Empirical Asset Pricing: Applications in Academic Research

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Abstract

One of the most fundamental questions in finance with the most far-reaching consequence is how does one determine the value of an asset. The idea of how to price risk and estimate the return an asset should generate is central to many decisions that individuals, firms and governments must face. In their quest to understand how asset prices behave and the relationship between risk and return, academics have created the portfolio construction technique which is central to empirical asset pricing research. This article provides a brief historical overview of the portion of research on asset pricing relevant to the portfolio construction technique and reviews alternative academic uses for business-related questions.

Keywords: Asset Pricing Model, Portfolio Construction Method, Multifactor Model, Investment Performance

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วิธีกำหนดราคาสินทรัพย์เชิงประจักษ์: การประยุกต์ใช้ในงานวิจัยวิชาการ

*คณิสร์ แสงโชติ**

บทคัดย่อ

หนึ่งในคำถามที่สำคัญที่สุดของศาสตร์การเงินคือ วิธีการกำหนดราคาสินทรัพย์ ซึ่งแนวคิดวิธีการให้ค่าชดเชยความเสี่ยงและประมาณการผลตอบแทนที่ควรได้รับจากสินทรัพย์เป็นหัวใจของการตัดสินใจหลากหลายประเภทที่ไม่ว่าจะเป็นบุคคลธรรมดา บริษัทห้างร้านหรือหน่วยงานของรัฐต่างต้องเจอ ในการแสวงหาคำตอบและทำความเข้าใจพฤติกรรมของราคาสินทรัพย์และความสัมพันธ์ระหว่างความเสี่ยงและผลตอบแทน นักวิชาการได้คิดค้นเทคนิควิธีการจัดกลุ่มหลักทรัพย์ซึ่งเป็นหลักสำคัญของการวิจัยวิธีกำหนดราคาสินทรัพย์เชิงประจักษ์ บทความนี้มีจุดประสงค์ที่จะเล่าประวัติความเป็นมาโดยสังเขปของงานวิจัย วิธีกำหนดราคาสินทรัพย์ที่เกี่ยวข้องกับเทคนิค วิธีการจัดกลุ่มหลักทรัพย์และทบทวนการนำเทคนิคนี้ไปใช้ในงานวิจัยวิชาการด้านอื่นที่เกี่ยวข้องกับการบริหารธุรกิจ

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1. Introduction

One of the most fundamental questions in finance with the most far-reaching consequence is how does one determine the value of an asset. For example, an investor who is looking to buy a stock might be interested in the value of the stock, or a company which longs for rapid growth might look at merger and acquisition as a growth strategy. As noted by the Economic Sciences Prize Committee of the Royal Swedish Academy of Sciences for the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel in 2013, understanding the behavior of asset prices is essential for many important decisions, both at the microeconomic and macroeconomic levels. The choices between consumption and saving for individuals, physical investment for corporations, and even investment in public infrastructures by governments, all depend-to varying degrees-on prices.

Readers trained in finance are well-aware of the discounted cash flow (DCF) valuation technique, where one estimates the expected future cash flow (or benefit) that will be generated by an asset, then "discount" the stream of cash flow using an appropriate discount rate that accounts for the level of risk inherent in the asset. That said value is often referred to as the "fair value" or "intrinsic value" of the asset-a level which, when compared to actual trading price of the asset, provides a benchmark for evaluating whether an asset is overpriced or underpriced. The much-vaunted mantra of "buy low, sell high" is compared to this computed fair value. Thus, in efficient markets where participants can determine the value of assets with speed and accuracy, prices tend to reflect value and the opportunities to profit from mispricing disappear quickly.

To illustrate the idea, suppose we are valuing a stock. The expected future cash flow relevant for the asset under consideration is dividends.[1] With some knowledge and assumptions about the business of the firm under consideration, we can forecast the

[1]Technically speaking, an equity investor (someone who bought stocks of a company) receives free cash flow to equity, which is an unencumbered amount of cash flow that can be distributed back to shareholders after meeting requirements for investments and repayment of debt. Under certain assumptions about how cash is distributed to shareholders, this amount is equivalent to dividend payments.

dividends that we expect the firm to pay in the future. The expected future cash flow, of course, is risky: we do not know for certain how much the firm can actually pay. As most investors generally dislike risk, we would like to receive the “fair” compensation for the amount of risk we are taking-hence another millennia-old adage of “high risk-high return”. From an investment perspective, we often refer to the discount rate as the required return that appropriately compensates investors for the risk.

At this point, two question arises: first, what kind of risk should be rewarded, and second, how much reward should be given for a certain amount of risk. Both of these are big-picture questions as they essentially pertain to how we evaluate risk-return tradeoffs, and both of them are addressed by a single number: the discount rate.

While both asset cash flows and discount rates matter for the process of valuation, typically researchers focus on only asset returns. Given that the forecasts of expected future cash flows tend to be more asset-specific while the determinants of discount rate are more general, it is not surprising that much emphasis is given to understanding the discount rate. Theoretical research in asset pricing has provided us with frameworks that help us understand the linkage between risk, return and hence asset prices (e.g., Markowitz, 1952; Treynor, 1961, 1962; Sharpe, 1964; Lintner, 1965; Mossin, 1966; Ross, 1978), and empirical research puts the frameworks to test and investigates whether asset prices (or returns) behave in the way we predict them to or not (e.g., Fama and MacBeth, 1973; Fama and French, 1993; Carhart. 1997).

The research on asset pricing not only sheds light on the big question in finance, but it also yields a very important byproduct: a framework for evaluation. Readers will see in subsequent section that in evaluating whether an asset pricing model is correctly specified, we rely on the “alpha” of the estimated model. If a model works, then we expect to see alpha take the value of zero. However, suppose we take a stance that the asset pricing model is correctly specified, the alpha now takes on entirely different meanings. This could be the skill of an investment manager, the better-than-expected profit from a trading strategy, or a greater-than-anticipated value created by corporate managers. All of these interpretations are very useful for researchers of different finance topics, as well as business-related fields.

In this article, I will first briefly discuss the history of asset pricing research that relate to the portfolio construction technique, beginning with the theoretical background in section 2, then empirical testing of such theories in section 3.[2] In due course, empirical asset pricing researchers invented a very powerful technique that has since been adopted in a variety of applications, opening up new research possibilities even in fields beyond finance. This is the main contribution of this article, which will be discussed in section 4. Section 5 concludes this article.

2. Fundamentals of Asset Pricing

At the core of asset pricing is the idea that markets should be free of arbitrage opportunities. With no arbitrage opportunity, risky assets can be priced relative to their payoffs under different states of the world.[3] The work of Ross (1978) and Harrison and Kreps (1979) on general equilibrium under uncertainty provides the foundation for modern asset pricing. To illustrate the idea, let s denote possible states of the world, where $s = 1, ..., S$. Each state has its own probability $\pi(s)$ such that $\sum_{s \in S} \pi(s) = 1$. Define a contingent claim as an asset that pays 1 when whenever state s occurs with price of $q(s)$ - that is, $q(s)$ is the "state price" for state s. If markets are complete (in a sense that we have tradable contingent claims for every possible states of the world, so any payoff pattern in the world can be achieved by bundling relevant contingent claims together), at any given time t, the value of any asset or investment opportunity whose payoff in state s is $x(s)$ can be written as:

[2] Readers should note that this article is not meant to be a complete review of asset pricing research. The objective of this article is to provide enough background so that readers understand the rationale behind the portfolio construction technique often credited to Fama and French (1993). There are other important topics which are not addressed in this article (e.g. Consumption-Based CAPM, Generalized Method of Moments and behavioral finance). For further readings, the book "Asset Pricing" by Cochrane (2005) and the Scientific Background on the Sveriges Riks bank Prize in Economic Sciences in Memory of Alfred Nobel in 2013 compiled by the Royal Swedish Academy of Sciences are excellent references.

[3] In the crudest sense, different states of the world can be events like disaster/no disaster, global geopolitical events or economic conditions. In reality, there can be infinitely many possible states of the world. Theoretical frameworks typically deal with finite states of the world, but the intuition of these models generally follows when we extend to infinite possibilities.

$$P_t(x) = \sum_{s=1}^{S} q_{t+1}(s) x_{t+1}(s) \tag{1}$$

That is, any asset or investment opportunity can be represented as a collection of contingent claims. Let us multiply and divide equation (1) by $\pi_{t+1}(s)$ and define $m_{t+1}(s) = \frac{q_{t+1}(s)}{\pi_{t+1}(s)}$, we have:

$$\begin{aligned} P_t(x) &= \sum_{s=1}^{S} \pi_{t+1}(s) \frac{q_{t+1}(s)}{\pi_{t+1}(s)} x_{t+1}(s) \\ &= \sum_{s=1}^{S} \pi_{t+1}(s) m_{t+1}(s) x_{t+1}(s) \\ &= E_t[m_{t+1} x_{t+1}] \end{aligned} \tag{2}$$

m_{t+1} is known as the stochastic discount factor, which is the central piece for asset pricing. The dependence of $m_{t+1}(s)$ on the state of the world s highlights the fact that the degree of discounting may be different for each state of the world: there may be some states which we care about more than others. Thus the value of any asset depends on both the level of the payoff and the weight we attach to different states of the world, as described by equation (2).

Using this asset pricing framework, let us consider two assets: the risk-free asset, and risky asset. The risk-free rate provides a fixed payoff with certainty across all states of the world. For this case, let that payoff be 1, so that $x_{t+1}(s) = 1 \ \forall s$ (in other words, the risk-free asset is a bundle of every possible contingent claims). Let $\mathbb{I}$ be a vector that has value one in all states of the world and $P_{f,t}$ be the price of the risk-free asset at t, then the pricing equation for the risk-free asset can be written as follow:

$$E_t[m_{t+1}\mathbb{I}] = E_t[m_{t+1}] = \sum_{s=1}^{S} q_{t+1}(s) = P_{f,t} \tag{3}$$

Define the risk-free rate of return $r_{f,t}$ as $r_f = \frac{1}{P_{f,t}} - 1$, we have $E_t[m_{t+1}] = \frac{1}{1+r_{f,t}}$ and therefore $1 + r_{f,t} = \frac{1}{E_t[m_{t+1}]}$. Since the risk-free rate is generally very low, the stochastic discount factor must be fairly close to one.

The risky asset provides two types of payoff: cash payoff, and changes in asset value (which may increase or decrease). Letting d_{t+1} denote the cash payoff at $t+1$ and P_{t+1} denote the asset value at $t+1$, the payoff $x_{t+1} = d_{t+1} + P_{t+1}$. By iterating the pricing equation and using the Law of Iterated Expectations, we can write equation (4).

$$\begin{aligned} P_t(x) &= E_t[m_{t+1}(d_{t+1} + P_{t+1})] \\ &= E_t\big[m_{t+1}d_{t+1} + m_{t+1}E_{t+1}[m_{t+2}(d_{t+2} + P_{t+2})]\big] \\ &= E_t[m_{t+1}d_{t+1}] + E_t\big[m_{t+1}E_{t+1}[m_{t+2}d_{t+2}]\big] \\ &\qquad + E_t\Big[m_{t+1}E_{t+1}\big[m_{t+2}E_{t+2}[m_{t+3}d_{t+3}]\big]\Big] + \cdots \\ &= \sum_{k=1}^{\infty} E_t\left[\prod_{h=1}^{k} m_{t+h}\, d_{t+k}\right] \end{aligned} \tag{4}$$

Equation (4) suggests that the price of the risky asset is the sum of the weighted expected future cash payoff from the asset. Notice the stochastic discount factor is the same for all assets in the economy, while the DCF framework that we are familiar with uses a discount rate that is specific to the asset. Thus the discount rate that we are familiar with is a combination of the stochastic discount factor and the risk profile of the asset (reflected in d_{t+k} in this framework). Using the covariance expansion of $cov_t(m_{t+1}, x_{t+1}) = E_t[m_{t+1}x_{t+1}] - E_t[m_{t+1}]E_t[x_{t+1}]$ and the fact that $E_t[m_{t+1}] = \frac{1}{1+r_{f,t}}$, we can rewrite equation (4) as follow:

$$P_t(x) = \frac{E_t[x_{t+1}]}{1 + r_{f,t}} + cov_t(m_{t+1}, x_{t+1}) \tag{5}$$

This rearrangement yields an interesting insight into how assets are priced: the first term represents risk-free discounting of future payoff, and the second term represents state-dependent discounting. The risk-free discounting reflects the elasticity of intertemporal substitution, i.e. how one values consumption today versus delaying to the future, ignoring uncertainties, while the state-dependent discounting reflects the degree of risk aversion and the compensation required for the risk that the asset possesses, i.e. the risk exposure of the asset. Following Shiller (1981), multiplying and dividing the second term with $E_t[x_{t+1}]$ and defining the asset-specific discount factor $\delta_t = \frac{1}{1+r_{f,t}} + \frac{cov_t(m_{t+1}, x_{t+1})}{E_t[x_{t+1}]}$ brings us back to the familiar DCF framework.

$$P_t(x) = \frac{E_t[x_{t+1}]}{1+r_{f,t}} + \frac{cov_t(m_{t+1}, x_{t+1})}{E_t[x_{t+1}]} E_t[x_{t+1}] \qquad (6)$$
$$= \delta_t E_t[x_{t+1}]$$

Most of the time, we are interested in asset returns are than prices, so we work with the pricing equation for returns rather than payoffs. Define the return of asset i by $1 + r_{i,t} = \frac{x_{i,t+1}}{P_t(x)}$. Equation (6) becomes:

$$1 = \frac{E_t[1+r_{i,t}]}{1+r_{f,t}} + cov_t(m_{t+1}, r_{i,t})$$
$$E_t[1+r_{i,t}] = (1+r_{f,t})\left(1 - cov_t(m_{t+1}, r_{i,t})\right) \qquad (7)$$

Now subtract $1 + r_{f,t}$ from both sides and define return in excess of the risk-free rate as $r^e_{i,t} = r_{i,t} - r_{f,t}$, we get an expression that measures the risk premium (i.e. the risk compensation) for a risky asset i, which, like before, depends on the risk profile of the asset and the values of the stochastic discount factor, m_{t+1}.

$$E_t[r^e_{i,t}] = -(1+r_{f,t}) cov_t(m_{t+1}, r_{i,t} - r_{f,t}) \qquad (8)$$

Note that, so far, equation (7) and (8) are theoretical representations of the asset pricing equation, which are mathematically true. In order to test this against the data, we turn our attention to the next challenge: what exactly is m_{t+1}?

3. Empirical Asset Pricing Research

It is clear that the key ingredient in asset pricing is the form of the stochastic discount factor, m_{t+1}, which is supposed to reflect the pricing of risks in economy. So what kinds of risks should be priced? The central insight of Markowitz (1959) is that, with diversification, only systematic (non-diversifiable) risk should be rewarded, but the question of what constitutes systematic risk still remains.

The early years of empirical asset pricing research focus on several classes of factor pricing models, which specify "factors" that capture systematic risk, mostly in the linear form (i.e. $m_{t+1} = a + b'f_{t+1}$). The exposures to these risk factors would then explain the cross-sectional variation in asset returns.[4] The most well-known and widely-taught class of factor models is the Capital Asset Pricing Model (CAPM), which was developed independently by Treynor (1961, 1962), Sharpe (1964), Lintner (1965) and Mossin (1966). The CAPM uses the wealth portfolio as pricing factor (proxied by market portfolio, hence often referred to as the "market" model), so the pricing equation becomes:

$$E_t\left[r_{i,t}^e\right] = \beta_{i,m} E_t\left[r_{m,t} - r_{f,t}\right] \quad (9)$$

Empirically, the CAPM does not work very well. Either because the model-implied risk-free rate represented by the intercept of the estimated pricing equation seem high compared to observed risk-free rate (see, for example, Black, Jensen and Scholes, 1972; Black and Scholes, 1973; Fama and MacBeth, 1973), or because there are other "anomalies" such as size, leverage, book-to-market ratios, momentum and seasonality, not explained by the market model (see, for example, Basu, 1977, 1983; Banz, 1981; DeBondt and Thaler, 1985; Rosenberg, Reid, and Lanstein, 1985; Bhandari, 1988).[5] Nevertheless, Fama and French (1992) show that much of the anomalies can be explained by variations in book-to-market ratio and firm size.

Over the course of time, other pricing models that incorporate factors beyond the realm of the traditional CAPM were in development, starting from the Intertemporal CAPM (ICAPM) of Merton (1973), and the Arbitrage Pricing Theory of Ross (1976) that allow for non-market factors such as macroeconomic shocks as measures of systematic

[4] The time-series determinants of returns are also a research question of great interest with a literature of its own, but it is not the focus of this article.

[5] These deficiencies are in addition to the critique by Roll (1977) that using the stock index as proxy for the wealth portfolio lead to misleading results, and any such test of the CAPM would, in essence, be a joint test of the model itself and the proxy for the wealth portfolio.

risk, provide the theoretical foundation for the multifactor models.[6] On the empirical side, the work of Fama and French (1993) introduced portfolio "sorts" as a factor-construction technique to augment the single-factor market model of the CAPM.[7]

A good asset pricing model should be able to explain variations in assets returns, so how does one put the model to test? Let f_t be a $k \times 1$ vector of factors, and β_i be a $k \times 1$ vector of "factor loadings" for asset i (think of this as the contribution that each factor has for the asset under consideration), then a linear factor pricing model for asset i takes the form of equation (10). The equation is then estimated and if the pricing model works, we would expect to see $\hat{\alpha} = 0$ (and very high adjusted R-squared statistics).

$$r_{i,t}^{e} = \alpha_i + \beta_i' f_t + \varepsilon_{i,t} \qquad (10)$$

There are several tests available but the most prominent ones employed are the two-stage estimation procedure and test developed by Fama and MacBeth (1973), commonly referred to as the Fama-MacBeth regression, and the test proposedby Gibbons, Ross and Shanken (1989), known as the GRS test.

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[6] An important strand of asset pricing research is the Consumption-Based CAPM (CCAPM) based on the work of Merton (1973), Lucas (1978) and Breeden (1979) which focuses on the utility-maximizing consumption and saving problem of the representative agent. In this class of model, the stochastic discount factor represents the ratio of the agent's marginal utility of consumption, which, in turn, depends on the intertemporal elasticity of substitution and risk aversion. However, since the focus of this article is on the portfolio construction technique which is rooted in the multifactor model, I omit the discussion of CCAPM.

[7] The factors that were added by Fama and French (1993) were SMB ("small-minus-big"), based on market capitalization of the stock and HML ("high-minus-low"), based on the book-to-market ratio. The idea is to construct zero-cost (long-short) portfolios based on stock characteristics and include them into the pricing equation. In essence, most factor models are zero-cost portfolios models, as the CAPM market factor is a portfolio of investing in the market portfolio (long position) and borrowing in the risk-free asset (short position). In the Fama-French 3-factor model, this is referred to as the MKT factor. So for the SMB factor, one would need to sort stocks based on their market capitalization and decide on how to segment them, then a portfolio is formed by taking a long position in small stocks and short position in big stocks. This sorting process is the cornerstone of factor construction in the spirit of Fama and French.

The zero-cost portfolio approach (often referred to as the "style" portfolios) and the corresponding tests allow researchers to formulate hypotheses about the determinants of systematic risk, construct tradeable factors, and empirically test them in a scientific way. The book-to-market ratio and market capitalization factors identified in Fama and French (1993) formed the basis for the Fama-French 3-factor model which has been widely used by both researchers and market practitioners. Around the same time, Jegadeesh and Titman (1993) documented that asset returns tend to be serially correlated, which Carhart (1997) later formalized into a momentum factor; this extension is known as the Carhart 4-factor model. More recently, Titman, Wei and Xie (2003) found that firms with high investment rates tend to underperform firms with low investment rates, while Novy-Marx (2013) found that firms with higher gross profitability tend to outperform firms that have lower profitability and proposed a factor based on profitability sort.[8]

While the byproducts of these factors are tradeable strategies, the ultimate goal of this strand of research is to understand the determinants of risks and hence asset value. In addition to allowing researchers to address the big question in finance, the portfolio construction technique opened new research possibilities, even in areas previously thought to be unrelated to asset pricing.

4. Applications of the Portfolio Construction Technique

4.1 Investment Performance Evaluation

The natural application of the portfolio construction technique lies in the realm of portfolio management and performance evaluation. After all, these anomalies are supposedly returns that are in excess of what asset pricing models predict one should earn. Let us suppose that a pricing model is correct. Then, given this yardstick, investment managers are judged based on the "alpha" they are able to generate for their investors, after adjusting for management fees and turnovers. The choice of yardstick depends by and large on the preference of researchers, but the most common models used are variants and extensions of the Fama-French 3-factor model.

[8] Both of these factors have since been consolidated by Fama and French (2015) into the Fama-French 5-factor model.

While the performance evaluation strand of research tries to answer the question of whether hiring active fund managers is necessary, the portfolio management strand tends to look for profitable trading strategies. Market phenomena that are described as anomalies are, in essence, such trading strategies. The familiar work of Fama and French (1993), Jegadeesh and Titman (1993), Carhart (1997), Titman, Wei and Xie (2013) and Novy-Marx (2013) started off as documentation of such anomalies before providing economics rationale and formally constructing a tradeable, market-based factors. From a corporate finance perspective, one can think of these factors as firm characteristics that are sources of value creation. This point will be elaborated further in section 4.3.

In one of the first application of the CAPM (single factor model), Jensen (1968) measures the performance of U.S. mutual funds during 1945-1964 using the CAPM alpha, often referred to as the Jensen's alpha. Elton, Gruber, Das, and Hlavka (1993). use a similar approach, augmenting the S&P 500 benchmark index with the non-S&P equity index and bond index to broaden the proxy of investor's wealth. Carhart (1997) is among the first papers to employ the Fama-French 3-factor model as the benchmark, extending it with a factor-mimicking portfolio constructed based on the finding of Jegadeesh and Titman (1993) (i.e. Carhart 4-factor model). Nevertheless, even as our understanding of returns determinants progress, much of the literature on fund performance evaluation relies on the Carhart 4-factor model (Daniel, Grinblatt, Titman, and Wermers, 1997; Baks, Metrick, and Wachter, 2001; Pástor and Stambaugh, 2002; Avramov and Wermers, 2006; Banegas, Gillen, Timmermann, and Wermers, 2013; Berk and Van Binsbergen, 2015).[9]

[9] Recent papers have adopted the Fama-French 5-factor model, e.g. Jordan and Riley (2015). Nevertheless, the Carhart 4-factor model and Fama-French models are not the only asset pricing models available at researcher's disposal. For example, there are other market-based factors that have been shown to price assets, such as liquidity (Pástor and Sambaugh, 2003), volatility (Ang, Hodrick, Xing, and Zhang, 2006; 2009) and optionality (Agarwal and Naik, 2004).

4.2 Market Efficiency

On occasion, the portfolio construction technique has also been employed to test the efficiency of markets. In efficient markets, information relevant for corporate valuation is disseminated quickly and hence prices tend to reflect the intrinsic values of assets. For marginal investors, it is impossible to earn abnormal returns-in other words, alphas. Often, however, one hear of anecdotes suggesting that assumptions that underlie efficient markets are violated; for example, the most notable is the assumption that market is arbitrage-free. For asset prices to converge to their intrinsic values, the typical textbook explanation is that arbitrageurs will trade away any mispricing in the market. Such arbitrageurs will take zero risk exposure and employ zero capital. However, in reality, to engage in such trades, arbitrageurs often take both risk and capital. In addition, arbitrage opportunities may require short selling, which may not always be available to general investors. In the presence of these "limits to arbitrage", Shleifer and Vishny (1997) argue that anomalies in financial markets can appear.[10]

Much of the empirical work done in this strand aims to reconcile the anomalies with institutional features of the market that jeopardize market efficiency. Often, the causes of frictions can be institutional; the short-selling constraint being the obvious one. Lamont (2012) documents that firms that employ anti-shorting mechanisms (e.g. legal threats, investigations and lawsuits) against investors are overpriced (i.e. abnormal negative alphas). Consistent with the finding of Lamont (2012), Grullon, Michenaud and Weston (2015) use a regulatory experiment that relaxes short-selling constraints to show that increased short-selling activity causes prices to fall and also reduces real investments. Drawing on the fact that many groups of investors, such as individuals, pension funds and mutual funds, are constrained in the leverage that they can take, Frazzini and Pedersen (2014) argue that these investors tend to overweight in risky assets instead of using leverage, bidding up the prices of high beta asset (and hence lowering their required returns). That is, asset alphas are decreasing in their betas.

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[10] Earlier works in mutual fund performance (e.g. Ippolito, 1989) also interpreted the fund alphas as evidence of market inefficiency.

Some frictions are caused by investors' limitations, or under/overreaction to news. For example, Ikenberry, Lakonishok and Vermaelen (1995) find that investors underreact to news of repurchases. Share repurchases are often conducted to signal to the market that the firm is undervalued, yet the market seems to not react much upon announcement but rather adjust over time. Cohen and Lou (2012) show that conglomerates react more slowly to the same news than standalone firms. For a given event, investors can earn abnormal returns (alphas) by trading stocks of conglomerates after observing the stock market reaction of comparable standalone firms, as there are delays in processing news in "complicated" firms (i.e. conglomerates) as investors' processing capacity is limited. Li and Yu (2012) show that investors seem to use Dow 52-week high and historical high as reference points in forming their expectations about future market returns.

4.3 Determinants of Corporate Value

However, in addition to asset pricing-related research, the portfolio construction technique is often utilized in corporate finance studies. The goal of the firm is to maximize shareholder value, which can also be measured in terms of shareholder returns. However, in measuring returns, the same issue that appears in investment evaluation still applies: investors look to maximize returns while minimizing risks. As such, abnormal returns provide a useful measure with which one could judge whether certain corporate actions or characteristics are creating unanticipated value for shareholders or not.

This approach has a distinct advantage over using traditional, accounting-based measures such as operating profit margin, return on sales (ROS), return on assets (ROA) or return on equity (ROE), which are available over shorter frequencies and often employed at the annual frequency. Corporate actions that are often of interest include, but are not limited to, share issuances, share repurchases, dividend payments, earnings management, and corporate governance.

Loughran and Ritter (1995) find that investments in initial public offerings (IPO) and seasoned equity offerings (SEO) of shares tend to underperform, giving rise the famous IPO Puzzle in finance research. For dividend payments, Asquith and Mullins (1983); Michaely, Thaler, and Womack, (1995) are among the early studies that document price reactions to changes in dividend policy, but later Boehme and Sorescu (2002) use a variant of the Fama-French 3-factor model to re-examine the long-run abnormal returns and conclude that part of the reaction is due to changes in risk loadings of the stocks after the dividend event. Bessembinder and Zhang (2013, 2015) examine broader classes of corporation actions, such as M & A, special dividends, stock dividends or stock splits.

For corporate governance, the most well-known study is probably Gompers, Ishii and Metrick (2003), which finds that firms with stronger governance (in terms of takeover defenses and shareholder rights) earn abnormal returns compared to firms with weaker governance. Cremers and Nair (2005); Bebchuk, Cohen, and Ferrell, (2009) arrive at a similar conclusion that firms with stronger governance tend to perform better. In their 2010 study, Gompers, Ishii and Metrick explore an alternative definition of governance by examining firms with dual-class equity that separate cash-flow rights and voting rights and find that there are no abnormal returns to firms with governance classified under this definition.

4.4 Non-Finance Applications

Assessment of corporate value need not be limited to financial actions or characteristics of the firm; rather, any business-related concepts such as innovation, marketing, operations management, or competitive strategy can be evaluated using this framework as well.

Eberhart, Maxwell, and Siddique, (2004) find that firms experience positive abnormal returns after they unexpectedly increase their R & D expenditure, while Sood and Tellis (2009) broaden the definition of innovation to several events and find that markets react to development activities such as commercialization of technology the most, and new product launch the least. More recent evidence seems to suggest that a firm's ability to innovate is predictable based on their past track record, as documented by Cohen, Diether, and Malloy, (2013).

In addition to documenting abnormal returns to R & D, Chan, Lakonishok, and Sougiannis (2001) also document a similar pattern in advertising expenditure, underlining the importance of investments in intangible assets such as brand capital. The idea is taken further by Fehle, Fournier, Madden, and Shrider, (2008) who directly demonstrate superior returns of strong-brand firms as defined by Interbrand's rankings. Maintaining a good relationship with the local media by advertising is also another way to influence returns, as Fang and Peress (2009) and Gurun and Butler (2012) find that firms which receive positive media coverage tend to earn positive alphas.

Turning our attention to operations management, Chen, Frank, and Wu, (2005, 2007) use the portfolio construction technique by sorting stocks based on abnormal inventory and the Fama-French 3-factor model to document that inventory management performance is reflected in stock returns. Hendricks, Singhal, and Zhang, (2009) examine the effect of supply chain disruption on stock returns and find that firms that maintain operational slack tend to experience less negative stock market reaction. Even in the discipline of competitive strategy, the technique has been used by Hou and Robinson (2006) to show that firms in more concentrated industries earn lower returns because they engage less in innovation, highlighting the relationship between competitive advantage and value creation.

While many of these examples are published in finance and economic journals, it is becoming more common in journals of other fields as well, such as marketing or management science. In my opinion, this technique presents a potentially fruitful opportunity for researchers in business-related fields to explore questions from a fresh, new perspective.

4.5 Limitations of the Technique

As convenient as it is, the portfolio construction technique relies on financial markets as the business barometer. Aside from the discussion of whether markets are efficient or not, the Achilles heel of this technique is that the subjects of study must be listed in the stock market and traded on a regular basis. Needless to say, without listing, prices-and hence returns-do not exist.[11] This limits the scope of study to firms that are well-established and have sufficiently long track records in the stock market. In many countries, the main economic engine may comprise private, unlisted SMEs, precluding researchers from generalizing their findings to the larger population.

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[11] One may argue that, for unlisted firms, returns can be still imputed from valuation models, but such valuation outputs are subject to assumption and not vetted by the "wisdom of the crowd" that market-based price data incorporates.

Second, abnormal returns (and hence value creation) are output of a black box. Without attempting to understand the mechanisms through which value is created, researchers may lose sight of the underlying economics. Unlike traditional micro econometric techniques that aim to reduce endogeneity problems, the original aim of the portfolio construction technique is not to document causality, so researchers must be extra careful when using this technique and discuss clearly what the economics of the transmission mechanism are.

5. Summary

In this article, I provide a brief historical overview of the research on asset pricing that is related to the portfolio construction technique. The idea of how to price risk and estimate the return an asset should generate is central to many decisions that individuals, firms and governments must face. The Sveriges Riks bank Prize in Economic Sciences in Memory of Alfred Nobel in 2013 awarded to Eugene Fama, Lars Hansen and Robert Shiller-the pioneers of asset pricing research-serves as a testament to how advances in this field have changed our everyday life. In their quest to understand how asset prices behave and the relationship between risk and return, academics have created a very powerful technique that allows us to address questions in fields beyond the origin of the technique. If one takes the stance that a given pricing model is correct, then the alphas, initially intended to be used to evaluate the accuracy of asset pricing models, can be used as measure of skill, to assess market efficiency, and to measure value creation in corporate finance research. Given access to historical data, the portfolio construction technique can be easily implemented and is very helpful to both finance practitioners and researchers, as well as researchers in business-related fields, as an alternative approach that allows us to assess practices that create or destroy values in businesses.

References

Agarwal, V., & Naik, N. Y. (2004). Risks and portfolio decisions involving hedge funds. ***Review of Financial Studies,*** *17*(1), 63-98.

Ang, A., Hodrick, R. J., Xing, Y., & Zhang, X. (2006). The cross-section of volatility and expected returns. ***The Journal of Finance,*** *61*(1), 259-299.

Ang, A., Hodrick, R. J., Xing, Y., & Zhang, X. (2009). High idiosyncratic volatility and low returns: International and further US evidence. ***Journal of Financial Economics,*** *91*(1), 1-23.

Asquith, P., & Mullins Jr, D. W. (1983). The impact of initiating dividend payments on shareholders' wealth. J***ournal of Business,*** 77-96.

Avramov, D., & Wermers, R. (2006). Investing in mutual funds when returns are predictable. ***Journal of Financial Economics,*** *81*(2), 339-377.

Baks, K. P., Metrick, A., & Wachter, J. (2001). Should investors avoid all actively managed mutual funds? A study in Bayesian performance evaluation. ***The Journal of Finance,*** *56*(1), 45-85.

Banegas, A., Gillen B., Timmermann A., & Wermers R. (2013). "The cross section of conditional mutual fund performance in European stock markets." ***Journal of Financial Economics*** *108*(3), 699-726.

Banz, R. W. (1981). The relationship between return and market value of common stocks. ***Journal of Financial Economics,*** *9*(1), 3-18.

Basu, S. (1977). Investment performance of common stocks in relation to their price-earnings ratios: A test of the efficient market hypothesis. ***The Journal of Finance,*** *32*(3), 663-682.

Basu, S. (1983). The relationship between earnings' yield, market value and return for NYSE common stocks: Further evidence. ***Journal of Financial Economics,*** *12*(1), 129-156.

Bebchuk, L., Cohen, A., & Ferrell, A. (2009). What matters in corporate governance?. ***Review of Financial Studies,*** *22*(2), 783-827.

Berk, J. B., & Van Binsbergen, J. H. (2015). Measuring skill in the mutual fund industry. ***Journal of Financial Economics,*** *118*(1), 1-20.

Bessembinder, H., & Zhang, F. (2013). Firm characteristics and long-run stock returns after corporate events. ***Journal of Financial Economics,*** *109*(1), 83-102.

Bessembinder, H., & Zhang, F. (2015). Predictable corporate distributions and stock returns. ***Review of Financial Studies,*** *28*(4), 1199-1241.

Bhandari, L. C. (1988). Debt/equity ratio and expected common stock returns: Empirical evidence. ***The Journal of Finance,*** *43*(2), 507-528.

Jensen, M. C., Black, F., & Scholes, M. S. (1972). The capital asset pricing model: Some empirical tests.

Black, F., & Scholes, M. (1973). The pricing of options and corporate liabilities. ***The Journal of Political Economy,*** 637-654.

Boehme, R. D., & Sorescu, S. M. (2002). The Long-run Performance Following Dividend Initiations and Resumptions: Underreaction or Product of Chance?. ***The Journal of Finance,*** *57*(2), 871-900.

Bondt, W. F., & Thaler, R. (1985). Does the stock market overreact?. ***The Journal of Finance,*** *40*(3), 793-805.

Breeden, D. T. (1979). An intertemporal asset pricing model with stochastic consumption and investment opportunities. ***Journal of Financial Economics,*** *7*(3), 265-296.

Carhart, M. M. (1997). On persistence in mutual fund performance. ***The Journal of Finance,*** *52*(1), 57-82.

Chan, L. K., Lakonishok, J., & Sougiannis, T. (2001). The stock market valuation of research a nd development expenditures. ***The Journal of Finance,*** *56*(6), 2431-2456.

Chen, H., Frank, M. Z., & Wu, O. Q. (2005). What actually happened to the inventories of American companies between 1981 and 2000?. ***Management Science,*** *51*(7), 1015-1031.

Chen, H., Frank, M. Z., & Wu, O. Q. (2007). US retail and wholesale inventory performance from 1981 to 2004. ***Manufacturing & Service Operations Management,*** *9*(4), 430-456.

Cochrane, J. H. (2005). *Asset Pricing: (Revised Edition).* Princeton University Press.

Cohen, L., & Lou, D. (2012). Complicated firms. ***Journal of Financial Economics,*** *104*(2), 383-400.

Cohen, L., Diether, K., & Malloy, C. (2013). Misvaluing innovation. ***Review of Financial Studies,*** hhs183.

Cremers, K. J., & Nair, V. B. (2005). Governance mechanisms and equity prices. ***The Journal of Finance,*** *60*(6), 2859-2894.

Daniel, K., Grinblatt, M., Titman, S., & Wermers, R. (1997). Measuring mutual fund performance with characteristic-based benchmarks. ***The Journal of Finance,*** *52*(3), 1035-1058.

Eberhart, A. C., Maxwell, W. F., & Siddique, A. R. (2004). An examination of long-term abnormal stock returns and operating performance following R & D increases. ***The Journal of Finance,*** *59*(2), 623-650.

Elton, E. J., Gruber, M. J., Das, S., & Hlavka, M. (1993). Efficiency with costly information: A reinterpretation of evidence from managed portfolios. ***Review of Financial Studies,*** *6*(1), 1-22.

Fang, L., & Peress, J. (2009). Media coverage and the cross-section of stock returns. ***The Journal of Finance,*** *64*(5), 2023-2052.

Fama, E. F., & French, K. R. (1992). The cross-section of expected stock returns. ***The Journal of Finance,*** 47(2), 427-465.

Fama, E. F., & French, K. R. (1993). Common risk factors in the returns on stocks and bonds. ***Journal of Financial Economics,*** *33*(1), 3-56.

Fama, E. F., & French, K. R. (2015). A five-factor asset pricing model. ***Journal of Financial Economics,*** *116*(1), 1-22.

Fama, E. F., & MacBeth, J. D. (1973). Risk, return, and equilibrium: Empirical tests. ***The Journal of Political Economy,*** 607-636.

Fehle, F., Fournier, S. M., Madden, T. J., & Shrider, D. G. (2008). Brand value and asset pricing. ***Quarterly Journal of Finance and Accounting,*** 3-26.

Frazzini, A., & Pedersen, L. H. (2014). Betting against beta. ***Journal of Financial Economics, 111***(1), 1-25.

Gibbons, M. R., Ross, S. A., & Shanken, J. (1989). A test of the efficiency of a given portfolio. ***Econometrica: Journal of the Econometric Society,*** 1121-1152.

Gompers, P., Ishii, J., & Metrick, A. (2003). Corporate Governance and Equity Prices. ***The Quarterly Journal of Economics,*** 107-155.

Gompers, P. A., Ishii, J., & Metrick, A. (2010). Extreme governance: An analysis of dual-class firms in the United States. ***Review of Financial Studies, 23***(3), 1051-1088.

Grullon, G., Michenaud, S., & Weston, J. P. (2015). The real effects of short-selling constraints. ***Review of Financial Studies, 28***(6), 1737-1767.

Gurun, U. G., & Butler, A. W. (2012). Don't believe the hype: Local media slant, local advertising, and firm value. ***The Journal of Finance,*** 67(2), 561-598.

Harrison, J. M., & Kreps, D. M. (1979). Martingales and arbitrage in multiperiod securities markets. ***Journal of Economic Theory,*** 20(3), 381-408.

Hendricks, K. B., Singhal, V. R., & Zhang, R. (2009). The effect of operational slack, diversification, and vertical relatedness on the stock market reaction to supply chain disruptions. ***Journal of Operations Management, 27***(3), 233-246.

Hou, K., & Robinson, D. T. (2006). Industry concentration and average stock returns. ***The Journal of Finance, 61***(4), 1927-1956.

Ikenberry, D., Lakonishok, J., & Vermaelen, T. (1995). Market underreaction to open market share repurchases. ***Journal of Financial Economics, 39***(2), 181-208.

Ippolito, R. A. (1989). Efficiency with costly information: A study of mutual fund performance, 1965-1984. ***The Quarterly Journal of Economics,*** 1-23.

Jacobsen, R. (1988). The persistence of abnormal returns. ***Strategic Management Journal, 9***(5), 415-430.

Jegadeesh, N., & Titman, S. (1993). Returns to buying winners and selling losers: Implications for stock market efficiency. ***The Journal of Finance, 48***(1), 65-91.

Jensen, M. C. (1968). The performance of mutual funds in the period 1945-1964. ***The Journal of Finance, 23***(2), 389-416.

Jordan, B. D., & Riley, T. B. (2015). Volatility and mutual fund manager skill. ***Journal of Financial Economics,*** *118*(2), 289-298.

Lamont, O. A. (2012). Go down fighting: Short sellers vs. firms. ***Review of Asset Pricing Studies,*** *2*(1), 1-30.

Li, J., & Yu, J. (2012). Investor attention, psychological anchors, and stock return predictability. ***Journal of Financial Economics,*** *104*(2), 401-419.

Lucas Jr, R. E. (1978). Asset prices in an exchange economy. ***Econometrica: Journal of the Econometric Society,*** 1429-1445.

Lintner, J. (1965). The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. ***The Review of Economics and Statistics,*** 13-37.

Loughran, T., & Ritter, J. R. (1995). The new issues puzzle. ***The Journal of Finance,*** *50*(1), 23-51.

Markowitz, H. M. (1959). *Portfolio selection: efficient diversification of investments* (Vol. 16). Yale University Press.

Michaely, R., Thaler, R. H., & Womack, K. L. (1995). Price reactions to dividend initiations and omissions: Overreaction or drift?. ***The Journal of Finance,*** *50*(2), 573-608.

Merton, R. C. (1973). An intertemporal capital asset pricing model. ***Econometrica: Journal of the Econometric Society,*** 867-887.

Mossin, J. (1966). Equilibrium in a capital asset market. ***Econometrica: Journal of the Econometric Society,*** 768-783.

Novy-Marx, R. (2013). The other side of value: The gross profitability premium. ***Journal of Financial Economics,*** *108*(1), 1-28.

Pástor, L'., & Stambaugh, R. F. (2002). Investing in equity mutual funds. ***Journal of Financial Economics,*** *63*(3), 351-380.

Pástor, L'., & Stambaugh R. F. (2003) "Liquidity Risk and Expected Stock Returns. ***Journal of Political Economy*** *111*(3).

Roll, R. (1977). A critique of the asset pricing theory's tests Part I: On past and potential testability of the theory. ***Journal of Financial Economics,*** *4*(2), 129-176.

Rosenberg, B., Reid, K., & Lanstein, R. (1985). Persuasive evidence of market inefficiency. ***The Journal of Portfolio Management,*** *11*(3), 9-16.

Ross, S. A. (1976). The arbitrage theory of capital asset pricing. ***Journal of Economic Theory,*** *13*(3), 341-360.

Ross, S. A. (1978). A simple approach to the valuation of risky streams. ***Journal of Business,*** 453-475.

Sharpe, W. F. (1964). Capital asset prices: A theory of market equilibrium under conditions of risk. ***The Journal of Finance,*** *19*(3), 425-442.

Shiller, R. J. (1981). The use of volatility measures in assessing market efficiency. ***The Journal of Finance,*** *36*(2), 291-304.

Shleifer, A., & Vishny, R. W. (1997). The limits of arbitrage. ***The Journal of Finance,*** *52*(1), 35-55.

Sood, A., & Tellis, G. J. (2009). Do innovations really pay off? Total stock market returns to innovation. ***Marketing Science,*** *28*(3), 442-456.

Titman, S., Wei, K. J., & Xie, F. (2013). Market development and the asset growth effect: International evidence. ***Journal of Financial and Quantitative Analysis,*** *48*(05), 1405-1432.

Treynor, Jack L. (1961). Market value, time, and risk. *Unpublished manuscript* 95-209.

Treynor, Jack L. (1962). Toward a theory of market value of risky assets. *Unpublished manuscript* 40.