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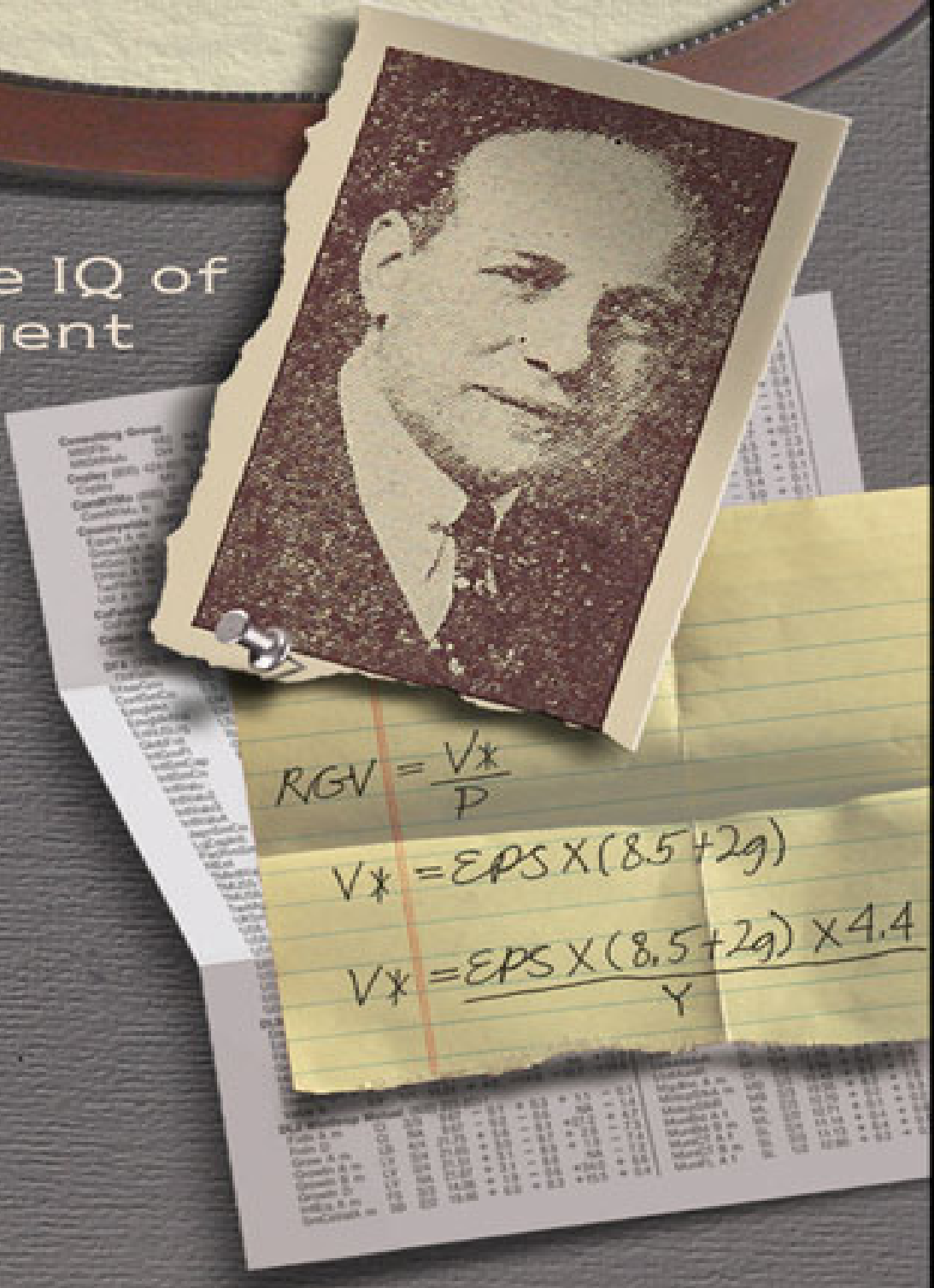
BEN GRAHAM WAS A QUANT

Raising the IQ of the Intelligent Investor



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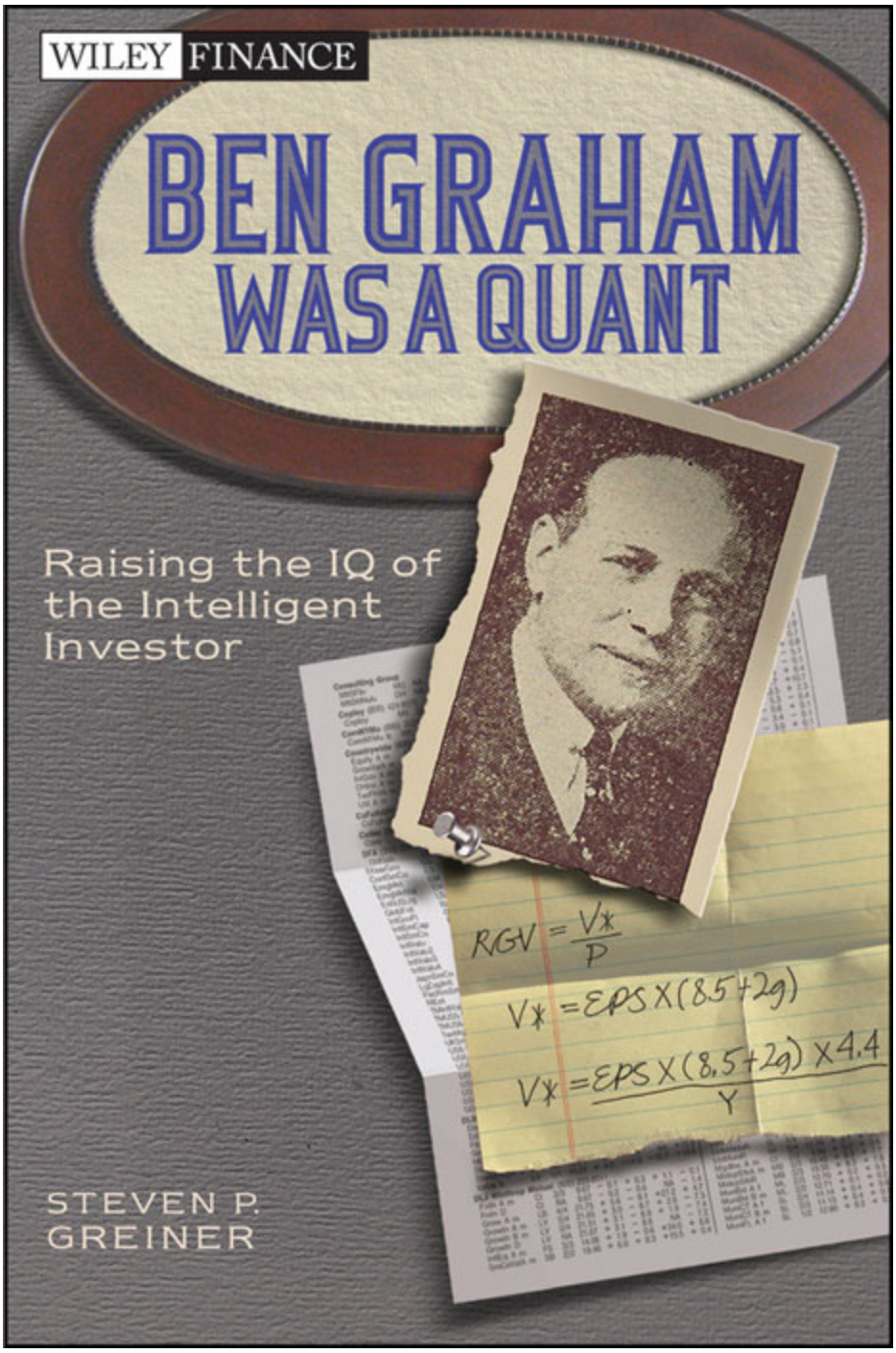
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RGV = Vx/P
Vx = EPS X (8.5+2g)
Vx = EPS X (8.5+2g) X 4.4 / Y
STEVEN P. GREINER

Contents

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Raising the IQ of the Intelligent Investor

STEVEN P. GREINER, PhD

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There are two groups I dedicate this book to. The first are those just entering the quant workforce, whether experienced scientists making a career change, or those graduating from some financial engineering curriculum. They should find the history in this book enabling. The second group are those people who helped me get started in this business, too numerous to mention individually. To both, I raise a hearty glass of burgundy and toast them, “to success in the markets.” Cheers!

Preface

> *I earnestly ask that everything be read with an open mind and that the defects in a subject so difficult may be not so much reprehended as investigated, and kindly supplemented, by new endeavors of my readers.*
>
> *—Isaac Newton, The Principia*[1]

The history of quantitative investing goes back farther than most people realize. You might even say it got its start long before the famous Black-Scholes option pricing equation was introduced.[2] You could even say it began before the advent of computers, and certainly before the PC revolution. The history of quantitative investing began when Ben Graham put his philosophy into easy-to-understand screens. Graham later wrote *The Intelligent Investor*, which Warren Buffett read in 1950 and used to develop his brilliant formula for investing.[3] Since then, quantitative investing has come from the impoverished backwater of investing to the forefront of today's asset management business.

So what is quantitative investing? What does it mean to be a quant? How can the average investor use the tools of this perhaps esoteric but benign field? Quantitative investing has grown widely over the past few years, due in part to its successful implementation during the years following the tech bubble until about 2006. Since then poorer years followed, in which algorithms all but replaced the fundamental investment manager. Then during the 2007--2009 credit crisis, quant investing got a bad rap when many criticized quantitative risk management as the cause of the crisis and even more said that, minimally, it did not help avoid losses. For these people, quant is a wasting asset and should be relegated to its backwater beginnings for it is indeed impoverishing. However, these criticisms come from a misunderstanding of what quant methods are and what it

means to be a quantitative investment manager or what it means to use a quantitative process in building stock portfolios. We shall clarify these matters in the body of this work.

In reality, investment managers have a bias or an investment philosophy they adhere to. These investment philosophies can be value oriented like Ben Graham's, or they can be growth oriented, focusing on growing earnings, sales, or margins. Good managers adhere to their principles both in good times and in bad. That is precisely the message (not the only one) famed value investor Ben Graham advocates in *The Intelligent Investor*—that of adhering to your stock selection process come hell or high water, and it puts the onus on the individual investor to control your impulses to give in to primal urges or behaviors governed by fear. For instance, we are naturally disposed to not sell assets at prices below cost (i.e., the sunk-cost effect) because we expect price rebound and are subject to anchoring (we tend to remember the most recent history and act accordingly). This results in investors chasing historical returns rather than expected returns, so we constantly choose last year's winning mutual funds to invest in. However, if we design and implement mathematical models for predicting stock or market movements, then there can be no better way to remain objective than to turn your investment process over to algorithms, or quantitative investing!

This book is for you, the investor, who likes to sleep at night secure in the knowledge that the stocks you own are good bets, even if you have no way of knowing their daily share price. What is so good about quantitative investing is that it ultimately leads to disciplined investing. Codifying Ben Graham's value philosophy and marrying it with quantitative methods is a win-win for the investor and that is what this book is about.

This book will teach you how to:

- Create custom screens based on Graham's methods for security selection.
- Find the most influential factors in forecasting stock returns, focusing on the fundamental and financial factors used in selecting Graham stocks.
- Test these factors with software on the market today.
- Combine these factors into a quantitative model and become a disciplined intelligent investor.
- Build models for other style, size, and international strategies.

There is no reason you cannot benefit from the research of myriad PhD's, academics, and Wall Street whiz kids just because you did not take college calculus. This book is the essential how-to when it comes to building your own quantitative model and joining the ranks of the quants with the added benefit of maintaining the 3T's (i.e., tried, true, and trusted) fundamental approaches of Ben Graham. All this and very little mathematics! Nevertheless, we cannot forget that despite his investment methods, Graham himself suffered a harrowing loss of over 65 percent during the Crash of 1929--1932. The adage "past performance is not a predictor of future returns" must always apply.

This book is not about financial planning, estate planning, or tax planning. This book is part tutorial, part history lesson, part critique, and part future outlook. Though the prudent investor must remain aware of corporate bond yields, this book is mostly about investing in stocks. Also, it generally refers to investment of liquid investable securities and does not address emergency cash needs, household budgeting, or the like. You might also read this book before tackling Ben Graham's *The Intelligent Investor*, especially if you are approaching the investment field from an engineering background rather than a financial one, for the brevity of the financial terms in this book is far more

understandable, approachable, and filtered down to those most relevant variables for you. Conversely, in Ben's Graham's book, an accounting background is more helpful than a degree in mechanical engineering.

Likewise, the investable universe in vogue today that includes stocks (equities), fixed income (government and corporate bonds), commodities, futures, options, and real estate are all part of an institutional asset allocation schema that is not addressed here either. This book is 99 percent about equities with a smidgen of corporate debt.

You will come away with a much better understanding of value, growth, relative value, quality, momentum, and various styles associated with equity investing. Certainly the Morningstar-style box, defined by small to large and value to growth, will be studied, and the differences among developed markets, global investing, international investing, and emerging markets will all be heavily defined. We will cover how the Graham method can be applied to markets outside the United States as well.

Generally, this book takes the perspective of the long-term investor talking about saving for retirement, so this constitutes the focus we have adopted, well in line with Graham's focus. In addition, we concentrate on mid- to large-cap equities in the United States and talk about how to apply the Graham method to global markets. Global markets allow for the universe of equities chosen. As written previously, the very first step is to define the investment area one wants to concentrate on and, from this, choose the universe of stocks on which the intelligent investor should concentrate.

This book is organized as follows: The introduction covers some history and identifies who the quants are, where they came from, and the types of quants that exist. Chapter 1 defines the search for alpha and explains what alpha is. Chapter 2 discusses risk; it is a "think chapter" filled with

useful information and new perspectives. Chapter 2 also functions a bit as an apologetic for quants, but it comes down hard on those who criticize quant methods without also lauding their accomplishments. Chapter 3 moves on to discuss some inadequacies of modern portfolio theory and explains why easy approximations and assumptions are usually violated in finance. It is here that g-factor is introduced as a better method to measure stock volatility.

After the first three chapters, you will be armed to dig into Graham's method, which is outlined in Chapter 4. The chapter defines the Graham factors and shows examples of other factors, illustrating what they are and how they are measured and validated. Chapter 5 is an important chapter that teaches the relevant methods in building factor models, and it reviews important data considerations before modeling can commence. Chapter 6 is about the actual testing of factors; you will see exactly how to do so with live examples and data. Chapter 7 takes the output of the previous chapter and shows how to put factors together to form models, specifically several Graham models. Chapter 8 summarizes the issues for putting the Graham model to work and reviews consideration for building a portfolio.

Chapters 9 and 10 are more unusual. Chapter 9 breaks down stock returns by discussing new ways to describe them and introduces better, lesser known theories on stock behavior. This is not a finance chapter. However, it has its base in econophysics, but it is far easier to understand than material you would find elsewhere written by academics. Chapter 10 offers the future view. Anyone who cares to know what the world will be like in the near future as well as twenty years from now should read this chapter. It is based on broad trends that seem to have nothing to stop them from continuing. From here, get your latte or pour your favorite Bordeaux and jump in. You are about to get the keys to quantdom!

Steven P. Greiner
Chicago, Illinois
November 2010

Introduction

The Birth of the Quant

Quantitative investing (quant) as we know it today began when computers became both small enough and fast enough to process data in real time. The start of quantitative investing is still in debate, but cannot claim usage widely enough until after the advent of the personal computer. This would obviously be after 1982, for in that year, the “Z-80” was still the programmer’s basic system.[1] When DOS came into its own from its birth from under CP/M, the operating system of the time, the quant world began. This was the Big Bang for quant, for then investment houses and proprietary trading desks began hiring physicists and mathematicians, and it was when many quants began their careers.[2]

Going back further, many cite a paper written in 1952 by Harry Markowitz as giving birth to quant’s modern beginnings.[3] His creativity also birthed Modern Portfolio Theory (MPT), which was later added to by Sharpe, Merton, Black, Litterman, and many others. That the theoretical gave way to the practical and the use of normal (sometimes referred to as Gaussian, for the name of the shape of the normal distribution) statistics came into use as tools of the quant was simply because computing power was small and normal statistics were easy to compute, sometimes even by hand with paper and pencil.

Initially, quant had the wind at its back because of people like John C. Bogle who, in launching Vanguard Funds in 1975, argued that active management was not worth it for two main reasons: first, the fees were too high, and second,

investors could not beat the market in the long run. These two accusations launched a strong attack on fundamentally active managers. Sophisticated analytics were in their infancy at the time, and it was difficult to generate data to argue against John Bogle's viewpoint. Only the Capital Asset Pricing Model (CAPM) was around, having been published by William Sharpe in 1963, to allow Bogle support for his supposition that most active managers offered little "alpha" and that many of their supposed returns were from "beta" plays.[4],[5]

In my attempt to offer a basic understanding of alpha and beta, I will throw away Joseph de Maistre's quote: "There is no easy method of learning difficult things. The method is to close the door, give out that you are not at home and work." In so doing, we offer a simple explanation of alpha and beta using a very plain analogy (though clearly incorrect). Think of the ninth-grade algebra equation $y = mx + b$. In the CAPM, y is the excess return of the active manager's portfolio over cash, and x is the market's return over cash. Then, m is like beta and b is like alpha. This is clearly wrong in the absolute sense, but makes the idea easy to grasp so it is only a little wrong.

Beginning in the 1960s, the Efficient Market Hypothesis (EMH) gained hold (believed and espoused by Bogle, for instance) and was being taught at schools like the University of Chicago. The EMH implied that all known information about a security was already in its market price. Eugene Fama, an EMH founder, along with Ken French began a search for a model to replace the outdated CAPM from William Sharpe, finally publishing a seminal paper outlining three main factors that do a better job explaining returns.[6] These were classic CAPM beta (the market beta), firm size (market capitalization), and book to market. The analogy for the Fama-French model, then, is an equation like $y = m_1x_1 + m_2x_2 + m_3x_3 + b$, so that now there are three betas (m_1, m_2

and m_3) but still only one alpha. This work motivated one of the largest concentrations of academic effort in finance, that of finding other equations made similarly using financial statement data as factors (balance sheet, income statement, or cash flow statement data), in a simple linear equation like the Fama-French.

Indeed, even more work was done (most of which remains unpublished) in the basements and halls of the large institutional asset managers, banks, and hedge funds, looking for the Holy-Grail equation to explain returns and offer the investor an advantage over the market. However, the intent of these efforts were meant to contradict the EMH in the sense that the researchers were out to build portfolios in which to outperform the market and seek alpha, whereas Fama-French were trying to describe the market, in support of the Efficient Market Hypothesis. So imagine if you were the researcher who came up with a model that showed a positive *b* or alpha in the equation describing returns. This would indeed give you a competitive advantage over the market, if your equation held through time. The fact that most of these researchers utilized math and statistics, searching through the data looking for these relationships while rejecting the old-fashioned method of combing through the fundamental data manually, is what branded them as quants. Of course, to find such an anomalous equation was rare, but the promises of riches were enough to motivate far more than a few to the chore.

CHARACTERIZING THE QUANT

The quant method can be defined as any method for security selection that comes from a systematic, disciplined, and repeated application of a process. When a computer program performs this process in the form of a mathematical algorithm, the computer, not the process, is

the topic of conversation. If we change the topic of conversation from computers to process or methodology, then a working definition of a quant becomes: A quant designs and implements mathematical models for the pricing of derivatives, assessment of risk, or predicting market movements. There's nothing in that definition about the computer.

Back in 1949, when Benjamin Graham published *The Intelligent Investor*, he listed seven criteria that, in his opinion, defined "the quantitatively tested portfolio," consisting of (1) adequate size of the enterprise, (2) sufficiently strong financial condition, (3) earnings stability, (4) dividend record, (5) earnings growth, (6) moderate P/E ratio, and (7) moderate ratio of price to book.[7] He then goes on to show the application of these criteria to the list of stocks in the Dow Jones Industrial Average (DJIA) index. There cannot be any other interpretation than that of the author himself who concludes that the application of these criteria builds a quantitatively derived portfolio.

Thus begins quantitative asset management, its birth given to us by Benjamin Graham. Since that time there has been growth of assets and growth of the profession. Quants have roles to play and it appears their role can be categorized in three succinct ways. The first group of quants, which we call Type 1, still are beholden to the EMH.[8] In so doing, they employ their talents creating exchange traded funds (ETF) and index tracking portfolios. Thus the firms of Barclays Global, WisdomTree, PowerShares, Rydex, State Street Global, and Vanguard have many quants working for them designing, running, and essentially maintaining products that don't compete with the market but reproduce it for very low fees. They attend academic conferences; publish very esoteric pieces, if they publish at all; and tend to be stable, risk averse individuals who dress casually for work. Their time horizon for investing is typically

years. These quants have PhDs but fewer CFAs. Of course, I'm generalizing, and many quants employed as Type 1 deviate from my simple characterization, but my description is more fun.

The second group of quants, Type 2, are those employed in active management; they attend meetings of the Chicago Quantitative Alliance, Society of Quantitative Analysts, and Quantitative Work Alliance for Applied Finance, Education, and Wisdom (QWAFAFEW). These people are those sifting through financial statement and economic data looking for relationships between returns and fundamental factors, many of the same factors that traditional fundamental analysts look at. Their time horizon of investing is a few months to a couple of years. Their portfolios typically have a value bias to them, similar to Ben Graham–style portfolios. Here you will find equal numbers of PhDs, MBAs, and CFAs. Typical companies employing these quants are First Quadrant, Numeric Investors, State Street Global, Acadian Asset Management, InTech, LSV, DFA (though with a caveat that DFA founders were EMH proponents), Batterymarch, GlobeFlex, Harris Investment Management, Geode Capital, and so forth. These quants are generally not traders, nor do they think of themselves as traders, as wrongly accused.[9] In fact, these quants actually don't want to trade. They want portfolios with low turnover, due to the costs of trading, because, in general, trading costs a portfolio alpha. These quants are investors in the same mode as traditional asset managers using fundamental approaches like Peter Lynch (formerly of Fidelity), Bill Miller (of Legg Mason), or Robert Rodriguez (of FPA). They tend to specialize mostly in equities and ordinary fixed income (not sophisticated structured products, distressed debt, real estate, derivatives, futures, or commodities).

I digress just for a moment to distinguish trading (more speculative in its nature) from investing, and Ben Graham

makes a clear distinction in *The Intelligent Investor*'s first chapter where he says, "An investment is one which, upon thorough analysis, promises safety of principal and an adequate return. Operations not meeting these requirements are speculative." Later he says, "We must prevent our readers from accepting the common jargon which applies the term 'investor' to anybody and everybody in the stock market." Likewise, applying the term *trader* to everybody and anybody in the stock market is apportioning a very small part of what is involved in the activity of investing as an apt title for the activity as a whole. We don't call all the players of a baseball team catchers, though all of them catch baseballs, right? I make a point of this because, within the industry, traders, analysts, and portfolio managers are separate activities, and quants are hired into each of those activities with clearly distinct roles and job descriptions.

The last type of quant, the Type 3 quant, is probably the rocket-science type if ever there is any, and their activities mostly involve trading. These people are working in the bowels of the investment banks, hedge funds, and proprietary trading desks. Often they are considered traders rather than investors because their portfolios can consist of many asset classes simultaneously and have very high turnover with holding periods ranging from intradaily to days. They also encompass the flash traders and high-frequency traders. Their members are hard-core quants working on derivatives doing fancy finite element models, Black-Scholes option solvers, and working to solve complicated equations in finance. Firms like D.E. Shaw, Renaissance Technologies, Bluefin Trading, Two Sigma, and Citadel hire these positions. In the book *My Life as a Quant* by Emanuel Derman, these kinds of quants are described quite succinctly, and their history may be typical of Dr. Derman's.[10] They attend the International Association of

Financial Engineers meetings and, occasionally, maybe, the Q-Group. They correspond with the scientists at the Sante Fe Institute (complexity and nonlinear research institute). Most of them have PhDs, but, more recently, they are obtaining Financial Engineering degrees, a new academic curriculum. For the most part, these types of quants are not employed as investors nor thought of as such. The kind of work they do and the applications of their work are more speculative in nature and heavily involved in trading. Their trading is very technology oriented, and without trading, these types of firms do not make money. In contrast, trading is an anathema to the process for the previous Type 2 quants. Type 3 quants work in all asset classes including equity, fixed income, CMOs, CDOs, CDS, MBS, CMBS, MUNIs, convertibles, currencies, futures, options, energy, and commodities. If you can trade it, they are into it.

Now, these three types articulate the basic operations and definitions of quants in what is known as the buy side, that is, quants who manage other people's money or capital. There are quants on the sell side as well, who would rather sell picks and shovels to the miners rather than do the mining. Firms such as CSFB, Bernstein Research, Nomura Securities, UBS, Leuthold Group, and various broker/dealers also have quants on their staff providing quantitative research to buy-side quants in lieu of trading dollars. Their clients are mostly Type 2 quants, those doing active management. Type 1 quants use less of this research because they aren't necessarily looking for a market advantage and Type 3 quants compete with the broker/dealers and sell side since they, too, are doing a lot of trading.

Next, there are many quants working for firms that provide data to the buy-side quants, too. They are separate from sell-side quants, however, in that they don't provide research per se; they provide research tools and data. Firms

like FactSet, Clarifi, S&P, Reuters, and Bloomberg provide sophisticated tools and data for company or security analysis, charting, earnings release information, valuation, and, of course, pricing. They provide other content and value, too. For instance, FactSet offers portfolio optimization, risk modeling, portfolio attribution, and other analysis software. These firms either collect soft or hard dollars for their services.[11] Their clients are all three types of quants on the buy side.

The last group of quants resides in risk-management firms. These are rather unique in their service in that they are much more highly integrated into the investment process than other service providers. Their product is usually composed of two parts: part data and part model. Just like their buy-side brethren, these quants produce models, not to explain return, but to explain variance or the volatility of return. Firms like FinAnalytica, Northfield, MSCI-Barra, Axioma, ITG, SunGard-APT, and R-Squared Risk Management all provide quant investors risk models as well as optimizers or risk attribution software, enabling buy-side quants (mostly Type 2) to partition their portfolios by various risk attributes. These firms are filled with quants of all three types. They also get paid by hard or soft dollars. Algorithmics and MSCI-RiskMetrics are two firms noted for risk management, and they also hire quants, but these are mostly back-office quants whose clients need firm-wide risk management and are less directly involved in the management of assets. Many of their quants are actuaries and focus on liabilities, so they are not of the same color as the quants previously defined.

Now that you know the three types of quants, let’s look at the three elements of a portfolio. These involve the return forecast (the alpha in the simplest sense), the volatility forecast (the risk), and lastly the weights of the security in the portfolio and how you can combine them. These three

elements are essential and a necessary condition to have a portfolio, by definition. All three quant types need these three elements. From here on, however, I will be restraining my conversation to Type-2 quants on the buy side. These are the quants whose general outcome is most similar to the Ben Graham type of investor, that of constructing portfolios of stocks (or corporate bonds) with holding periods perhaps as short as three months to several years. The details of these three components of a portfolio will be examined in greater detail in the beginning chapters, but there remains one more topic of discussion in this introduction—that of the contrast between proponents of active management and those supporting the Efficient Market Hypothesis (EMH).

ACTIVE VERSUS PASSIVE INVESTING

Ben Graham clearly was a believer in active management. There can be no doubt that he believed there were companies on the market that were available at a discount to their intrinsic price. On the other hand, the market is smart, as are the academics who founded Modern Portfolio Theory and the EMH, so how does the individual investor reconcile these differences? This is a very, very good question that I've been thinking about for years. I may not have the answer, but I will offer some reasonable explanations that allow you to sleep at night after having purchased a portfolio of individually selected stocks. First, what is the market? There are, at any one time, somewhere around 5,000 investable securities in the U.S. stock market for the average investor. Is this the market? What about securities in other countries? If we add the rest of the world's securities, there are maybe 35,000 that the average

investor can invest in. Is this the market the efficient market theorists are talking about?

Generally, in the United States, we're talking about the S&P 500, which in its simplest sense are the 500 largest stocks in the country. Often people quote the DJIA, which is composed of only 30 stocks, so if we want to make a proxy for the market, the S&P is certainly a better choice than the DJIA. However, where does the S&P 500 come from? Well, it's produced by Standard & Poors taking into account liquidity, sector representation, public float of the security, domicile, financial viability, and other factors.[12] Well, wait a minute. That sure sounds like an actively managed portfolio to me, and, yes, it is. There is no doubt that the S&P 500 is not the market. It is a proxy, and the assumptions that make it a proxy aren't all bad. In fact, they are pretty good. But in reality, the S&P 500 is an actively managed portfolio produced by the company Standard & Poors. It is not passive; do not let anybody kid you. It has low turnover, but it is actively managed.

Moreover, the Wilshire 5000 is a better proxy than is the S&P because it contains 5,000 stocks, right? Do you get the picture? The market isn't so clearly defined as many people would have you believe. So when we say "efficient market," what exactly are we talking about? We are really saying that any publically traded stock has all the information that's fit to print and known, already in its current price, and it moves rapidly to reflect any change in known information, so that the market is efficient in its adjustment to new information.

The implication is that no investor can gain an advantage over any other because the stock moves too quickly to arbitrage the information. Hence, buy the market we are told, but as I have just illustrated, what is the market? This is the conundrum. It is not surprising that there's a correlation between the Wilshire 5000 and the S&P 500, but having a strong correlation doesn't mean their returns are

equivalent. For instance, from their respective web sites, the returns ending 12/31/2009 for the Wilshire 5000 and the S&P 500 were:

Index:	1-Year	3-Year	5-Year
W-5000	28.30	−5.25	0.93
S&P 500	23.45	−7.70	−1.65

This comparison clearly distinguishes the performance of the two indexes, in which neither is really the market. So far, we have established that the market is a broad, inexact concept that is hard to define and that the S&P 500 isn't the market. The financial engineers and quants of Type 1 pedigree have made plenty of "assive" (conjugation of active-passive) investment opportunities through ETFs and index tracking funds for anybody to purchase, given the information just disclosed.

Now, it is common knowledge that the majority of open-ended mutual funds have not beaten the S&P 500 over long time periods, which isn't the market, by the way. This is often taken as evidence in support of why you should buy the S&P 500, the supposed market. However, doing so is seldom seen as just poor investment management; rather, buying the S&P 500 is seen as supporting the efficient market. In other words, it could still be true that markets are inefficient, as Ben Graham would have us believe, and simultaneously it could be true that the majority of open-ended mutual funds have not beaten the S&P 500. It is not a proof that markets are efficient, that open-ended mutual funds mostly lose to the S&P 500, because the S&P 500 is really another managed portfolio. It might just mean that the managers of the S&P 500 are good managers.

Lastly, and here is a single example where subjectivity rules but I can only offer anecdotal evidence in support of inefficient markets, or shall we say semi-efficient markets. In