The “Machinery” of Asset Pricing and Its Implications

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Abstract

The assumption that final investor/consumers maximize intertemporal utility supports an asset pricing theory that is both elegant and intuitive. Unfortunately, the assumption is counterfactual. Final investors/consumers with few exceptions lack the capacity to operationalize the model. More to the point, they don’t try. Instead, investment decision making is delegated via a complex structure involving numerous layers of investment professionals in addition to regulators and the financial media. Based on a high level empirical investigation, we argue that the marginal investors are active fundamental managers who base investment decisions on a comparison of market price with discounted cash estimates of fundamental value. This turns out to have provocative implications for asset pricing. In particular, the cross section of expected returns is determined by the models that the marginal investors use for estimating the discount rate in their DCF valuations. This leads to a feedback relation between asset pricing theories and the asset prices the theories describe that warrants further investigation.
The goal of asset pricing theories is to explain the variation in expected returns. The standard model begins with the assumption that prices are set by final consumers/investors (there is no distinction in the basic model) who maximize the expected utility of stochastic intertemporal consumption. To briefly review the model in its simplest form, the consumer/investor’s problem is choosing assets and consumptions so as to maximize,

$$E_0 \sum_{t=0}^{\infty} B'u(c_t)$$

where $B$ is the investor’s subjective rate of discount or time preference and the expectation is defined over states of the world at each date. When investors solve the intertemporal optimization problem correctly, as described by Cochrane (2005), asset prices are then given by

$$p_0 = E_0 \sum_{t=1}^{\infty} B' \frac{u'(c_t)}{u'(c_0)} x_t$$

where $p_0$ is the price of the asset and $x_t$ is the future random cash flow produced by the asset in period $t$. Defining,

$$m_t = B' \frac{u'(c_t)}{u'(c_0)}$$

to be the stochastic discount factor, equation (2) can be written more compactly as

$$p_0 = E_0 \sum_{t=1}^{\infty} m_t x_t$$

The theory is both elegant and intuitive. A security which produces a large relative payout in good times when consumption is high (the marginal utility of consumption is low) and the reverse in bad times is riskier and must offer higher
expected returns to compensate. Despite its elegance, the theory has one glaring deficiency. For equation (3) to “work” there must be a mechanism by which it is enforced. Consumer/investors must compare market prices with the prices generated from equation (3), buying those securities that are underpriced and selling those that are overpriced. The argument here is that the world does not operate in that fashion for several reasons. **First**, the world is so complex and nonstationary that it is not feasible for even the most sophisticated investors to operationalize equation (3). Instead, investors must rely on approximations. **Second**, final consumers are no longer the price setting investors, if they ever were. Instead, investment decisions are mostly delegated to professional managers who operate through a complex structure involving layers of management and evaluation. These professional managers will maximize an objective function tied to their contract, not the utility function of final consumers as set out in equation (1). **Third**, professional money management services have to be sold through multiple intermediaries to final consumers. Generally, investment strategies need to be understood and accepted by end consumers, who often have little financial knowledge and, at worst, can have very flawed understanding of the capital market. What they understand and desire, in turn, is influenced by an extensive financial market media, which has neither the aptitude nor the appetite for equation (3). **Fourth**, the marginal price setters are active fundamental investment managers. They compare price with estimates of fundamental value based standard discounted cash flow (DCF) models. There is no evidence whatsoever that active fundamental managers use discount rates derived from equation (3). Instead, the discount rates are primarily based on extended versions of the CAPM. **Finally**, given that the cross section of expected returns is
determined by a weighted average of the discount rates used by fundamental managers in their DCF models, it is unlikely that the cross-section of realized returns would be well described by equation (3).

The paper proceeds by working through each of the foregoing four points in order. At each step, the goal is to lay out the framework that describes how the actual machinery of asset pricing works and to provide some broad empirical justification. There is one distinction to bear in mind. The analysis is both specific and general. At a specific level, we offer a description of how the evidence available to us suggests the machinery of asset pricing operates. However, that description is high level and devoid of any formal statistical tests. Consequently, skeptical readers may well disagree. What is more important is our general point that models of asset pricing must address the question of the mechanism by which actual trading decisions are made by the marginal investors and translated into prices. We show that this has important implications for asset pricing theory whether or not one accepts our empirical description of how the machinery currently operates. Along the way, we point to several other issues raised by the analysis that are interesting and deserving of future research but are beyond the scope of our analysis.

Consumers and investors

Surveys of financial literacy such as Lusardi and Mitchell (2013) and the Securities and Exchange Commission (2012) are consistent with the largely self-evident proposition that final consumers, whose utility is what ultimately matters, with few exceptions have nowhere near the information, training or skills to operationalize the standard model even if they are not subject to psychological biases. For instance, Lusardi
and Mitchell report that only about half the individual investors surveyed understood that diversification reduces risk and only 21% understood the inverse relation between bond prices and interest rates. Similarly, the SEC reports that most investors fail to understand how compound interest is calculated or the distinction between real and nominal returns.

As a result, it is not surprising that most investment decision making is delegated. French (2008) reports that direct holding of U.S. equity by households dropped from 47.9 percent to 21.5 percent from 1980 through 2007, a trend that continues to the present. The majority of investors delegate investment decision making by buying professionally managed funds or other investment products, such as variable annuity and insurance or unit trusts. However, even investors who hold equity shares directly mostly delegate their investment decision making. For the top 1% of households, which hold approximately 50% of the total household direct equity holdings, they hire personal investment bankers or financial advisors to manage securities on full discretionary basis directly in their accounts instead of purchasing fund products for tax and cost reasons. Even small individual investors often rely on professionals such as stockbrokers when making investment decisions.

The delegation that occurs in financial markets is not a straightforward principle-agent relationship. For example, corporate pension fund investments are typically overseen by a chief investment officer (CIO) appointed by a Board of Trustees that

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1 Many investment managers offer both fund products and segregated management service based on the same investment strategies. Ultra high networth individuals often use segregated account management offered by tax-aware managers (such as Parametric) to perform tax loss harvesting to improve after-tax performance. For large account sizes, the segregated account management format can represent meaningful cost reduction as well.
generally includes a few corporate treasury officers and labor union representatives. The CIO, in turn, commonly retains a pension consulting firm to help formulate a strategic asset management plan as well as to help hire and monitor the performance of asset managers. For public pension funds, such the corporate officers are replaced by government officials. In addition, the interaction among final investors and the intermediary investment professionals is subject to government regulation and in many cases involves implicit or explicit government insurance as well—that is the government may guarantee pension benefits regardless of the pension fund investment result; this means that the final consumer’s consumption planning is further delinked from stock returns. Finally, the entire process is heavily influenced by a massive financial media that is intensely focused on short-term investment performance rather than its impact on long-term consumption planning. That media includes, at a minimum, financial newspapers and magazines, radio and television stations devoted in part or in whole to following and dissecting financial markets, and untold numbers of blogs and websites devoted to financial market analysis. The objective of these media outlets is to maximize their own values. That requires acquiring and retaining an audience. This fact, in combination with the aforementioned lack of financial sophistication on the part of the majority of the potential audience, means that media outlets tend to focus on entertainment and enticement more than education.\(^2\) Unfortunately, this means that the media often compound rather the ameliorate the problem of final investor/consumer ignorance. Understanding and combating this potentially negative feedback loop is an intriguing area for future research.

\(^2\) Jim Cramer’s *Mad Money* is a good example.
We conclude that the overall result of the complex interaction is that the marginal price setting investors can only be the active professional money managers. These managers, however, do not have free rein. They have to market their services to final investors through the nexus of oversight committees and consultants. This means that manager objective functions written into their contracts must be sufficiently straightforward and transparent that all parties including final consumers, oversight committees, investment consultants and regulators, as well as the managers themselves, are willing to accept them.

As described by Cuoco and Kaniel (2011), who present an extensive bibliography on the topic, the equilibrium incentive contract that has emerged from this interaction favors relatively simple compensation that include a component that depends on value of the managed assets plus a component that is related to excess performance relative to a benchmark. However, even the fixed component is related to benchmark performance because over the longer-run performance affects funds under management. Client newsletters issued by global consultant Towers Watson reveal that most institutional consultants and asset owners often hire and fire manager based on the past three years of performance. This adds another layer of interesting complication to the delegation process because three years is typically too short of time to reach any statistically meaningful conclusions. However, we leave this issue to future research.

There are two basic ways that active managers can attempt to earn superior returns. The first is through exploiting relative pricing anomalies that might arise, for instance, due to order imbalance or perhaps some sentiment related effect. But as

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3 Baker and Penfeld 2011, Penfeld 2011
Summers (1986) emphasizes, relative pricing models just push the investigation back one step. The focus here is on the long-run equilibrium cross section of expected returns, which depends on the level of prices for fundamental assets. The mechanism by which that equilibrium is achieved requires that fundamental investors have a method by which they compute fundamental values, compare them with market prices and trade on the discrepancies. Furthermore, in light of our previous discussion that method must be something that can be understood by and marketed to fund fiduciaries, investment consultants, final investors and the financial media. Furthermore, fund fiduciaries are generally unwilling to invest in strategies that they cannot understand and explain for liability reasons. We turn next to the evidence we have on how active fundamental investors solve this problem.

*Estimating fundamental value*

The evidence we have reviewed, described below, indicates that discounted cash flow analysis is overwhelmingly the method of choice for estimating fundamental value. This should not be surprising because it is the method expounded in standard finance texts including Brealey, Myers and Allen (2012). With respect to investing, the DCF method is developed in detail in books such as Pratt (2008), Damodaran (2012) and Koller, Goedhart and Wessels (2010) and Rosenbaum and Pearl (2013) that are aimed at investment professionals. The DCF method is also the method of choice for the CFA curriculum as well as its certifying exams.

We have accumulated direct evidence of the role of DCF valuations in the non-academic half of our careers. As an investment professional and an expert witness we have been privy to dozens of valuation analyses prepared in making investment
decisions. Though the details of those reports are confidential, we can disclose that the fundamental method of valuation was almost exclusively discounted cash flow. In the sample of reports to which we had access, the typical approach was to project debt-free cash flows annually for an horizon typically between five and ten years. Next the continuing value at the terminal horizon was estimated by applying a simplified growth model, often constant growth. The annual cash flows and the terminal value are then discounted to present value at the weighted average cost of capital (more on that later). The cash flow projections are interpreted as statistical expectations, consistent with the theory, but they are almost never calculated as such. That is rather than developing a series of scenarios that are weighted by probabilities and summed, the projections are taken to be the expectations directly. This is basically the exact procedure described in the aforementioned practitioner texts.

The foregoing should not be interpreted as saying that DCF was the only methodology employed in the valuation analyses we reviewed. In fact, methods based on market comparables or acquisition comparables were even more common. But those are relative models which cannot be used to set the prices of fundamental assets, so we do not consider them further.

Fortunately, the evidence regarding the prominence of the DCF approach extends beyond confidential valuation reports. Based on their study of analyst reports, Asquith, Mikhail and Au (2005) report that although not as commonly used a relative valuation approaches, the DCF approach was analysts’ method of choice for fundamental valuation. Our review of more recent analyst reports confirms that their conclusion is robust.
In some sense, this is all tautological. What method of fundamental valuation could there be other than DCF broadly interpreted because cash flow is the ultimate source of value? Equation (3) can be read as a DCF model using the stochastic discount factor.

Assuming that market prices equal the DCF valuation of the marginal fundamental investor (active manager), the critical question is how was the discount rate used in the DCF valuations determined? Recall that if the market price equals the DCF value of an asset, the expected return on the asset is, by mathematical identity, equal to the discount rate used in the valuation. Consequently, predicting the cross section of expected returns amounts to investigating how discount rates were estimated.

Before turning to the discount rate issue, there is one added point worth noting. Although academicians focus on determining discount rates (since they determine expected returns in a rational market), the confidential valuation reports we examined and virtually all analyst reports focus almost exclusively on the numerator of the valuation problem, future cash flows, and not the denominator, the discount rate. This focus is consistent with the fact that active fundamental managers need to appeal to their clients’ world view - that good active manager can evaluate the company’s prospects and cash flows better than the market. The managers claim that they can earn superior returns by exploiting the discrepancies between their superior cash flow forecasts and the market’s. As a result, there is fierce competition amongst active managers to demonstrate their ability to forecast future earnings; analysts are frequently ranked by trade journals for their accuracies. However, there is very little competition in selecting the proper discount rate; in fact, the exercise is so ignored that fiduciaries and consultants are not the
least concerned by the fact that most people use simple heuristics based on variants of the CAPM.

As Grossman and Stiglitz (1980) and Cornell and Roll (1981) demonstrate, the pursuit of superior performance via more accurate cash flow forecasting than the market must be a rational undertaking for at least some managers. If the market were so efficient that active fundamental investors could not earn a fair return on their efforts, they would withdraw from the market. As they did so, market prices would become noisier until the discrepancies between price and value were sufficient that sophisticated fundamental investor could earn a fair return from exploiting them.

The focus on the numerator is also reasonable from the standpoint of the manager. Presumably managers develop specialized skills in collecting and evaluating information regarding the future earning power of a company. There are no such specialized skills involved with estimating the discount rate which is an exercise in choosing and implementing publicly available asset pricing theories. Further as noted above, there little evidence of a demand for investment strategies based on more accurate assessments of discount rates. Finally, it is worth noting that from a social point of view the focus on the numerator is beneficial. As Hayek (1941) and Tobin (1982) emphasize, the ultimate goal of the capital market is to allocate funds among competing business opportunities. That allocation requires detailed assessments of the viability of those opportunities – the is their expected cash flows.

*Estimating the cost of equity*

We focus here on the cost of equity because we are interested in the cross section of equity returns. Beginning with the confidential valuation reports to which we had
access, five models were used to estimate the cost of equity. In order of the frequency of appearance they were:

1) The CAPM with a size adjustment

2) The CAPM

3) The CAPM (with or without a size adjustment) and a judgmental premium for company risk. In most cases, this judgment premium appeared to be related to idiosyncratic volatility or firm distress.

4) The Fama-French three factor model.

5) A dividend discount model applied to comparable companies.

Of the five, the fifth can be excluded because it is again based on relative valuation. In applying the dividend discount model, the prices of the comparable companies are assumed to be fair. From the standpoint of estimating fundamental value, that assumption is not warranted.

We start by noting what is not included in the valuation reports. There was no attempt to use a consumption based model. There was no effort to estimate a conditional model or take account of variation in the investment opportunity set. The only factor model used was the Fama-French three factor model. This suggests that given the complexity and the nonstationarity of the environment, professional managers did not deem it worthwhile to attempt to operationalize these more sophisticated models.

A skeptical reader should rightly be concerned that our sample is biased. Fortunately, the investment profession has become sufficiently specialized that there is delegation in the area of discount rate estimation as well. Services such as Morningside (2013b), Bloomberg (2013), and Duff and Phelps (2013) provide estimates of the cost of
equity capital. They all focus on variants of the CAPM and, secondarily, the Fama-French three factor model.

Notice that the manner in which the models are implemented implies the existence of a small-firm effect and quite possibly a value effect. The small firm effect is effectively hard wired into the cross section of expected returns by the fact that it is included as a component of the discount rate in the most popular model (more on this hardwiring below). Similarly, the value effect is hardwired to the extent that the marginal investors use the Fama-French model, but it could also come into play in an extended version of the CAPM via the inclusion of an individual firm risk factor. For instance, in his discussion of the size of the individual firm risk adjustment, Pratt (2008) lists factors to be considered in making a judgmental assessment. Many of the factors Pratt lists are related to “firm distress.” Furthermore, in the valuation reports to which we had access there is evidence consistent with Pratt’s suggestions in that adjustments appear to be related to firm distress. However, this observation is based on a few potentially biased observations. Clearly, a more systematic study would be helpful.

In addition, the fact that these apparently rational models were employed does not rule out the possibility that behavioral biases affect expected returns. For instance, the individual company risk factor might be adjusted to reflect the sentiment of the investment manager. As one example, our experience is that managers generally are willing to set higher short-term price targets for firms experiencing positive sentiments (strong recent price appreciation). If this sentiment is incorporated into the discount rate, expected returns would be affected in a direction consistent with momentum.
Furthermore, implementation of the models requires estimating the parameters. For instance, implementation of the basic CAPM requires:

1) Choosing the risk-free rate.

2) Estimating beta.

5) Selecting an estimate for the market premium.

Because there are no hard and fast procedures for estimating any of these quantities, it is possible that fundamental investors alter their procedures in response to changing market conditions or sentiment. The market risk premium provides a good example. Estimates of the premium can vary by three percent or more depending on the choice of method (historical average versus a dividend discount model). Even within the context of one method (historical averages), estimates are sensitive to sample selection opening the door for sentiment to affect the discount rate via the choice of sample.

Implications of the analysis and conclusions

The most intriguing implication of our analysis is the existence of a feedback relation between asset pricing theory and asset prices. The analysis of the machinery of asset pricing implies that the cross-section of expected returns is not only described by financial theory, it is also determined by it. The models that fundamental investors use to estimate the discount rate are the ones that, by definition, must describe the cross section of expected returns. In this respect, our analysis is markedly different than the standard model of asset pricing based intertemporal utility maximization. The standard pricing model given by equation (3) holds whether or not it has been discovered by financial economists. Put another way, the development of the theory has no impact on the cross section of expected returns, it simply describes them. The same is not true of asset
pricing theories in the context of our analysis. For instance, if it comes to be accepted that there is a small firm effect, then that effect will become baked into the structure of asset prices through its adoption by fundamental DCF investors whether or not there was a theoretically supportable reason for including it in the first place. This implication is a bit unnerving. It is possible that anomalies that are unique to a given period of time, of which the Fama-French factors and the size effect may be examples, will become determinants of asset prices precisely because they are accepted as such.

To avoid pushing this idea too far, it should be noted that if the anomalies baked into discount rates become sufficiently inconsistent with intertemporal utility maximization a manager should be able to attract final investors to a fund designed to exploit the discrepancy. For instance, if the small firm premium built into expected returns was both large and unrelated to consumption risk, then some hedge fund manager could presumably market a fund with a small cap tilt designed to exploit the mispricing (mispricing in terms of equation (3)). However, we suggest that because of the complexity and the nonstationarity of world, the bounds placed on anomalies that can be baked into discount rates are likely to be loose because mispricing based on equation (3) will be difficult identify and more difficult to market to skeptical clients.

With regard to the standard consumption based asset pricing model, because the marginal fundamental investors do not use discount rates based on the model, there is no pathway by which the marginal utility of consumption is incorporated into asset prices.\footnote{The consumption model could still work to some extent because consumption and market returns are correlated and discount rates do depend on market returns through the machinery of asset pricing. This logic stands traditional theory on its head. Traditional theory postulates that CAPM type models work to date.}
From this perspective, it is not surprising that detailed reviews of the empirical literature by Campbell (2003) and Ludvigson (2013) find that the standard consumption based model fails. As Campbell and Ludvigson go on to discuss, that failure set off a massive research effort designed to extend the basic model given by equations (1) to (3) designed to rationalize the failure. If our analysis is correct, those efforts are misguided. The standard consumption model fails not because it is oversimplified, but because the marginal fundamental investors actually use simpler models to estimate discount rates.

The feedback between financial research and discount rate estimation also complicates the manner in which the machinery itself might evolve. As one example, asset prices could become locked into one equilibrium for extended periods (such as incorporating a small firm effect) and then suddenly shift to a new equilibrium if the deviation from intertemporal utility maximization becomes too great. However, as stressed earlier, in a complex and nonstationary world it will be difficult for a new procedure to be judged superior as long the old procedure is baked into the cross-section of returns through the machinery of asset pricing.

To sum up, the assumption that final investor/consumers maximize intertemporal utility supports an asset pricing theory that is both elegant and intuitive. Unfortunately, the assumption is counterfactual. Final investors/consumers with few exceptions lack the capacity to operationalize the model. More to the point, they don’t try. Instead, investment decision making is delegated via a complex structure involving numerous layers of investment professionals in addition to regulators and the financial media.

because they are special cases of the standard model as described by Cochrane (2005). Our analysis reverses the causality.
Based on a high level empirical investigation, we argue that the marginal investors are active fundamental managers who base investment decisions on a comparison of market price with discounted cash estimates of fundamental value. This turns out to have provocative implications for asset pricing. In particular, the cross section of expected returns is determined by the models that the marginal investors use for estimating the discount rate in their DCF valuations. This leads to a feedback relation between asset pricing theories and the asset prices the theories describe that warrants further investigation.
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