A Brief History of Financial Risk

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Abstract: Finance models typically reflect the prevailing understanding of the world today, but the asset prices they attempt to explain reflect the understanding at the time. We explore the evolution of thought relating to equity risk. In the early 20th century, equities were largely viewed as "speculations" that were not even an investment, or were viewed as a hedge against inflation. Once stocks were considered legitimate investments, they were mostly understood by imprecise metaphors about bonds. "Risk" meant the chances of losing money in the long run, similar to bond defaults. This conception of risk means that higher average returns *reduce* risk, instead of being compensation for risk, and leads to inconsistent evaluations of the same assets at different horizons. Performance was mostly long-run cumulative performance (like bond yields), and investors mostly did not focus on intermediate prices, lacking theories about such prices when they did. The idea of risk as standard deviation of single period returns was pioneered by Markowitz (1952), and not popular until the 1960s. The idea of risk as coming from correlation with consumption was absent until Lucas (1978). We argue for taking seriously the idea of "model discovery" when understanding equity prices.

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One of the most puzzling disconnects in finance is the question of knowledge advancement. It is easy to look back on the history of finance and see Nobel-prize winning insights that greatly advanced academics' understanding of financial markets.[1] But when authors write down a new model, they nearly always write it as being *static* with respect to the model's structure. The understanding of the world that they have just developed is assumed to be held by agents throughout the history of prices being studied. That is, they assume that they are the last to know, relative to everybody else in financial markets.[2] Genuine innovation in understanding is everywhere around us, but nowhere in the models we write.

We examine this question of static understanding, that people in the past understood the problem as we do today, for the perception of equity risk. Modern asset pricing models emphasize the risk of equities as arising from correlations with consumption growth (e.g. Cochrane 2009), while earlier versions like the CAPM considered the standard deviation of market returns as being the risk investors are concerned about. These risks cause investors to demand compensation via higher expected returns for equities. We ask a simple question – was this actually how investors thought about the problem?

One possible reason this hypothesis is not often explored is that it may seem that there is not even a clear way to test it. Showing the existence of certain types of knowledge in the distant past is hard enough. Showing the *absence* of knowledge is considerably harder. Most empirical tests of asset pricing models treat only past prices as the admissible data, with occasional tests of volume and trades. But these often provide relatively weak tests of models, because the same aggregate returns can be calibrated to a variety of different models (e.g. Lewellen et al. (2010))

Our paper proceeds from a simple premise – to understand what people *thought* in past periods, one should carefully examine what they *wrote* in past periods. A close reading of historical articles, and especially the assumptions underlying what they do and don't say, can fill

[1] To name but a few, portfolio theory in Markowitz (1952), dividend irrelevance in Miller and Modigliani (1961), the CAPM in Sharpe (1963), market efficiency tests in Fama (1965), the consumption CAPM in Lucas (1978), and others

[2] Even in models where learning occurs, it tends to be limited in scope. In parameter uncertainty, agents understand the structure of the model from the start, but only update slowly about the parameters that drive it (e.g. Collin-Dufresne, Johannes and Lochstoer (2016)). In model uncertainty, agents understand the structure of multiple models from the start, but are unsure which is the true one (e.g. Hansen and Sargent (2001), Hansen (2007)).

a role rather like well-designed survey (e.g. Chinco, Hartzmark and Sussman (2022)), revealing important information about investor beliefs that is otherwise difficult to obtain. We undertake a close reading of a large number of 20th century academic finance articles, practitioner books and newspapers to answer the question of how these participants thought about the risk of equities. Our results document a largely forgotten history of very alien and confused ideas about risk that persisted until at least the 1960s. This helps us to understand the evolution of how risk was perceived, and also illustrates how certain investors may still conceive of it today.

Our main finding, and our most surprising one, is that risk was not described or conceived of as being the standard deviation of single-period returns until Markowitz (1952). Part of the reason that this is not widely appreciated is that Markowitz himself did not understand this point. He asserts that when past authors referred to "risk", one can usually substitute in "variance" without loss of meaning, a claim that we show is totally unsupportable when we examine actual historical writings.[3] In the early 20th century, the prevailing attitude (as described in Smith (1924)) was that equities were just gambling and speculation, and not even an investment (unlike bonds). The assessment of their risk amounted to a categorical objection at the asset class level, like in Chamberlain (1911). The closest modern equivalent might be the attitude of many towards cryptocurrency today – highly uncertain, full of scams and frauds, and best avoided (e.g. Duchin et al, 2025). The main alternative was the Fisher (1912) view that the difference between stock and bond performance was mostly due to inflation. Under high inflation, stocks will outperform bonds, as bonds suffer lower real cash flows but dividends are mostly immune. Fisher himself was surprisingly ambivalent on the overall risk differences between stocks and bonds, saying in Fisher (1912) that there was not much to judge between them, just different types of risks. This came from a qualitative consideration of scenarios where one could lose money, and Fisher considered risk as purely subjective, without a clear sense of how it should be measured.

Some of the explanation behind this attitude is that there was not a general consensus that stocks outperformed bonds *at all*. The first empirical demonstration of the equity premium was in Smith (1924), albeit using highly imperfect performance measures, and with no

[3] Early understanding was limited further by the fact that there was not a concrete and agreed-upon definition of returns in the modern sense until the idea was formalized in Miller and Modigliani (1961). In our companion paper, Hartzmark and Solomon (2026), we consider in detail the related question of how investors perceived returns.

consideration of risk. The outperformance of equities was considered surprising, as (contra Fisher (1912)) stocks also beat bonds during deflationary periods. The results remained contentious with many claiming an equity premium was not real (Chamberlain and Hay (1931), Bosland (1937)).

Our second main finding is that once the consensus shifted towards a belief in the equity premium, much of the incomplete understanding of stocks stemmed from imperfect and loose analogies to bonds, which were a much older and more familiar asset class. Sometimes, like in Graham and Dodd (1934), this comparison was made explicit. But even when not stated directly, bond-like thinking encompassed several key aspects. First, risk was principally considered as the chances of losing money at a long horizon, analogous to bond default. Second, stock performance was considered only as long-run, cumulative performance, similar to a bond yield if held to maturity, and did not mean a distribution of single-period returns. Third, when intermediate risk was considered, it was the riskiness of intermediate dividends (which analogize to coupons). Finally, intermediate price changes tended to get ignored, and were the area where people displayed the least understanding of how they ought to work (because intermediate bond price changes mean revert in the absence of default, but stock price changes do not).

These aspects of mindset explain the complete absence of standard deviation of returns as a measure of risk before Markowitz (1952). The conception of performance as long-run, cumulative outcomes (like a bond yield) meant that these authors did not generally *see* single period outcomes, and so did not think in terms of their volatility. This is trivially true for papers like Smith (1924) and Fisher (1912) that tried to measure long-run equity outcomes, and only computed a single long horizon performance measure. But it is also true for papers that tried to construct indices of stock prices each year, none of which report or discuss standard deviations of returns (e.g. Jackson (1928a), Cowles (1938)). We are unable to locate a standard deviation of market returns that was published before Lintner (1965), which occurred in the context of the CAPM. As Miller (1960) notes, the contribution of Markowitz (1952) was still almost entirely theoretical in 1960, due to the difficulty of obtaining data before the CRSP tapes were produced. The lack of reported standard deviations of returns is not just because earlier authors were unfamiliar with standard deviations in general, or found them too burdensome to compute – both Jackson (1928a) and Cowles (1938) compute standard deviations in their paper for *other*

purposes, but not as applied to market returns. Jackson (1928a) refers briefly to common stocks swinging more wildly that preferred stocks, but makes no attempt to quantify this.

Instead, risk was mostly considered as the chance that the investment lost money at a long horizon. For instance, Graham and Dodd (1934) is widely described as pioneering value investing, but they maintained the same pre-Smith (1924) focus on "*investments*" versus "*speculations*", and differed mostly in arguing that not *all* stocks were speculations, nor all bonds investments. Analogies between stocks and bonds were an explicit basis for their argument. Their category of investments required a reasonable rate of return, as well as "*safety of principal*", meaning it *"holds every prospect of being worth the price paid except under quite unlikely contingencies*". This description of risk as probability of loss is very hard to interpret *except* as applying to long term outcomes, otherwise there would be no stocks that one could realistically say would only decline in price (or value) in "*quite unlikely contingencies*". As Hayes (1950) noted, Graham and Dodd (1934) were quite vague on what being "*worth the price*" meant. Like long-horizon returns, "risk as probability of loss" lasted a long time. Fisher (1965) studies stock level risk, and computes the risk outcome as the probability of losing money for various random choices of stock and time horizon. He does not compute or discuss standard deviations anywhere.

The combination of "risk as probability of loss" and "focus on long horizon outcomes" sounds intuitively reasonable, but its early, loose formulations are difficult to reconcile with modern asset pricing. Probability of loss combines both mean returns and the standard deviation of returns. Because higher expected returns reduce the chances of losing money at long horizons, they are viewed as *making a stock safer*. Graham and Dodd (1934) make this argument for value stocks, the exact opposite of the Fama and French (1993) view that the high returns are compensation for risk. There is often not a clear sense of a risk/return tradeoff at all, and the asset with the higher expected return is often simply described as "better", like in Jackson (1928a) (comparing common versus preferred stocks) and Smith (1924) (comparing stocks versus bonds).

Second, under probability of loss, the riskiness of the same asset depends greatly on the horizon. The probability of loss declines as the horizon gets longer, as the mean effect dominates the variance effect for determining loss probability. This was observed by both Jackson (1928) and Fisher (1965), who viewed stocks as less risky at longer horizons than shorter horizons. This

perception of risk declining with horizon has a tendency to produce expected utility violations as in Samuelson (1963). He proved that it cannot be rational to take the same identical bet many times in a row if it is irrational to take it once. That is, if stock returns are i.i.d, an investor cannot rationally choose to hold stocks for a long horizon if the same stocks are deemed too risky to hold for a month or a year. Probability of loss was formalized in a much more coherent manner by Roy (1952) in terms of choosing optimal portfolios to minimize chances of loss. The results are quite similar to Markowitz (1952), but also rely on the standard deviation of price changes for their implementation, the very concept that had been missing before this in the literature.

Meanwhile, consistent with a bond mindset, another set of papers argued for the existence of a risk/reward tradeoff through the lens of the riskiness of cash flows. Fisher (1906) and Williams (1938) considered the idea of equity yields that compared price today with estimated cash flows, and argued that the lower price relative to expected cash flows reflected the higher expected return to cash flow risks. Fisher (1906) even speculated that standard deviation may at some point be a useful way to measure this. But since this applied to the (unobserved) distribution of possible future cash flow states, it was hard to apply. Fisher (1906) only gave a revealed preference perspective (turning a given price into discount for risk under certain assumptions about average cash flows), but did not say what the right discount was, or how risk should be measured. Future prices tended to be left out of the discussion altogether.

An analysis of risk-related terms used in New York Times and Wall Street Journal financial markets columns confirms the trends above. The rise of the term "Volatil*" mirrors the importance of Markowitz (1952). "Volatil*" was only the 12th most common risk word in 1915 (0.3% of all risk-related words), and still only the 10th most common risk word in 1951 (2% of risk words). But by 1971, it was the 3rd most common risk word, at 11% of risk words. A Wald test reveals a significant structural break in usage in 1962, in line with the history above.

Early descriptions of risk tended to be vague subjective descriptions like "Fluctaut*" (3rd in 1915, 21% of risk words) and "Uncertainty" (1st in 1915, 23% of risk words), or descriptions of pure psychology like "Panic" (4th in 1915, 19% of risk words). All of these declined in usage over the sample. Initially, they were more common even than the term "risk" itself, which was ranked only 5th in 1915 at 5% of risk words (though it ended the sample ranked 2nd). Concrete

descriptions of price movements only began to emerge in the 1950s and 60s, with "sell-off" being the highest ranked risk word in 1963, and "correction" being the second highest ranked in 1964. The term with the most staying power was "fear", ranked 2nd in 1915, and 1st in 2007.

Finally, the focus on risk as coming from the correlation of asset returns with consumption growth is even more modern. There is no discussion of this idea prior to the pioneering work of Lucas (1978). Meanwhile, the fact that the intertemporal CAPM of Merton (1973), which has many possible state variables an investor may care about in partial equilibrium, reduces to a single concern with consumption correlations when solved in general equilibrium, was not known until Breeden (1979). Earlier empirical work that considered how equity returns correlated with macroeconomic variables, such as Smith (1969), did not consider consumption growth as an important variable to evaluate. The first empirical consumption correlation was not published until Grossman and Shiller (1981).

Our paper has important implications for asset pricing theory. The history we document highlights a type of learning that is largely absent from current models, and might be characterized as *model discovery* – there is a point in time before which a model is not known, and after which it is. This could be viewed as a structural break where participants shift from one model to another, a gradual diffusion of understanding, or the introduction of uncertainty as to the correctness of the two models. Such a class of models seems to describe a type of learning that occurs in the real world, yet is almost totally unexplored in theoretical terms.[4] The "last to know" assumption is often treated as almost innocuous. We argue that this is wrong – not only is this assumption non-obvious, it is both *falsifiable*, and largely *falsified.* The publication of return anomalies is shown to affect those anomalies themselves in McLean and Pontiff (2016), indicating that the market *didn't* know about these findings until they were published. The "last to know" assumption, when stretched to its limit, becomes almost nonsensical – if every investor already knew what a Sharpe Ratio was, why did Sharpe (1964) win a Nobel Prize? Intuitively, papers that garner thousands of citations were less than fully obvious almost by definition.

[4] Such learning is consistent with the Kuhnian idea of scientific discovery (Kuhn and Hacking 1970). In high stakes real world settings, such learning is not uncommon. For example, historically professional football teams were far too hesitant to attempt fourth downs, and professional basketball players took far too few three point shots. After such alternative models were proposed with empirical evidence, the strategies for all teams shifted to the new model quite rapidly, even though such a strategy could have been implemented for decades prior.

Second, if investors view risk as being about the probability of losing money, then the horizon of evaluation becomes a first-order question. Models like the CAPM and portfolio theory were single-period, and agnostic as to what horizon they applied to. Horizon becomes more important in the intertemporal CAPM of Merton (1973), and the long-run risk model of Bansal and Yaron (2004), though decisions in such settings are explicitly time-consistent. The closest equivalent to our history is myopic loss aversion in Benartzi and Thaler (1995), where investors choose how often to evaluation stocks versus bonds to reduce the chances of observing a loss.

A close study of historical writing also presents a fertile area for finding *current* types of investor mistakes and confusion. The sources we examine represent highly intelligent and educated people who thought about finance a great deal, but who lacked a modern understanding of many concepts. Their writings reflect alternative conceptions that are half-understandings, plausible-but-wrong views, or frameworks that get some parts right but miss others. To the extent that these intuitions are appealing to people encountering a problem for the first time, it seems likely that they are still present today in some form, even if less prevalent. Our main example of such an idea – viewing risk as probability of loss – may help explain a number of otherwise puzzling findings. It may explain the appeal of structured products with capital guarantees to appeal to investors with such an understanding of risk, but which deliver extremely poor performance (e.g., Celerier and Vallee (2017)). Similarly, investors who hold a stock for the dividend income tend to view the income stream of the dividend like a series of bond coupons, and ignore intermediate price effects (e.g. Hartzmark and Solomon 2019). The application of other similar concepts, especially those arising from analogies between stocks and bonds, is another promising angle for future research into investor behavior.

1. Standard Deviation of Returns in Markowitz (1952), and the Absence of Earlier Knowledge

1.1 Variance of Returns is described in Markowitz (1952), But Less than Precisely

We begin with the simplest and most trivial claim to establish – almost tautologically, Markowitz (1952) uses the concept of variance of returns when computing mean-variance portfolio optimization:

"The return (R) on the portfolio as a whole is a weighted sum of random variables (where the investor can choose the weights). From our discussion of such weighted sums we see that the expected return E from the portfolio as a whole is

$$E = \sum_{i=1}^{N} X_i \mu_i$$

and the variance is

$$V = \sum_{i=1}^{N} \sum_{j=1}^{N} \sigma_{ij} X_i X$$

The rest of our paper is devoted to the much harder claim – showing that people did not know this idea earlier, and demonstrating how they thought about the problem instead. The first obstacle here is Markowitz (1952) himself, who explicitly *disclaims* it as a contribution to describe risk as the standard deviation of returns:

> *"The concepts 'yield' and 'risk' appear frequently in financial writings. Usually if the term 'yield' were replaced by 'expected yield' or 'expected return,' and 'risk' by 'variance of return,' little change of apparent meaning would result."*

We argue that Markowitz (1952) is wrong on this substantive claim. Rather, this is best interpreted as a manifestation of the curse of knowledge (Camerer, Loewenstein and Weber (1989)). That is, people who know something have genuine difficulty credibly putting themselves in the shoes of someone who does not know it. They will tend to assume that what they know ought to be able to be inferred by other people, when it often cannot. These ideas were obvious *to* Markowitz, but we will show at length that there were not at all obvious to earlier authors.

There are also several other background aspects to the Markowitz (1952) paper that reveal important aspects about the general level of understanding. First, while he claims that *"Variance is a well-known measure of dispersion about the expected [sic].",* he also spends considerable time defining terms that most readers today would take for granted: an expected value, a variance, a covariance, and how all these apply to weighted sums of random variables. Even if he thinks that people intuitively may have grasped something similar to variance (a notion we also dispute), the formalization of this as applied to portfolio means and standard deviations assumes a very low level of background familiarity with these concepts for the reader.

Second, as discussed in greater length in Hartzmark and Solomon (2026), at no point does Markowitz actually explain how a return is calculated. In the main analysis of the paper, they are simply defined as being a random variable

"*Let R_I be the return on the i^{th} security.*"

without giving a more detailed definition. The horizon of this variable, or how these numbers should be arrived at, is not discussed. Markowitz (1952) also describes the returns concept earlier in the context of alternative investment rules about capitalizing future returns:

> *"Let r_{it} be the anticipated return (however decided upon) at time t per dollar invested in security i"*

"However decided upon" is important, and presupposes different ways of calculating expected returns. Markowitz references Williams (1938), which (as we will discuss) only computes expected returns in terms of relating today's price and future cash flows, with future prices being largely left out of the analysis.

Finally, it bears emphasis that until the creation of the CRSP tapes, the analysis in Markowitz (1952) was almost wholly theoretical, and the level of understanding of the empirical properties of returns was very limited. This is described in Miller (1960), which was a book review of the longer treatment of portfolio theory in Markowitz (1959). Miller lamented the lack of progress that had been made since the original article on any actual practical applications:

> *"We do not know enough yet about the properties of the underlying data, about forecasting techniques and forecast errors, about real-world portfolio constraints, objectives, and practices, or about the processing and computing costs of the model itself, to be able to say how much, if anything, could be gained currently from using the apparatus."*

This provides important context for understanding the gap between Markowitz (1952), and when market standard deviation measures were actually published.

1.2 Absence of Understanding Before Markowitz (1952)

The principal challenge of the rest of the paper is threefold. First, to demonstrate that the description in Markowitz (1952) of risk as the standard deviation of single-period returns was in fact a novel and important intellectual contribution of the paper. We examine what theoretical

writers said about the nature of financial risk – whether they used ideas about standard deviation of returns, or ideas that could plausibly map to this idea (even if going by different terms). Second, to show that the actual operationalization of this in any empirical sense did not occur until the 1960s, and the absence of computed standard deviations of returns before that time.[5] Third, to understand what people *did* think about risk before this time, and what the problems were. We will provide considerable evidence not only on what people said about risk during earlier periods, but also the broad mindset that they held.

As a timeline, it is useful to summarize the main conceptual breakthroughs that needed to be overcome to arrive at this conception of risk as single-period standard deviations of returns. Investors needed to overcome their initial beliefs that stocks should not be considered an investment at all. Once this changed, investors attempted to understand stocks through imperfect analogies to bonds. This led to a focus on risk being considered as a long-term probability of losing money. Most focus on intermediate outcomes related to cash flows, not stock prices, and authors in this period generally lacked any theory of what intermediate price changes should do.

2. Early 20th Century Views: Stocks as Speculations, Stocks as Inflation Hedges

2.1 Low Background Level of Understanding Before Smith (1924)

To understand the puzzling attitudes taken towards equity risk in the early 20th century, it is important to understand the very limited amount of knowledge about equities in general and basic properties of their performance. We can actually say when the equity premium was discovered – in Smith (1924). Before this, it seems very likely that people were not generally aware that stocks beat bonds *at all*. That is, they were not just uncertain whether the higher returns to stocks were worth the risk, or how large the overall outperformance was. Rather, they were generally incorrect in their belief about the *sign* of the equity premium. This judgment is not just our own. Morrison (1949), writing a history of investment thought in the Journal Finance, devotes a chapter heading to Smith (1924) with the title "Smith Revolutionized Investment Thought". Even after Smith (1924), the equity premium remained contentious, with many arguing

[5] The A second, and more subtle contribution of Markowitz (1952) is that performance should be conceived of as a distribution of single-period returns at all. We describe this second finding in Hartzmark and Solomon (2026), and focus primarily here on the innovation on the risk dimension.

Smith's finding was mistaken or a fluke (e.g. Chamberlain and Hay 1931, Bosland 1937).[6] Performance was only compared in very approximate terms in Smith (1924), reflecting a common level of confusion on this topic - a long-horizon comparison of stock dividends with bond coupons, and stock price changes with bonds that were assumed to not default.

2.2. Stocks as Speculations

Smith (1924) is also useful for characterizing the prevailing viewpoints when he was writing. The two main prevailing views about risk before Smith (1924) were i) that stocks were not an investment, and instead were "speculations", or ii) that the return on stocks versus bonds was mostly about inflation, most associated with Fisher (1912). Smith (1924) summarizes these views, and considers the finding of an equity premium to be an unexpected refutation of both:

> *"When the topic of conservative investment is under discussion, high grade bonds hold an unassailable position in the minds of most people, and the discussion usually resolves itself into weighing the relative merits of different issues of such bonds or how far it is safe to stray away from the most highly secured bonds in an effort to obtain a higher income return. Those who venture to suggest preferred stocks sometimes feel that they have gone as far as conservative opinion will support them. Common stocks are ordinarily left out of the discussion altogether.*
>
> *'Common Stocks are, in general, regarded as a medium for Speculation-not for Long Term Investment. Bonds, on the other hand, are generally held to be the best medium for Long Term Investment-free from the hazards of Speculation.'*
>
> *Is this view sound? What are the facts?"*

One can find this view repeated in other early authors such as Chamberlain (1911):

> *"Common stocks as such, are not superior to bonds as long-term investments, because primarily they are not investments at all. They are speculations."*

This category of "speculations" tended to be viewed as a species of gambling, with the attendant social ills that this caused. Hardy (1937) describes a historical attitude that is vastly at odds with the idea of equity investment as a safe and responsible activity suitable for the average man:

[6] We discuss this aspect of performance measurement in considerable detail in Hartzmark and Solomon (2026)

"The American attitude toward public gambling is strongly colored by our inheritance from Puritan New England, and consequently stock exchanges have always had to contend with a type of criticism which is almost unknown in Continental Europe and relatively weak in England. Since the World War there has been some relaxation of standards in this regard. But I see no evidence that this liberalizing tendency has helped the stock exchange. Its alleged gambling character is still brought forward as a blanket indictment against the whole system of stock speculation in every Congressional hearing....

This attitude was reinforced in the early 20th century by the much larger number of frauds and scams that accompanied stock trading before the passage of the Securities and Exchange Act (1934). As Hardy (1937) describes, this included:

"[A]dmitted abuses such as manipulation, wash sales, trading against customers' orders, bucketing, and the dissemination of false news. Everyone agrees that these practices are against the social interest…"

The situation was especially bad on the less reputable New York Curb Exchange. Cowles (1938) justified why it excluded all quotes from this exchange, despite it making up 17% of volume, due to it having no guarantees that the prices quoted were actually genuine, or even necessarily that the securities themselves were genuine. Against this backdrop of general perceptions of fraud and scams, Hardy (1923) describes different ways to profit from financial transactions:

"- Purchase of securities with a view to obtaining income from interest or dividends.

- Purchase or sale of securities, land, contracts, or commodities, with a view to profit from price changes.

- Gambling transactions."

As noted in Hartzmark and Solomon (2026), the price change component and the interest/dividend component are viewed as *separate* ways to profit, rather than components in a single return measure. There is also a surprisingly large focus on the category of gambling transactions, and how much all trading on price changes is essentially the same thing. In Hardy (1923), the difference between gambling and speculation not risk-seeking and negative expected returns (as usually described today), but whether the trading relates to some inherent and unavoidable risk that already exists, or a risk that was created for the purposes of trading.

Importantly, the price change component is discussed nearly entirely as a zero sum component. Trading based on any expectation of price changes is described in ways that only make sense for active trading, rather than an expectation that stock prices might rise In general over time:

> *"Success in all these lines depends on ability to forecast price changes, which in turn depends upon ability to weigh the importance of complicated and conflicting indications of the movement of demand and supply, not with absolute accuracy, but with greater accuracy than someone else does it. All speculation on the price of anything is essentially a contest."*
>
> *"For this reason all speculative activity is often condemned by moralists as a species of gambling. Speculation is not a form of gambling; gambling is a form of speculation. All forms of speculation are attempts to secure profits, to get for the service of one's capital (or labor) more than they are worth; that is, more than they would be worth if the relevant facts were generally known and account taken of them"*

Indeed, by modern standards it is striking that when Hardy (1923) is discussing "Risk and the Management of Capital" (the paper's title), he gives considerably more space and discussion to the gambling transactions, and the extent to which speculation should be considered different, than the role of price changes in stocks themselves. He views the social utility of stock market transactions as coming from the useful social functions behind the transactions:

> *"The only thing which differentiates gambling from"" legitimate"" speculation (hereafter referred to for brevity's sake as speculation) is that in speculation the risks are inherent risks of industry, and must be borne by someone if production is to go on."*
> *"[M]ost of the arguments which have been advanced to show that gambling is socially harmful apply also to other forms of business just in so far as they make on''s income depend on luck in guessing the unknown. In varying degree, they apply to all forms of speculation and speculative business."*

In Hardy (1923, price changes are not discussed in any context *except* these zero-sum gambling transactions. This is especially important, because it occurs before Smith (1924) revelation that stock prices went up on average. Without this insight (which required significant data collection and analysis), the zero sum aspect of stock trading was extrapolated to mean that winning was as

likely as losing, and the whole enterprise was just about superior information. The risks of stock price changes were not viewed as something associated with higher expected returns, but as a reason to avoid trading in anticipation of price changes altogether:

> *"Except for the few who possess superior information concerning the probabilities of a favorable outcome, gambling enterprises involve a greater risk than is justified by the chance of profit"*

Indeed, the idea of stocks as gambling did not wholly end with Smith (1924), and, contra Hardy (1937), it was also not only an American attitude. For example, many modern economists would agree with the assertion from Keynes' (1936) that *"It is usually agreed that casinos should, in the public interest, be inaccessible and expensive."* Where they would differ is in thinking this is relevant to stock investments. But Keynes did not, claiming that "*And perhaps the same is true of stock exchanges."* It was in the context of this mindset that many people applied a blanket categorization of stocks as being risky forms of gambling that ought to simply be avoided.

2.3 Stocks as Hedge Against Inflation

The chief alternative to the categorical assessment of equities as "not an investment" in the early 20th century was the view that stock versus bond performance was mostly a function of inflation. Stocks were thought to be a valuable hedge against high inflation regimes due to their underlying cash flows. Thus, the main risks to be considered were inflationary regimes and the real cash flows of the underlying business. This viewpoint is most associated with Fisher (1912), which evaluated investment choices in periods of rising inflation. It argued that stocks were a superior investment versus bonds during such times. As Fisher (1912) describes in the introductory essay

> "*In a general way during the recent decade and a half of upward prices, it is the bondholder who has lost and the stockholder who has gained. This is clearly shown in several of the papers which constitute this book. We may say roughly that the rise in prices has subtly robbed the bondholder for the benefit of the stockholder."*

Like Fisher's analysis of risk in general (e.g. Fisher (1906), which we shall discuss below), this principally concerned the effect of inflation on the cashflows of stocks and bonds, rather than the effect of inflation on the price of each asset. For instance, in Fisher (1925), he again considers the various factors recommending stocks versus bonds in general, and gives as headings:

1. *The Stockholder has a chance of gain* (that earnings increases accrue to stockholders, but not bondholders)
2. *Steadiness of income* (that conservative earnings reinvestment and dividend policies mean dividends are actually fairly smooth)
3. *The Bondholder loses on rising prices* (that inflation reduces the real value of bond payments, but stockholders are protected, or do better)
4. *Diversification of stock investments* (that stock failure is idiosyncratic and can be diversified, but inflation hurts all bonds at once)

As can be seen from this list, the only aggregation of these factors is a qualitative one of synthesizing various possible outcomes – there is not a concrete metric of risk that can be measured. This is reinforced by his claim that the risks from stock underperformance are idiosyncratic and can be diversified away, a claim incompatible with any serious analysis of stock return correlations. Based on a similar, qualitative comparison, Fisher (1912) writes that he sees stocks and bonds as having essentially *similar* levels of risk:

> *"There is not much to choose between the risks run by investing in stocks and risks run by investing in bonds. The two risks are, it is true, of different kinds, one being the risks of particular industries, and the other the risks of changes in the value of the gold dollar. But they are both real risks."*

Much of the argument in Fisher (1912) focuses on the effect of inflation on cash flows of each asset (point 3 above in Fisher (1925)). In Fisher (1925), he argues that stockholders actually benefit in terms of cashflows during periods of inflation, rather than just doing better than bonds:

> *"So when prices are rising-that is, when the dollar is shrinking–- the bondholder complains of a "high cost of living" which is another way of saying that he is losing real income and principal though nominally they remain the same. Moreover, since, during rising prices, the world is getting no poorer (but rather richer) in real goods , what the bondholder loses the stockholder must gain. Thus we find that the bondholder's "steady income" is a delusion and a snare, so long as we do not stabilize our dollar."*

The title of the volume of essays in Fisher (1912) is "How to invest when prices are rising", which shows the preoccupation with one side of the relationship – that high inflation benefits

stockholders, and hurts bondholders. Strangely, the book does not directly address the opposite implication – that in periods of unexpectedly *low* inflation (or high *deflation*), bondholders will benefit at the expense of stockholders. However, the logic laid out in the book implies this result.

Smith (1924) took this as the prevailing viewpoint that he went to test in the data, and that he himself previously believed – do bonds actually do better in periods of deflation? The answer, surprising both to him and the logic of Fisher (1912), was that they still do worse. Smith took this as a rejection of the Fisher worldview, though he does not mention Fisher by name in his book, nor indeed provide any references at all. As Smith (1924) describes in the introduction

> "*These studies are the record of a failure - the failure of facts to sustain a preconceived theory. This preconceived theory might be stated as follows: While a diversity of common stocks has, without doubt, proved a more profitable investment than high-grade bonds in the period from 1897 to 1923, during which dollars were depreciating, yet with the upturn in the dollar, bonds may be relied upon to show better results than common stocks, as they did in the period from the close of the Civil War to 1896, during which the dollar was constantly increasing in purchasing power.*"
>
> *"[These studies] failed, because, quite unexpectedly, they demonstrated that the premise upon which the preconceived theory rested, namely, that high-grade bonds had proved to be better investments during the period of appreciating dollars, could not be clearly sustained by any evidence available. The preconceived theory was, therefore, abandoned."*

But even after Smith (1924), Fisher (1925) never addresses the question of whether bonds ought to have higher returns during periods of deflation. He notes the Smith (1924) paper, and argues that bonds do not seem like great investments overall. He glosses the Smith (1924) result as claiming that *"during the falling prices following the Civil War stocks and bonds are about equal as to yield",* in contrast to Smith's own assessment that they are higher. But he does not describe whether he views the Smith result as consistent with the earlier view, or a refutation of it.

Finally, Fisher (1925) has an interesting perspective on the causes for low bond returns – he attributes it to excess behavioral demand for bonds:

> *"Thus the bondholder pays dearly for his supposed safety and regularity of income. True, the stockholder buys a lottery, but the facts show that the price he pays is below the*

mathematical chance . The lottery tickets are unduly cheap , just because of the traditional preference for bonds, which are unduly dear."

However, aside from his empirical claims, his statements that bonds and stocks have similar risks imply that they ought to earn *similar* returns, a perspective that almost nobody believes today.

3 Stocks as Bonds, and Risk as "Long Horizon Probability of Loss"

Once stocks were considered to be an investment, investors began to grapple with the question of how to properly conceptualize the risk and performance of the less familiar asset class. Much of the discussion drew analogies with bonds, an older investment they were comfortable with. This led to two forms of confusion relative to Markowitz's understanding of equity risk. One was a focus on long-term horizons, and risk as the probability of losing money at that horizon (analogous to bond default). Second, interim outcomes were considered mostly in terms of firm cash flow changes, with authors generally lacking a clear theory of price changes.

3.1 Different Conceptions of "Loss" Benchmark

The idea of risk as "the chance of eventually losing money" is intuitive if one begins with a perspective of bonds. Bond default and its associated probability are still today the chief risk metric under which bonds are evaluated (along with interest rate risk). If the metaphor is to bonds, a key question is what quantity will take the place of the bond's face value for defining what counts as default when it is not paid back.

This can be considered from an investor's perspective, or from an accounting or corporate finance perspective. For an investor, the most obvious equivalent is losses relative to the initial investment or principal. In this view, loss is continuous, like in bond default, and may correspond to a complete default (e.g., the equity holder being wiped out, like in bankruptcy) or a partial recovery (losing some money relative to one's initial stake, but not the whole amount).

This perspective of "loss relative to initial investment" was the common way of considering risk. However, during earlier periods, there was also an accounting and corporate finance perspective. Here, one needs some notional amount of money that the stock corresponds to which is common to all investors. This is the best explanation for the frequent early discussion of "par value" for a stock – the notional amount of paid-in capital that investors may or may not have completely contributed on the initial subscription. Indeed, the entire focus on stock par-

value is baffling without this perspective. Economically, par value has no real ongoing importance, as equity holders own the firm's current assets, whatever they are worth. The historical initial investment has no equivalent future relevance like the bond's face value, which is a concrete obligation to pay back in the future. But if one needs a common, accounting value to attach to all shares that functions vaguely like a bond's face value, this can serve the purpose.

Par value was most often discussed as a way of normalizing dividends, as measure of dividend yields as a percentage of par value. While sometimes dividends were quoted in the more economically useful sense of scaling by price, such as in Scott (1910) and Robinson (1930), dividend yields relative to par value were common, such as in Mitchell (1910) and Matherly (1923). Since bond coupons are typically quoted relative to face value instead of price, the search for some stock-level equivalent caused people to quote dividend yields that way too, even though the calculation doesn't reflect any meaningful economic reality.

However, we are principally interested in the alternative and more persistent version – risk as the chances of losing money on one's investment at a long horizon. We shall find evidence for such perspectives, and that part of the rationale is from comparisons with bonds.

3.2 Graham and Dodd (1934) and probability of loss

Graham and Dodd (1934) marks an interesting transition between the early categorical rejection of stocks as "not an investment", and the later view of stock risk as the chances of long horizon losses. The book has aspects of both kinds of thinking. Graham and Dodd (1934) was famous for popularizing, if not inventing, the idea of value investing. It was a major inspiration for Warren Buffett, and features considerably in Morrison (1949)'s history of investment thought.

Graham and Dodd (1934) is very difficult to reconcile with the Markowitz claim that risk generally meant variance. Despite being an enormous work, even in the sixth edition, it has no mention of the word "volatility."[7] The word "variance" occurs only for ideas that are "at variance" with some facts. "Standard deviation" does not appear anywhere. This is neither an accident, nor due to the idea going by a different name.

[7] Though some editions contain a preface written in a more modern setting by different authors which use it, but not Graham and Dodd themselves.

Importantly, Graham and Dodd (1934) *maintained* the importance of categorical distinctions between investments and speculations, but they no longer drew these boundaries at the asset class level. Instead, they argued for categorization based on the chances of losing money at long horizons, but held that the categorization itself was nonetheless still important. Chapter 4 of the book is titled *"Distinctions Between Investment and Speculation*". They departed from previous authors by arguing that not *all* bonds should be considered as investments, and not *all* stocks should be considered speculations. They explicitly criticize Smith (1924) and the "investment theory" writers that followed for failing to maintain this distinction, and for arguing for an unconditional equity premium rather than a high return only for value stocks:

> "*[T]two theoretical weaknesses that could and did result in untold mischief. The first of these defects was that they abolished the fundamental distinctions between investment and speculation. The second was that they ignored the price of a stock in determining whether or not it was a desirable purchase."*

The appeal of value investing was to find stocks that met the criteria of "investments":

> *"[W]e suggest the following definition of investment: as one in harmony with both the popular understanding of the term and the requirements of reasonable precision:*
>
> *An investment operation is one which, upon thorough analysis, promises safety of principal and a satisfactory return. Operations not meeting these requirements are speculative."*

They shortly follow up on this concept of what risk and safety mean:

> "*The safety sought in investment is not absolute or complete; the word means, rather, protection against loss under all normal or reasonably likely conditions or variations. A safe bond, for example, is one which could suffer default only under exceptional and highly improbable circumstances. Similarly, a safe stock is one which holds every prospect of being worth the price paid except under quite unlikely contingencies."*

This passage represents perhaps the sharpest example of not only thinking of stock risk in terms of chances of losing money, but explicitly doing so by analogy to bond defaults. In other words, they are trying to find "bond-like" stocks that count as investments, and formalize exactly what it

is one is seeking with a bond. The view of risk as probability of loss was very influential. Hayes (1950), summarizes its influence at the time, especially the Graham and Dodd (1934) conception:

> *"Writers on investment theory and practice seem to be almost universally agreed on the fact that one of the crucial general tests of investment quality is "safety of principal."*

Viewing risk as the probability of loss has an intuitive appeal, and as we will see in later work like Roy (1952), it can be formalized into some workable frameworks. However, the idea as actually applied by most writers before Markowitz (1952) tended to be confused and loosely defined. As expressed, it is actually quite difficult to reconcile with modern asset pricing, and liable to produce confusion, if not outright mistakes. Moreover, the ways that the early versions were mistaken can also be understood through leaky metaphors about bonds – failing to consider total returns in favor of long term yields, and failing to have clear theories of intermediate prices.

3.3. Probability of Long-Horizon Loss" Leads to Confused or Absent Risk Return Tradeoff

The first problem with viewing risk in terms of probability of loss is that it has a tendency to obscure or even eliminate an understanding of the tradeoff between risk and return. Mean returns and standard deviations of returns are fundamentally separable. This allows one to think of economic tradeoffs between these variables. However, higher expected returns both increase average performance *and* decrease chances of loss. This both means the ideas tend to get merged, and they do not obviously present as quantities likely to have a tradeoff between them.

This is true in Graham and Dodd (1934). The conception of value investing they present is altogether alien to the Fama and French (1993) view. Graham and Dodd (1934) did not think that value stocks earned higher returns because they were *riskier*. They thought that they earned higher average returns, *and that made them safer.* These high expected returns would produce their definition of an investment, namely something that would not lose money except under very unlikely contingencies. Graham and Dodd (1934) describe how value metrics lead to both better overall performance and a greater level of safety, or low chances of losing money:

> *"Common stocks that (1) are selling below their liquid-asset value, (2) are apparently in no danger of dissipating these assets, and (3) have formerly shown a large earning power on the market price, may be said truthfully to constitute a class of investment bargains. They are indubitably worth considerably more than they are selling for, and there is a*

reasonably good chance that this greater worth will sooner or later reflect itself in the market price. At their low price these bargain stocks actually enjoy a high degree of safety, meaning by safety a relatively small risk of loss of principal."

This speaks to the more basic question – under probability of loss thinking, is there a perceived risk/return tradeoff *at all*? This may seem almost impossible to imagine, but if a high enough mean produces both a greater reward and a lower risk (probability of loss at long horizons), assets with high expected returns may simply be viewed as dominating choices. Indeed, we can find explicit statements consistent with this. Several early authors that analyze returns of different asset classes describe those with higher expected returns as simply being superior. For instance, consider again Smith (1924) describing the inflation hypothesis:

"*While a diversity of common stocks has, without doubt, proved a more profitable investment than high-grade bonds in the period from 1897 to 1923, during which dollars were depreciating, yet with the upturn in the dollar, bonds may be relied upon to show better results than common stocks, as they did in the period from the close of the Civil War to 1896, during which the dollar was constantly increasing in purchasing power."*

In one period of time stocks will be *"more profitable"* than bonds, but in the other period of time, bonds will *"show better results"*. The parallel construction of these two clauses suggests they are essentially synonyms. There is not a sense of a higher return coming as compensation for higher risk. Higher returns just make an asset *better*.

Jackson (1928a, 1928b) are other examples. Jackson (1928a) first computed an equal-weighted stock return index, and Jackson (1928b) focused on how to construct cumulative return outcomes. Both papers have the same mindset as above, where higher cumulative returns simply make an asset *better*. Common and preferred stocks were evaluated in terms of their cumulative returns at different horizons. From Jackson (1928a):

"The general problem is that of determining which is the better form of investment, common stock or preferred stock."…

"When the common stocks are better, their superiority is quite marked. When the preferred stocks are better, their superiority is much less in amount."

Jackson (1928b) describes one asset as being “better” or a “better investment” a total of 31 times, and “superior” a further three times. The term “better” is used 15 times in Jackson (1928a). In both papers, this is nearly always in the context of having higher cumulative returns.

Nor do these papers compare the risk of these assets in a way that implies that "better” is meant in the context of a risk/reward tradeoff. The term “risk” appears only once in Jackson (1928b), in the context of business risk, and once in Jackson (1928a), when comparing partnerships with preferred stock. Neither description is in the context of price volatility. There is a brief discussion in passing in Jackson (1928a) of price volatility, but not in a manner that suggests it represents an important risk tradeoff to the “better” returns of common stocks:

> *“[T]he common stocks have in every group a wider swing”…*
>
> *“Finally, the chart shows clearly that preferred stocks are more stable in price than common stocks, though perhaps not to the extent generally believed.”*

No attempt is made to quantify these wider swings, as might be expected if they were viewed as an important part of a risk-reward tradeoff.

3.3 Hayes (1950) and Ambiguous Definitions of “Worth” and “Loss”

The second problem with the Graham and Dodd (1934) view is the inherent ambiguities in measuring the quantities involved. A modern reader likely interpret the concept in terms of negative returns (either single period, or cumulative). But the idea of holding single returns was not formalized until Miller and Modigliani (1961), as Hartzmark and Solomon (2026) describe. Consider again the actual words Graham and Dodd (1934) use to describe safety of principal:

> *[A] safe stock is one which holds every prospect of being worth the price paid except under quite unlikely contingencies.”*

As Hayes (1950) notes when discussing the concept, a great deal hinges on what it means for a security to be “worth” the price paid, and it is not clear what the answer is:

> *“On the whole it does not appear very enlightening to define a safe stock as one which in all probability will be ”worth" the price paid for it. To be very useful as either a theoretical or practical definition it would seem obvious that it is necessary to remove the ambiguities pertaining to the critical word in this definition: ‘worth.’”*

Without a clear concept of returns, and without "worth" being sharply defined in Graham and Dodd (1934), Hayes (1950) argues that investors were apt to apply very different interpretations:

> *"Some might well regard 'safety' as being synonymous with 'recoverability,' and thus limit their conception of 'safe' investments to those promising dollar stability of market price. Others might think of 'safety' strictly in dollar terms wherein it becomes more or less identifiable with assurance of continuity of income. Still others, taking a broader view, might well take the attitude that 'safety' cannot possibly be achieved in any absolute sense in view of the wide range of risks that confront the investor in the real world. From this viewpoint 'safety' becomes an illusion, and the investor is well advised to forget the phrase and spell out his objectives with a greater degree of precision"*

Essentially, one view of "*safety*" involved long term price changes, and the other involved fundamental value. One can find versions of both in Benjamin Graham's writing. Graham and Dodd (1934), when describing their concept of investment bargains, explicitly note the role of price changes, and in context that suggests that investors may care about price increases:

> *"They are indubitably worth considerably more than they are selling for, and there is a reasonably good chance that this greater worth will sooner or later reflect itself in the market price. At their low price these bargain stocks actually enjoy a high degree of safety, meaning by safety a relatively small risk of loss of principal."*

But in Graham (1949), he describes price changes as principally being of interest only in terms of being able to time the market, or in using prices to value securities:

> *"By timing we mean the endeavor to anticipate the action of the stock market—to buy or hold when the future course is deemed to be upward, to sell or refrain from buying when the course is downward. By pricing we mean the endeavor to buy stocks when they are quoted below their fair value and to sell them when they rise above such value."*

He explicitly argues that market timing (the only stated alternative to pricing) is infeasible for the average retail investor:

> *"There is no basis either in logic or in experience for assuming that any typical or average investor can anticipate market movements more successfully than the general public, of which he is himself a part."*

More strikingly, argues that as long as an investor has bought sufficiently undervalued securities, he need not worry about price changes:

> *"The investor with a stock portfolio having such book values behind it can take a much more independent and detached view of stock-market fluctuations than those who have paid high multipliers of both earnings and tangible assets. As long as the earning power of his holdings remains satisfactory, he can give as little attention as he pleases to the vagaries of the stock market."*

All of this leaves open the crucial question – are changes in price something that affect whether a security is "*worth the price paid*" for determining safety of principal, or not? Reflecting on these works, and the original definition of "*safety of principal*", Hayes (1950) argues convincingly that most investors' conceptions of "*worth*" would include prices, at least to some extent:

> *"Without attempting to appear dogmatic on the subject it may be conjectured that the ordinary purchaser of securities would be inclined to identify 'worth' and market price. This is not to say that minor variations in market price would have disturbing implications as to 'worth' and resultant safety, but if any material depreciation ensued in the market price after purchase (say 30 per cent), then the average investor might be hard pressed to imagine that the stock was 'worth' the price paid."*

In other words, if one has to find a security that is unlikely to decline in *price* in order to obtain safety of principal, then price volatility becomes a central consideration, even though it is not actually focused on much at all by Graham and Dodd (1934). From Hayes (1950):

> *"The natural conclusion from this general identity: any stock having a volatile price history and therefore vulnerable marketwise could not properly be classified as an investment promising safety of principal."*

Hayes (1950) describes how this was informally dealt with via appeals to diversification:

> *"It is probably fair to state that the most common technique introduced by investment practitioners to minimize variations in the market value of a portfolio is diversification … Along this line Graham and Dodd state that 'instability' of common stocks require the 'investor' to commit funds to common stocks only if a diversified group can be obtained."*

But coming before Markowitz (1952) portfolio theory, the question of how this should work in a quantitative sense, or how much risk could really be eliminated, was entirely absent. Indeed, the central role of covariance in all such calculations is also missing. A quantitative assessment was further hampered by investors generally lacking a coherent metric of total returns that aggregated both income and price changes. This explains the odd oscillations between intermediate prices being considered important versus unimportant, depending on setting and horizon. Hayes (1950) discusses a number of other conceptual problems, such as whether fundamental value can be estimated value with sufficient certainty, how much value is subject to change, and whether value should be considered in real terms instead of nominal (reintroducing difficult questions of inflation effects). Ultimately, Hayes (1950) concludes that the entire concept was sufficiently vague as to make it difficult to apply, or even agree on concepts:

> *"To some extent it is unfortunate that 'safety of principal' has become such a universally accepted cliché in discussions of investment principles and practices because it is quite likely that casual use of the phrase will have widely different meanings to various investors."*

3.4 "Safety First" and the Roy (1952) Formalization

The weaknesses in the early "probability of loss" model were substantially improved upon in the work of Roy (1952). This was another version of the portfolio theory problem tackled in Markowitz (1952) around the same time, but with an investor trying to reduce the probability of reaching some disaster state. However, in most key respects, the assumptions were far closer to modern asset pricing than to the earlier works described so far. First, assets are assumed to have both a mean return, a standard deviation of returns, and a covariance of returns. These crucial assumptions of the underlying price process were quite close to the Markowitz (1952) version. This bears emphasizing – even if one is trying to formalize how to avoid a disaster state (like falling below one's initial principal), doing this properly still requires first conceiving of single period price changes (if not returns) with a mean and standard deviation – the very thing earlier writers lacked.

Compared with Markowitz (1952), the objective function of the investor was very different. The investor's problem is specified in a concrete fashion – minimizing the $P(R<d)$, where d is the disaster level of prices. Roy bounds the shortfall probability with Chebyshev's inequality,

then solves for the portfolio that minimizes the upper bound. The resulting solution involves maximizing $((\mu - d)/\sigma$, which is the Sharpe Ratio with the disaster level in place of the risk-free rate. The resulting optimal choice is a specific point on the Markowitz mean-variance frontier.

Markowitz, writing in Markowitz (1999) viewed the Roy (1952) model as very significant:

> *"On the basis of Markowitz (1952), I am often called the father of modern portfolio theory (MPT), but Roy (1952) can claim an equal share of this honor."*

3.5 Time Inconsistent Assessments of Risk and Asset Tradeoffs

The second major problem with "risk as the probability of loss" is that it is liable to produce time-inconsistent choices when applied across different horizons. If risk is the "probability of losing money at a given horizon", when the horizon gets long enough, *the riskiness of stocks converges to zero*. This is because the probability of stocks losing to bonds also converges to zero. For an investor who places any weight on the magnitude of losses when they occur, this does not actually make stocks safe. At longer horizons, there is a decreasing probability of loss, but an increasing magnitude of those losses when they occur. A standard risk-averse agent will still worry about the utility of those states, even as the probability of encountering them diminishes. But if risk is just the probability of loss, one will not see this tradeoff. Risk will just decrease with horizon. We can see statements noting this relationship. For instance, Jackson (1928b)

> *"[T]he results show an advantage in favor of the common stocks when the period is taken as one year. When several years are combined to form a longer period, the common stocks are quite generally the better."*

And again in Fisher (1965), which discusses how geometric average returns decrease as the horizon expands:

> *"The variability of rates of return is much greater for short-term investments than it is for long-term investments."*

Given the metrics being computed, these statements themselves are not *mistakes* – they are accurate descriptions of the empirical patterns in the variables they are studying. However, this kind of mindset is likely to produce mistakes when applied to risk/return tradeoffs at different horizons. If equity risk is considered to decrease with horizon, the equity premium puzzle becomes almost infinitely large at a long enough horizon. The problem is that the same sequence

of bets is apt to appear wildly different if considered as a group, versus one at a time. This point is quite subtle, and was a focus of Samuelson (1963) around the same time:

> "*A few years ago, I offered some lunch colleagues to bet each $200 to $100 that the side of a coin they specified would not appear at the first toss. One distinguished scholar… gave the following answer: 'I won't bet because I would feel the $100 loss more than the $200 gain. But I'll take you on if you promise to let me make 100 such bets."*

The rest of the article was demonstrating that this statement was actually inconsistent not just with modern asset pricing, but with expected utility *in any form*:

> *"If you would always refuse to take favorable odds on a single toss, you must rationally refuse to participate in any (finite) sequence of such tosses."*

But despite his proof, the appeal of the fallacy – that as long as the probability of loss goes to zero with a large number of bets, the risk goes to zero – is quite strong. So much so, that in 1979, frustrated with continued examples of this mistake, Samuelson restated a variation of the same result in an article written only in words of one syllable (Samuelson (1979)):

> *"When you lose – and you sure can lose – with N large, you can lose real big. Q.E.D. …*
>
> *If it does not pay to do an act once, it will not pay to do it twice, thrice,…, or at all"*

It is worth emphasizing that not *every* version of "risk as probability of loss" leads to violations of expected utility. The Roy (1952) framework, of minimizing the probability of a disaster state, is equivalent to maximizing $u(W) = 1\{ W \geq d \}$, which is a legitimate (if nonstandard) utility function that can be applied in a time-consistent manner. Such an investor does not violate the Samuelson (1963) claim, because unlike Samuelson's assumptions, the bet is *not* undesirable at all wealth levels – he would take it when he is below the disaster level, and not take it when he is above. But few investors are *actually* indifferent to the magnitude of losses when they occur. "Risk as probability of loss" is apt to appear as if the bet becomes free if done enough times, as it obscures the magnitude of the loss in the bad states. The fact that the original motivation for the mistake was Paul Samuelson's colleagues at MIT in the 1960s suggests that the mistake is not an obvious one. If it does not pay to choose stocks over bonds for one month or one year, and stock and bond returns are i.i.d., it generally does not pay to choose stocks over bonds for 30 years either.

The application to individual stock returns is complicated slightly by the fact that they are not generally i.i.d. (see Jegadeesh (1990) for one-month reversals, Jegadeesh and Titman (1993) for 2-12 month momentum, DeBondt and Thaler (1985) for 3-5 year reversals, Heston and Sadka (2008) for calendar seasonality, and others). These patterns are weaker for market returns, where the assumption of i.i.d. returns is more reasonable. The point is less that stock market returns are i.i.d. and the Samuelson (1963) argument holds exactly (e.g. it is impossible under expected utility to like stocks at a ten-year horizon if you don't also like them for one month). But conceiving of risk as a horizon-dependent chance of losing money is likely to lead to confusion and actions inconsistent with expected utility, like Samuelson (1963)'s interlocutor – risky actions taken again and again are somehow believed to become safe. Investors thinking this way are likely to have a confused conception of risk and return from the perspective of a standard risk aversion.

4 *Early Risk/Reward Tradeoff Focused on Cash Flows*

An alternative strand of investment thought considered the riskiness of stocks versus bonds along a different analogy to bonds, by comparing their cash flows. These authors argued for a concept of risk being related to expected returns, and in some cases even perceived that risk as relating to standard deviation. Crucially, these arguments only applied to the risk of future *cash flows.* These were nearly all theoretical works comparing the price today and future cash flows. They lacked any framework for thinking about future price changes, or the risk they involve.

This focus on cash flow risks also can be understood in terms of bond metaphors. Because intermediate price changes mean revert in the absence of default, holding period returns for bonds are much less discussed than bond yields, even today. An investment mindset that began with this conception was likely to similarly focus on yields on stocks, comparing price today and future cash flows. Without a framework for thinking about price changes, the role of prices tended to be downplayed or ignored, thus missing a crucial piece of the risk/return tradeoff. This perspective will be particularly misleading given the finding in Shiller (1981) that price changes are much more volatile than dividends or earnings, and so the largest part of risk will be missed.

4.1 Cash Flow Risk and Reward in Mill (1848)

While most of our focus is on 20th century sources, Mill (1848) presents an interesting general argument that higher risk should earn higher returns. He discusses a farmer deciding whether to obtain land for a farming project:

> *"…he will probably be willing to expend capital on it (for an immediate return) in any manner which will afford him a surplus profit, however small, beyond the value of the risk, and the interest which he must pay for the capital if borrowed, or can get for it elsewhere if it is his own."*

This passage is particularly interesting, because it was argued by Goetzmann and Ibbotson (2005), (who discuss a lot of the same history as we do) to be consistent with a modern conception of investment risk and reward as applied to the equity risk premium. They describe it thus:

> *"Mill thus separates profit into three parts: first, the interest that must be paid for the capital borrowed, determined in terms of alternative opportunity cost of money. This is equivalent to the riskless rate. The second component is the 'value of the risk' associated with the investment. This is equivalent to the equity risk premium. Mill's third component is a surplus profit, no matter how small. In modern parlance, the 'alpha' – a portion of compensation expected to be small in a competitive market."*

We argue that this is overly charitable to the level of understanding that Mill (1848) had. First, later in the passage, it becomes apparent that Mill is not thinking about a farmer *purchasing* the land, and exposing himself to capital appreciation or loss based on price changes. He is thinking about a farmer *leasing* the land:

> *"[E]ven when the lease expires, the landlord may be unwilling to grant a necessary diminution of rent, and the farmer, rather than relinquish his occupation, or seek a farm elsewhere when all are occupied, may consent to go on paying too high a rent."*

Indeed, for the farmer to obtain an "*immediate return*" suggests that this cannot be a case of the price of the land going up, since this component will be either long term, or unobservable. Mill (1848) displays a good conceptual understanding of the riskiness of *cash flows* relative to an initial capital investment, and is decent evidence that this concept is quite old. Even here, however, there is no attempt to quantify this risk, nor give guidance as to how one should assess it. But importantly, the discussion was in contexts that did not have a clear role for price changes,

something typical of this kind of early writing. Given the context of how underdeveloped equity markets were in 1848, it is not clear it is intended to apply to equities at all.

4.2 Cash Flow Risk and Reward in Fisher (1906)

Another early example of cash flow risk and reward is Fisher (1906). He is quite far-sighted in several respects regarding risk. He notes that there is a risk/reward tradeoff for the price that investors will be willing to pay for different assets. Most people will pay less than the expected value of a risky gamble, but that there are individual differences in attitudes to risk.

> *"But the actual price which one will pay is not necessarily the mathematical value of the chance. It may be higher; it is usually lower. The gambler is usually a person who will pay more than the mathematical value of the chance. … The ordinary man is unwilling to pay even the full mathematical value of the chance . He is reluctant to assume any risks , and is , on the contrary , willing to make sacrifices in order to rid himself of them."*

Fisher's conception of risk is quite different to modern ones, even when applied to cash flows. Risk is fundamentally subjective, and Fisher denies the possibility of objective risk measures:

> "*Chance is subjective. Although one man's estimate may be better than another's through superior knowledge, intuition, or experience, the best estimate is still only an estimate, not a certainty. In the actual world of events there is no uncertainty. Aside from human opinion, there is no such thing as chance."*

Fisher does not describe how to distinguish between quantity of risk, and the individual risk aversion. Both are lumped into a single discounting measure call the coefficient of caution. The discussions are nearly all bond-centered. The main discussion is about the riskiness of future cash flows, and risks attached to changes in interest rates (also a very bond-centered framework). In terms of estimating these risks, Fisher mostly provides simple numerical probabilities attached to different cash flow outcomes. He notes that the practical ability to apply this is quite limited:

> *"Usually, however, the chances involved are so indefinite that the reckoning is made only by rule of thumb. Any further attempt to apply the theory of probability would therefore outrun the exigencies of practice."*

Fisher is, however, foresighted in terms of forecasting a role for standard deviation at all. The above passage, disclaiming the current ability to measure cash flow volatility, contains a footnote:

"*Nevertheless it is more than conceivable that the time may come when practical brokers will make use of probability computations in the same way that they now make use of bond tables.*"

This links to a discussion where he references the work of Norton (1902), who was one of the first authors to use standard deviations in economic settings. Mathematical understanding of standard deviations was fairly modern. The earliest form of the normal distribution was studied in de Moivre (1738), Gauss (1809) and Laplace (1774). But in those versions, Gauss and Laplace parameterized the distribution with a precision parameter, h, which operated like the inverse of variance. The modern statistical version of standard deviation dates only to Pearson (1894).

Fisher (1906) describes the possibility of using standard deviations to describe the volatility of cash flows. In this sense, his work is very prescient. But the crucial limitation is that these are standard deviations across different possible states at the same future point, which are difficult to quantify. There is no sense of the time-series standard deviation of realized cash flows (which could actually be measured), nor the standard deviation of future price changes. This missing component helps explain how Fisher could later judge stocks and bonds to be of similar risk levels, and miss the principal dimension on which a modern reader considers stocks riskier than bonds, namely their differences in total return and their difference in price volatility.

While Fisher is often discussed for his substantive contributions to understanding inflation, his contributions to asset pricing tend to be largely forgotten. He is most famous, perhaps unfairly, for his remark in 1929 that stocks appeared to have reached "a permanently high plateau". This ought not discredit the many ways his work has genuine novelty and insight (risk aversion, standard deviations, the role of inflation), but it highlights the weakness of relying strongly on informal, qualitative arguments for understanding of asset prices.

4.3 Cash Flow Risk and Reward in Williams (1938).

Williams (1938) provided a much fuller treatment of how to generate expected returns on stocks by comparing today's price with estimated future cash flows. Markowitz (1952) cites pages 55-75, which is devoted to i) computing present values of stocks and bonds based on forecasts of dividends/coupons and their probabilities of occurring, and discounting them to the present, and

ii) converting these to expected returns relative to current prices. Like Fisher (1906), Williams (1938) argues that expected but risky cash flows will be discounted by a risk premium:

> "*The customary way to find the value of a risky security has always been to add a "premium for risk" to the pure interest rate, and then use the sum as the interest rate for discounting future receipts."*

Like Fisher (1906), Williams (1938) also gives no guidance on how to quantify this risk, or what kind of discount it should command. Williams (1938) is also much more explicit than Fisher (1906) that he is not concerned with forecasting price changes themselves. Price is interesting to the extent that it implies information and beliefs about earnings. Williams begins the book (p3) by arguing that a long term investor need not care about price at all, and can focus solely on income:

> *"[T]he longer a buyer holds a stock or bond, the more important are the dividends or coupons while he owns it and the less important is the price when he sells it. In the extreme case where the security is held by the same family for generations, a practice by no means uncommon, the selling price in the end is a minor matter. For this reason we shall define an investor as a buyer interested in dividends, or coupons and principal, and a speculator as a buyer interested in the resale price. Thus the usual buyer is a hybrid, being partly investor and partly speculator."*

But as he notes immediately prior:

> "*But speculators as a class can profit only by trading with investors, to whom they can sell only for income; therefore in the end all prices depend on someone's estimate of future income.*"

Second, Williams (1938) is skeptical that price changes have any real information value at all, over and above the current orders that the firm is receiving (p7):

> "*In the field of financial speculation more than anywhere else, people seem to believe in a "social mind," or "collective intelligence" – a mind above and apart from the minds of individual traders, and greater than the mind of any one of them in the range of its knowledge and sureness of its judgment. …*
>
> *"People say that, since speculative prices move first, business volumes second, and interest rates third, the reason why speculation precedes everything else must be that speculators*

as a class can foretell, even though speculators as individuals cannot, the course of business months ahead. …"

"[T]here does exist a business series, to be described below, that moves as soon as, or even sooner than stocks, and one which any novice can follow if he can only get access to it. Hence we must conclude that the speculative fraternity as a class has no greater ability to foresee business conditions than have well-informed traders as individuals. …"

"The business series referred to above, which moves even sooner than stocks, and which displays even longer forecasting power, is called "Orders Received," or "Bookings." It leads all other series in the business cycle."

The evidence for this claim, which a modern reader is likely to be skeptical of, is a single graph of a stock price, with no formal tests at all. Profiting off price changes is described as essentially a zero-sum game, with prices as likely to become more incorrect over time as more correct (p33):

"*To gain by speculation, a speculator must be able to foresee price changes. Since price changes coincide with changes of marginal opinion, he must in the last analysis be able to foresee* changes in opinion. *Successful speculation consists in just this. It requires no knowledge of intrinsic value as such, but only what people are going to* believe *intrinsic value to be. Now opinion, when it changes, need not change for the right; it may change for the wrong, and the probability of a change for the wrong is about as great as of a change for the right."*

The conception of expected returns In Williams (1938), and referenced in Markowitz (1952), is one in which the price change component plays a minor, speculative role of little interest to long term investors. Prices are further described in a manner where they as likely to go up as go down. Despite the idea of applying a discount for risk to future cash flows based on their expected volatility, none of the authors made much headway on this, because the Fisher (1906) observation was still largely true in 1938 – it was difficult to specify in any precise way what the distribution of future cash flows would be, and thus difficult to describe its standard deviation. The practical use of standard deviation only came later in time series settings when applied to returns, which (unlike subjective cash flow expectations) can be concretely observed.

5 Bachelier (1900)

A final theoretical paper that is difficult to classify in the history of understanding financial risk is Bachelier (1900). He developed a Brownian motion model of stock price movements in the context of understanding option prices. While Bachelier (1900) does not directly describe his properties in variance terms, in the Mark Davis translation and annotation from 2006, footnote 22 by Davis with respect to the price process reads:

> *"This is the probability density function of a normally distributed random variable with variance t/2πH2. The price process is what we would now call a Brownian motion with variance parameter 1/2πH2"*

In other words, the equation contains variance, but the interpretation in this manner is more a modern one than an emphasis by Bachelier himself.

Closer to the modern version of volatility, Bachelier describes his coefficient k which, as Davis notes, *"plays the role of the volatility in modern mathematical finance"*:

> "*The coefficient k that we introduced previously is the coefficient of instability 46 or of the excitability of the security; it measures its static state. Its strength indicates a state of anxiety; its weakness, by contrast, is the indicator of a calm state."*

However, a few aspects bear emphasis. First, in options pricing terms, this is the equivalent of implied volatility, not realized volatility. That is, one infers the parameter from options prices, rather than measuring it in realized price series, which Bachelier also does not do:

> *"This coefficient is given directly in speculation on commodities by the formula* $a = k\sqrt{t}$*, but in speculation on securities, as we shall see, one cannot calculate it except by approximation."*

Second, the volatility is of absolute price changes. Bachelier does not have the concept of a return, and so Brownian motions are all with respect to the price level. This has the further complication that on a long enough time frame, prices will become negative under such a law of motion. Finally, and most importantly, Bachelier (1900) was almost totally forgotten, until it was rediscovered and translated by Samuelson in the 1960s, with the most famous translation being in Cootner (1964). In this respect, it is widely acknowledged as being far ahead of its time, and represents a path not taken up by the field for over 60 years.

6 The evolution of the empirical study of stocks

We have so far discussed conceptual understanding of risk by early authors. This creates a concern that the underlying concept of standard deviation of returns may have been intuitively present, even if discussed in different terms or not discussed at all. To examine whether this is likely, we next turn to what was actually calculated once academics began to use data to examine stock performance. If this concern was valid, it is likely that one of the first things to be empirically examined would have been single period price volatility of some sort. We find this is not the case, with the first such measures not published until Lintner (1965). Rather, the conceptual understanding that we document above is largely mirrored by the empirical study of returns.

6.1 Early papers did not compute standard deviations

Contradicting the Markowitz (1952) claim that risk nearly always meant the variance of returns, none of the papers which studied market performance in the early 20th century ever computed a standard deviation of returns. Most of the papers do not even use terms like volatility, standard deviation, variance, or other related concepts, and in the rare cases where these terms appear, they are always in entirely unrelated contexts, not referring to returns or price changes. These papers also do not correctly compute single period returns either, as described in detail in Hartzmark and Solomon (2026). But even when considering other performance measures, standard deviation as a measure of risk was entirely absent.

Fisher (1922) came close to modern definitions of returns, when he compared different index constructions to settle on his “ideal index” which is not quite a return. His “ideal index” ends up being similar to value-weighting, but uses the average of market cap at both the beginning and end of the return period. While he computes a cross-sectional standard deviation of index price levels across different types of index, he does not compute a time-series standard deviation for any of them, as one would if the volatility of performance were the concern. Indeed, he does not actually describe or conceptualize one-period price changes, consistent with the general focus on long-horizon outcomes, rather than single-period outcomes.

Smith (1924) compares the long-run performance of stocks and bonds, taking starting and ending period prices, adding in cumulative dividends (not reinvested), and comparing this to total

bond coupons. He only computes a single outcome, and no intermediate outcomes (which are a precondition to conceiving of returns in any form, let alone their standard deviation).

Jackson (1928a) is arguably the first paper to compute a an equal-weighted portfolio return index, and annual percentage changes in that index. But while he obliquely notes that

"[T]he common stocks swing far more wildly than preferred stocks for the same class"

He never quantifies this concept. Despite computing annual gross returns for the index, he never computes a standard deviation nor discusses the concept.

Cowles (1938) computes a value-weighted index level. He too does not compute a standard deviation, nor use any terms relating to it.

A number of the early empirical papers that failed to compute a standard deviation of returns as a risk measure also primarily reported long horizon cumulative returns as their main object of interest (Cowles (1938), Fisher and Lorie (1964)). We argue that this is unlikely to be a coincidence. Thinking of performance as a distribution of short period outcomes is a necessary step towards thinking about the standard deviation of that distribution, or even the arithmetic mean (which the empirical papers above also fail to compute).

In principle, one could conceive of a distribution of long-horizon returns, and still think of their standard deviation. Indeed, this is how most modern readers would conceptualize long horizon performance. But an idea like "the standard deviation of 30 year returns" is a very abstract concept if one were Fisher and Lorie (1964), who only have a single 30 year period of data to examine. Mostly, one comes to this idea by taking standard deviations of short period returns (which one *can* see in an intuitive way), and extrapolating known statistical properties about how standard deviation changes with horizon under the assumptions in question. Without this framework, it is quite intuitive to do what Fisher and Lorie (1964) do, and take the single long horizon outcome and treat it as a singular event, perhaps with some interest in sub-periods. We submit, however, that one is unlikely to think about the volatility of 30-year returns (which they could not even compute) if one has not first thought about the volatility of one-year or one-month returns (which they could compute, but which we can concretely observe that they failed to do).

A modern reader might be apt to wonder if this is simply due to an incomplete search, and that there may have been dozens of other papers doing similar exercises that we have failed

to uncover. The principal reason this seems unlikely is that the amount of work required to compute a value-weighted return, in data collection and manual calculations, was enormous, and so the number of people attempting it was relatively small. As Cowles (1938) describes:

> "*Some idea of the magnitude of the project may be indicated by the fact that over 1,500,000 work sheet entries were made, requiring 25,000 computer hours"*

"Computer" here in 1938 means "a person who computes", not the modern version of a mechanical or electronic device. As a matter of pure historical fact, none of the papers prior to Markowitz (1952) where one might expect to see a standard deviation of returns computed ever do so, and generally do not discuss the concept at all, even in vague or imprecise terms.

6.2 (Lawrence) Fisher (1965), and the persistence of 'probability of loss'

The strongest evidence for "risk as chances of long-horizon loss" as the primary way of viewing risk is that not only was it prominent *before* Markowitz (1952), it even maintained considerably popularity even *afterwards*. Papers like Dirks (1958) reference the concept briefly in various forms. However, the clearest demonstration of the prominence of this risk metric even after Markowitz (1952) is Fisher (1965). This was the second of the CRSP papers, after Fisher and Lorie (1964), which introduced formal definitions of returns (especially for dealing with different corporate events), and a database that standardized them. Unlike the critique in Hayes (1950) that the performance metric is ambiguous, the risk of loss here is applied to the well-defined returns series from Fisher and Lorie (1964).

All three early CRSP papers (Fisher and Lorie (1964), Fisher (1965) Fisher (1966)) focus on properties of newly-created market and stock returns, but do not compute a standard deviation of returns. For Fisher and Lorie (1964), the first on market returns, one might charitably assume it is because they were not *discussing* risk, but if they had, they would measure it as standard deviation, like Markowitz (1952). This view becomes untenable when seeing how risk is treated in Fisher (1965). The paper studies individual stock returns over every possible period of multi-year performance and reports the geometric average returns. These geometric averages are just described as "the rate of return", singular, for each combination of stock and time-period, consistent with the long-horizon, cumulative focus for performance. The conclusion of Fisher

(1965) makes clear that i) "returns" are geometric average returns over long horizons, and ii) risk is considered as the discrete category of losing money over this horizon:

> "*The variability of rates of return is much greater for short-term investments than it is for long-term investments. Therefore, on the average the probability of a gain on a long-term investment was substantially greater than 78 per cent. … The results of this study do not conflict with the belief that there is a substantial chance of losing money on an investment in an individual common stock. There were, however, few long periods during the last forty years when the chances of loss were as great as the chances of gain; and the factors which have made investment in competing media less risky in recent years have also operated to make investment in common stocks less risky."*

These statements emphasize that *"probability of a gain on long term investments"* is the main conception of risk. This is mirrored in both the stated conclusions and the choice of numbers displayed. Table 3 reports the fraction of stocks at a gain at each horizon. Variability is considered only as the interquartile range of the geometric averages (that is, how wide is the distribution across stocks of geometric average returns for that stock, given the horizon). The variability of single-period returns is not measured or discussed anywhere.

Finally, the first sentence above is especially telling – "*the variability of rates of return is much greater for short-term investments than long-term investments"*. Superficially, Fisher (1965)'s discussion of the variability of returns might lead one to believe that he is following some kind of Markowitz (1952) conception of risk as standard deviation. The first obstacle to this is that the only numbers displayed are averages, and the variability of the average, not the variability of the single period returns. Strikingly, his claimed result that variability is higher at short horizons than long ones *only* makes sense for average returns, not single-period returns. If stock returns are i.i.d., the standard deviation of single-period returns does not increase or decrease on average depending on how many years' data are used.[8] If cumulative returns are used, standard deviations of returns are *larger* at long horizons than short horizons. But if the average return is used, then the variance of these averages decreases with the square root of the number of observations,

[8] That is to say, *sample* standard deviations themselves get less volatile relative to true standard deviations as n increases, but they do not increase or decrease on average as the number of observations changes.

according to the Central Limit Theorem. Hence the Fisher (1965) conception – "variability of returns" decreases at long horizons. There is no way to reconcile this claim with thinking of "variability of returns" as the standard deviation of single-period returns.

The standard deviation of single period returns was simply not an Intuitive statistic to be calculated, even after the computing and data barriers made it feasible to do so. This suggests that investors did not conceptualize it as being of particularly strong relevance to the investment problem they were undertaking, consistent with the conceptual literature discussed prior.

6.3 Lintner (1965) is the first published market standard deviation

While the concept of standard deviation of returns as a risk measure was developed in Markowitz (1952), it did not seem to occur to people to apply it to the market portfolio until the development of the CAPM. The earliest example of a computed standard deviation for any kind of market performance measure that we were able to locate was in Lintner (1965), one of the seminal papers developing the CAPM. The other two famous CAPM papers, Sharpe (1964) and Mossin (1966), have no data at all, not even numerical examples or indications of market returns. Lintner (1965) was an exception, containing an empirical section that computed a standard deviation of the S&P Price Index (which is not actually a return), and compared this with individual stock returns (failing to note the difference of units). This market standard deviation result is only contained in a footnote, however, and is not a major focus of the paper

After Lintner (1965), stock-level and market-level standard deviations were computed with some regularity, though like in Lintner (1965), they were mostly not the main point of the paper. Grubel (1968) computes market standard deviations over a five year period for estimating the gains to international diversification. Smith (1969) computes the standard deviation of various market indices for a version of portfolio theory that uses index correlations to generate covariances. Lintner (1970) computes market means and standard deviations to compute the market price of risk under a CAPM, though only using quite imprecise measures.

The first paper to consider the mean and standard deviation of market returns as a principal focus was Friend and Blume (1975). This was in the context of a similar risk/return quantification exercise to the equity premium puzzle in Mehra and Prescott (1985), but using

mean and standard deviation outcomes instead of consumption. They describe the relative lack of interest in market return properties up to that point in the very first sentence of their paper:

> "*A striking characteristic of recent research on capital asset pricing is the paucity of empirical work on the determinants of the market price of risk in contrast to the abundance of work on the interrelationships of the risk premiums among different risky assets.*"

Most of the research focus up to this point had been on the cross-sectional implications of the CAPM, such as tests of the relationship between market betas and expected returns in Fama and Macbeth (1973) and Black, Jensen and Scholes (1972). The focus on market risk-to-reward ratios only developed gradually. The CAPM model is often taught today by noting that the slope of the Capital Allocation Line is the Sharpe Ratio of the market, and this reflects the reward-to-risk ratio of the market itself. But this description is not contained in Sharpe (1964), and the Sharpe Ratio is only Introduced in Sharpe (1966) for evaluating mutual fund performance, and is placed alongside (and deemed less useful than) the Treynor ratio of Expected Excess Return / Beta.

6. Risk-Related Words in New York Times and Wall Street Journal

Most of this paper has focused on language and concepts in books and academic articles. This is both for the considerable information contained in the citations they use, and because they tend to have extended discussions of finance concepts that are illuminating for understanding the mindset involved. We next confirm that the trends we described above are mirrored in discussions in newspapers. We examine the New York Times Financial Markets column since 1905, and the Wall Street Journal "Abreast of the Market" column since 1926, from Garcia (2013).

We began with a short list of risk-related words, and asked Claude Code to analyze the articles for these words, and suggest other related terms and synonyms that appear which we had not thought of. From this, we generated a set of search terms, which we classify into broad categories that we think capture related underlying concepts. These are:

1. Pure Psychology = {Fear, Jitter*, Panic, Turmoil}
2. Price-Related & Emotionally Laden = {Crash, Plunge, Whipsaw, Meltdown}
3. Price-Related & Neutral = {Downturn, Sell-off, Correction}
4. Economic Interpretations = {Bubble, Crisis, Contagion}

5. Risk-Related & Neutral = {Fluctuat*, Instability, Uncertainty, Volatil*, Standard Deviation, Turbulence, Risk}

Since our interest is in the long-horizon relative frequency of these ideas, we compute counts for each word (or word category) as a fraction of all risk-related words, over rolling ten-year periods across both newspapers (so the earliest 10 year window ends in 1914, and the last ends in 2007).

We begin with the question most central to our paper – the rise in terms that approximate the standard deviation of returns. While we include "standard deviation" as a possible risk term, it is almost never used, appearing only 14 times in over 100 years, with only one such mention before 1987. Instead, we focus on "volatility", which has both a colloquial and statistical meaning. Because we are interested in which terms are relatively more common, rather than changes in the level of risk, we measure each risk term as the fraction of all risk-related words used. We compute this both on an annual basis, and on a rolling ten year basis.

We show this pattern in Figure 1, which confirms the principal arguments of the paper. We study the frequency of the string "volatil*" (e.g. volatile, volatility) relative to the rest of the risk-related terms. Concepts of volatility were a relatively minor fraction of words until the 1950s. In the first 10 year window ending in 1915, "volatil*" made up only 0.3% of all risk-related terms. The usage began to climb after Markowitz (1952), and ended the sample in 2007 making up 10.5% of all risk-related terms. When we use a Wald test to test for a single structural break at an unknown date (based on annual values), it identifies the break point at 1962, with a p-value less than 0.0001. This date is close to our previously discussed rise in academic discussion of standard deviations in the early 1960s, and supports the central thesis of our paper.

If people were not talking about volatility early on, what were they talking about? Figure 2 shows the three most frequently used words for each rolling 10 year period. Until the late 1950s, the top 3 most common risk words alternated between "Uncertainty", "Fear", and "Fluctuat*", with some instances of "Panic". Starting in 1960, there began the rise of words like "Sell-Off", "Correction", and "Plunge", as well as "Volatil*" and "Risk".

Initially, discussions of risk tended to use subjective concepts, or describe investor emotions, rather than actual price movements. The 1950s and 1960s saw an increase in words

describing recent price movements, and towards language about risk that mapped closer to the statistical measures of risk and volatility that grew in popularity after Markowitz (1952).

In order to better show changes in these category levels, in Figure 3, we plot the fraction of words in each of the broad categories above. At the start of the sample the two largest categories were "Risk, Neutral" (49.6% of all risk words) and "Pure Psychology" (41.5% of risk words). Other categories were small: 3.3% for neutral price movement descriptions, 3.3% for economic interpretation terms, and 2.3% for emotionally laded price movement descriptions. By the end of the sample, the last 3 categories had all grown at the expense of the first two. In 2007, neutral risk terms were 33.3%, pure psychology was 22.2%, neutral price descriptions were 18.1%, emotionally laden price descriptions were 16.6%, and economic interpretations were 9.7%. The large increase in descriptions of prices began in the 1950s and 1960s.

In Figure 4, we plot the frequency of words within each category above. Panel A examines words within pure psychology. At the start of the sample, "Fear" was 52.8% of psychology terms, and "Panic" was 46.3%. Over time, however, "Fear" maintained its overall popularity (being 74.2% of the category in 2007), while "Panic" declined in usage considerably, being only 6.7% of the category by the end. In overall prevalence in 1915, "Fear" and "Panic" were 22% and 19% of all risk words (ranks 2 and 4). By the end of the sample, "Fear" was still popular, being the top ranked word at 16% in 2007. "Panic" had fallen to 14th rank and 1.5% of words. Within psychology, the baseline understanding shifted from panic, which is generally irrational, to fear, which can be rational or irrational depending on circumstance. The early view that market declines were simply panic fits in with the generally low focus on stock prices as sources of important information.

Figure 2 Panel B examines the category of neutral risk words. At the start of the sample, the two main neutral risk words were essentially qualitative in nature – "Uncertainty" (47.0% of category) and "Fluctuat*" (41.8% of category). These words were also important overall. In 1915, "Uncertainty" and "Fluctuat*" were ranked first and third among all risk-related, at 23% and 21% of risk words. By the end of the sample, uncertainty was only ranked 6th (6% of risk words), while "Fluctuat*" was down to 15th, and less than 1% of risk words. Even within the category, "Uncertainty" was only 17.4% of words in 2007, while "Fluctuat*" was only 2.7% of the category.

The two terms that grew to replace them were “Volatil*” and “Risk”. “Volatil*” grew from only 0.7% of the category in 1915, to 31.4% of the category in 2007, as discussed previously. “Risk” grew from 9.8% of the category in 1915 to 44.8% of the category. Meanwhile, the graph shows the usage of “standard deviation”, but this is so infrequent as to not actually be visible.

Conceptually, this shift represented a change from a mostly subjective awareness of price changes and economic outcomes, to terms conceptually closer to modern understandings of risk and standard deviation (volatility, when annualized). The large increase in focus on neutral descriptions of price changes included words like “Correction” and “Sell-Off”, shown in Panel C. “Sell-Off” peaked in 1963 as the top-ranked risk word, at 17% of risk words. “Correction” peaked in 1964 as the second-ranked risk word, at 13.

In terms of emotionally laden descriptions of prices (Panel D), “Crash” and “Plunge” alternative in importance, with “Plunge” becoming more important by the end of the sample. In terms of economic interpretations (Panel E), “Crisis” was always the largest term, with “Bubble” rising in importance towards the end of the sample.

7 Aggregate Consumption Risk Was Not Considered Until Lucas (1978)

Finally, while most of our discussion has been of risk as the standard deviation of market returns, the risk measure that Mehra and Prescott (1985) consider is consumption covariances. This last development occurred very late. For example, the text books of Fama and Miller (1972) and Fama (1976) attempt to layout the most important theoretical and empirical components to understanding financial markets. Consumption, and the hedging of consumption risk as relevant to the equity premium is absent from both textbooks. Even Friend and Blume (1975), which studied the risk/reward tradeoff in the market, did so in Sharpe ratio terms, not consumption covariances. This may seem like a small distinction, but it is quantitatively important – the actual calibration of risk aversion to mean and standard deviation of market returns in Friend and Blume (1975) produces numbers that Mehra and Prescott (1985) judge to be somewhat sensible, and not an obvious puzzle (as opposed to the quantification that comes from a consumption focus).

The reason consumption was not a focus at this stage was that in the original CAPM, investors put all their wealth in financial assets for a single period, so the volatility of those assets *was* the volatility of their wealth and their consumption, and thus the driver of market risk. In

Merton (1973)'s intertemporal CAPM, in a partial equilibrium setting risk includes not just the market portfolio, but changes in economic state variables (left unspecified in Merton (1973), although changes in interest rates are given as an example).

The idea that risk comes from correlation with aggregate consumption growth comes from the pioneering work of Lucas (1978). The modern understanding of the intertemporal CAPM is that it resolves in general equilibrium to a single aggregate consumption risk variable. But this understanding was only developed in Breeden (1979), and before this it was not clear that the partial equilibrium setup in Merton (1973) with multiple economic state variables collapse to aggregate consumption as the only source of risk when solved in general equilibrium.

Like for stock market volatility, empirical interest in the correlation between stock returns and aggregate consumption growth only came after theoretical models on the subject. The first empirical examination was in Grossman and Shiller (1981), only 4 years before Mehra and Prescott (1985) framed the equity premium puzzle. Earlier papers on correlations between stock returns and economic variables did not consider consumption growth to be important. For instance, Smith (1969) examines correlations with gross national product, CPI, industrial production, the Business Week index, and the money supply, but not consumption growth.

Empirical analysis of the consumption-based model using the newly-developed generalized method of moments was also done in Hansen and Singleton (1982). The absence of this technique prior to this time also helps partly explain the relatively imprecise earlier calibration in Friend and Blume (1975). In other words, the theoretical understanding of the importance of consumption only came about shortly before the actual posing of the equity premium puzzle. Mehra and Prescott (1985) themselves consider whether equity returns and the risk-free rate from 1889-1978 can be explained by an equilibrium class of consumption-based models. Having found that they cannot, they argue in the introduction:

> "*Our conclusion is that most likely some equilibrium model with a friction will be the one that successfully accounts for the large equity premium.*"

The rational expectations assumption in Mehra and Prescott (1985) presumes that the marginal investor was behaving consistent with the model from the start of the period – having the necessary data, knowing the relevant parameters, framing the problem correctly, etc. Our analysis

suggests a very different answer –Mehra and Prescott (1985) were probably the *first* people to have thought about the equity premium in the terms that they did, and quantify whether it made sense. Previous generations of investors had gotten the answer wrong at least partly because they lacked the basic understanding and data needed to even frame the problem correctly.

It Is worth pondering what level of insight and talent was needed to make not just the final step in the intuition, but even intermediate steps. Many of the important intermediate papers were Nobel Prize-level insights - Markowitz, Sharpe, Miller, Modigliani, Lucas, Shiller, Hansen, Prescott. The full understanding involved contributions from all of them. It would seem unlikely, even before examining the empirical evidence, that the average investor decades earlier understand as much or more about finance than these authors. In one view, the entire historical analysis we have carried out seems almost superfluous. But it is not superfluous. The framing of the equity premium puzzle treats it as entirely serious – did the man in the street decades prior have a level of understanding greater not only than these individual Nobel Prize winners, but also greater than the sum of all of them? The answer, it appears, is no.

We know, trivially, that academics didn't already know about the puzzle, because old and well-understood facts rarely generate 9000-odd citations like Mehra and Prescott (1985) did. The more subtle question is whether investors in markets had a superior understanding. This is not actually obvious – perhaps real market participants were better informed and better incentivized to get the answer correct than academics at the time. However, we already have large sample evidence already on the question of "do academic publications in finance generally come as a surprise to market participants?". McLean and Pontiff (2016) study 97 return anomalies, and show how the returns to the strategies decline after publication. Importantly, they distinguish data mining from the effects of publication by comparing the period after the original sample ends, but before the paper was published. They estimate a 32% decline in returns specifically due to publication alone. Indeed, they argue credibly that this is actually a lower bound on the effects of publication, because some anomalies were publicly disclosed in working paper form even before the publication date, so the earlier decline in returns can also be due to publication.

None of the returns anomalies that McLean and Pontiff (2016) study speak directly to knowledge of the equity premium specifically. But they show quite persuasively that there are

strong reasons to think that academic research may in general *not* be well appreciated by investors, even for return anomalies where the financial incentives for investors to discover and trade on them are enormous. This adds further to the defensibility of the conclusion that investors simply didn't know the things Mehra and Prescott (1985) were testing.

We note a similar pattern is apparent in financial products. Many of the broad shifts in how investors broadly implement investment strategies can draw their origins from evolutions in the finance literature. The widespread growth of well diversified mutual funds can be viewed as driven in part by Markowitz's findings. The growth of index funds reflects the rising prominence of beliefs in market efficiency. Growth of value and momentum in industry, and quantitative strategies more broadly, reflected the findings of Fama and French and Jegadeesh and Titman's results. Many finance academics are recruited to industry to implement their ideas. None of these patterns is consistent with academics being the last to know. Academic advances in knowledge appear to represent general advances in knowledge for market participants as a whole.

7.1 The modern relevance of old ideas

The ideas that we document were the best attempts that smart people could come up with at the time given their limited knowledge. The history we document shows modern ideas about risk are far from intuitive. Many investors do not receive or seek out financial education. For such an investor, the pre-Markowitz idea of investing may well hold more intuitive appeal. Graham and Dodd (discussed at length above) just released its seventh edition in 2023. As of May 2026, it ranks #8 on Amazon in Investment Portfolio Management and #13 in Investment Analysis and Strategy, with an overall rank of about 160,000. Graham (1949) released a new edition in 2026 and it sells at an extremely high rate, currently the #5 book in stock market investing and the #2,067 book overall on Amazon. These books likely remain popular not due to historical interest, but rather because investors view their lessons as relevant to their decisions today.

Another example is the growth of structured products with capital guarantees. These products, particularly popular in Europe, offer equity exposure with a guarantee of a total return of capital. In other words, these are products designed explicitly to cater to investors focusing on the conception of risk that dominated prior to Markowitz's revelations. The explosive growth of

these products, suggests that many investors still frame investments consistent with the confusion that existed in the early finance literature.

8 Conclusion

In this paper, we examine the question of "when did investors actually have a modern understanding of risk in financial markets?". The answer can be stated surprisingly crisply: in the 1960s at the earliest. Between 1924 and the 1960s, thinking was dominated by loose analogies to bonds that mostly considered long horizon outcomes, with risk as the probability of losing money at a long horizon. Before 1924, thinking was even more vague, either viewing equities as "speculations" akin to gambling, or (in more sophisticated forms) as a way to bet on inflation.

Our results serve as a cautionary note for authors trying to solve a problem of lack of data in modern periods by collecting additional data from further in the past.[9] While this task can be valuable in certain settings, it is important to consider whether the understanding of the people involved for the question of interest was radically different in the past. We document that the understanding of equity risk in the early 20th century was very different to that in the mid 20th century, which was different again from that later in the 20th century.

We also make a methodological contribution, by arguing for the importance of close reading of historical articles. Historical writings ought to be considered important evidence of beliefs that archival data cannot supply. "Close reading" here necessitates reading the original articles, not just later authors' summaries of them. More importantly, it involves trying to understand the worldview behind the statements, which is often more elusive. For instance, our claim that early authors mostly thought about stocks using imperfect analogies to bonds is not something most authors explicitly stated, nor were they necessarily aware of it themselves.

Finally, our paper is also intended as part critique and part corrective of some of the other papers on the history of financial thought. There is sometimes a tendency to take a "glass is half full" perspective on historical authors. Papers like Goetzmann and Ibbotson (2005) and Dimand (2007) provide excellent summaries of many of the important historical articles, but can be overly charitable (in our opinion) in filling in gaps and omissions in historical work with contemporary

[9] e.g. Linnainmaa and Roberts (2018), who study accounting anomalies before the standard Computstat data in the 1960s, Goetzmann and Huang (2018) who study momentum in Imperial Russia

understanding. Showing how historical writing influenced, reflected and presaged later formalizations is a fine and important task. However, it is important to not neglect the second component – understanding the ways that historical authors gave arguments that were incomplete, confused, or simply wrong according to modern understanding.

When done properly, this task is not intended to mock or diminish the contributions of these early authors – quite the contrary. It is only by properly understanding past mistakes and past confusion that we can appreciate *how hard it is* to make genuine advancements in knowledge. We can see which papers represented important partial insights, even if they were ultimately incomplete. For instance, Irving Fisher is frequently cited in this paper as showing early, partially confused ideas. But this is because the scale of his contributions was very large and innovative, and it was difficult to get the entire answer right the first time. An appreciation of both the insights and the mistakes leads one to better appreciate the difficulty of what early writers were trying to undertake. It also provides a useful, salutary and humbling perspective - to reflect on how our own work may be perceived years or decades hence (if we are lucky!), when we become the judged, rather than the judges.

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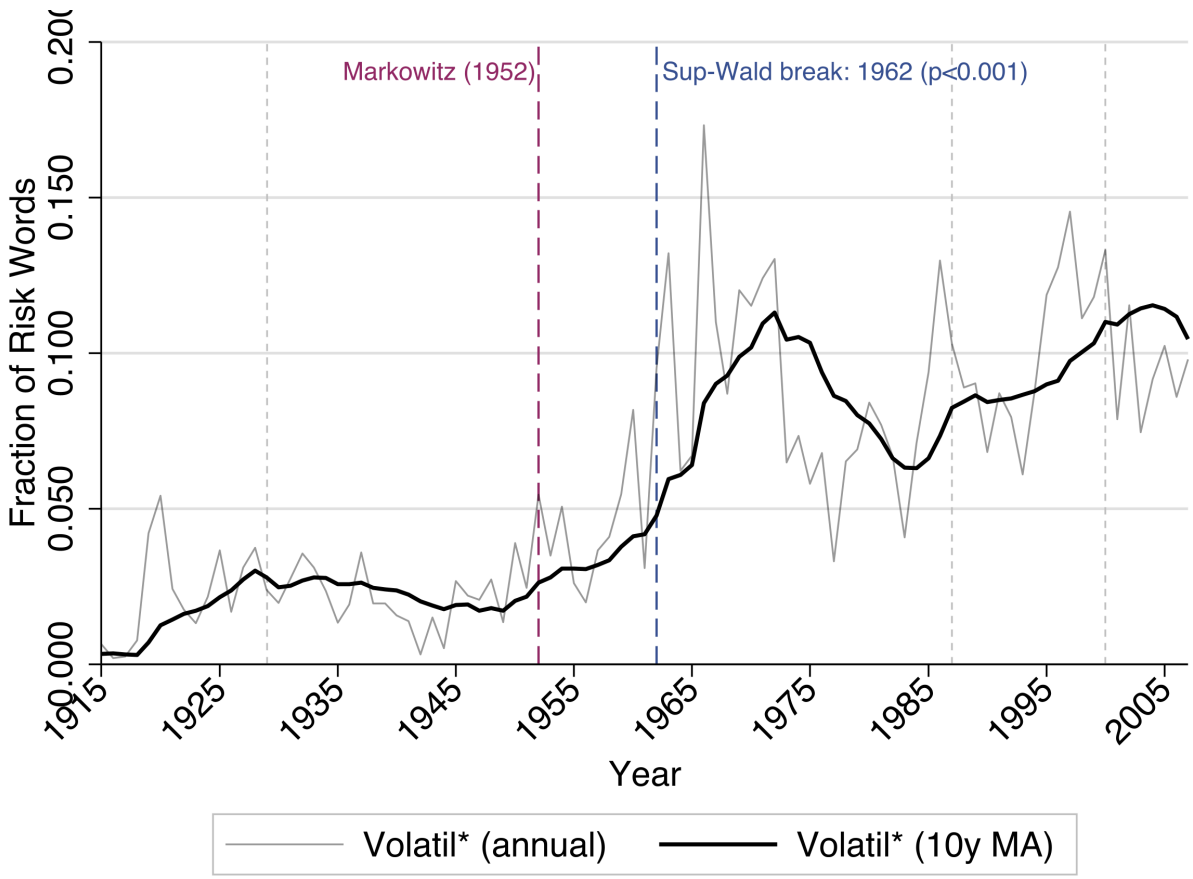
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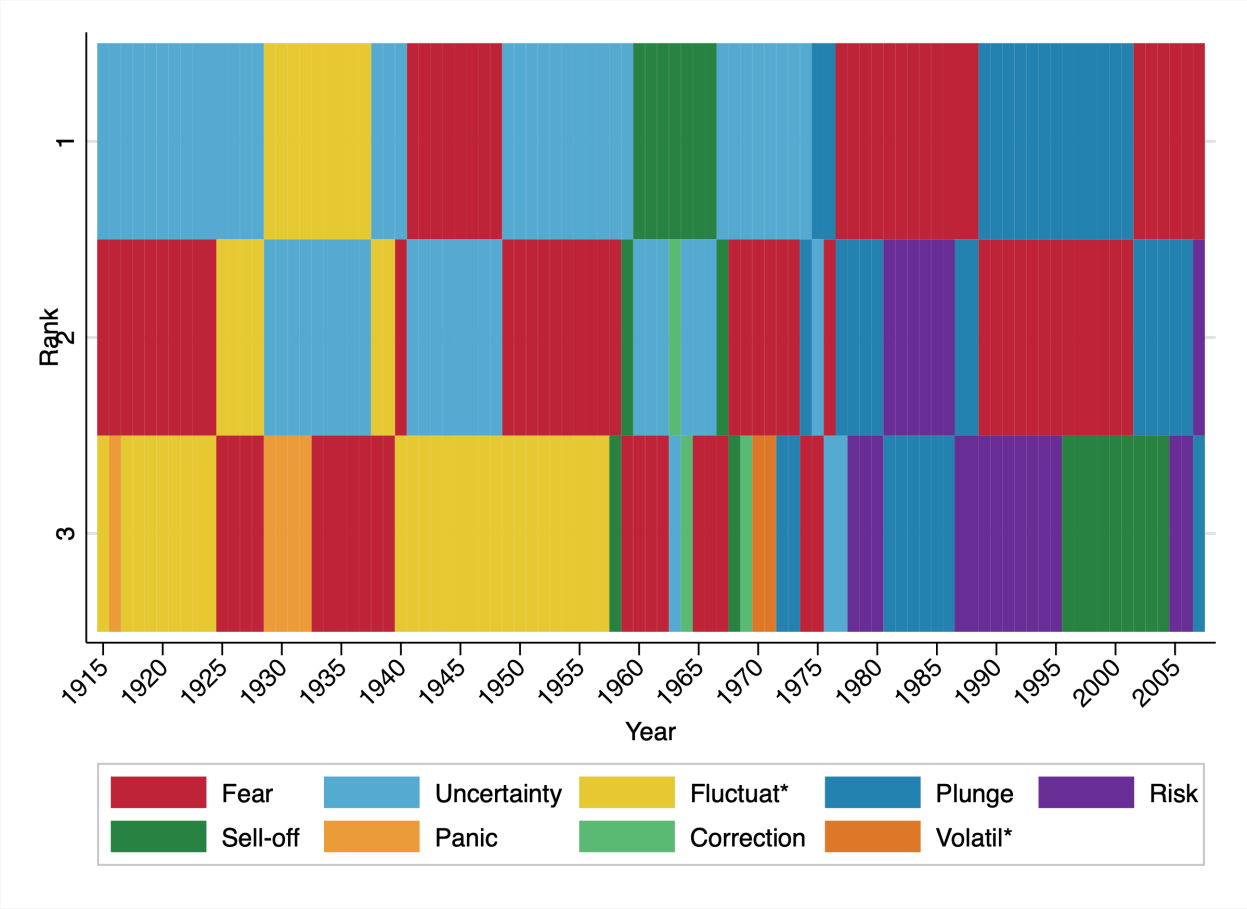
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Figure 1 – Frequency of "Volatil*" as Fraction of All Risk-Related Words



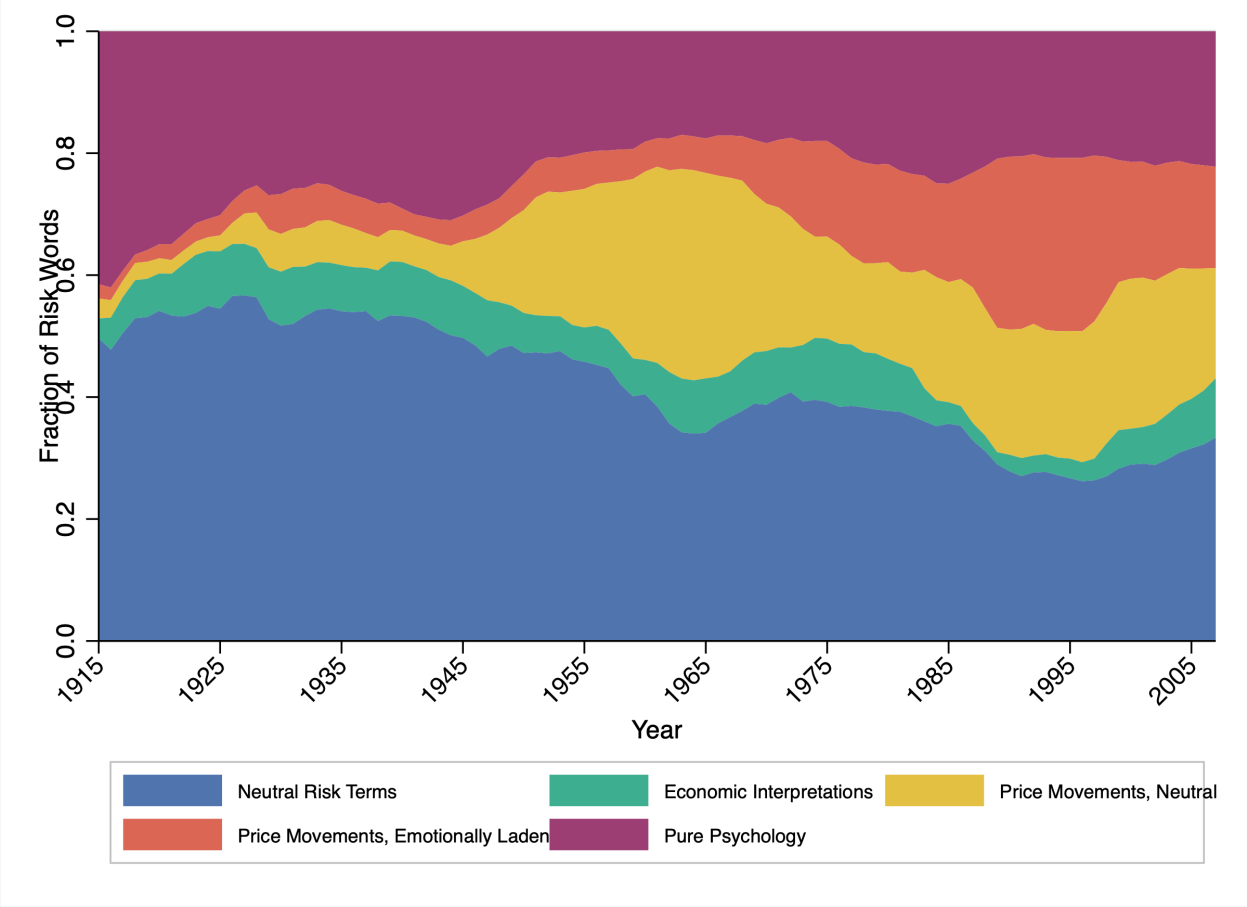
This Figure plots the number of uses of the string "volatile*" (i.e. volatile, volatility) as a fraction of all risk-terms appearing in the Wall Street Journal "Abreast of the Market" or New York Times Financial Markets column, between 1905 and 2007. The lighter gray line plots individual year's values, the heavier black line plots the ten-year rolling average. Vertical dashed lines indicate i) the publication year of Markowitz (1952), and ii) the date identified for a single structural break (1962) using a Supremum-Wald test on the annual values, with a p-value less than 0.0001

Figure 2 – Most Popular Risk-Related Words By Year



This Figure plots the three most common risk-related words appearing in the Wall Street Journal "Abreast of the Market" or New York Times Financial Markets column, between 1905 and 2007 (with each year representing ranks over the previous rolling 10 years). Rank 1 is the most common word, and rank 3 is the third most common.

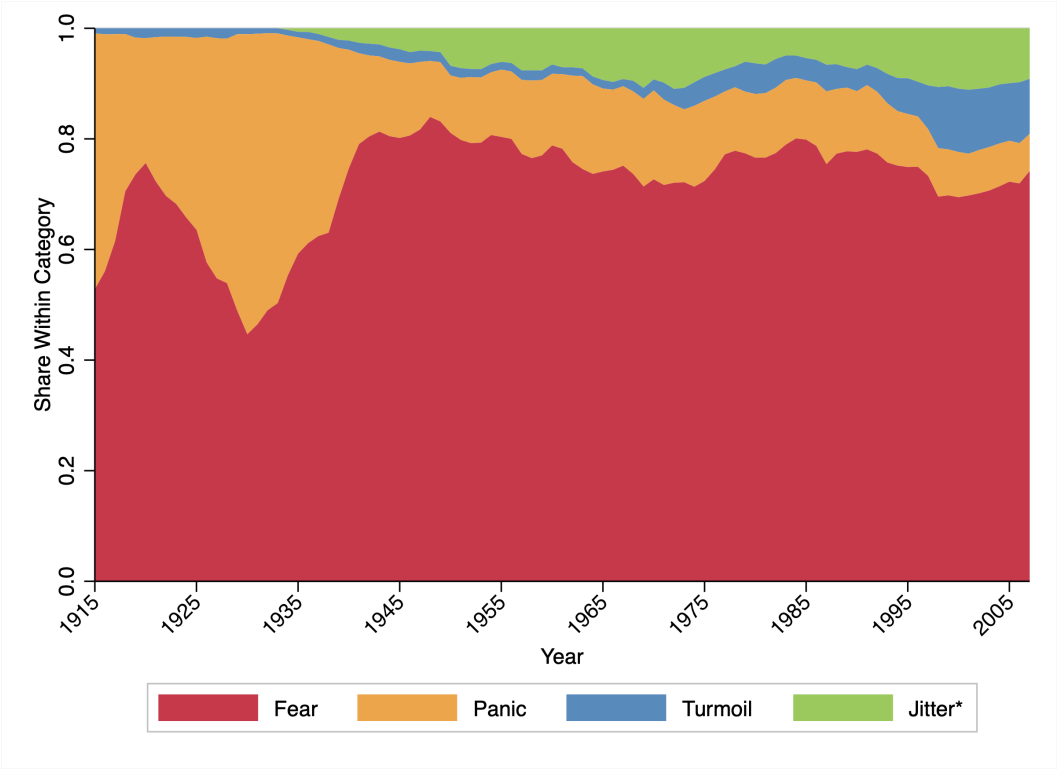
Figure 3 – Frequency of Risk-Word Categories in New York Times and Wall Street Journal



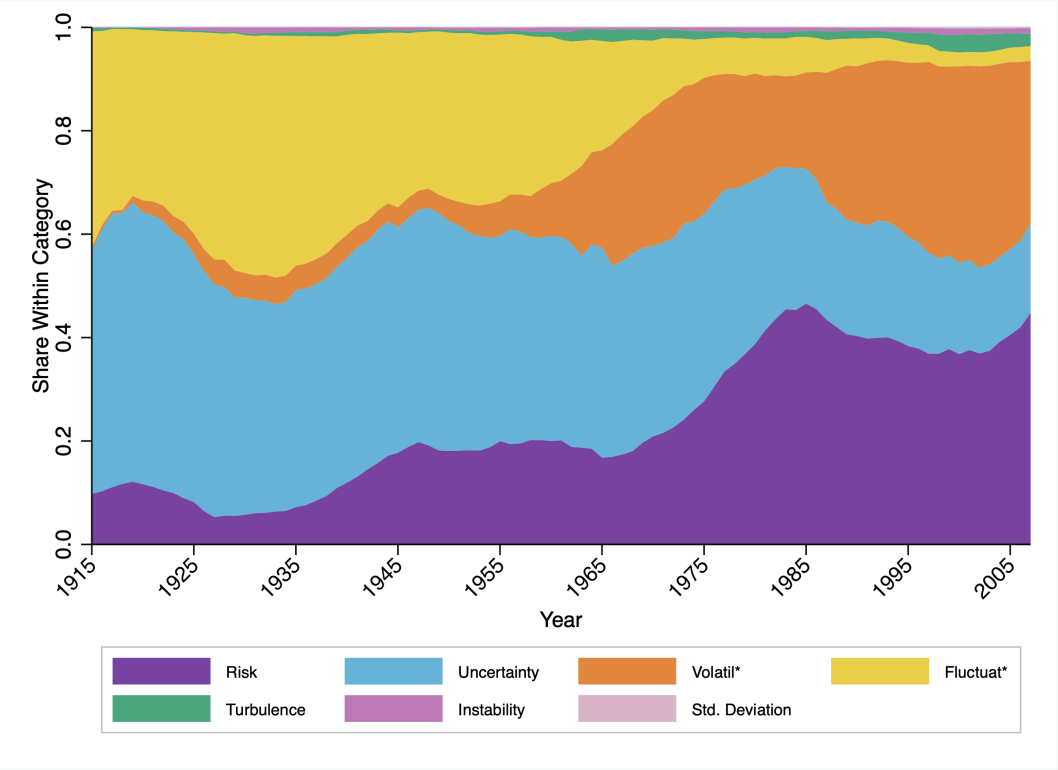
This Figure plots the fraction of all risk-related words across different categories of risk-terms appearing in the Wall Street Journal "Abreast of the Market" or New York Times Financial Markets column, between 1905 and 2007. Each plotted year takes the previous ten years' worth of articles across both papers, and computes the category total fraction of all risk-related words (i.e. all words in any category). The categories and words corresponding to them are: "Pure Psychology" = {Fear, Jitter*, Panic, Turmoil}, "Price-Related & Emotionally Laden" = {Crash, Plunge, Whipsaw, Meltdown}, "Price-Related & Neutral" = {Downturn, Sell-off, Correction}, "Economic Interpretations" = {Bubble, Crisis, Contagion}, "Risk-Related & Neutral" = {Fluctuat*, Instability, Uncertainty, Volatil*, Standard Deviation, Turbulence, Risk}

Figure 4 – Frequency of Risk-Related Words Within Each Category in NYT and WSJ

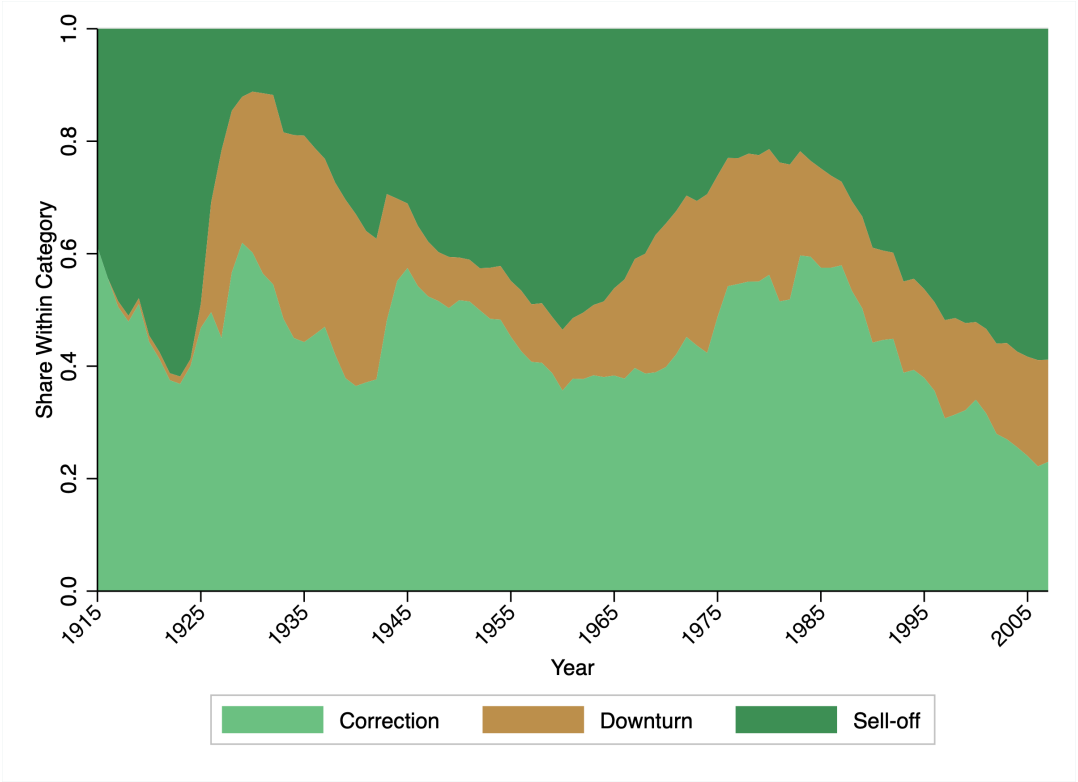
Panel A – Pure Psychology



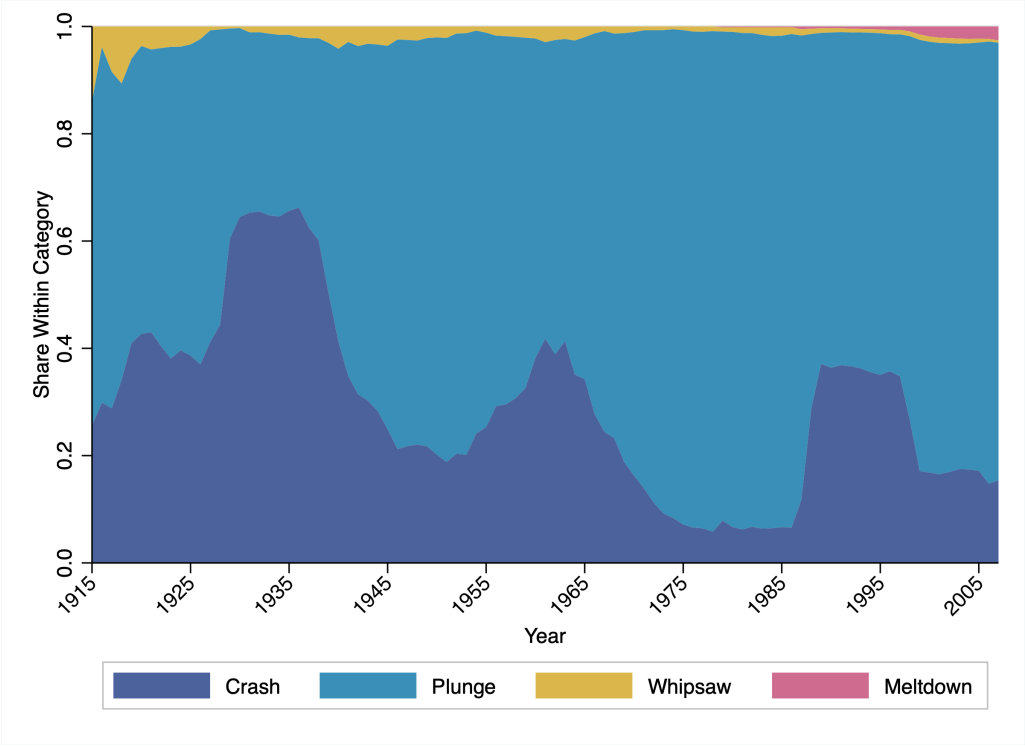
Panel B – Neutral Risk Terms



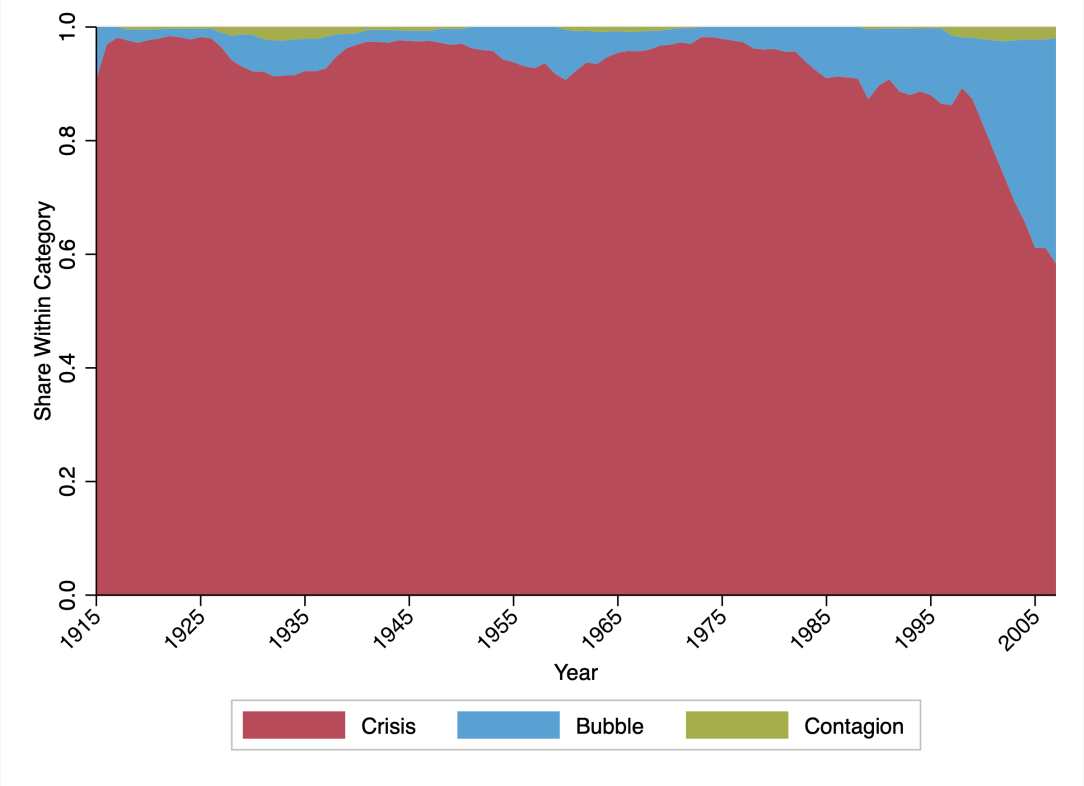
Panel C – Neutral Descriptions of Price Changes



Panel D – Emotionally Laden Descriptions of Price Changes



Panel E – Economic Interpretations



This Figure plots the fraction of all risk-related words within each different categories of risk-terms appearing in the Wall Street Journal "Abreast of the Market" or New York Times Financial Markets column, between 1905 and 2007. Each plotted year takes the previous ten years' worth of articles across both papers, and computes the category total fraction of all risk-related words (i.e. all words in any category). The categories and words corresponding to them are: "Pure Psychology" = {Fear, Jitter*, Panic, Turmoil} (Panel A), "Risk-Related & Neutral" = {Fluctuat*, Instability, Uncertainty, Volatil*, Standard Deviation, Turbulence, Risk} (Panel B), "Price-Related & Neutral" = {Downturn, Sell-off, Correction} (Panel C), "Price-Related & Emotionally Laden" = {Crash, Plunge, Whipsaw, Meltdown} (Panel D) and "Economic Interpretations" = {Bubble, Crisis, Contagion} (Panel E).