt provides another example of such reporting:

> "U.S. stocks rose for a second day, after Federal Reserve Chairman Alan Greenspan fueled optimism for a growing economy and higher company profits." (July 23, 1997)

Scoring rule 1 implies a "1" for optimism.

The last excerpt we consider shows how *Bloomberg* reports on the importance of pure psychology factors (that is, which are not mentioned explicitly in connection with interpreting the influence of news about fundamental factors for stock prices):

> "U.S. stocks slid...'This is what happens when the contagion of fear spreads,' said Quincy Krosby, who helps manage about $380 billion as chief investment strategist at the Hartford in Hartford, Connecticut." [October 9th, 2008]

Scoring rule 1 implies a "1" for fear.

Technical Factors

The technical factors listed in Table A3 are grouped into two categories: those that behavioral models emphasize, which involve some type of momentum or bandwagon trading, and those that are unrelated to such trading. The following two excerpts illustrate how *Bloomberg News* reports on the importance of these two types of factors, respectively:

> "U.S. stocks rose as...some of the buying came from 'momentum' traders, who buy stocks that are going up in order to realize a quick gain. 'It's just money chasing stocks at this point, anticipating the market making a new high and then carrying forward on its own momentum,'said Joseph DeMarco, head of trading at HSBC Asset Management Americas Inc." [July 8, 1998]
>
> "U.S. stocks rose...[t]he so-called January effect was in evidence as communications equipment stocks, the worst-performing group in the major indexes last year, rose." [January 3, 2002]

Scoring rule 1 implies a "1" for both market momentum and momentum traders on July 8, 1998, whereas on January 3, 2002, it implies a "1" for the January effect.

References

Allen, Franklin, Stephen Morris, and Hyun Song Shin (2006), "Beauty Contests and Iterated Expectations in Asset Markets," *The Review of Financial Studies*, 19(3), 719–752.
http://rfs.oxfordjournals.org/content/19/3/719.abstract

Andersen, Torben G., Tim Bollerslev, Francis X. Diebold, and Clara Vega (2007), "Real-Time Price Discovery in Global Stock, Bond and Foreign Exchange Markets," CREATES Research Paper, No. 2007–20.

Ang, Andrew and Allan Timmermann (2012), "Regime Changes and Financial Markets," *Annual Review of Financial Economics*, 4(1), 313–337.
http://ideas.repec.org/a/anr/refeco/v4y2012p313-337.html

Antweiler, Werner and Murray Z. Frank (2005), "Is All That Talk Just Noise? The Information Content of Internet Stock Message Boards," *Journal of Finance*, 59(3), 1259–1294.
http://www.jstor.org/stable/3694736?seq=1

Barberis, Nicholas C. and Richard Thaler (2003), "A Survey of Behavioral Finance," in *Handbook of the Economics of Finance*, G. Constantinides, R. Stulz, M. Harris eds., North Holland, Amsterdam, 2003.

Boudoukh, Jacob, Ronen Feldman, Shimon Kogan, and Mathew Richardson (2013), "Which News Moves Stock Prices? A Textual Analysis," NBER Working Paper Series, No 18725, January.
http://ideas.repec.org/p/nbr/nberwo/18725.html

Boyd, John H., Jian Hu, and Ravi Jagannathan (2005), "The Stock Market's Reaction to Unemployment News: Why Bad News is Usually Good for Stocks," *Journal of Finance*, 60(2), 649–672.
http://www.jstor.org/stable/3694763?seq=1

Campbell, John Y., Andrew W. Lo, and A. Craig MacKinlay (1997), *The Econometrics of Financial Markets*, Princeton, NJ: Princeton University Press.

Campbell, John Y. and Robert J. Shiller (2001), "Valuation Ratios and the Long-run Stock Market Outlook: An Update," *Cowles Foundation Discussion Papers*, No. 1295, Yale University.
http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.2.8077

Campbell, John Y. and Robert J. Shiller (1988), "Stock Prices, Earnings, and Expected Dividends," *Journal of Finance*, 43(3), 661–676.
http://onlinelibrary.wiley.com/doi/10.1111/j.1540-6261.1988.tb04598.x/abstract

Cassidy, John (2010), "Interview with John Cochrane," New York:
http://www.newyorker.com/rational-irrationality/interview-with-john-cochrane.

Chen, Zengjing and Larry G. Epstein (2002), "Ambiguity, Risk, and Asset Payoffs in Continuous Time," *Econometrica*, 70, 1403–1443.

Cornell, Bradford (2013), "What Moves Stock Prices? Another Look," *Journal of Portfolio Management*, 39(3), 32–38.
http://www.iijournals.com/doi/abs/10.3905/jpm.2013.39.3.032

Das, Sanjiv and Mike Chen (2007), "Yahoo for Amazon: Opinion Extraction from Small Talk on the Web," *Management Science*, 53(9), 1375–88.
http://pubsonline.informs.org/doi/abs/10.1287/mnsc.1070.0704

Davis, Angela K., Jeremy M. Piger, and Lisa M. Sedor (2006), "Beyond the Numbers: An Analysis of Optimistic and Pessimistic Language in Earnings Press Releases," Working Papers 2006–005, Federal Reserve Bank of St. Louis.
http://ideas.repec.org/p/fip/fedlwp/2006-005.html

Demers, Elizabeth and Clara Vega (2010), "Soft Information in Earnings Announcements: News or Noise?" Working Paper, *INSEAD*.
http://www.insead.edu/facultyresearch/research/doc.cfm?did=44292

Driffill, John and Martin Sola (1998), "Intrinsic Bubbles and Regime-Switching," *Journal of Monetary Economics*, 42(2), 357–373.
https://ideas.repec.org/a/eee/moneco/v42y1998i2p357-373.html

Engelberg, Joseph (2008), "Costly Information Processing: Evidence from Earnings Announcements," AFA 2009 San Francisco Meetings Paper. Available at SSRN: http://ssrn.com/abstract=1107998.

Fair, Ray C. (2002), "Events that Shook the Market," *Journal of Business*, 75(4), 713–731.
http://ideas.repec.org/a/ucp/jnlbus/v75y2002i4p713-732.html

Fama (2014), "Two Pillars of Asset Pricing," *American Economic Review*, 104(6), 1467–1485.
http://tasmania.ethz.ch/images/4/45/Fama-Nobel-work2014.pdf

Frydman, Roman and Michael D. Goldberg (2015), "A New Rational Expectations Hypothesis: What Can Economists Really Know About the Future?" paper prepared for the Institute for New Economic Thinking 2015 Plenary conference, "Liberté, égalité, fragilité," April 8–11, 2015, Paris, France.

Frydman, Roman and Michael D. Goldberg (2011), *Beyond Mechanical Markets: Asset Price Swings, Risk and the Role of the State*, Princeton, NJ: Princeton University Press.

Frydman, Roman and Michael D. Goldberg (2007), *Imperfect Knowledge Economics: Exchange Rates and Risk*, Princeton, NJ: Princeton University Press.

Frydman, Roman, Michael D. Goldberg, and Nicholas Mangee (2015), "New Evidence for the Present-Value Model of Stock Prices: Why the REH Version Failed Empirically," Institute for New Economic Thinking Working Paper, No. 2, March.
http://ineteconomics.org/ideas-papers/research-papers/new-evidence-for-the-present-value-model-of-stock-prices-why-the-reh-version-failed-empirically

Gutiérrez, Maria José and Jesús Vázquez (2004), "Switching Equilibria: The Present Value Model for Stock Prices Revisited," *Journal of Economic Dynamics and Control*, 28, 2297–2325.
http://www.sciencedirect.com/science/article/pii/S0165188903002082

Hamilton, James D. (1994), *Time Series Analysis*, Princeton, NJ: Princeton University Press.

Hamilton, James D. (1989), "A New Approach to the Economic Analysis of Non-stationary Time Series and the Business Cycle," *Econometrica*, 57(2), 357–384.
http://ideas.repec.org/a/ecm/emetrp/v57y1989i2p357-84.html

Hansen, Lars Peter (2014), "Uncertainty Outside and Inside Economic Models," NBER Working Paper, No. 20394.
http://www.nber.org/papers/w20394

Hansen, Lars Peter and Thomas J. Sargent (2008), *Robustness*, NJ: Princeton University Press.

Kahneman, Daniel and Amos Tversky (1979), "Prospect Theory: An Analysis of Decision Under Risk," *Econometrica*, 47(2), 263-291.
http://www.princeton.edu/ kahneman/docs/Publications/prospect_theory.pdf

Kaminsky, Graciela (1993), "Is There a Peso Problem?: Evidence from the Dollar/Pound Exchange Rate, 1976-1987," *American Economic Review*, 83(3), 450–472.
http://www.jstor.org/stable/2117528?seq=1

Keynes, John M. (1936), *The General Theory of Employment, Interest and Money,* Harcourt, Brace and World.

Knight, Frank H. (1921), *Risk, Uncertainty and Profit,* Boston: Houghton Mifflin.

Li, Feng (2010), "Textual Analysis of Corporate Disclosures: A Survey of the Literature," *Journal of Accounting Literature*, 29, 143–165.
http://webuser.bus.umich.edu/feng/LI

Lucas, Robert E. Jr. (1995), "The Monetary Neutrality," The Nobel Lecture, Stockholm: The Nobel Foundation.

Lucas, Robert E. Jr. (2001), "Professional Memoir," mimeo: http://home.uchicago.edu.

Mangee, Nicholas (2014), "Stock Prices, the Business Cycle and Contingent Change: Evidence from *Bloomberg News* Market Wraps," *Economics Bulletin,* 34(4), 2165–2178.
http://ideas.repec.org/a/ebl/ecbull/eb-14-00791.html

Mangee, Nicholas (2011), "The Long Swings Puzzle in Equity Markets: Which Way Forward?," Ph.D. Dissertation, University of New Hampshire.

McQueen, Grant and V. Vance Roley (1993), "Stock Prices, News and Business Conditions," *The Review of Financial Studies*, 6(3), 683–707.
http://www.jstor.org/stable/2961983?seq=1

Muth, John F. (1961), "Rational Expectations and the Theory of Price Movements," *Econometrica*, 29(3), 315–35.
http://www.fep.up.pt/docentes/pcosme/S-E-1/se1_trab_0910/se1.pdf

Pearce, Douglas K. and V. Vance Roley (1985), "Stock Prices and Economic News," *Journal of Business*, 58(1), 49–67.
http://www.jstor.org/stable/2352909?seq=1

Pettenuzzo, Davide and Allan Timmermann (2011), "Predictability of Stock Returns and Asset Allocation under Structural Breaks," *Journal of Econometrics*, 164(1), 60–78.
http://ideas.repec.org/a/eee/econom/v164y2011i1p60-78.html

Sargent, Thomas J. (2005), "An Interview with Thomas J. Sargent," by Evans, George W. and Seppo Honkapohja, *Macroeconomic Dynamics*, 9, 561–583.

Shiller, Robert J. (1981), "Do Stock Prices Move Too much to Be Justified by Subsequent Changes in Dividends?," *American Economic Review*, 71, 421–436.
http://www.aeaweb.org/aer/top20/71.3.421-436.pdf

Shleifer, Andrei (2000), *Inefficient Markets*, Oxford: Oxford University Press.

Sullivan, Peter (2013), "What Drives Exchange Rates? Do Fundamentals Matter?," Working Paper.

Tetlock, Paul C. (2007), "Giving Content to Investor Sentiment: The Role of Media in the Stock Market," *Journal of Finance*, 62(3), 1139–1168.

Tetlock, Paul C., Maytal Saar-Tsechansky and Sofus Macskassy (2008), "More Than Words: Quantifying Language to Measure Firms' Fundamentals," *Journal of Finance*, 63(3), 1437–1467.
http://onlinelibrary.wiley.com/doi/10.1111/j.1540-6261.2008.01362.x/abstract

Tuckett, David, Paul Ormerod, Rickard Nyman and Robert Elliot Smith (2015), "Information and Economics: A New Way to Think About Expectations and to Improve Economic Prediction," paper presented at the Institute for New Economic Thinking 2015 Plenary conference, "Liberté, égalité, fragilité," April 8–11, 2015, Paris, France.