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chapter 2

The History of Security Analysis

2.1 LIFE ANNUITY VALUATION¹

Development of life contingent contracts

An aleatory contract has a payoff that depends on a random outcome. Examples of such contracts arise in the early history of insurance where, say, a contract would be made to protect against the loss of a cargo at sea. In a sense, any security that is not riskless is aleatory but this stretches the notion in a direction that is not too helpful. In the early history of security analysis, it is aleatory contracts with outcomes dependent on life contingencies which are, by far, the most significant. Not only were such contracts socially important prior to the development of modern pension plans and life insurance schemes, life contingent contracts also provide the first instance of significant analytical solutions to security pricing problems. In providing contingent claims pricing formulas for the range of life annuity contracts that were traded in the late seventeenth and early eighteenth centuries, intellectual giants of that era, such as Edmond Halley and Abraham de Moivre, laid the foundations for modern security analysis.

The origins of life annuities can be traced to ancient times. Socially determined rules of inheritance usually meant a sizeable portion of the family estate would be left to a predetermined individual, often the first born son. Bequests such as usufructs, maintenances and life incomes were common methods of providing security to family members and others not directly entitled to inheritances.² One element of the Falcidian law of ancient Rome, effective from 40 BC, was that the rightful heir(s) to an estate was entitled to not less than one-quarter of the property left by a testator, the so-called "Falcidian fourth" (Bernoulli 1709/1975, ch. 5). This created a judicial quandary requiring any other legacies to be valued and, if the total legacy value exceeded three-quarters of the value of the total estate, these bequests had to be reduced proportionately.

The Falcidian fourth created a legitimate valuation problem for jurists because many types of bequests did not have observable market values. Because there was not a developed market for life annuities, this was the case for bequests of life incomes. Some method was required to convert bequests of life incomes to a form that could be valued. In Roman law, a legal solution was introduced by the jurist Ulpian (Domitianus Ulpianus,

?-228] who devised a table for the conversion of life annuities to annuities certain, a security for which there was a known method of valuation. Ulpian's conversion table is given by Greenwood (1940) and Hald (1990, p. 117):

<i>Age of annuitant in years</i>								
0-19	20-24	25-29	30-34	35-39	40 ... 49	50-54	55-59	60-
30	28	25	22	20	19 ... 10	9	7	5
<i>Comparable Term to maturity of an annuity certain in years</i>								

The connection between age and the pricing of life annuities is a fundamental insight of Ulpian's table. However, it seems that, in practice, the use of Ulpian's table did not produce accurate valuations. For example, Nicholas Bernoulli in the *De Usu Artis Conjectandi in Jure* (1709) indicates that values were often determined by taking the annual value of the legacy, and multiplying this value by the term to maturity of the annuity certain to get the associated legacy value (Hald 1990, p. 117). For example, if the individual was 37 years old and was receiving a life income of £100 per year, then the legacy value according to Ulpian's table would be £2000. Bernoulli correctly identifies the method of multiplying the table value by the size of the payment as faulty due to the omission of the value of interest. Bernoulli observes that at, say, 5% interest the value of the legacy would be only £1246.22.

Ulpian's table was concerned with life incomes, maintenances and the like, which are not quite the same as life annuities which are traded securities with defined cash flow patterns dependent on life contingencies. The life annuity evolved from the *census* which was a form of investment dating at least to feudal times. The English word annuity is an approximate translation, but annuity does not make the appropriate connection to the source of the *census* return being derived from a "fruitful good" (Noonan 1957, p. 155). In Roman law, the *census* was not used, though various types of annuities were available. The various forms of *census* contracts formed the basis for the emergence of government debt issues of annuities certain (fixed term annuities), perpetual annuities and life annuities to fund, first, municipal and, eventually, national borrowing.

Census contracts were initially designed, in feudal times, as a type of barter arrangement, present goods for future goods. The contract appears to have originated in continental Europe, eventually facilitating the evolution of a market for long-term debt (Tracy 1985, pp. 7-8):

Continental landholders had, since the twelfth century or earlier, been possessed of a technique for converting their property to credit. In France, at least, the practice of borrowing by "constituting" a *rente* on one's land, or of extending credit on this basis, was pioneered by monastic institutions. As the agrarian economy improved, twelfth-century lords found they could obtain credit from the local monastery by pledging the usage fees (*cens*) paid by their peasants instead of having to mortgage the land itself. From this

practice, there derived the idea of creating an artificial income on one's property by constituting a *rente* (= annual income) on it. In default of annual interest payments at the stipulated rate, creditors had the right to seize the property against whose "income" the contract had been secured. Such rents could either be for the life of the creditor or his assignee, or, at an appreciably lower rate, perpetual. By the late Middle Ages, however, all perpetual or "heritable" *rentes* in France were generally considered redeemable in principle, in deference to canon law prohibitions against usury. It was this form of private credit, widely diffused in Spain, Germany, northern France, and the Low Countries, which subsequently became the basis for long-term public credit in the same regions.

The conventional *census* contract gradually took the form of a modern annuity where cash was received by the seller of the annuity in exchange for an agreement to make a stream of annual payments over time. By the end of the fifteenth century, the nobility, the church, the state and the landed gentry were all involved as sellers of *census*. Many different variations of *census* were offered: a life *census* in which payments were made over the life of a buyer, or their designee; a perpetual *census*, that had no fixed maturity date; and, a temporary or term *census* that ran for a fixed number of years, similar to a mortgage. A *census* could have conditions that permitted it to be redeemable at the option of either the buyer or seller. Noonan (1957) estimates that credit raised using *census* arrangements may have exceeded that raised through *societas* (business partnerships).

The growth of markets, the Reformation, and a host of other factors contributed to the further evolution of securities derived from the *census*. In turn, this led to the evolution of security pricing techniques. By the sixteenth century, financial markets had developed to the point where an array of investment securities were available. There were short-term commercial loans, often implicitly constructed in the form of bills obligatory or bills of exchange that disguised the direct payment of interest. Other short-term financial securities included bank deposits and triple contracts. The conventional *census* contract had also evolved. There was a range of mortgage contracts, secured by land and there was a range of life annuities often, though not always, issued by states and municipalities. Other instruments of government finance included long-term and perpetual annuities.

A major impetus to the development of securities markets was provided by the various "financial revolutions" in government finance. These revolutions started at different times, in different countries, beginning with the Italian city states and, somewhat later, extending to the cities in northern France and Flanders. The key feature of these revolutions was the transition of government debt from the status of a short-term loan to an individual, debt as an obligation of the sovereign, to a long-term loan to a political entity independent of the ruler (Hamilton 1947, p. 118):

The nascent states of Western Europe began to borrow by the middle of the thirteenth century, and modern methods of issuing and transferring public obligations arose even earlier in the Italian city states. But owing to the scarcity of liquid capital, the canonical and civil opposition to interest upon loans, and the instability of central governments, the sums borrowed were never large. The debts were usually guaranteed by pledges of jewelry, specific revenues, or real property; and almost invariably they were regarded as personal obligations of the reigning sovereign. The prevalent tendency for monarchs to default upon the debts of their predecessors prevented continuity and accumulation.

The revolutions in government finance transformed government debt operations from the realm of individual borrowing, which was typically short-term and secured by assets, to long-term borrowings which were secured by specific funding sources and were, to varying degrees, independent of the creditworthiness of the monarch.

The earliest forms of "public debt," issued by Italian city states and the northern European cities and municipalities, were either forced loans on wealthy citizens, for example, the *prestiti* in Venice, or were *rentes* backed by specific revenue sources of the sovereign or town government. Northern European towns favoured annuities or *rentes* secured by urban taxes. As early as 1260, such early issues of *rentes heritables* and *rentes vagieres* (life annuities) appeared in the French cities of Calais and Douai, spreading to the Low Countries and German towns such as Cologne (Tracy 1985, p. 13). Between 1275 and 1290 the city of Ghent in Flanders issued *lijfrenten* or life annuities followed by issues of *erfrenten* or redeemable *rentes*. There was a form of guarantee by the sovereign associated with some of these municipal issues, for example, the Court of Flanders "undertook to see that the city lived up to its promises." Municipalities, particularly in Holland, Flanders and Brabant, continued to issue life and redeemable annuities leading to increasingly larger stocks of public debt and, ultimately, to repayment difficulties for some towns by the sixteenth century.

The transition from municipal to national public debt issues was gradual. Though claims could be made for certain German territories, Dutch provinces or the Spanish monarchies, Hamilton (1947) traces the beginnings of national public debt to sixteenth century France. For some centuries before, the French had a tradition of the monarch selling long-term *rentes*, supported by the income from royal properties. These sales were often sold at deep discounts to royal officials and could not be considered "public debt" but, rather, were obligations of the sovereign. Hamilton (1947, p. 119) marks 1522 as a turning point:

For practical purposes, the national debt began in the reign of Francis I. Following the loss of Milan, the key to northern Italy, on September 15, 1522, Francis I borrowed 200,000 francs, then called *livres tournois*, at $12\frac{1}{2}$ per cent from the merchants of Paris, to intensify the war against Charles V. Administered by the city government, this loan inaugurated the famous series of bonds based on revenues from the capital and known as *rentes sur l'Hotel de Ville* . . . the public debt rose to 100 million francs by 1576 and to 300 million, of which 157 million were funded, by 1595.

Though sovereigns had recognized the importance of the debt market in financing state military ventures for some time, the emergence of the public debt gave the debt market a new status as an instrument of state power.

Despite this claim to first-mover status by the French, there were numerous difficulties with the administration of the French public debt. Large increases in outstanding principal to sustain various military adventures led to periods of suspended interest payments and forced reduction through partial bankruptcy. By the beginning of the eighteenth century, French national finances were in a sorry condition. The Dutch were

decidedly more successful in developing their public debt. The Dutch provincial governments pioneered various innovations in public debt issues during the sixteenth century, including the development of a "free market" for provincial *renten* issued in Holland (Tracy 1985, ch. IV). The English were relative late comers in developing public debt issues, with the beginnings of English public debt starting only with the reign of William and Mary in 1688.³ However, by the mid-eighteenth century the English had assumed front-runner status and the system of English public debt had become a model for European governments.⁴

In the medieval and Renaissance periods, difficulties associated with valuing a life annuity were advantageous from the perspective of avoiding usury laws, e.g., Noonan (1957), Poitras (2000, ch. 3). However, by the later seventeenth century financial markets required more precise methods of handling the pricing risks associated with issuing life annuities. In addition to improvements in pricing techniques, different variations on the life annuity were proposed to deal with the difficulty of valuing the life contingency risk. The most important of these proposals was the tontine, a funding scheme recommended to Cardinal Mazarin of France in 1652 by Lorenzo Tonti, an expatriate Neapolitan banker living in Paris.

While a number of variations were used, for example, compound tontines, the generic tontine classified the subscribers' nominees into groups, by age class, creating a fund for each group. Each of the surviving persons in a group would share the interest from the fund associated with that group. When the last member of a group was dead, payments would cease. After two aborted 1653 attempts at issuing state tontines in France and Denmark, the first tontine was issued in 1670 by the Dutch town of Kampen. Following an initial issue in 1689, the tontine became an important source of state finance in France during the eighteenth century (Weir 1989; Alter and Riley 1986). Starting in 1693, the tontine was also used, though less extensively, for state finance in England.⁵

*De Witt and Halley*⁶

In the late seventeenth and early eighteenth centuries, analytical solutions were proposed to the problem of valuing life annuities. Arguably, these analytical solutions represent the most important theoretical contributions to the early history of security analysis. The intellectual preliminaries required to sustain these contributions start around the latter part of the sixteenth century in Holland where important university mathematicians, such as Simon Stevin, were drawn to solving practical fixed income valuation problems, complementing the work of the commercial algorists. Even though the development of discounting and compounding techniques were important for determining the return from partnerships and valuing commonly traded term annuities such as mortgages and lease-purchase transactions, these techniques were not sufficient to value life annuities and other types of securities involving life contingent claims. Such problems were important because, in the absence of pension funds and life insurance, life annuities performed an essential social function.

The life annuity usually was a contract between three parties, the subscriber who provided the initial capital, the shareholder who was entitled to receive the annuity payments and the nominee on whose life the payout was contingent, e.g., Weir (1989). Different variations were possible. For example, one person could be subscriber, shareholder and nominee; a parent could be a subscriber and designate a child as the nominee with the shareholder status passing from parent to child as an inheritance; or, joint life annuities could be specified where more than one nominee was designated and payments continued until both nominees died. The life annuity was further complicated by the need to establish proof of survival for the nominee prior to each annuity payment date. While it was technically possible to resell most life annuity contracts to third parties, the difficulties associated with verifying the survival and probability of survival for the nominee made resale difficult. Oddly enough, until the nineteenth century, market practice usually involved selling life annuities without taking accurate consideration of the age of the nominee.

Life annuities have a long history with the earliest transactions involving individuals. Issues of *rentes vagieres* by municipalities in northern France, such as Calais, appeared around 1260 (Tracy 1985, p. 13). The practice of raising municipal funds using life annuities soon spread to the Low Countries and the German towns. By the fifteenth century, it was common for cities and religious orders to use life annuities to raise funds in Germany and the Low Countries, though Italian public finance appears to have adopted the practice somewhat later with "the Venetian mint (*zecca*) offering life annuities at 14% between 1536 and 1540." Issues of life annuities for national financing appear somewhat later in France and England; the French government first using *rentes vagieres* during the Nine Years' War (1688–1697) and the English government making a first issue of life annuities in 1693 (Velde and Weir 1992).

Though there were larger and less frequent issues of life annuities by the emerging nation states starting in the seventeenth century, the typical government issuers of life annuities were municipalities, with prices varying widely from town to town depending on prevailing local interest rates and pricing conventions. Amsterdam, for example, sold municipal annuities at regular intervals starting in 1402, typically "charging flat rates of $9\frac{1}{11}$ percent for annuities on two heads and $11\frac{13}{17}$ percent for one, regardless of age" (Daston 1988, p. 121). Annuity prices were quoted in "*years' purchase*," which is the price of the annuity divided by the annual annuity payment. For a perpetual annuity, years' purchase is the inverse of the annual yield to maturity.

Nicholas Bernoulli (1709) provides historical examples of life annuities selling for 6 to 12 years' purchase, without allowance being made for the age of nominee.⁷ De Witt quotes a 1671 price for a single life annuity in Amsterdam of 14 years' purchase with a 4% interest rate and no allowance for age of nominee; this is compared with a price of 25 years' purchase for a redeemable annuity, effectively a perpetual annuity with an embedded option for the borrower to redeem at the purchase price. Houtzager (1950) quotes a sixteenth and early seventeenth century Dutch pricing convention of 1.5 to 2 times the years' purchase for a redeemable annuity to determine the price for life annuities, i.e., the years' purchase of a life annuity equaled the years' purchase for a redeemable annuity divided by 1.5 to 2. The inefficiency of the practice of selling life

annuities without reference to the age of the nominee did not escape the notice of those responsible for government finance. However, solving the problem of determining a correct price was not easy. The first sound solution to this difficult analytical problem was proposed by Jan de Witt.⁸

Jan de Witt was not a professional mathematician. He was born into a burgher-regent family. While attending university at Leiden as a student of jurisprudence, de Witt lived in the house of Frans van Schooten who, while a professor of jurisprudence, was also deeply involved in mathematical studies. Van Schooten encouraged Christian Huygens, Jan Hudde and de Witt in their mathematical studies and published their efforts as appendices to two of his mathematical books. De Witt's contribution on the dynamics of conic sections was written around 1650 and published as an appendix to van Schooten's 1659 exposition of Cartesian mathematics, *Geometria a Renato Des Cartes*. From the perspective of the history of mathematics, de Witt's contribution is an interesting and insightful exposition on the subject but "marks no great advance" (Coolidge 1990, p. 127).

Around 1650, de Witt began his career in Dutch politics as the pensionary of Dordrecht. In 1653, at the age of 28, de Witt became the grand pensionary or prime minister of Holland. During his term as grand pensionary, de Witt was confronted with the need to raise funds to support Dutch military activities, first in the Anglo-Dutch war of 1665-67 and later in anticipation of an invasion by France which, ultimately, came in 1672. Life annuities had for many years been a common method of municipal and state finance in Holland and de Witt also proposed that life annuity financing be used to support the war effort. However, de Witt was not satisfied that the convention of selling of life annuities at a fixed price, without reference to the age of the annuitant, was a sound practice. Instead de Witt proposed a method of calculating the price of life annuities which would vary with age. This remarkable contribution can be considered the start of modern contingent claims analysis.

More precisely, aided by contributions from Huygens in probability and Hudde in mortality statistics, in *Value of Life Annuities in Proportion to Redeemable Annuities* (1671, in Dutch) de Witt provided the first substantive analytical solution to the difficult problem of valuing a life annuity.⁹ Unlike the numerous variations of fixed term annuity problems which had been solved in various commercial arithmetics, the life annuity valuation required the weighting of the relevant future cash flows by the probability of survival for the designated nominee. De Witt's approach, which is somewhat computationally cumbersome but analytically insightful, was to compute the value of a life annuity by applying the concept of mathematical expectation advanced by Huygens in 1657.¹⁰

De Witt's approach involved making theoretical assumptions about the distribution of the number of deaths. To provide empirical support for his calculations, he gave supplementary empirical evidence derived from the register at The Hague for life annuitants of Holland and West Friesland for which he calculated the average present values of life annuities for different age classes, based on the actual payments made on the annuities. This crude empirical analysis was buttressed by the considerably more detailed empirical work of Hudde on the mortality statistics of life annuitants from the Amsterdam register for 1586-90. For the next century, the development of pricing

formulas for life annuities is intimately related to progress in the study of life contingency tables, a subject which is central to the development of modern statistical theory and actuarial science.

Not long after submitting his *Value of Life Annuities* to the States General, de Witt's life came to a tragic end. The invasion of the Dutch Republic by France in 1672 led to a public panic which precipitated de Witt's forced resignation and his replacement by the Stadholder William III. However, the demand for public retribution for the grand pensionary's perceived failings did not end with his resignation. Later in 1672, de Witt was set upon by a mob and shot, publicly hanged and his body then violated. However, despite the tragic demise of de Witt, Jan (Johan) Hudde had been consulted by de Witt on various aspects of the results contained in the *Value of Life Annuities*, particularly the validity of the calculations, the empirical evidence on mortality of annuitants and the theoretical procedures required to calculate annuities on two or more lives. Hudde continued and expanded de Witt's work on life annuity valuation.¹¹

The solution to the problem of pricing life annuities given by de Witt uses an age interval between 3 and 80.¹² Hence, de Witt is considering the value of a life annuity written on the life of a 3-year-old nominee. As the practice up to his time was to sell life annuities at the same price, regardless of the age of the nominee, it was conventional to select younger nominees from healthy families. Based on Hudde's data for 1586–90 Amsterdam life annuity nominees, approximately 50% were under 10 years of age, and 80% under 20 (Alter and Riley, p. 33). *Throughout the following annuities will be assumed to make a payment of 1 unit of currency (florin, dollars, etc.) each period.*

Instead of assuming a uniform distribution where death at each age would be equally likely, De Witt divided the interval between 3 and 80 into four subperiods: (3, 53), (53, 63), (63, 73) and (73, 80). Within each subperiod, an equal chance of mortality is assigned. The number of chances assigned to each subgroup is 1, 2/3, 1/2, 1/3. The chance of living beyond 80 is assumed to be zero. While de Witt corresponded with Hudde about mortality data he was collecting and tabulating for the 1586–9 Amsterdam annuitants, these probabilities were assumed and not directly derived from a life table.

From these assumptions, de Witt constructs a distribution for the number of deaths and calculates the life annuity price as the expectation of the relevant annuity present values. In doing this, de Witt explicitly recognizes that life annuities were paid in semi-annual instalments, requiring time to be measured in half years and for survivors to be living at the end of the half year in order to receive the payment. The 77-year period translates into 154 half years. Using a discount rate of 4% per annum, De Witt uses his assumed chances of mortality in any half year to calculate a weighted average of the present values for the certain annuities associated with each half year. The resulting value is the expected present value of the life annuity which is the recommended price at which the annuity should be sold.

Algebraically, de Witt's technique can be illustrated by defining A_n to be the present value of an annuity with a 4% annual rate to be paid at the end of the half year n (Hald, pp. 124–5):

$$A_n = \sum_{t=1}^n \frac{1}{(1+r)^t} = \frac{1}{r} - \frac{1}{r(1+r)^n} \quad \text{where} \quad (1+r) = \sqrt{1.04}$$

To evaluate the expected present value of the life annuity, de Witt performs the calculation:

$$E[A_n] = \frac{\sum_{n=1}^{99} A_n + \frac{2}{3} \sum_{n=100}^{119} A_n + \frac{1}{2} \sum_{n=120}^{139} A_n + \frac{1}{3} \sum_{n=140}^{153} A_n}{128}$$

Interpretation of the sums is aided by observing that individuals must be alive at the end of the half year to qualify for annuity payments. For example, dying in the first half year means that no payments will be received. The divisor of 128 is calculated by determining the total number of chances as:

$$(100)1 + (20)\frac{2}{3} + (20)\frac{1}{2} + (14)\frac{1}{3} = 128$$

where the number in brackets is the number of half years in each subgroup. De Witt's solution can be compared to the less realistic case where the distribution of deaths is assumed to be uniform:

$$E[A_n] = \frac{\sum_{n=1}^{153} A_n}{154} = \frac{1}{154}(0) + \frac{1}{154} \frac{1}{1+r} + \frac{1}{154} \sum_{t=1}^2 \frac{1}{(1+r)^t} + \dots + \frac{1}{154} \sum_{t=1}^{153} \frac{1}{(1+r)^n} + 0$$

By assigning less weight to the largest cash flows, de Witt's calculated expected value of 16.0016 florins for *annual* payments of 1 florin differs from the expected value of 17.22 florins calculated using a uniform distribution.

It is difficult to assess the impact of de Witt's contribution to the practice of pricing life annuities. Based on his recommendation, in 1672 the city of Amsterdam began offering life annuities with prices dependent on the age of the nominee. However, this practice did not become widespread and by 1694, when Edmond Halley (1656–1742) published his influential paper "An Estimate of the Degrees of Mortality of Mankind, drawn from the curious Tables of the Births and Funerals at the City of Breslaw; with an Attempt to ascertain the Price of Annuities upon Lives," the English government was still selling life annuities at seven years' purchase, independent of age.¹³ Halley's paper is remarkable in providing substantive contributions to both demography and to security analysis. The importance of this paper reinforces the intellectual stature of an individual who is recognized in modern times primarily for his contributions to astronomy.

The Breslau data used in the preparation of Halley's "Estimate..." was much better suited to construction of a life table than the bills of mortality data used by John Graunt. Thanks to Leibnitz, the data set came to attention of the Royal Society and Halley, the editor of the Society's journal, was selected to analyze the data. From the end of the sixteenth century, Breslau, a city in Silesia, had maintained a register of

births and deaths, classified according to sex and age. For the purpose of constructing a precise life table, only the population size is missing. The paper is primarily concerned with constructing Halley's life table and touches on the valuation of life annuities only as an illustration of applying the information in the life table. In the process, Halley presents a somewhat more general approach than de Witt to the valuation of a life annuity. While this paper was Halley's primary effort in demographics, he did make other contributions to security analysis, such as detailing the use of logarithms in solving present value problems, e.g., Poitras (2000, p. 155).

General details of Halley's life are available in numerous sources, e.g., Ronan (1978): Halley was born in Haggerston, England on October 29, 1656; the eldest son of a well-to-do landowner, soapmaker and salter from the City of London, also known as Edmond Halley. The father had sufficient means to ensure an impressive education for his son, who showed an interest in astronomy from an early age. Together with an extensive and valuable collection of astronomical instruments that had been purchased by his father and in part made for himself, the younger Edmond Halley set off to study at Oxford at the age of 17. After three productive years of study, which included three papers published in the *Philosophical Transactions* of the Royal Society, at the age of 20 Halley moved from the overachieving to the remarkable (Pearson 1978, p. 82):

at the age of 20 an idea occurred to this young undergraduate. Why should he not go to the Southern Hemisphere and catalogue the stars which never rose above the horizon of either Dantzig or Greenwich? No sooner thought of than carried out. Halley packed up his telescope, left Oxford without a degree . . . and sailed under the auspices of the East India Company to St. Helena, where he arrived after three months' (!) voyage and set up his telescope, sticking to the work for eighteen months, until he had completed his star catalogue, reaching England again, exactly two years after he had left it, to be hailed as the Tycho Brahe of the Southern Hemisphere.

The star map by itself was considered sufficient for the King, Charles II, to issue a *mandamus* to Oxford for granting Halley a Master of Arts. In 1678, at the age of 22, Halley was made a Fellow of the Royal Society.

Unfortunately, there is so much in the life of Edmond Halley that a conventional historiography quickly covers many pages, the writer is overwhelmed and the process of sifting out important details becomes unmanageable. For example, Halley had an important relationship with Sir Isaac Newton. Some of the connections between Halley and Newton were immediate, such as Halley being instrumental in getting the *Principia* published: "There is little doubt that we owe its publication to the good offices of Halley" (Pearson 1978, p. 86). This aid came both in financial support for publication from both the Royal Society and Halley, as well as "important editorial aid" (Ronan 1978, p. 68) in preparing the manuscript. Newton was a reluctant author, if only because he was not fully satisfied with the results that were being published.

The connections between Halley and Newton were not all so apparent. For example, in addition to the star map, Halley also returned with some puzzling observations about the behaviour of an English clock pendulum in St Helena. "Halley found that his clock pendulum, which kept good time in England, had to be shortened to do so in St. Helena." When this information was passed on to Newton, he was able to interpret Halley's

observations as being due to gravity. From this Newton drew the conclusion that the earth was not a sphere, but rather is an oblate spheroid. In another instance, Halley designed a diving bell and a diver's helmet. In experiments on this equipment, Halley reports "on the colour of sunlight that he observed at various depths were sent to Newton, who incorporated them in his *Opticks*." In an interesting development, Halley formed a public company for the purposes of developing commercial applications of the bell and helmet, in particular wreck salvaging. Shares in Halley's company were quoted from 1692-6.

Halley is best known for his work on the periodicity of comet orbits. The naming of Halley's comet was a posthumous recognition for his theoretical and empirical work on a particular bright comet which exhibited a periodicity of 75 years. Though Halley's observations were well known to astronomers, "it was not until the 1682 comet re-appeared as predicted in 1758 that the whole intellectual world of western Europe took notice. By then Halley had been dead fifteen years; but his hope that posterity would acknowledge that this return "was first predicted by an Englishman" was not misplaced, and the object was named "Halley's comet" (Ronan 1978, p. 69). This recognition was a fitting tribute for someone who had contributed to so many fields, from astronomy and mathematics to history and philology.

As was the fashion at the time, Halley's presentation of the life annuity pricing problem was done by presenting mathematical concepts in a verbal format. With this in mind, it is possible to reexpress Halley's formula in more mathematical form by observing that the total number of annuities sold on a life starting at year x , ℓ_x , equals the sum of $d_x + d_{x+1} + \dots + d_{w-1}$ where d_i is the number of annuities which terminate in period i due to the death of annuitant nominees in that half year and that $d_i = 0$ for $x \geq w$. Taking ℓ_{x+t} to be the number of nominees, starting in year x surviving in period $x + t$, it follows that: $d_{x+t} = \ell_{x+t} - \ell_{x+t+1}$ and that the probability of death in any given half year j is (d_{x+j}/ℓ_x) . The general pricing formula for a life annuity follows:

$$\begin{aligned} E[A_n] &= \frac{1}{\ell_x} \sum_{n=1}^{w-x-1} A_n d_{x+n} = \frac{1}{\ell_x} \sum_{n=1}^{w-x-1} d_{x+n} \sum_{t=1}^n \frac{1}{(1+r)^t} \\ &= \frac{1}{\ell_x} \sum_{t=1}^n \sum_{n=1}^{w-x-1} d_{x+n} \frac{1}{(1+r)^t} = \frac{1}{\ell_x} \sum_{n=1}^{w-x-1} \ell_{x+n} \frac{1}{(1+r)^n} \end{aligned}$$

The last step in the derivation comes from progressively collecting terms associated with $(1+r)^{-t}$. For example, the $(1+r)^{-1}$ term will appear in each annuity and will, as a result, have coefficients which are the sum of $d_{x+1}, d_{x+2}, \dots, d_{w-1}$. Recalling the definition of d in terms of ℓ , this sum returns ℓ_{x+1} . In symbolic form, this is the life annuity pricing formula presented by Halley (1694).

*De Moivre's approximations and Bernoulli's problem**

In assessing Halley's contribution to the history of financial economics, it is natural to immediately mention Abraham de Moivre (1667-1754), an expatriate Frenchman

transplanted to London following the Repeal of the Edict of Nantes. Halley and de Moivre were first acquainted in 1692 and in 1695 de Moivre's first paper contributed to the Royal Society was presented by Halley. Unlike Halley who touched only briefly on the pricing of securities, de Moivre spent much of his productive life studying the practical problem of pricing life annuities. By the time de Moivre undertook his work on life annuities, the basic groundwork had been laid. However, Halley and others recognized that the brute force approach to calculating tables for valuing life annuities would require "a not ordinary number of Arithmetical operations." Halley attempted to develop simplifying mathematical procedures, "to find a Theorem that might be more concise than the Rules there laid down, but in vain."

In the early history of security analysis de Moivre can be recognized for fundamental contributions involving the application of applied probability theory to the valuation of life annuities. This work laid the theoretical foundation for Richard Price, James Dodson and others to develop the actuarially sound principles required to implement modern life insurance. The immediate incentive for de Moivre was to value the various aleatory contracts which became increasingly popular as the eighteenth century progressed. Being (together with Laplace) one of two giants of probability theory in the eighteenth century (Pearson 1978, p. 146), de Moivre was singularly well suited to the task of developing the foundations of insurance mathematics. It is one of the quirks of intellectual history that de Moivre's most significant contributions, which lay primarily in the areas of probability theory and applied mathematics, contributed little to his personal comfort while his contributions to security analysis and valuation managed to help de Moivre maintain body and soul.

To the modern reader, it is strange that a person of de Moivre's stature had to endure most of his life in "the hardest poverty." Never able to secure an academic position, de Moivre earned a living as an eighteenth-century reckoning master and algorist, tutoring mathematics, calculating odds for gamblers and reckoning values for underwriters and annuity brokers. Pearson (1978, p. 143) observes that "this seamy side of life had a golden lining. Every evening (Sir Isaac) Newton would come and fetch de Moivre from (Slaughter's) Coffee House, and take him for philosophical discussion to his own house in Golden Square. I picture De Moivre working at a dirty table in the coffee house with a broken-down gambler beside him and Isaac Newton walking through the crowd to his corner to fetch out his friend. It would make a great picture for an inspired artist."

De Moivre began his close friendships with Newton and Halley around the same time in the early 1690s. The timing of the 1694 publication of Halley's "Estimate..." and Halley's subsequent presentation of de Moivre's first paper to the Royal Society in 1695 make it possible that de Moivre played some role in the inclusion of the life annuity valuation problem in the "Estimate..." It is not difficult to conceive enlightened interaction between the two on the subject of applying Halley's life table and de Moivre's suggesting and explaining the important problem of life annuities. However, de Moivre's primary contribution to pricing life annuities did not appear until much later in the *Annuities Upon Lives* (1725) with a second edition (1743). Also important is the 1756 edition of his *The Doctrine of Chances* which contains a section titled "A Treatise of Annuities on Lives" together with discussion of the life tables of Halley, Kersseboom, Simpson and Deparcieux.

In *Annuities*, de Moivre examined a wide variety of the life annuities available in the early eighteenth century: single life annuities, joint annuities (annuities written on several lives), reversionary annuities, and annuities on successive lives. His general approach to these valuation problems involves two steps: first, to develop a general valuation formula for each type of annuity based on Halley's approach; and, second, to produce an approximation to the general formula suitable for calculating prices without the considerable efforts involved in evaluating the more exact formula. In order to implement some of the approximations, de Moivre developed a mathematical formulation, a piece-meal linear approximation, of the information contained in the life table.

The computational advantages of de Moivre's approximations were considerable and the methods became widely used in day-to-day commercial practice. The ensuing development of actuarial science and insurance mathematics progressed by working with the more tedious exact formulae, estimating more accurate life tables and calculating tables with exact prices for different situations and levels of interest rates. The next important person in the intellectual linkage developing life insurance mathematics was James Dodson, a pupil and friend of de Moivre. While admitting that Dodson's interest in life contingencies almost surely originated with de Moivre, Ogborn (1962, p. 23) speculates that it "is an interesting question whether (Dodson and de Moivre) ever discussed the mathematics of life assurance but there is no published evidence that they did so and it seems that the work is wholly Dodson's."

De Moivre provided an important simplification for the value of a single life annuity under the assumption that the "Probabilities of Life . . . decrease in Arithmetic Progression" or, in other words, are uniformly distributed starting at year x up to some terminal year w , $n = w - x$. Generalizing the uniformly distributed case, de Moivre's result is derived by observing that for the uniform case:

$$\begin{aligned} E[A_n] &= \frac{n-1}{n} \frac{1}{1+r} + \frac{n-2}{n} \frac{1}{(1+r)^2} + \dots + \frac{n-(n-1)}{n} \frac{1}{(1+r)^{n-1}} + \frac{n-n}{n} \frac{1}{(1+r)} \\ &= \sum_{t=1}^n \frac{1}{(1+r)^t} \left(1 - \frac{t}{n}\right) = \sum_{t=1}^n \frac{1}{(1+r)^t} - \sum_{t=1}^n \frac{t}{n(1+r)^t} \end{aligned}$$

From this point, de Moivre provides an obscure derivation in the first edition of *Annuities upon Lives* and a more tedious demonstration in later editions. A more modern derivation is provided in Pearson (1978, pp. 147-8) where it is observed that:

$$\sum_{t=1}^n \frac{t}{n(1+r)^t} = \frac{1+r}{n} \sum_{t=1}^n \frac{t}{(1+r)^{t+1}} = -\frac{1+r}{n} \frac{dA_n}{d(1+r)}$$

It follows that:

$$E[A_n] = \left[A_n + \frac{1+r}{n} \frac{dA_n}{d(1+r)} \right] = \frac{A_n}{n} \left[n + \frac{1+r}{A_n} \frac{dA_n}{d(1+r)} \right]$$

The last term, not provided by Pearson, contains the familiar Macaulay duration for the annuity applicable to the longest life.

Substituting the relevant expressions back into $E[A_n]$ and evaluating the derivative gives:

$$\begin{aligned} E[A_n] &= \left[A_n + \frac{1+r}{n} \frac{dA_n}{d(1+r)} \right] \\ &= \left(\frac{1}{r} - \frac{1}{r(1+r)^n} \right) + \frac{1+r}{n} \left[\frac{n}{r(1+r)^{n+1}} + \frac{1}{r^2(1+r)^n} - \frac{1}{r^2} \right] \\ &= \frac{1}{r} - \frac{1+r}{n} \left[\frac{1}{r} \left\{ \frac{1}{r} - \frac{1}{r(1+r)^n} \right\} \right] = \frac{1}{r} \left\{ 1 - \frac{1+r}{n} A_n \right\} \end{aligned}$$

The final right-hand-side expression is de Moivre's approximation to the value of a single life annuity. If only for the computational savings provided, this formula is a considerable advance. From the tedious calculation of a long weighted sum, with weights extracted from the not completely accurate life tables available at his time, de Moivre provides a calculation which could be done in a matter of seconds with or without the aid of an appropriate table for annuities certain. While the derivation provided is not precisely de Moivre's (see Hald, pp. 521–2), the connection to the familiar notion of Macaulay duration is instructive for modern readers. Similar to the improvement of the duration measure provided by the introduction of convexity, the accuracy of de Moivre's formula can be improved by considering higher order derivative terms (Pearson, pp. 150–2). In this case, the higher order terms improve on the accuracy of the solution associated with the assumption of uniformly distributed death rates.

De Moivre provided numerous approximations relevant for other cases, such as joint life annuities, where two lives are nominated and the annuity payments continue until both are dead. Some of de Moivre's approximations were more successful than others and Simpson expended considerable effort showing that direct calculation making use of life tables was substantially better for pricing the joint life annuity (Hald, p. 532). De Witt also considered the problem of joint life annuities and, implementing an early version of Pascal's triangle, provided an insightful solution, considered to be his "most important contribution to mathematics" (Coolidge 1990, p. 131). De Moivre, Simpson and later writers used a more direct approach to the price of a joint life annuity, $E[A_{mn}]$ for two joint lives, involving the price of the single life annuities $E[A_n]$ and $E[A_m]$ and an annuity for joint life continuance which makes payments only when both nominees are alive $E[_mA_n]$. Because the pricing problem for single life annuities was solved, the joint life annuity problem involved solving for $E[_mA_n]$.

The de Moivre approach to solving a joint life annuity written on two lives involved the relationship:

$$E[A_{mn}] = E[A_n] + E[A_m] - E[_mA_n]$$

This result follows from observing that the probability of having survival of at least one of the two lives at time t is $1 - (1 - \text{Prob}[x, t])(1 - \text{Prob}[y, t]) = \text{Prob}[x, t] + \text{Prob}[y, t] - \text{Prob}[x, t]\text{Prob}[y, t]$ where $\text{Prob}[x, t]$ is the probability of $x(y)$ surviving at time t which can be related to ℓ_{x+t}/ℓ_x in the $E[A_n]$ formula given previously. Multiplying by $(1+r)^{-t}$ and summing gives the required result. From this point de Moivre used two approaches to solve for approximations to $E[A_n]$, one involved taking $\text{Prob}[\cdot]$ to be arithmetically declining and the other geometrically declining. While the former leads to a more exact result for $E[A_n]$, the latter has a less complicated formula (Hald, pp. 528–30). An example of market prices for joint annuities are the 14%, 12% and 10% (7, 8.5 and 10 years' purchase) rates offered on annuities for one, two and three lives, irrespective of age, in a 1694 issue by the government of England.

A final point to be considered is the relationship between $E[A_n]$ and the value of a term annuity for the expected duration of life from a given starting age x . The difference between these two valuations was recognized by de Witt but the point was still a revelation to Nicholas Bernoulli (1709) who stated: "I notice that the value of (life annuity) incomes is not correctly calculated by supposing that the return will last as many years as someone is supposed probably to live." To illustrate this problem, for simplicity assume all deaths occur at the beginning or end of period. This assumption permits the exclusion of the problem of evaluating where the average time of death will be in the year for persons that die after s but before $s + 1$, e.g., averaging would give $s + 1/2$ years. Given this, the expectation of life at birth, D , can be compared with $E[A_n]$ starting at birth and the associated value of the term annuity with length D :

$$D = \sum_{t=1}^{w-x-1} t \frac{d_{x+t}}{\ell_x} \quad E[A_n] = \sum_{n=1}^{w-x-1} A_n \frac{d_{x+n}}{\ell_x} \quad A_d = \sum_{t=1}^D \frac{1}{(1+r)^t}$$

Comparing D with $E[A_n]$ and A_d it is apparent that $D > E[A_n]$ and $D > A_d$, due to the impact of discounting on the terms in $E[A_n]$ and A_d . Even if interest rates are zero and $D = A_d$, $E[A_n]$ and D are still not equal due to the $E[A_n]$ only crediting the cash flow if the end of period is reached. (This is the point that was suppressed for simplicity).

The difference between D and $E[A_n]$ is well known, e.g., Alter and Riley (p. 9), Hald (p. 128). However, the comparison between A_d , a certain annuity with term equal to expected life, and $E[A_n]$, the expected value of an annuity lasting for the duration of a life, is not as obvious. Under the simplifying assumption, these values will be equal if interest rates are zero. However, for $r > 0$, $A_d \geq E[A_n]$ with = only when all deaths occur at n . To see this, consider the uniformly distributed case where:

$$E[A_n] = \frac{1}{r} \left\{ 1 - \frac{1+r}{n} A_n \right\} \quad A_d = \frac{1}{r} - \frac{1}{r(1+r)^D}$$

It follows:

$$\begin{aligned}
A_d - E[A_n] &= \frac{1}{r(1+r)^D} - \left[\frac{1+r}{n} \cdot \frac{1}{r} \right] \left\{ \frac{1}{r} - \frac{1}{r(1+r)^n} \right\} \\
&= \frac{1}{r^2} \left\{ \frac{r}{(1+r)^D} - \left[\frac{1+r}{n} \left\{ 1 - \frac{1}{(1+r)^n} \right\} \right] \right\} \\
&= \frac{1}{r^2} \left\{ \frac{nr(1+r)^{n-D} + (1+r) - (1+r)^{n+1}}{n(1+r)^n} \right\} > 0
\end{aligned}$$

In more general form, this was the relationship observed by Nicholas Bernoulli.

2.2 WRITERS ON STOCK MARKETS UP TO THE EARLY TWENTIETH CENTURY

*Early European writers: J. de la Vega and T. Mortimer*¹⁴

Shares in joint stock companies are the precursors of modern common shares. The joint stock form of ownership evolved somewhat slowly from earlier forms of business organization. Most of the early joint stock companies retained some of the essential features of partnerships. Hecksher (1955) makes an important distinction between partnerships and joint stock companies by referring to the latter as "capital associations of a corporative character." As such, the early joint stock companies were an alternative form of business organization to the regulated companies which had a business structure evolved along the lines of the medieval guilds. Unlike joint stock companies where capital contributions were combined and subject to the control of a single management, the regulated companies were associations of independent traders and merchants, each with their own independent capital, operating under a grant of monopoly in a specific type of trade. The Fellowship of Merchant Adventurers was an important example of an English regulated company.

Joint stock companies differed in a number of significant ways from modern publicly traded corporations. As late as the eighteenth century, transferability of joint stock shares was restricted in various ways. For example, there was a process requiring approval and registration of new shareholders. In addition, many of the earlier joint stock companies were involved in long-distance trade, with paid-in capital being dispersed together with any profits after the completion of a voyage. Sometimes profits were distributed in the form of goods such as spice. Increases in capital were usually achieved by making calls on existing shareholders, rather than issuing new shares. It was during the seventeenth century that joint stock companies with modern features started to emerge (Parker 1974). Starting with the creation of the Dutch East India Company (VOC) in 1602, these more modern joint stock companies included ready transferability of shares, a permanent capital stock, profits-only distributed as dividends and new capital requirements being raised by new stock issues (see table 2.1).

Table 2.1 Timeline for intellectual and historical events, 1602–1776

1602	Formation of Dutch East Indies Company (VOC); shares start trading in Amsterdam
1618–48	Thirty Years War, last of the major religious wars in Europe, decimates Germany
1637	Rene Descartes publishes the <i>Discourses</i>
1660	The British Restoration of Charles II
1662	John Graunt publishes <i>Natural and Political Observations</i>
1671	J. de Witt submits the <i>Value of Life Annuities</i> to the Dutch States General
1687	Isaac Newton publishes first edition of the <i>Principia</i>
1688	Glorious Revolution in Britain; J. de la Vega publishes <i>Confusion des Confusiones</i>
1693	Edmond Halley publishes “An Estimate of the Degrees of Mortality”
1694	Bank of England founded
1719–20	John Law’s Mississippi Scheme in France
1720	South Sea Bubble in England
1725	A. de Moivre publishes first edition of <i>Annuities Upon Lives</i>
1761	Thomas Mortimer publishes first edition of <i>Everyman His Own Broker</i>
1771	Richard Price publishes first edition of <i>Observations on Reversionary Payments</i>
1776	Adam Smith publishes <i>Wealth of Nations</i> ; American Declaration of Independence

Starting with the trading of VOC shares on the Amsterdam bourse at the beginning of the seventeenth century, joint stocks proved to be an excellent trading vehicle for the merchants populating the bourses. Shares were allocated a designated area within the bourse and were traded alongside a range of other commodities such as spice goods and copper. Even though there was sporadic trading in Dutch West Indies Company shares and selected Dutch government debt issues, VOC shares were the primary security being traded. During the seventeenth century, the Amsterdam share market achieved an extremely sophisticated level of development featuring both forward and option transactions. In addition, possibly as early as 1640, the *rescontre* system of clearing and settling accounts was perfected. This system used quarterly settlement intervals that permitted payment of differences and allowed for “continuations,” similar to the operations of a clearing house at a modern futures exchange.

The emergence and growth of joint stocks was accompanied by considerable public discussion and debate which is captured in the pamphlet literature and parliamentary records of the time. However, unlike the pricing theories for fixed income securities that were relatively well developed by the end of the seventeenth century, much of the analysis of joint stock companies was concerned with describing manipulative trading practices by stockjobbers and proposing remedies for the “infamous practice,” rather than with developing methods of security valuation. For example, di Marchi and Harrison (1994) describe the seventeenth-century Dutch pamphlet literature which attacked the practice of short selling securities that were not owned by the individual making the short sale. Against the polemical backdrop of the pamphlet literature can be found a number of interesting anomalies that stand out as early classics of security analysis: Joseph de la Vega’s *Confusion de Confusiones* (1688) and Thomas Mortimer’s *Everyman His Own Broker* (1761).

To say that *Confusion de Confusiones* is an isolated gem in the history of financial economics is an understatement. The book itself is an oddity, initially written in Spanish, published in Amsterdam by a Jewish writer of Portuguese descent. Joseph de la Vega was the second son in a family of four sons and six daughters. His parents were Isaac Penso and Esther de la Vega. Though his formal name was Joseph Penso de la Vega Passarinho, according to custom he typically used the shortened name derived from his mother. Isaac Penso was born in Spain though the family's ancestral roots appear to have been in Portugal. As was the case with many Jews in seventeenth-century Spain, the Inquisition produced a forced emigration and his parents moved first to Antwerp, then Hamburg and finally Amsterdam. Joseph was likely born sometime around 1650, soon after the family had relocated to northern Europe.

Isaac Penso achieved success as a banker in Amsterdam and became a prominent member of the local community. Though Jews in Amsterdam were relatively unrestricted in comparison to almost all other cities, there were still considerable barriers to Jewish participation in various trades. However, Jews were permitted to engage in activities such as wholesale trading in goods, shipping and banking functions such as money lending and money changing. Some Jews were also permitted to engage in brokering. Not surprisingly, Jews were central players in the business of trading stocks. Anecdotal evidence indicates that as much as 85% of Amsterdam stock trading circa 1700 was in the hands of Jews, many of whom were of Iberian descent.¹⁵ Based on this, de la Vega was in an excellent situation to gather the type of information needed to write a detailed account of stock trading on the seventeenth-century Amsterdam bourse.

Confusion de Confusiones is written as four dialogues between a shareholder, a philosopher and a merchant. Each dialogue describes different features of the activities of the Amsterdam bourse in the later seventeenth century. In *Confusion*, de la Vega (1688, p. 156) demonstrates a modern understanding of the use of fundamental information to value stocks:

The price of shares [in the Dutch East India Company] is now 580 . . . it seems to me that they will climb to a much higher price due to extensive cargoes that are expected from India, because of the good business of the Company, of the reputation of its goods, of the prospective dividends and of the peace in Europe.

Recognizing the uncertainties in seaborne trade and the difficulty in obtaining information about incoming cargoes, de la Vega goes on to describe how some traders could profitably trade on information about incoming cargoes from the East. He correctly recognizes that such information alone is insufficient but would depend also on European conditions and the safe arrival and unloading of cargo.

Modern Finance typically models the security valuation problem as determining the discounted value of expected future cash flows. This reliance of the valuation problem on expectations is explicitly recognized by de la Vega (1688, p. 165), who gives this story an additional twist:

The expectation of an event creates a much deeper impression upon the exchange than the event itself. When large dividends or rich imports are expected, shares will rise in price; but

if the expectation becomes a reality, the shares often fall; for the joy over the favourable development and the jubilation over a lucky chance have abated in the meantime.

Recognizing that there are "natural reasons for this phenomenon," de la Vega attributes this share pricing behavior to a struggle between bulls and bears over market sentiment: "the leaves tremble in the softest breeze, and the smallest shadow causes fear."¹⁶

In the second dialogue, de la Vega (pp. 158–9) provides four useful rules to guide investment activities in shares: "The first principle: . . . Never give anyone the advice to buy or sell shares . . . The second principle: Take every gain without showing remorse about missed profits . . . The third principle: Profits on the exchange are the treasure of goblins . . . The fourth principle: Whoever wishes to win in this game must have patience and money." Variations of the second and third of these principles could easily pass as commonsense advice given to modern security traders. The fourth principle is evidence that de la Vega, an astute seventeenth-century observer of stock trading, was an adherent to "long-run investment strategies." Combining this fourth principle with de la Vega's recognition of the importance of fundamental information anticipates the approach to security investment pioneered by Benjamin Graham more than two hundred and fifty years later.

Even though de la Vega identifies how the price of joint stocks can be determined by fundamental information, much of his dialogue is taken up in a description of how prices will deviate from the fundamental values based on the expectations of bulls and bears. In particular, the last of the four dialogues is concerned with detailing methods of market manipulation: "the acme of Exchange operations, the craftiest and most complicated machinations which exist in the maze of the Exchange and which require the greatest possible cunning" (*Confusion*, p. 191). The manipulation of securities markets in the seventeenth and eighteenth centuries was facilitated by the social practice of using securities for purposes of gambling. This practice was in keeping with the widespread public acceptance of gambling reflected, for example, in the use of lotteries to increase the attractiveness of government debt operations (Daston 1988; Cohen 1953).

In contrast to the almost voluminous discussion of the nefarious practice of stockjobbing, eighteenth-century English publications dealing with the use of security analysis to value joint stocks are relatively scarce. The success of *Every Man His Own Broker* by Thomas Mortimer speaks to the lack of such a guide prior to this time. Originally published in 1761 with a further 14 editions to follow, the last being in 1807, the book was intended as a practical guide to investors seeking to make investment in the English security market without the aid of a broker. Cope (1978) describes *Every Man His Own Broker* as the first detailed account of the English stock market. Mortimer was compelled to write the book based on his experiences from dealing on his own at Jonathan's without a broker in order to save the cost of brokerage. As a result of these activities, Mortimer managed to lose a "genteel fortune" and, in the process, acquired a genuine hostility to stockjobbers and other such speculators. The book goes far beyond the basic objective of being a how-to-book for trading in the British funds to provide numerous insights on the workings of the English stock market.

A constant theme in *Every Man* is the need to be wary of "this medley of Barbers, Bakers, Butchers, Shoe-makers, Plasterers, and Taylors, whom the mammon of unrighteousness has transformed into Stock-Brokers" (p. xiii). This wariness is not to be

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In contrast to the almost voluminous discussion of the nefarious practice of stockjobbing, eighteenth-century English publications dealing with the use of security analysis to value joint stocks are relatively scarce. The success of *Every Man His Own Broker* by Thomas Mortimer speaks to the lack of such a guide prior to this time. Originally published in 1761 with a further 14 editions to follow, the last being in 1807, the book was intended as a practical guide to investors seeking to make investment in the English security market without the aid of a broker. Cope (1978) describes *Every Man His Own Broker* as the first detailed account of the English stock market. Mortimer was compelled to write the book based on his experiences from dealing on his own at Jonathan's without a broker in order to save the cost of brokerage. As a result of these activities, Mortimer managed to lose a "genteel fortune" and, in the process, acquired a genuine hostility to stockjobbers and other such speculators. The book goes far beyond the basic objective of being a how-to-book for trading in the British funds to provide numerous insights on the workings of the English stock market.

A constant theme in *Every Man* is the need to be wary of "this medley of Barbers, Bakers, Butchers, Shoe-makers, Plasterers, and Taylors, whom the mammon of unrighteousness has transformed into Stock-Brokers" (p. xiii). This wariness is not to be

To say that *Confusion de Confusiones* is an isolated gem in the history of financial economics is an understatement. The book itself is an oddity, initially written in Spanish, published in Amsterdam by a Jewish writer of Portuguese descent. Joseph de la Vega was the second son in a family of four sons and six daughters. His parents were Isaac Penso and Esther de la Vega. Though his formal name was Joseph Penso de la Vega Passarinho, according to custom he typically used the shortened name derived from his mother. Isaac Penso was born in Spain though the family's ancestral roots appear to have been in Portugal. As was the case with many Jews in seventeenth-century Spain, the Inquisition produced a forced emigration and his parents moved first to Antwerp, then Hamburg and finally Amsterdam. Joseph was likely born sometime around 1650, soon after the family had relocated to northern Europe.

Isaac Penso achieved success as a banker in Amsterdam and became a prominent member of the local community. Though Jews in Amsterdam were relatively unrestricted in comparison to almost all other cities, there were still considerable barriers to Jewish participation in various trades. However, Jews were permitted to engage in activities such as wholesale trading in goods, shipping and banking functions such as money lending and money changing. Some Jews were also permitted to engage in brokering. Not surprisingly, Jews were central players in the business of trading stocks. Anecdotal evidence indicates that as much as 85% of Amsterdam stock trading circa 1700 was in the hands of Jews, many of whom were of Iberian descent.¹⁵ Based on this, de la Vega was in an excellent situation to gather the type of information needed to write a detailed account of stock trading on the seventeenth-century Amsterdam bourse.

Confusion de Confusiones is written as four dialogues between a shareholder, a philosopher and a merchant. Each dialogue describes different features of the activities of the Amsterdam bourse in the later seventeenth century. In *Confusion*, de la Vega (1688, p. 156) demonstrates a modern understanding of the use of fundamental information to value stocks:

The price of shares [in the Dutch East India Company] is now 580 . . . it seems to me that they will climb to a much higher price due to extensive cargoes that are expected from India, because of the good business of the Company, of the reputation of its goods, of the prospective dividends and of the peace in Europe.

Recognizing the uncertainties in seaborne trade and the difficulty in obtaining information about incoming cargoes, de la Vega goes on to describe how some traders could profitably trade on information about incoming cargoes from the East. He correctly recognizes that such information alone is insufficient but would depend also on European conditions and the safe arrival and unloading of cargo.

Modern Finance typically models the security valuation problem as determining the discounted value of expected future cash flows. This reliance of the valuation problem on expectations is explicitly recognized by de la Vega (1688, p. 165), who gives this story an additional twist:

The expectation of an event creates a much deeper impression upon the exchange than the event itself. When large dividends or rich imports are expected, shares will rise in price; but

if the expectation becomes a reality, the shares often fall; for the joy over the favourable development and the jubilation over a lucky chance have abated in the meantime.

Recognizing that there are "natural reasons for this phenomenon," de la Vega attributes this share pricing behavior to a struggle between bulls and bears over market sentiment: "the leaves tremble in the softest breeze, and the smallest shadow causes fear."¹⁶

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restricted to tradesman turned stock brokers, for even stock brokers from the higher ranks of society can be corrupted as “both ancient and modern history, furnishes us with many remarkable instances of the basest actions being committed by men of high rank, and the most exalted stations in government, for smaller pecuniary advantages than those which might arise in cases here supposed” (p. 45). As for the types of advice to be suspected Mortimer observes: “Always suspect the man who wants to engage you to be continually changing the situation of your money, to be influenced by some private motive, unless you are a JOBBER yourself” (pp. 22–3). Similarly, Mortimer also advises: “it is almost impossible for a broker, to give any gentleman, candid disinterested advice, when to buy into, or sell out of, the funds” (p. xvi).

As for the specific topic of joint stock valuation, Mortimer (1761, p. 9) states:

Every original share of a trading company's STOCK must greatly increase in value, in proportion to the advantages arising from the commerce they are engaged in; and such is the nature of trade in general, that it either considerably increases, or falls into decline; and nothing can be a greater proof of a company's trade being in a flourishing condition, than when their credit is remarkably good, and the original shares in their stock will sell at a considerable premium.

This reference to stock selling at a premium harkens back to a time when stock was issued with a par value. Writing at a time when accounting information for publicly traded securities was cursory, at best, Mortimer suggests that the ability of a firm to borrow was an important signal of fundamental value. In modern times, this could be translated into a statement about factors that would provide a basis for a firm to access credit markets such as the credit rating as well as the state of a firm's balance sheet and debt service capacity. Mortimer also makes reference to the type of “advantages” of the particular business of the firm. This hints at the sector specific approach to common stock investing which is pervasive in the modern security industry.

Mortimer proceeds to explain this general valuation approach using one of the important British public companies, the British East India Company, as an example:

This, for instance, has always been, and still is the case of EAST INDIA STOCK in particular, not to instance any other. The present price of a share of £100 in the company's stock is £134. The reason of this advance on what cost the original proprietor only £100 is, that the company, by the profits they have made in trade, are enabled to pay £6 *per annum* interest or dividend for £100 share. But then it is uncertain how long they may continue to make so large an annual dividend, especially in time of war; for several circumstances may occur (though it is not likely they should) that may molest their trade in their settlements, and diminish their profits.

It follows that Mortimer subscribed to the view that share price was driven by the sustainable level of dividend payout that, in turn, was affected by the various factors driving firm profitability. The dividend level is implicitly being compared to the prevailing level of interest rates. Dividends, firm profitability and interest rates drive stock valuation. This view is an early precursor of what, in modern times, is referred to as fundamental analysis.¹⁷

Perhaps the most interesting view presented in *Every Man* concerns Mortimer's views on the superiority of fixed income investments over joint stocks. For example (pp. 20-1):

That shares in annuities, bought at a great discount, that is to say, greatly under par, are the cheapest and most advantageous to the purchaser; and considerably more profitable than any STOCKS bought at a high premium. Because the probability of the premium (given on any STOCK) totally subsiding, is infinitely greater, than that the low price at present given for a 3 per cent Annuities, should fall much lower; and there is a greater probability of their rising, and a greater likelihood of its continuance, than there is, the premium now given on any STOCK should rise much higher, or continue so high as it is, for any number of years; therefore shares in STOCKS that bear a premium, are the dearest; and shares in funds or annuities under par, the cheapest to purchase.

Though difficult to translate into modern terms due to the differing characteristics of today's security markets and those of eighteenth-century England, Mortimer is clearly arguing in favor of the superiority of fixed income investment over stocks when interest rates are high relative to long term level of interest rates. This echoes the modern views of individuals in the trade such as Bill Gross of PIMCO Funds questioning the prevailing view that stock returns will outperform bond returns in the long run.

Reminiscences of the US stock operators

Much as in more modern times, the literature on security analysis of the late nineteenth and early twentieth centuries is populated by two general types of contributions. On the one hand, are the works written by academics, designed primarily to appeal to other academics. Included in this grouping are contributions by Irving Fisher, Edgar Smith, John Maynard Keynes and John Burr Williams.¹⁸ On the other hand, are the contributions from those in the trade and the financial press, such as Henry Clews (1908), Alexander Noyes (Klein 2001), Edwin Lefèvre (1923) and Hartley Withers (1911). Though these contributions were aimed at a broad audience, the best of the contributions contain fundamental insights about views on security analysis and investment strategy prevailing at that time. Even though some members of the academic grouping, such as Irving Fisher and J.M. Keynes, did make some contributions that could easily be included in the second grouping, there is generally a different flavor to the contributions of the two groupings.

This dichotomy between academic and trade publications serves to reinforce the importance and relevance of Graham and Dodd (1934): a book written by individuals with academic standing that is fundamentally concerned with the types of problems that are at the core of what practitioners do. Graham and Dodd (1934) redefined the role of academics in relation to the practice of security analysis. Benjamin Graham (1894-1976), the senior author of the book, was well suited to this task. Born in London in 1894 as Benjamin Grossbaum, he immigrated to the US in 1895. Following an undergraduate education at Columbia, Graham graduated in 1914 and went to work at the Wall Street firm of Newburger, Henderson, and Loeb, performing mostly lower

level tasks. By 1920, Graham had worked his way up to partner. During the 1920s, Graham went on to form a number of investment firms in which he was a principal. It was a keen mind and a wealth of market experience that Graham brought to his classes at Columbia. Starting in 1928, Graham was a part-time instructor of investment classes at Columbia University. It was in one of these classes that David Dodd was a student.

To appreciate the importance of Graham and Dodd (1934) for the development of security analysis as a subject, it is useful to recognize what had been written up to that time and to recount some historical background. With this in mind, it is not easy to pick a starting point for a discussion of the relevant contributions from those in the trade and financial press. In general, the published contributions chronologically increase in depth and understanding of security valuation issues. This development is roughly consistent with the growth of New York as the world's financial capital. As late as the 1820s, Philadelphia had as strong a claim as New York to be the nation's financial capital. In the period before the Civil War, London was still, by far, the world's dominant securities market. Even with the sizeable influx of funding issues associated with the war, around 1866 London still had a market cap of some \$10 billion compared to \$3 billion for New York (Gordon 1999, p. 123).

From the beginning of trading in joint stocks, a range of trade publications covering a number of different facets of security analysis and the securities industry have appeared. One type of publication is articles in the business press. In the US, the *Commercial and Financial Chronicle* was a key source until it was superseded by the *Wall Street Journal* (first published in 1884).¹⁹ The business section of the major newspapers, such as the *New York Times* in the US and the *London Times* in England, also are important sources. As daily or weekly publications, these sources did not usually proceed much beyond a focus on current events. Though this often involved discussion about the valuation of specific stock issues, there was no scope to present a reasoned development for the methods of security valuation. Much like a business reporter today, the financial reporter would gather information from those involved in the trade knowledgeable about security analysis as it pertained to the topic of the interest.

Almost from the beginning of securities trading in the US, it is evident from some of the articles in the financial press that the practice of security analysis was more than rudimentary. This is not that surprising when it is recognized that market practices in the US were transplanted from European centers, such as London and Amsterdam, where there was more than a century of prior development in securities trading. Despite the availability of expertise in the industry, before Graham and Dodd there is no source which systematically develops the techniques of security analysis. This does not mean that the methods of security analysis being used at the time are completely unknown today; rather, much of the information is contained in studies that are biographical or autobiographical accounts of those involved in the industry, such as Henry Clews *Fifty Years on Wall Street* (1908) or Edwin Lefèvre *Reminiscences of a Stock Operator* (1923). There are also insightful accounts of the securities being traded such as Hartley Withers *Stocks and Shares* (1911).

In examining the various stories and accounts of the activities of market participants, it is possible to go back as far as, say, 1792 when the 21 individual brokers and 3 firms signed the Buttonwood Agreement "not to buy or sell from this day for any person

whatsoever any kind of Public Stock, at a rate less than one quarter per cent Commission on the specie value, and that we will give preference to each other in our negotiations." This arrangement was eventually to evolve into the New York Stock Exchange (NYSE), a title that was introduced in 1863 as a name change for the Regular Board of the New York Stock and Exchange Board. The New York Stock Exchange emerged as the dominant exchange for trading stocks in New York with its merger with the Open Board of Brokers in 1869 (Gordon 1999, pp. 95, 124–5). The New York Stock and Exchange Board, formed in 1817 (Eames 1894, p. 18), could trace its pedigree to the Buttonwood Agreement. The Open Board was a relative newcomer that flourished in the face of the flood of issues arising from the Civil War.

Until the emergence of a dominant exchange, stock trading in New York was scattered across a range of venues. For example, in 1856 Gordon (1999, p. 87) reports there were 360 railroad stocks, 985 bank stocks, 75 insurance stocks, in addition to hundreds of corporate, municipal, state and federal bonds and other types of stocks being traded in New York. Of these most were not traded on the New York Stock and Exchange Board, the lineal precursor of the NYSE, as the Board did not trade new and untested issues. These issues were curb traded. The primary venue for curb trading was various lamp posts in the Wall Street area where brokers who were not Board members, as well as some Board members, would meet to trade securities. Though the volume of curb trading was usually higher than trading on the Board, the market cap of curb issues was lower. In contrast, to curb trading, activities of the Board were conducted at daily auctions which were held in fixed quarters.

The tales of American stock operators predate the Buttonwood Agreement. Notoriety was, and still is, the result of doing something on a grand scale, often in conjunction with a massive bull market speculation, or the creation of a colossal conglomerate or the execution of an immense market manipulation. An early example is William Duer who was at the center of a 1791–92 speculative scheme to inflate the value of bank stocks, particularly the Bank of New York (Gordon 1999, pp. 40–5). The scheme was based on leveraged speculation and trading on insider information. At the height of the speculative frenzy, a number of banks were incorporated that, ultimately, did not open. As such, these stocks represent an early US instance of bull market "paper hanging." The collapse of the scheme resulted in the bankruptcy of many of the players, including Duer. The scheme prompted Alexander Hamilton to write: "'Tis time there should be a line of separation between honest Men and knaves, between respectable Stockholders and dealers in the funds, and mere unprincipled Gamblers." This seeking of the line of separation is a task that has occupied regulators up to the present day.

The formation of the New York Stock and Exchange Board in 1817 also marks the beginning of the Wall Street career of Jacob Little, the first of a long line of big-time Wall Street speculative operators (Gordon 1999, pp. 59–62, 89–90). Unlike Duer who only used Wall Street as a trading venue, Little made a career on Wall Street. Though Little was also a broker, gaining membership to the Board in 1825, it is his activities as a speculator that made his reputation. Little's trading strategies were typically short-term, aimed at anticipating market movements. During his career, Little made and lost four fortunes in speculative trading activities. In the end, he was unable to recover from his last insolvency brought on by the market panic of 1857. From that time, until his

death a few years later, Little ended his Wall Street career as a trader of penny stocks and odd lots.

Though Little was primarily a short seller, he made his first fortune in a 1834 short squeeze involving the Morris Canal and Banking Company. The objective of a short squeeze in a stock issue is to gain control of the quantity of that stock available for trading (the "float" or "floating supply") at a time when a sizeable amount of stock has been sold short by traders who do not have a sufficient amount of stock to deliver. As was the case in the squeeze on Morris Canal and Banking, the capital requirements for gaining control of the stock for delivery usually involved a group or pool of speculators operating in concert. When the time comes for the short to make delivery of the stock, the short has to enter the market to buy – but there is no supply available because the short squeezers have already gained control. The result is a rapid rise in stock prices as short sellers bid up prices to tempt new supply onto the market (either from accounts of long-term investors or from the short squeezers). At Little's time, most short sellers were brokers that had sold stock they did not own to investors, speculators or other brokers. The short position was sometimes the outcome of longer settlement periods than in modern times. In other cases, the objective of both parties was to engage in speculative forward trading, resulting in delivery dates on the short that could be many months in the future.

Prior to the wide reaching regulatory reforms of 1933–34, stock market self-regulation was an important theme of government policy toward the securities market. Yet, self-regulation suffered from the conflicting interests of the legitimate brokers, who recognized the negative impact associated with widespread unscrupulous trading activities, and the big-time speculators, who saw the market as a conduit for achieving big profits from a range of trading schemes. Many practices that are illegal in modern markets were considered fair game, such as trading on insider information or the formation of pools to engage in trading activities aimed at creating price movements favorable to speculation on stock price changes. The process of reform using self-regulation was slow and problematic. It was not until November 1868, just prior to the merger of the Open Board and the New York Stock and Exchange Board, that registration of securities and 30 days notice of new issues was required of companies listed on the two Boards.

The imposition of the listing requirement had an immediate impact on the activities of the big-time speculators, Daniel Drew, Jay Gould and James Fisk, involving the Erie Railway. The 1864–9 manipulations associated with the securities of the Erie are almost epic, reflecting the state of securities markets of that time. On one side of the struggle was "Commodore" Cornelius Vanderbilt, a giant in the transportation industry, who wanted to control the Erie in order to be able to control the pricing of railway freight rates into and out of New York City. On the other side was a group including Drew, Gould, Fisk and other big-time speculators who were seeking to control the Erie as a vehicle for making speculative gains through manipulation of the company's security issues. The machinations of the two camps has been captured in some of the early classics of business finance, e.g., Adams and Adams, *Chapters of Erie* (1871) and Henry Clews, *Fifty Years on Wall Street* (1908). The struggle between these two groups is the epitome of the problems that prevailed in securities markets of that time, e.g., Medbery (1870, ch. 9), Gordon (1999, ch. 6).

Vanderbilt was concerned with securities markets only as a vehicle for creating and managing a business empire, primarily involving railways. As part of the ongoing process of expanding this empire, Vanderbilt moved to acquire a controlling position on the Erie board of directors during the late summer and early fall of 1867. Vanderbilt had been involved with the Erie as recently as 1865, when he resigned from the board over concerns about the evident manipulations in the stock that took place during 1864–5. A major player in these manipulations was Daniel Drew, also a board member who, conveniently, served as treasurer. In his position as treasurer, Drew was able to issue securities, and in 1866 had done so by loaning the company \$3.5 million in exchange for 28,000 unissued shares and \$3 million in convertible bonds that had the provision that the 30,000 shares obtained from conversion could be reconverted back into convertible bonds. This provided Drew with the ability to expand and then contract about 10% of the outstanding stock – providing effective control of the floating supply.

When Vanderbilt was unsuccessful in using his influence to control the Erie board of directors, starting in January 1868 he moved to gain control of the company by making purchases of as much of the outstanding stock as could be obtained. The speculators saw this as an opportunity to issue more convertible bonds that became a conduit to print stock certificates that were then sold to Vanderbilt. From late February to mid-March, Drew and his group were able to sell 100,000 newly issued shares. The absence of registration and listing requirements prevented the New York Stock and Exchange Board from knowing what was happening. All this was set against a backdrop of corrupt judges issuing injunctions and arrest warrants and legislators being bribed to pass laws favorable to one or the other of these groups. On April 19, Vanderbilt was able to strike a deal with Drew, Gould and Fisk and recoup his potential losses from his stock dealing. Following this, Gould and Fisk continued to manipulate Erie stock issues, until the listing and registration requirements were introduced by the two Boards. Gould attempted to resist the requirements, even trying to establish a new exchange for the purposes of trading Erie stock. In September 1869, Gould capitulated and agreed to the new regulations. At that time, it was revealed that the number of Erie shares outstanding was around 700,000, about double the 351,000 shares outstanding at the time of the Vanderbilt agreement of April 1868.

To modern observers, events surrounding the Erie have the appearance of a classical farce. A business titan attempting to rest control of a railway company in order to implement a pricing cartel enters battle with a group of big time speculators seeking to use the company as a vehicle for generating profits from stock price manipulation. Drew, Gould and Fisk are usually lumped in with Andrew Carnegie, J.D. Rockefeller and Commodore Vanderbilt and recognized as the “robber barons” who dominated American industry through their financial dealings in the 1870–90 period, e.g., Geisst (1997, ch. 3). The activities of the robber barons took place against a backdrop of increasing concentration of economic power in the hands of the trusts such as American Telephone and Telegraph, General Electric, Standard Oil and the American Tobacco Company. The trusts were formed largely as a way of dealing with the legal restriction that corporations had up to around 1900 that prevented the holding of stock of other corporations. During the 1890s there were about fifty trusts operating throughout the US, involving most of the major industries. This number includes some agricultural trusts that were concentrated primarily in the south.

Trusts were formed as a legal device largely to circumvent state corporation laws that restricted the ability of a corporation to expand using mergers and takeovers. Prior to the changes in state corporation law that started with New Jersey during the 1890s, the ability of a corporation to act as a holding company was quite limited. Trusts provided a legal avenue around these restrictions. In a trust, the companies being merged or taken over would exchange the common shares in the original corporations for trust certificates that possessed a claim to earnings of the trust as well as voting rights to elect the trustees that ran the trust. Standard Oil, for example, had nine trustees. Trust certificates traded like common stocks on the stock exchanges. The trust was a useful legal mechanism for the takeover ambitions of the emerging industrialists. Instead of having to issue new shares to raise new capital for a takeover, trusts could pay for the takeover using trust certificates or internal sources of funds.

Due to changes in various state corporation laws, the trusts had a relatively short lifespan. The legal status of trusts did not prevent various states from initiating legal actions under other grounds, such as the common law restrictions on monopoly, aimed at preventing the increasing monopolization of specific industries. In addition, the public perception of economic and social problems posed by the trusts were addressed in 1890 with the passage of the Sherman Anti-Trust Act. Though this Act did not result in many successful prosecutions, it did provide a federal definition and jurisdiction for what constituted a monopoly. The trusts gradually reorganized as holding companies and trust certificates were replaced by common shares. Standard Oil, for example, completed the shift in 1899. Whether it was trading in trust certificates or the common shares, the changes in American industrial structure were good for Wall Street. The importance of trading in shares of these industrial companies gradually came to surpass the railroads. The volume and value of trade on the NYSE doubled between 1875 and 1885 with more growth on the horizon.

Yet, despite the growth, the securities markets of that era justly deserved the public perception as a speculator's haven. Henry Clews (1908, p. 19), a veteran broker and investment advisor with fifty years experience on Wall Street from 1857 to 1907, provides an informed view of "How to Make Money on Wall Street":

To the question often put, especially by men outside of Wall Street, "How can I make money in Wall Street?" there is probably no better answer than the one given by old Meyer Rothschild to a person who asked him a similar question. He said, "I buys 'sheep' and sells 'dear'."

Those who follow this method always succeed. There has hardly been a year within my recollection, going back nearly thirty years, when there has not been two or three squalls in "the Street," during the year, when it was possible to purchase stocks below their intrinsic value. The squall usually passes over in a few days, and then the lucky buyers of stocks at panic prices come in for their profits ranging from five to ten per cent on the entire venture.

The question of making money, then becomes a mere matter of calculation, depending on the number of squalls that may occur during any particular year.

If the venture is made at the right time – at the lucky moment so to speak – and each successive venture is fortunate, as happens often to those who use their judgment in the best way, it is possible to realize a net gain of fifty per cent. per annum on the aggregate of the year's investments.

Coming from an individual so intimately connected to the dealings of "the Street," it is difficult to deny the essential role played by speculation in US securities markets of the time. Given the numerous abuses associated with common stocks, the disposition of the small investor to favor bonds over stocks during this period is understandable.

Many of the systemic problems raised by the predominance of speculators in securities markets persisted until the regulatory reforms following the Great Depression. The introduction of legislation such as the Securities Act (1933) involved a radical realignment of the federal government's role in securities markets. The collapse of securities markets from late 1929 to early 1933 was sufficient to end the period of self-regulation that had largely governed securities trading up to that time. Yet, the period of self-regulation was not without contributions. Many of the tools needed to lay the foundation that Graham and Dodd used to launch security analysis had evolved without government intervention. The growth of securities markets witnessed the emergence of professionals who made their living in the market and had a vested interest in making sure the game was played, if not always fairly, at least according to accepted rules. For example, the listing and registration requirements imposed by the newly formed NYSE were a direct assault on Jay Gould's manipulations of Erie Railroad Company securities.

A key element in self-regulation involved the availability of accurate information. It was during the 1890s that the New York Stock Exchange required listed companies to produce annual reports. Though, even with this change, many of the annual reports that were produced did not have much substance by modern standards, the rise of the professional investment advisor necessitated that some useful information be made available. Though much of the literature of the time is largely concerned with pontificating on the good or evil of speculation, or glorifying the deeds of the big-time speculators or documenting use of the securities market to propel the rise of a business titan, the financial press did spearhead a number of important innovations. Of particular importance is the introduction of the indexes to measure the performance of the stock market. The introduction and subsequent use of indexes represents a major advance in the sophistication of market participants. Though there were some other indexes around previously, it is Charles Dow (1851–1902) who is often credited with being the father of the modern stock market index. Dow is also important in having, together with Edward Jones and Charles Bergstresser, founded Dow Jones & Co., the company that created the *Wall Street Journal*.

Charles Dow is a caricature of the changes that were taking place in the US securities markets of the later nineteenth century. Dow was a lifelong newspaper journalist who converted to financial news after covering a mining story for the *Providence Journal* in 1879. Dow was able to achieve success in financial reporting by feeding the growing need for information to do security analysis. In 1880, Dow moved to New York where he started with a stint reporting on mining stocks. In 1882, he joined together with Edward Jones, a fellow reporter from his days in Providence who also had relocated to New York, to form Dow Jones & Company. With offices behind a soda shop located next door to the entrance of the New York Stock Exchange, the main activity of the company was to collect and distribute "flimsies" or "slips" containing market news of the day. It was in this "Customers Afternoon Newsletter" that on July 3, 1884 the first

version of the index appeared. The price-weighted average was calculated by summing the prices of the stocks in the index and dividing by the number of stocks.

According to Siegel (1998, p. 55), Dow began publishing a daily index of actively traded, high capitalization stocks starting in February of 1885. The original index contained 10 railways and 2 industrials. This collection was roughly consistent with the importance that railway stocks played in the stock market of that era. Dow expanded the index four years later to cover 18 railways and 2 industrials. The same year, Dow Jones & Co. started the *Wall Street Journal*. At this time the *Commercial and Financial Chronicle* was the most important financial newspaper. (Judging from accounts of Richard Wyckoff (1930, p. 44), the *Chronicle* continued to be the leading source of financial news until after Dow's death.) Recognizing the importance of the emerging industrial sector, in May 1896 Dow changed the index to a 12-stock index of industrial stocks. The first version of the Dow Jones Industrial Average appeared in the *Wall Street Journal* in October 1896. The index of 20 railway stocks, the precursor of the modern Dow Transportation Index, was renamed the Rail Average.

The original 12 stocks of the Dow Jones Industrial Average (DJIA) reflect the nature of the stock market at that time (see table 2.2). The stocks were: American Cotton Oil, American Sugar, American Tobacco, Chicago Gas, Distilling and Cattle Feeding, General Electric, Laclede Gas, National Lead, North American, Tennessee Coal and Iron, US Leather and US Rubber. All but US Leather survives today in some form, though only General Electric remains in the DJIA. In 1916, the DJIA was expanded to 20 stocks and to 30 stocks in 1928. The use of 30 stocks has continued up to the present day. Only three stocks (American Sugar, General Electric and US Rubber) of the original 12 appear in 1916, with 7 of the 20 from 1916 appearing in 1928. Oddly enough, American Tobacco and North American reappear in 1928 after being left off the 1916 list. This reflects the ongoing practice, still used today, to update the average to reflect the changing composition of trading, market capitalization and industrial composition of the leading common stocks.²⁰ The current 30 DJIA stock listings, together with some trading information, are given in table 2.3.

Irving Fisher, stock valuation and the 1929 crash

The roots of modern Finance can arguably be traced back to Irving Fisher. As time has advanced, a tendency has emerged to start the chronology of modern Finance in 1952 with the Markowitz portfolio diversification model, e.g., Markowitz (1999). Given the substantive institutional changes in securities markets that have taken place since World War II, this tendency is understandable. However, Fisher's seminal contributions spanned so many related areas, from index numbers to the theory of interest to the use of mathematical analysis in valuation problems, that Fisher can reasonably be identified as having laid the foundations for the theoretical superstructure that dominates the landscape of Finance. Siegel (1998, p. 44), for example, refers to Fisher as "the founder of modern capital theory." Yet, Fisher's importance to security analysis extends beyond his academic contributions. Fisher harks back to an era when leading academics, such as J.M. Keynes, also played important roles outside the academic realm. In addition to

Table 2.2 Components of the Dow Jones Industrial Average: 1896, 1916, 1928 and 1997

1896	1916	1928	1997
American Cotton Oil	American Beet Sugar	Allied Chemical	Allied-Signal
American Sugar	American Can	American Can	Aluminum Co. of America
American Tobacco	American Car & Foundry	American Smelting	American Express
Chicago Gas	American Locomotive	American Sugar	American Tel & Tel
Distilling & Cattle Feeding	American Smelting	American Tobacco	Boeing
General Electric	American Sugar	Atlantic Refining	Caterpillar
Laclede Gas	American Tel & Tel	Bethlehem Steel	Chevron
National Lead	Anaconda Copper	Chrysler	Coca-Cola
North American	Baldwin Locomotive	General Electric	Du Pont
Tennessee Coal and Iron	Central Leather	General Motors	Eastman Kodak
US Leather pfd.	General Electric	General Railway Sig.	Exxon
US Rubber	Goodrich	Goodrich	General Electric
	Republic Iron & Steel	International Harvester	General Motors
	Studebaker	International Nickel	Goodyear
	Texas Co.	Mack Trucks	Hewlett-Packard
	US Rubber	Nash Motors	IBM
	US Steel	North American	International Paper
	Utah Copper	Paramount Publix	J.P. Morgan
	Westinghouse	Postum, Inc.	Johnson & Johnson
	Western Union	Radio Corp.	McDonald's
		Sears, Roebuck	Merck
		Standard Oil (NJ)	Minn. Mining
		Texas Corp.	Philip Morris
		Texas Gulf Sulphur	Procter & Gamble
		Union Carbide	Sears Roebuck
		US Steel	Travelers Group
		Victor Talking Machine	Union Carbide
		Westinghouse Electric	United Technologies
		Woolworth	WalMart
		Wright Aeronautical	Walt Disney

writing investment newsletters and giving speeches to business leaders on financial topics, Fisher also started a profitable card indexing firm based on an invention that he had patented. Prior to the stock market collapse of 1929, his personal net worth was around \$10 million.²¹

Based on this background, it is somewhat unfortunate that, in the annals of securities analysis, Fisher is most remembered for comments and prognostications made just prior to the stock market collapse of 1929 and in the following year, e.g., Fisher (1930). Siegel (1998, pp. 43-44) provides a lively description of a most telling incident:

It was a seasonably cool Monday evening on October 14, 1929 when Irving Fisher arrived at the Builders' Exchange Club at 2 Park Avenue in New York City. Fisher, a professor of

Table 2.3 Stocks in the Dow Jones Industrial Average, September 5, 2003, 4.30 pm, EST

Company Name	Ticker	Price	Change	% change	Volume
3M Co	MMM	138.68	-1.32	-0.94	2,633,500
Alcoa	AA	27.99	-0.10	-0.36	2,748,100
Altria Group	MO	41.50	-0.28	-0.67	4,395,300
American Express	AXP	45.20	-0.29	-0.64	2,747,400
AT&T Corp	T	22.69	0.17	0.75	4,350,200
Boeing Co	BA	37.16	-0.73	-1.93	3,939,900
Caterpillar Inc	CAT	70.13	-0.96	-1.35	3,828,500
Citigroup Inc.	C	44.34	-0.07	-0.16	10,245,700
Coca-Cola Co.	KO	44.15	-0.35	-0.79	3,837,700
Disney (Walt) Co.	DIS	21.19	-0.27	-1.26	7,479,100
Du Pont (El)	DD	44.37	-0.08	-0.18	2,628,800
Eastman Kodak	EK	28.80	-0.50	-1.71	3,025,600
Exxon Mobil Corp	XOM	37.97	-0.19	-0.50	8,708,600
General Electric	GE	31.04	-0.28	-0.89	18,545,900
General Motors	GM	41.71	-0.76	-1.79	6,090,700
Hewlett-Packard	HPQ	20.23	-0.55	-2.65	13,569,000
Home Depot inc	HD	33.76	-0.48	-1.40	11,734,700
Honeywell Intl	HON	29.68	0.23	0.78	4,476,900
IBM	IBM	86.95	-0.96	-1.09	7,896,800
Intel Corp	INTC	28.71	0.11	0.38	68,483,289
Intl Paper Co.	IP	39.65	-0.29	-0.73	1,879,400
Johnson & Johnson	JNJ	50.50	-0.62	-1.21	6,486,000
JP Morgan Chase	JPM	34.19	-0.49	-1.41	6,752,900
McDonalds Corp.	MCD	23.30	-0.09	-0.38	5,618,500
Merck & Co.	MRK	51.00	0.40	0.79	5,987,900
Microsoft Corp.	MSFT	28.38	-0.05	-0.18	64,049,179
Procter & Gamble	PG	90.98	-0.45	-0.49	3,960,000
SBC Communications	SBC	23.00	-0.12	-0.52	7,321,800
United Tech Corp.	UTX	78.05	-1.43	-1.80	2,943,900
Wal-Mart Stores	WMT	58.89	-1.19	-1.98	10,593,500

economics at Yale University and the most renowned economist of his time, was scheduled to address the monthly meeting of the Purchasing Agents Association . . . Members of the association and the press crowded into the meeting room. Fisher's speech was mainly designed to defend investment trusts, the forerunner of today's mutual funds. But the audience was most eager to hear his views on the stock market.

Investors had been nervous since early September when Roger Babson, businessman and market seer, predicted a "terrific" crash in stock prices. Fisher had dismissed this pessimism, noting that Babson had been bearish for some time. But the public sought to be reassured by the great man who had championed stocks for so long.

The audience was not disappointed. After a few introductory remarks, Fisher uttered a sentence that, much to his regret, became one of the most quoted phrases in stock market history: "Stock prices have reached what looks like a permanently high plateau."

On October 29, two weeks to the day after Fisher's speech, stocks crashed. Fisher's "high plateau" transformed into a bottomless abyss.

Keen to promote the notion of "Stocks for the Long Run," Siegel is something of an apologist for Fisher. The depth of Fisher's misconceptions are not adequately explored or recognized. For example, the actual quote by Fisher could be more accurately given as: "Stocks have reached what looks like a permanently high plateau . . . I expect to see the stock market a good deal higher than it is today within a few months" (Klein 2001, p. 201). Fisher was not the only prominent academic bulling the stock market. For example, just prior to the crash, Charles Amos Dice, a professor at Ohio State, published *New Levels for the Stock Market* (1929) which provided a range of arguments as to why stock prices had to continue climbing.

Though Fisher was only a leading voice in a chorus of academics cheering the virtues of stock investment, it is disturbing to see the soundness of his arguments being undercut by the brutal reality of the collapse in stock prices. Fisher's outstanding academic and public reputation was justly deserved. He was a careful and methodical researcher employing valuation models that are similar to those employed today. For example, Fisher (1930, p. xxii) explicitly uses discounted cash flow valuation to arrive at estimates for common stock prices:

Since every stock price represents a discounted value of the future dividends and earnings of that stock, there are four reasons that may justify a rise in the price level of stocks: (1) Because the earnings are continually plowed back into the business instead of being declared in dividends, this plowing-back resulting in an accumulation at compound interest, so to speak; (2) Because the expected earnings will increase on account of technical progress within the industry; (3) Because less risk is believed to attach to those earnings than formerly; (4) Because the "basis" by which the discounting is made has been lowered.

Writing at the end of 1929, following the 40+% decline in stock prices of September to mid-November, Fisher (1930) explores all of these four points in detail and concludes (pp. 267-9): "the general plateau of the stock market is still the plateau of 1926-1929, still 55% higher than it was in 1926, and still higher than any previous plateau . . . For the immediate future, at least, the outlook is bright."

Fisher went far beyond a simple recognition that earnings were the key factor driving stock prices (p. 67): "The percentage increase in prices of stocks should be equal to the percentage increase in earnings per share if the ratio of price to earnings were to remain constant." Yet, the available data indicated that from 1922-27 industrial stock prices increased at 14.1% per year while "total profits" (earnings?) increased only 9%. This difference Fisher attributed to the gains to common stock from the low "rate of return on preferred stock" that permitted a greater share of the earnings growth to be captured by the common stock. In addition, the plowing-back of earnings permitted industrial corporations to purchase new plant and equipment that enhanced earnings capacity. Fisher recognized that the plow-back rate for industrial corporations had increased since 1927 and viewed this as a reinforcing influence (p. 80): "During the long bull market there was the record of increased real income, while plowed-back earnings gave promise of future values resident in the productive and consuming plant of the nation that were properly reflected in a heightened level of stock prices."

Fisher (1930, p. 67) credits Edgar Smith with the argument that the plowing-back of earnings was the main factor driving the increase in common stock prices. Fisher (p. 66) puts the argument this way:

The increase both in dividend payments and in plowed-back earnings during 1929 over 1928, was not only a primal cause of the new plateau of stock prices, but gave promise of continuing prosperity to business for 1930. This increase should minimize the effects of the panic, which was largely restricted to the stock market.

When earnings are turned back into a business it is in order to increase the rate of profits according to the same method by which interest is compounded on savings. There has always been a plowing-back of earnings, but it has been especially done in the last few years.

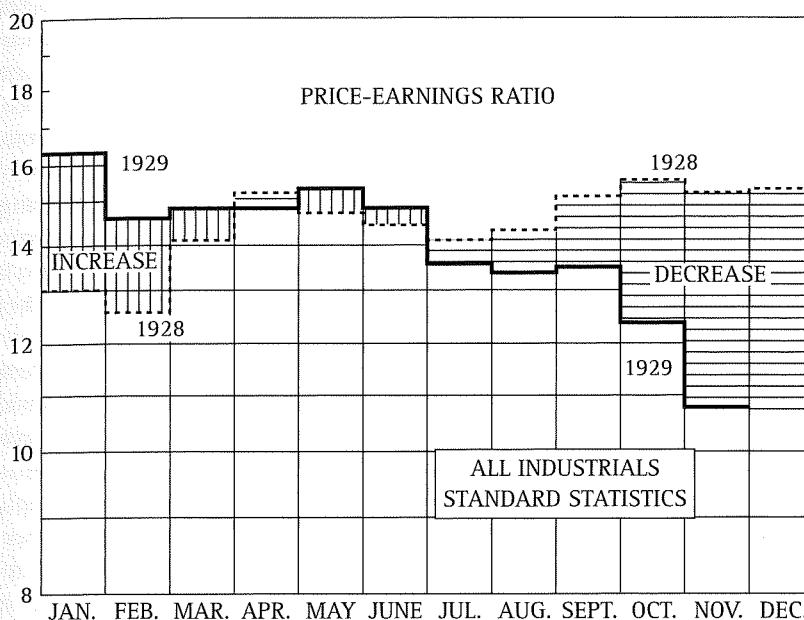
Having proposed the importance of plowing-back of earnings, Fisher (p. 81) asks the question: "Are the conclusions . . . with respect to the increased rate of plowed-back earnings, stated with too great optimism?" Fisher addresses this question with a reasoned analysis of the behavior of the aggregate price-earnings (P/E) ratio.

Modern security analysts are well versed in the difficulties of interpreting P/E ratios. Earnings can be an elusive number that, to be adequately interpreted, requires careful inspection of additional information from the financial statements and other sources. Unlike modern stock market prognosticators, Fisher was hampered by lack of data on earnings and many other variables that are considered essential today for doing security analysis. For example, data on both a price index of industrial stocks and the associated earnings of those companies, calculated by the Standard Statistics Company (later to merge with the publisher of *Poor's Manual* to form Standard and Poors), are only available from May 1927. Fisher was able to obtain his estimate of the increase in earnings of industrial companies over 1922–27 of 9% from a government report (Committee of Recent Economic Changes). From the bulletin of the National City Bank of New York he was able to obtain evidence that the increase in earnings from 3Q 1928 to 3Q 1929 was 14%. Excluding railways and utilities, the remaining manufacturing and trading companies had a gain of 15%.

Given the state of financial reporting requirements prior to the Securities Act (1933), the crude earnings numbers that Fisher had to work with are somewhat suspect. Fisher (1930, p. 88) observes: "There are also difficulties to be faced in the choice of stocks that publish annual earnings figures, and in those stocks where there is concealment of earnings for tax evasion purposes." Fisher is also somewhat unclear about what P/E multiple to apply to individual stocks:

The price-earnings ratios of the old-fashioned type should be perhaps ten times annual earnings, which is the traditional ratio for a fair selling price for stocks during the period prior to 1922. But for the new type of rapidly expanding corporation the price-earnings ratio might be 100 to 1, or even literally to infinity in the initial stages of investment when earnings are not being realized.

With this background, Fisher proceeds to examine aggregate stock price index and earnings data from the Standard Statistics Company (see figure 2.1). Examining the aggregate data (industrials including railways) Fisher concludes that the 9.8 P/E for



For all Industrial common shares earnings increased far more rapidly than the increase of stock prices during 1929. But this group is open to the objection that it is a variable group of stocks from Fisher (1930, chart 10).

Figure 2.1 Price-earnings ratio

November 1925 was justified. It was 40% below the peak of 16.2 in January 1929 and lower than the previous low of 11.2 for May 1927 "the earliest month for which such statistics are available."

In addition to examining the aggregate P/E data, Fisher made a number of astute observations about the behavior of aggregate and individual stock prices in the months surrounding the crash. In particular, Fisher observes that the run-up in prices was selective (p. 93): "As the market marched to its peak about half of the groups listed (on the NYSE) receded in price, while half went up." It was the high flyers that came crashing down. Using his own index for aggregate stock prices that took in all NYSE groups, Fisher estimates that stocks fell 38% overall during the crash, with railways down only 28%, the most speculative stocks fell over 50%. He attributes the downturn in "the best stocks" to the impact of "overextension of loans" to buy stocks. After reviewing the data surrounding the crash, Fisher remained a bull (p. 98): "the precipitous fall in the market went too far, in the light of sound reasons justifying the long bull market, namely, justifiable expectation of great and increasing earnings, the fact they were so generously plowed-back, the warranted expectation of safety through diversification of investments and, finally, a consequent lowered basis of discounting the future as apparently reflected in price earnings ratios."

As were many others at the time, Fisher was deeply impressed with the work of Edgar L. Smith on the long run performance of common stocks versus bonds. Prior to the

appearance of Smith's *Common Stocks as Long-Term Investments* (1925), Fisher (1912) held to the prevailing view that stocks would outperform bonds in periods of rising prices, while bonds would outperform stocks during periods of falling prices. Smith carefully demonstrated that this view was mistaken. Smith took care in recognizing that the stock holdings had to be well-diversified across companies that represented the major industries. In addition, stocks had to be held a sufficient period to permit liquidation at favorable prices. Smith recognized that the length of the holding period to liquidation could be as long as 6 years – extending to 15 years in extreme cases. Fisher (1930, pp. 198–200) explicitly recognized the contribution of Smith (1925) to “a material change during (1923–30) in the estimate of the public as to the risk of investing in common stocks.”

Fisher (1930) is well off the mark in terms of predicting future stock price movements. Yet, Fisher (1930, ch. 13) is an excellent illustration of why Fisher can be considered as laying the methodological foundation for modern Finance. The chapter is concerned with “Flight from Bonds to Stocks” – developing a theoretical basis for the rationale of why stocks are a superior long run investment than bonds. Fisher first explores the notion that bonds are “far safer” than stocks. Working with Smith's data, Fisher adjusts for the impact of price level changes and estimates the yield on a bond investment for 1866–85, a period of falling prices, as 11.7% in real terms (6.8% nominal), the same calculation for 1901–22 was 1.1% real (4% nominal). “This analysis indicates clearly enough that during periods of marked fluctuations in the general price level, bonds have a speculative character... bonds are not, as compared with a well-selected and diversified stocks, what they have been cracked up to be... even when prices are falling they are not usually superior to stocks” (p. 202).

In a precursor of modern portfolio theory, Fisher (p. 203) identifies “five reasons for the now proved fact that stocks are a better investment than bonds”:

first, because the stockholder stands to win as well as to lose; second, because modern dividend policy is toward steadiness; third, because a portion of stockholders' earnings is reinvested for him and ultimately yields further dividends; fourth, because the unstable dollar tricks the bondholder, but any effect on the shareholder is largely neutralized; and fifth, because diversification can correct the irregularities of the stockholder's income but not that of the bondholder.

Fisher recognizes that Smith, K. van Strum and other writers emphasize the importance of diversification – he does not claim originality on this point. Yet, Fisher was a vocal and active proponent of “investment trusts” run by “expert counsel” – precursors of modern mutual funds. For Fisher, diversification had to have another element added: “It is the principle of constant inspection or check-up as to the status of companies issuing stocks, and constant turnover accordingly... For the sound investor in common stocks must turn them over constantly, selling those that are losing in value and investing in those that are gaining” (p. 207). The skilled investment counsel situated in investment trusts were an essential element to achieving the gains associated with diversification that allowed stocks to be a superior investment than bonds.

Based on the limited data available, Fisher was able to observe the phenomenon, common to periods of intense speculation in stocks, of substantially increased equity

issues at the end of the 1920s. A comparison is made between corporate financing during the first eight months of 1925 (\$2.353 billion in long and short term corporate bonds with \$804 million in stock issues) with the first eight months of 1929 (\$2.360 billion in long and short corporate bonds with \$4.794 billion in stock issues). Fisher also observes that the bond issues in 1929 had relatively more equity related provisions such as conversion features. Oddly enough, Fisher interpreted this data as a positive development for stock valuation.

Fisher failed to foresee the precipitous fall in stock prices in the two plus years from 1930 to 1932. More importantly from the standpoint of individual investors at that time, he also failed to foresee that the general level of stock prices would not recover to 1929 levels until after WWII. It is convenient to look back on what Fisher said and conclude that he was just another prognosticator that got it wrong. Yet, Fisher was so much more than being just another prognosticator. With all the skills and information at his disposal, Fisher fails to be able to answer the American question: if you're so smart, why ain't you rich? Though adherents to modern Finance may want to ignore Fisher's foibles, perhaps this is a reflection on the positivist approach to security valuation. Based on as careful an implementation of the scientific approach as he could muster, Fisher was a strong proponent of stocks for the long run – a view that, in his time, proved to be profoundly incorrect. Perhaps more personally disturbing to Fisher was that his long time academic rival, J.M. Keynes, was so much closer to the mark.

*Keynes, uncertainty and the Stock Market*²²

Chapter 12 (and to a lesser extent chapters 13 and 15) of the *General Theory* is an essential source for the views of Keynes on the role of uncertainty in pricing of securities, though the story provided in chapter 12 is far from complete. "For convenience of exposition" (p. 149) chapter 12 abstracts from interest rate changes. While this abstraction does have pedagogical benefits, permitting Keynes to examine the process of changes in long term expectations of "prospective yield" on "the values of investments," it does suppress the portfolio management problem of determining the division of investments between fixed income and equity securities. Though these issues are incrementally developed in chapters 13 and 15, integration of the concepts is not presented, say, in the form of a security investment strategy. Given the key role attributed to the "speculative motive" in liquidity preference, e.g., p. 196, this is a significant limitation. In addition, there is limited discussion regarding both the maturity composition of the fixed income component of the investment portfolio and the riskiness of the bonds to be selected, e.g., corporate bonds vs. government bonds.

Given this, early in chapter 12 (p. 149) Keynes hints at a fundamental pricing model which can be used to value securities: "The outstanding fact is the extreme precariousness of the basis of knowledge on which our estimates of prospective yield have to be made. Our knowledge of factors which will govern the yield of an investment some years hence is usually very slight and often negligible . . . those who seriously attempt to make any such estimate are often so much in the minority that their behaviour does not govern the market." In this context, the market is "the Stock Exchange" which

"revalues many investments every day" (p. 151). After observing that, due to the separation of ownership from management, the price of shares on the Stock Exchange will be determined by stock traders rather than by the "professional entrepreneur" who has direct knowledge of the underlying business, Keynes asks a key question (p. 151): "How then are these highly significant daily, even hourly, revaluations of existing investments carried out in practice?" The answer provided to this question encompasses the philosophical foundations of the impact that uncertainty has on the human condition.

McKenna and Zannoni (1993, pp. 400–1) capture the basic issue where investment decisions are concerned: "situations may arise in which individuals may not have any knowledge at all concerning the probability distribution function of future outcomes." Yet, decisions have to be made and "economic agents must create alternative mechanisms that enable decisions to be made in the face of uncertainty." Confronted with uncertainty, the crux of the decision making process relies on *convention*. In a remarkable precursor to the modern EMH, Keynes observes that in the face of uncertainty the investor accepts the prevailing evaluation of market prices (p. 152): "the existing market valuation, however arrived at is uniquely *correct* in relation to our existing knowledge of the facts which will influence the yield of the investment, and that it will change in proportion to changes in this knowledge." In following this convention, "the only risk (an investor) runs is that of a genuine change in the news *over the near future*, as to the likelihood of which he can attempt to form his own judgment" (p. 153).

For Keynes, the EMH is a convention. This is an important observation because in the Keynesian model, "conventions are essentially shared rules of behavior that enable individuals to take actions in situations where the future results of these actions are unknowable . . . though the future may be unknowable the existence of conventions and the belief that they will be maintained provide a basis for decision making under uncertainty" (McKenna and Zannoni 1993, pp. 402–3).²³ The weakness of the EMH as a convention is that the actual security prices are not being determined with reference to the long-term prospective yield. Rather, prices are being determined "as the outcome of a large number of ignorant individuals" and misguided professional investors and speculators. This produces a stock market that, when confidence in the convention is "less plausible than usual," is "subject to waves of optimistic and pessimistic sentiment, which are unreasoning and yet in a sense legitimate, where no solid basis exists for a reasonable calculation" (p. 154). Such fluctuations are so pervasive that "the energies and skill of the professional investor and speculator are mainly occupied . . . not with making superior long-term forecasts of the probable yield of an investment over its whole life, but with foreseeing changes in the conventional basis of valuation a short time ahead of the general public" (p. 154).

This reference to convention has deep philosophical implications that cannot be ignored. Conventions are the result of social interaction, what McKenna and Zannoni (1993) pedantically refer to as the social matrix (the cultural context within which individuals exercise their freedom). As a consequence of the EMH being a convention, the extent of the violent fluctuations in the market depend on the temporal state of the social matrix. In other words, the institutional, social and historical context will impact the security pricing process. The same event occurring at different times may produce a violent fluctuation in pricing in one period and have no impact at another time. Uncertainty is

created by the infinite number of future outcomes which are possible at a given point in time. The specific outcome which occurs "is the result of individual choice in the context of social interaction . . . It is not the case that the far distant future is sometimes more knowable than at other times. It is always simply unknowable. What does change . . . is the meaning people choose to attach to this fact, and hence the manner in which people's behavior responds to this uncertainty" McKenna and Zannoni (1993, p. 403).

It is evident that Keynes was not a fully fledged dis-believer in the EMH and, as a result, cannot be considered in the same camp as the technical analysts. Yet, there are substantive misgivings about the success of fundamental analysis: "Investment based on genuine long-term expectation is so difficult to-day as to be scarcely practicable. [An investor] who attempts it must surely lead much more laborious days and run greater risks than [an investor] who tries to guess better than the crowd how the crowd will behave; and given equal intelligence, he may make more disastrous mistakes . . . It needs *more* intelligence to defeat the forces of time and our ignorance of the future than to beat the gun" (p. 157). Besides, there is more excitement in the chase after speculative profit: "life is not long enough; – human nature desires quick results, there is a peculiar zest in making money quickly, and remoter gains are discounted by the average man at a very high rate" (p. 157).

The reliance on the social matrix is one element of the Keynesian approach that is worrisome to neo-classical economists and, in the present context, presumably also to modern portfolio theorists. Yet, to be relevant to present day security markets, this material has to be reworked to fit the contemporary social matrix. Conventions, which are so important for decision making under uncertainty, depend fundamentally on the social matrix. In this vein, Keynes was writing at a time that was different in many ways from the world of today. There has certainly been substantive changes in financial markets since the time of the *General Theory*. Perhaps the world has changed enough that the investor motivated by long-term expectations has come to predominate, inducing an EMH convention which is more stable and less susceptible to violent fluctuation? Putting aside for the moment the empirical evidence to the contrary provided by the high tech/dot com/NASDAQ 5000 stock bubble of the recent past, what suggestions would Keynes have for those seeking to employ a security investment strategy based on fundamental analysis?

It is difficult to deny that the "zest" for quick profit is any less vigorous today than in times gone by. It is also still the case that (p. 157): "The game of professional investment is intolerably boring and overexacting to anyone who is entirely exempt from the gambling instinct." The investor who would seek to engage in fundamental analysis, i.e., "an investor who proposes to ignore near-term market fluctuations" and purchase a security on the basis of long-term prospective yield, is advised of the need for "greater resources for safety" and not to "operate on so large a scale, if at all, with borrowed money." All these potential difficulties are compounded by the following prediction (p. 158): "If I may be allowed to appropriate the term *speculation* for the activity of forecasting the psychology of the market, and the term *enterprise* for the activity of forecasting the prospective yield on assets over their whole life, it is by no means always the case that speculation predominates over enterprise." Unfortunately,

this hopeful statement is followed by: "As the organization of investment markets improves, the risk of predominance of speculation does, however, increase." If this prediction is correct, fundamental analysis is likely to be even more difficult today than at the time of the *General Theory*.

Based on these observations, it seems that the conclusions about fundamental analysis will extend into the modern world. For Keynes, uncertainty plays a fundamental role in the investment process. It is in the process of dealing with uncertainty that security markets produce violent and not so violent fluctuations in prices, causing unpredictable and potentially persistent deviations of prices from the values indicated by pricing models which accurately reflect the fundamentals of the security ("the long-term prospective yield"). This makes fundamental analysis a decidedly difficult, if not "risky," activity. For example, casual inspection of the current (post-tech-bubble) prices for stocks in sectors such as bio-technology and internet retailing are still confounding to explain using the techniques of fundamental analysis. The observation that stock prices move substantially more than is indicated by changes in underlying fundamentals has much the same truth today as at the time of the *General Theory*. This, again, creates real complications for fundamental analysts.

Recognizing the difficulties associated with fundamental analysis, the security investment strategy that Keynes apparently felt would produce the highest profit was to exploit predictions aimed at market instability. To leverage up (increase invested capital with borrowing) and ride the waves of exuberance and "spontaneous optimism" in the stock market until "animal spirits are dimmed" and pessimism besets the market: "if the animal spirits are dimmed and the spontaneous optimism falters, leaving us to depend on nothing but a mathematical expectation, enterprise will fade and die; – though fears of loss may have a basis no more reasonable than hopes of profit had been before" (p. 162). As outlined in chapters 13 and 15 of the *General Theory*, when the dark clouds are gathering, the investor liquidates stock and moves funds to short-term liquid assets, soldiering resources until the next wave of spontaneous optimism grips the market and the cycle is repeated.

Keynes concludes chapter 12 with a number of qualifications that, while relatively innocuous in terms of the macroeconomic theory being presented, are confounding from a security investment strategy viewpoint. For example, there is the statement: "We should not conclude from this that everything depends on waves of irrational psychology. On the contrary, the state of long-term expectation is often steady, and, even when it is not, the other factors exert their compensating effects" (p. 162). Is this arguing for a less than complete liquidation of the stock position? Perhaps a reduction in leveraged purchasing of stocks is indicated? Even more confounding is the following statement (p. 163): "There are, moreover, certain important factors which somewhat mitigate in practice the effects of our ignorance of the future. Owing to the operation of compound interest combined with the likelihood of obsolescence with the passage of time, there are many individual investments of which the prospective yield is legitimately dominated by the returns of the comparatively near future." Investments in buildings and utilities are identified as belonging to this class. These types of assets have predictable and relatively stable cash flow patterns extending out long enough that "compound interest" would produce cash flows in distant periods which have a present value approaching zero.²⁴

Having developed an elaborate theory of the impact of uncertainty on stock prices, Keynes explicitly recognizes that there may be types of investments which are not subjected to these forces. Keynes (p. 149) identifies a long list of investments which are subject to uncertainty: railways, mines, textiles, drug companies, shipping transport, and certain types of real estate ("a building in the City of London"). Yet, there are other types of companies which do have stable and relatively predictable cash flows. Hence, there appears to be a distinction being made between issues which are "speculative" and subject to the waves of optimism and pessimism and those which are "non-speculative" and relatively immune to the mis-pricing arising from uncertainty. If this is correct, then Keynes is moving some way towards the fundamental analysts where a similar distinction is made.²⁵ However, unlike the fundamental analysts, the set of securities which Keynes would classify as non-speculative is significantly smaller than that claimed by the fundamental analysts. Upon closer examination, the number potentially qualifying securities appears to be a set that is so small as to not be a practical basis for a widely acceptable security investment strategy.

In selecting an appropriate security investment strategy, there is also an ethical dilemma. Keynes (p. 157) captures the essence of the problem: "There is no clear evidence from experience that the investment policy which is socially advantageous coincides with that which is most profitable." An investment strategy which follows the socially responsible road is fraught with difficulty (pp. 157-8): "it is the long-term investor, he who most promotes the public interest, who will in practice come in for most criticism . . . if he is unsuccessful, which is very likely, he will not receive much mercy." Yet, Keynes still exhorts that "the social objective of skilled investment should be to defeat the dark forces of time and ignorance which envelop our future" (p. 155).

In the end, the investment strategy selected speaks to the philosophical inclinations of the individual investor. Some investors may be compelled to lead by example, attempting to conquer the dark forces of time and ignorance by selecting investments on the basis of the long term prospective yields. If a sufficient number of investors adopt this approach then, if Keynes is correct, there will be less instability in financial markets, the "game of Snap, of Old Maid, of Musical Chairs" (p. 156) will be replaced by more "socially advantageous" investment activities which contribute to stabilizing security prices at levels that reflect "long-term prospective yields." Others may take a more fatalistic view of the social matrix. The "zest" for the game may be viewed as too compelling to resist, both for themselves and for others. Uncertainty is too daunting an adversary. They will be drawn into "estimating the prospects of investment . . . (by considering) . . . the nerves and hysteria and even the digestions and reactions to the weather of those upon whose spontaneous activity it largely depends" (p. 162).

The realm of possible investment strategies extends well beyond these two general alternatives. Some may take solace in the possibility of investing in securities which are not as subject to the waves of pessimism and optimism, taking refuge in securities such as utility stocks and long-term high grade corporate securities leaving the game of Old Maid to be played by more intrepid investors with the zest for these activities. Still others may avoid financial assets altogether, preferring investments in real property which generates a predictable return, e.g., residential buildings as opposed to commercial properties. Finally, some may seek innovative investment solutions,

believing that socially responsible investments, such as ethical funds, have potential long-term prospective yields which, though they cannot be measured *ex ante*, provide something intangibly more than an investment in a tobacco or chemical company. For these investors, uncertainty is a refuge that prevents an investor from accurately identifying the most profitable securities, *ex ante*. In such a climate, investment selection can be made without giving undue consideration to profitability, leaving room for other characteristics of the investment to be determining factors for inclusion in the portfolio.

2.3 GRAHAM AND DODD (1934) AND AFTER

The historical context

Graham and Dodd (1934) is a product of the severe collapse in the corporate securities markets that started in October 1929 and continued until February 1933. This is evident from page one: "Any present examination into financial principles or methods must start with recognition of the distinctive character of our recent experiences, and it must face and answer the numerous questions which these experiences inspire." For Graham and Dodd, "recent experiences" stretch back to 1927, where the advance to the October 1929 peak is identified as beginning. Words like "unprecedented," "tidal wave," "special causes" and "unparalleled effects" are used to describe this period relative to the usual "repetition of business and stock market cycles" that typically characterize stock market price behavior. In contrast, a number of recent studies, e.g., Santoni (1987), Bierman (1991, 1998), have concluded that "overall (the) stock market was not obviously excessively high in September 1929 and the business outlook was favorable. Thus the October crash did not occur because the market was too high" (Bierman 1998, p. 17).

Were Graham and Dodd incorrect in their observations about security markets events that were, perhaps, too close to be judged accurately? This seems unlikely. If Graham and Dodd were correct, then Bierman and the other observers have misinterpreted the significance of "the crash of 1929" by focusing on the mechanics of common stock valuations surrounding the crash instead of dealing with the role of the crash in contributing to the ongoing collapse of stock market values that continued until February of 1933. Based on analyses starting from Fisher (1930) and continuing to the present, it is evident that theoretically sound rationales for the level that stock prices attained in 1929 can be provided. Yet, consistent with the argument of J.M. Keynes in *The General Theory*, e.g., chapter 11, the crash acted by changing investor perceptions; it was the severity of the negative shock to the perception of the prospective return to investments that was the key driving factor behind the aggregate economic problems that plagued the industrial world in the 1930s.

Security valuation requires more than an mechanical application of predefined rules. The uncertainty inherent in common stock returns can be resolved in different ways, depending on the impact of the historical context on investor psychology. Graham and Dodd (1934, p. 6) clearly recognized this point:

we do not accept the premise that 1927–1933 experience affords a proper norm by which to judge the future of investment. The swing of the speculative pendulum during this period was of such unprecedented amplitude as to warrant the belief that it will not recur in similar intensity for a long time to come. In other words, we should regard it more as an economic phenomenon akin to the South Sea Bubble and other isolated instances of abnormal gambling frenzy than as an indication of what the typical speculative cycle will be. As a *speculative* experience, the recent cycle differed from previous ones in kind rather than degree; but in its effects upon the *investment fabric* it had unique characteristics, seemingly of a nonrecurrent type.

This is by no means an isolated quote, e.g., “One of the striking features of the past five years has been the domination of the financial scene by purely psychological elements” (p. 11). The impact of the historically abnormal previous five years of common stock pricing on the analysis and principles advanced by Graham and Dodd (1934) is systemic, it affects the whole text.

Graham and Dodd were concerned about the inadequacies of an approach to security analysis that appeared in the latter part of the 1920s. Graham and Dodd (1934, p. 307) referred to this approach as “*The New Era Theory*”:

During the postwar period, and particularly during the latter stage of the bull market culminating in 1929, the public acquired a completely different attitude towards the investment merits of common stocks . . . The new theory or principle may be summed up in the sentence: “The value of a common stock depends entirely upon what it will earn in the future.”

From this dictum the following corollaries are drawn:

1. That the dividend rate should have slight bearing upon the value.
2. That since no relationship apparently existed between assets and earning power, the asset value was entirely devoid of importance.
3. The past earnings were significant only to the extent that they indicated what changes in earnings were likely to take place in the future.

This complete revolution in the philosophy of common stock investment took place virtually without realization by the stock buying public and with only the most superficial recognition by financial observers.

For those with the valuations of the NASDAQ-5000 tech stock bubble still fresh in memory, these statements by Graham and Dodd (1934) almost certainly have a timeless quality (see section 1.3).

By referring to “a completely different attitude towards the investment merits of common stocks,” Graham and Dodd’s observations about the New Era Theory implicitly make reference to the previous approaches to security analysis that, presumably, took a more informed view of “investment merits.” As such, Graham and Dodd (1934) represents a revival of the “advance of security analysis (that) proceeded uninterrupted until about 1927, covering a long period in which increasing attention was paid on all sides to financial reports and statistical data.” The “new era” was a diversion where facts and figures were “manipulated by a sort of pseudo-analysis to support the delusions of the period” (p. 14). The reliance on the analysis of financial reports permits a rough correspondence between the development of security analysis and the emergence

of the professional accountants required to prepare the corporate accounts. "The importance and prestige of security analysis have tended to increase over the years, paralleling roughly the steady improvement in corporation reports and other statistical data which supply its raw material" (Graham, Dodd and Cottle (GDC) 1962, p. 24). In the pre-1933 world of security market self-regulation, a professional accounting profession was needed to ensure that financial reports issued by companies would be a reliable source of information.

Compared to the English security markets, professional accounting was relatively slow to develop in the US. A useful reference date is 1882 when the Institute of Accountants and Bookkeepers was formed in New York state. The Institute issued certificates upon successful completion of a comprehensive examination. This development was significant because it reflected the growing need for independent accountants to prepare and audit accounts. While, in 1884, there were only 81 independent accountants "listed in the city directories of New York, Chicago and Philadelphia. Just five years later there were 322" (Gordon 1999, p. 173). In 1887 the precursor of the modern day American Institute of Certified Public Accountants was established as the American Association of Public Accountants. Recognizing the important role of states in regulating the accounting profession, in 1896 New York state established the legislation that designated criteria for individuals to be qualified to prepare and audit company accounts. This New York legislation, which was soon adopted by other states, is responsible for introducing the term certified public accountant.

While the 1890s is a potential reference date for exploring the precursors, Graham and Dodd (p. 14) make specific reference to "the last three decades" of security analysis. This suggests the first decade of the twentieth century as a starting point. Though written by a financial journalist from "the City" in London, Hartley Withers (1911) provides an excellent benchmark for examining the techniques of security analysis that predate Graham and Dodd. Withers' objective was "to glean among the best brains of the world of finance" and "to pass on the gleanings to readers." There is ample attention given to both English and US securities markets. Withers (1911) contains twelve chapters. After an initial chapter on the historical evolution of securities, starting from the sixteenth century, Withers proceeds with a chapter on the form of securities, dealing with the topics such as the definitions of stocks, shares and bonds and the difference between registered and bearer securities. While this material is somewhat pedestrian, the next four chapters are recognizable precursors of Graham and Dodd (1934).

The first of the four chapters details how the capital structure of companies relate to the various classes of securities. In this chapter there are the expected topics such as the role of the shareholders in choosing the board of directors, the difference between preferred and ordinary shares and stock splits. The presentation is structured around the fictionalized creation of the "Hygienic Tooth-powder Company" by "Mr. Cleanbite" who lives in Brixton and has a small dental practice in Finsbury Circus. The dentist has developed an effective toothpowder but does not have the capital for making it on a large scale. As chance would have it, one of his business neighbors in Finsbury Circus "a certain Mr. Mortimer... who carries on the mysterious profession of company promoter, underwriter, financier, and organizer of syndicates" happens to visit Cleanbite's dental office for treatment of a painful molar. The machinations and complications of

the ensuing formation of a public company, complete with issuing of stock, selection of the board of directors, watering of stock and so on reflects a solid understanding of the initial public offering. Having laid this foundation, Withers proceeds to a chapter with detailed examination of prospectuses.

Chapters 5 and 6 can fairly be considered as early gems of security analysis, in the sense of the Graham and Dodd mantra: "All security analysis involves the use of financial statements." Chapter 5 is a detailed dissection of the balance sheet and income statement of Babcock and Wilcox Ltd, a well known engineering firm at that time. After going over items on the liabilities side of the balance sheet, Withers (p. 127) observes:

It is when we come to the assets side of the balance-sheet that its difficulty really begins. On the liabilities side we have been faced with sums about which there is no doubt. Every penny that the company has to account for to its shareholders or pay to its creditors is a definite penny, no more and no less. But when we look into the assets that it holds against these liabilities there is room for infinite variety in the meaning of the figures attached to them.

Withers goes on to demonstrate that the simple process of accounting for asset values according to the values paid for purchase is "quite useless as a guide to its actual position at the moment." This lays the basis for chapter 6 which is concerned with the notions of depreciation and profitability. The connection of these concerns with Graham and Dodd (1934) are apparent in part IV which is composed of four chapters concerned with the implications of asset values for balance sheet analysis. In addition, part V is concerned with analysis of the income account and has a chapter on "the relation of depreciation and similar charges to earnings power."

Accounting standards were considerably less well defined at the time Withers was writing. Rules and practices that are taken for granted today were either non-existent or subject to dispute. Legal decisions associated with bankruptcies, securities frauds and the like often acted as a barrier to implementing sound accounting practices. This leads Withers (p. 151) to make the following statement about the position of the auditor:

The position of an auditor of a joint stock company is doubly difficult, from the indefinite and hazy nature of his duties, and from his relation to the shareholders and the Board. As we have seen, his duties are reduced by legal pronouncements to those of a checking-clerk, and the fees that he receives are very inadequate to the real importance of his task; while in practice, if a company gets into difficulties, the auditors are always likely to be blamed for not having pointed out that its published figures, though correct, were not veracious. Though originally, as a rule, appointed to be watch-dogs in the interests of the shareholders, to see that the Board and the officials are publishing true and correct statements. Their duty is to the shareholders, but their direct relations are with the Board and officials. When they take a high view of their duties, and call attention in their reports to matters which ought to be amended, it sometimes happens that their action is very foolishly resented by the shareholders, whose best interests they are trying to serve, and they sometimes get removed from office for having done their duty well.

In light of the recent events surrounding Enron and the collapse of one of the big five accounting firms, Arthur Anderson, this statement seems almost prophetic.

After three chapters, one on government and municipal securities, one on the stock exchange, and one on stock exchange transactions, Withers concludes with three remarkable chapters that explicitly deal with the implications of the distinction between speculation and investment, a distinction that also plays a key role in Graham and Dodd. Yet, Withers in these chapters goes beyond Graham and Dodd in some ways. The last three chapters of Withers have many elements that later appear in J.M. Keynes (1936, ch. 12). It is difficult to do justice in a short discussion. Chapter 10 is concerned with the price movements of securities. In this chapter, Withers starts by recognizing the role of psychological factors in determining stock prices, "price movements are chiefly a psychological question" (p. 283). After an insightful observation about the impact of dealers on pricing ("it often happens that an unexpectedly favourable traffic return or dividend announcement makes the dealers in a market raise the price of stock because they infer a quick rush of buying that will follow it"), Withers recognizes that share pricing ultimately has to be supported "by the action of the public."

Withers follows this introduction with a discussion that is clearly reminiscent of Keynes:

One curious result of this dependence of securities on public opinion in the matter of their price movements, is that it is often dangerous to be too clever and far-seeing concerning the influences that may be expected to improve or depress prices. It has happened before now that long-sighted operators have foreseen trade developments or other happenings that could not fail ultimately to have an important effect on prices, have backed their opinion by buying the securities likely to be affected, and have lost money by being too keen of vision. All that they foresaw may have happened, but if its effects did not dawn on the intelligence of a large enough number of buyers, the stocks that ought to be affected would not move . . . It is not enough for a stock to be worth buying. It must be recognized to be worth buying by the multitude before it will go up in price. Further, the fact that a stock may be absurdly over-valued will not for a moment prevent its rising still further if there are folk enough who believe that it is still cheap and are prepared to back their opinions by buying it.

This is not the only connection to Keynes (1936, ch. 12). After examining the bull and bear operations of speculators, Withers observes that the impact of such operations on security prices are "more or less temporary" and "what finally determines the price of a security is what the real investor thinks about it. Bulls and bears produce the waves on the surface, real buying and selling are the flow and ebb of the tide which determine the depth of the water" (pp. 293–4). This is followed by the remarkable statement: "The real investor . . . is likely to be guided by convention." Though the connection to the elaborate process of decision making under "true uncertainty" is unrecognized, Withers does devote substantial discussion to the social status of the real investor, "in most cases a member of the upper or middle classes of society" and the various social and psychological factors that would influence the conventions that guide their investment decisions, e.g., "old-time convention had been very much in favour of investments at home." It is difficult to tell whether Keynes was aware of Withers (1911) as Keynes did little referencing of the ideas gleaned from others and no reference is given to Withers in Keynes (1936).

The last two chapters of Withers (1911) are devoted to detailed examination of "the real investor" and "the speculative investor." After recognizing that making such a distinction is artificial because "every investor is a speculator, and the difference between

the two classes is finally, like most other differences, one of degree," Withers observes that real investors "look most of all to security of income and least to the hope of capital appreciation, while the pure speculator sets no store by income, and looks entirely to the chance of being able to make a big profit by a resale" (p. 317). Between these polar extremes are a range of speculative investors and investing speculators. The motivations of these speculative investors and investing speculators are of interest. In particular, much like the "value investor" of modern times, the investing speculator can follow the course "of buying good securities which the investing public is at present neglecting, knowing that some day or other it will come back to them, and in the meantime earning a good round yield on his money by buying stocks which are discredited."

A final point of interest in Withers (1911) are two "well known saws on the subject of investment" that are explored: "the higher the yield, the lower the security" and "never put all your eggs in one basket." On the latter saw Withers makes the remarkable (why?) statement: "expert advisers of the public are fertile in schemes for scientific distribution of risks by climate, or by geography, or by industries, etc., etc." Withers finds that neither of the old saws is "quite sound." The text ends with an exhortation (pp. 344-5): "the preceding pages have been written in vain if they have not shown that stocks and shares and market movements are a weltering chaos of uncertainty and haphazard guesswork, based on figures that often mean nothing - or worse than nothing, because they seem to mean so much - and on gusts of opinion blown hither and thither by causes which have no logical connections with the merits of the stocks affected. Whosoever is wise will ponder these things and try to be a real investor, exposing himself as little as possible to speculative anxieties and pitfalls." Sounds like a strong vote for bonds over stocks, circa 1911.

*Defining security analysis*²⁶

In contrast to Withers (1911), Graham and Dodd (1934) is a significant advancement in terms of depth and breadth. Seeing that Withers was a journalist recounting ideas that he had gleaned from discussions with market practitioners, this is not surprising. By 1934, Graham was a market practitioner, par excellence, with a wealth of personal experience about the practice of security analysis to draw on. In addition, in the quarter of a century separating these two texts there was also a substantive increase in the breadth and depth of available accounting and other statistical information that is an essential ingredient in security analysis. The two texts were also separated by a major security market event, the collapse of security markets from 1929 to 1933. Yet there are enough significant similarities that Graham and Dodd (1934) can be seen to be part of a progression of ideas about security analysis. The seminal status often attributed to Graham and Dodd (1934) is due more to the impact and influence that the text had, rather than to the seminal nature of the ideas being presented.

Graham and Dodd (1934) possesses the constant themes that precursors in the realm of security analysis, such as Withers (1911), also possess. These themes include the relevance of the distinction between investment and speculation, the emphasis on the use of financial statements to form opinions, and the problems raised by the vagaries of

market pricing. For example, chapter 4 of Graham and Dodd (1934) is dedicated to "distinctions between investment and speculation." On the vagaries of market pricing, Graham and Dodd (p. 23) explicitly recognize that the "intrinsic value" of a security may well differ from the market price:

the influence of what we call analytical factors over the market price is both *partial* and *indirect* – partial because it frequently competes with purely speculative factors which influence the price in the opposite direction; and indirect, because it acts through the intermediary of people's sentiments and decisions. In other words, the market is not a *weighing machine*, on which the value of each issue is recorded by an exact and impersonal mechanism, in accordance with its specific qualities. Rather we should say that the market is a *voting machine*, whereon countless individuals register choices which are the product of and partly of emotion.

Together with "inadequate or incorrect data" and "uncertainties of the future," the "irrational behavior of the market" is a principal obstacle to the success of the security analyst.

In a way, Graham and Dodd deal with the philosophical implications of the process of generating knowledge in the field of security analysis. In discussing Gadamer (1960) in section 1.3, it was argued that knowledge in the human sciences does not progress in the same fashion as in the natural sciences. Whereas knowledge in the natural sciences progresses linearly as more theoretical and empirical information is obtained about a given phenomenon, in the human sciences authoritative contributions can be timeless. Graham and Dodd (1934) is an excellent example of this point. To be sure, the historical context has changed since the text was written, but many of the insights still retain contemporary value. Consider the following comment about the objectives of security analysis (p. 14):

Analysis connotes the careful study of available facts with the attempt to draw conclusions therefrom based on established principles and sound logic. It is part of the scientific method. But in applying analysis to the field of securities we encounter the serious obstacle that investment is by nature not an exact science. The same is true, however, of law and medicine, here also both individual skill (art) and chance are important factors in determining success or failure. Nevertheless, in these professions analysis is not only useful but indispensable, so that the same should probably be true in the field of investment and possibly in that of speculation.

It seems that Graham and Dodd were grappling with many of the epistemological issues raised in section 1.3.

In surveying the scope of security analysis, three functions are identified: descriptive, selective and critical. Of these, it is the selective function that deals with "whether a given issue should be bought, sold, retained, or exchanged for some other" – the other two functions deal with the preparing of company reports or evaluating the terms and conditions of a particular security issue. As such, it is the selective function that is of general interest, with the other two functions being primarily of interest to practitioners. The key element in the selective function is the "intrinsic value" of the security: "the

intrinsic value is an elusive concept. In general terms, it is understood to be that value which is justified by the facts, e.g., the assets, earnings, dividends, definite prospects, as distinct, let us say, from market quotations established by artificial manipulation or distorted by psychological excesses" (p. 17). Much of Graham and Dodd (1934) is concerned with the appropriate methods for determining the intrinsic value of a security.

Graham and Dodd (1934) is often credited for defining security analysis to mean "the use of fundamental analysis to value securities issued by publicly traded corporations."

This has led to the mantra: "All security analysis involves the use of financial statements" (e.g., GDC 1962, p. 105). As such, security analysis is intimately connected to accounting practices. Yet, this interpretation of Graham and Dodd is too narrow. Determination of the intrinsic value requires analysis of both quantitative and qualitative factors. Quantitative factors are associated with statistical information from the income statement, balance sheet and additional data on factors such as capacity utilization, unit prices, costs and the like. Qualitative factors include: the nature of the business; the relative position of the company in the industry; physical, geographical and operating characteristics; the character of management; the longer term outlook for the unit, industry and business in general. Precisely how all these elements fit together to form an assessment of intrinsic value is the essence of security analysis.

Lasting insights: Graham, Dodd and Cottle (1962)

Even though a portion of Graham, Dodd and Cottle (1962) is material carried forward, unchanged from Graham and Dodd (1934), there is so much more in the 1962 edition that it can safely be considered as a separate text. To be sure, the themes of the two editions are consistent, but so were the themes that connected Withers (1911) with the 1934 edition. One of the features separating Graham, Dodd and Cottle (1962) is the substantive change in the approach to security analysis from the views advanced in the previous editions of 1951, 1940 and 1934. The change is attributed to a change in historical context (p. vi):

Beginning sometime in 1955, our value standards and the actual market level parted company, and the gap has tended to widen through the ensuing years. Thus we are not able to proceed in 1960-1961 with the same comforting assurance as formerly that our standards are in accordance with both long-term and recent-term experience. In this respect we face a three-pronged dilemma, which we share with all serious-minded security analysts. If we persist in clinging to our old, highly conservative standards of common-stock appraisal, we risk not only the certain charge of old-fogeyism, but a real possibility of failing to recognize important changes in the underlying structure of common-stock values.

Gone is the overwhelming concern with the collapse of investor confidence associated with the pre-WWII period. In its place is a "confident appraisal of the market's future on the general expectation of continued prosperity and growth" (p. 417).

Even in the material carried forward, the changes between the 1934 and 1962 editions are more than cosmetic. In particular, where the 1934 edition presented a uniform notion of security analysis, the 1962 edition maintained: "we should acknowledge that

there are some serious differences among practicing security analysts as to the basic approach to the selective function of security analysis" (p. 25). Speaking of the use of quantitative and qualitative information, the 1934 edition maintained (p. 34):

Broadly speaking, the quantitative factors lend themselves far better to thoroughgoing analysis than do the qualitative factors. The former are fewer in number, more easily obtainable, and much better suited to the forming of definite and dependable conclusions. Furthermore, the financial results will themselves epitomize many of the qualitative elements, so that a detailed study of the latter may not add much of importance to the picture. The typical analysis of a security . . . will treat the qualitative factors in a superficial or summary fashion and devote most of its space to the figures.

The 1962 edition takes a decidedly different tone about the qualitative factors. Leaving the first two sentences unchanged, the 1962 edition says: "Furthermore, the financial results in themselves epitomize such qualitative elements as the ability of a reasonably long-entrenched management. This point of view does not minimize the importance of qualitative factors in appraising the performance of a company, but it does indicate that a detailed study of them – to be justified – should provide sufficient additional insight to assist significantly in appraising the company" (p. 86). Similarly, the 1962 edition advocates: "the weight given to financial material may vary enormously, depending upon the kind of security studied and basic motivation of the prospective purchaser" (p. 105).

This emphasis on differences is not meant to imply that the texts are diametrically opposed. For example, on the distinction between speculation and investment the texts are still in agreement. Both editions italicize the statement: "*An investment operation is one which upon thorough analysis, promises safety of principal and a satisfactory return. Operations not meeting these requirements are speculative*" (1934, p. 54). Both texts explicitly recognize that security analysis has considerable limitations in speculative situations, e.g., "It is only where chance plays a subordinate role that the analyst can properly speak in an authoritative voice and accept responsibility for the results of his judgments" (1934, p. 26; 1962, p. 52). In other words, "the value of analysis diminishes as the element of chance increases." Both the 1934 edition and the 1962 edition continues with a discussion about the benefits of holding a diversified portfolio of securities: "the element of diversification is counted upon to offset the recognized risk existing in individual securities" (p. 54). Insofar as fundamental analysis seeks to benefit from firm specific risks, it would seem that relatively undiversified portfolios would be more attractive. However, the diversification envisaged is much less than the market portfolio suggested by modern portfolio theory, more along the lines of a specialized investment trust.

In contrast to the earlier editions, the 1962 edition was profoundly influenced by the emerging subject of modern Finance, the rudiments of which were appearing at that time. There are discussions related to optimal capital structure (pp. 548–9) and impact of dividend payments on firm value. The discussion about dividends moves from the "greater benefits to stockholders from dividends" in the 1934 edition to a more ambiguous view in the 1962 edition. There are also chapters dedicated to "newer methods for valuing growth stocks" and "market analysis and security analysis." The 1962 edition is also filled with copious footnotes that contain references to recent journal articles and trade publications. Where the 1934 edition examined fixed income investments and

proceeded to common stocks, with a view of applying valuation principles for bonds to common stocks, the 1962 edition has a substantial examination of the principles of financial statement analysis before proceeding to fixed income securities and common stocks. On balance, there is much new material presented in the 1962 edition.

Modern students of Finance would probably not bother to read the original texts, relying instead on what a long list of journal articles propose as the "Ben Graham approach." This approach is typically characterized by mechanical rules for security selection using selected financial ratios. Sometimes these rules are taken from the various editions of Graham and Dodd, in other cases from one of the editions of Graham *The Intelligent Investor* (1949, 1st edn.). For example, Oppenheimer (1981, p. 9) identifies four selection criteria for a defensive investor from the five editions of *The Intelligent Investor*. The rules differ only slightly from edition to edition. The rules from the 1973 edition are: (1) Some dividend paid each year since 1950; (2) the firm has at least \$50 million in assets or annual sales and is in the upper $\frac{1}{4}$ or $\frac{1}{3}$ of its industry in size; (3) the security price does not exceed 25 times average earnings of the past 7 years and does not exceed 20 times earnings over the last 12-month period; and, (4) the equity at book value is at least 50% of the total market capitalization (for utilities this value is 30%). Oppenheimer also suggests criteria for the enterprising investor, e.g., market capitalization of common stock is two-thirds or less of current assets less total liabilities (including preferred stock).

There are a number of other mechanical security selection criteria that have been attributed to the Graham and Dodd approach. A partial list would include: an earnings-to-price yield at least twice the AAA bond yield; a P/E ratio less than 40% of the highest P/E ratio the stock had over the past five years; a dividend yield of at least two-thirds the AAA bond yield; and, a stock price below two-thirds of tangible book value per share. In addition, Lowe (1994) provides a list of "Ben Graham's investment principles" that includes the following: be an investor, not a speculator; know the asking price; rake the market for bargains; regard corporate figures with suspicion; don't stress out; don't sweat the math; diversify, rule #1, minimum of 25% bonds, 25% stocks; diversify, rule #2, hold a large number of securities; when in doubt, stick to quality; dividends are a clue to value; defend your shareholder rights; be patient; and, think for yourself. Finally, armed with all this background, those seeking to undertake a security analysis need to consider the basic elements of fundamental analysis: profitability; stability; growth in earnings; financial position; dividends; and price history.

2.4 THE EMERGENCE OF MODERN FINANCE

History of portfolio diversification theory before Markowitz

While recognizing that the benefits of diversification had been identified long before, Markowitz (1999) emphasizes the contributions of Markowitz (1952, 1959): "What was lacking prior to 1952 was an adequate *theory* of investment that covered the effects of diversification where risks are correlated, distinguished between efficient and inefficient portfolios, and analyzed risk-return trade-offs on the portfolio as a whole." Markowitz

(1999) recounts that his motivation to develop a formal optimization model of the risk-return tradeoff for a portfolio of securities was inspired by a rejection of Williams (1938) where the rule guiding investment decisions was to "maximize the discounted ... (expected) value of future returns." For Williams, the value of a stock was the discounted expected value of future dividend payments. The resulting investment strategy called for selection of securities with the highest expected return. For Markowitz, the Williams approach to investment decisions ignored benefits of diversification. Though Williams (1938) did deal with the impact of uncertainty, the approach suggested was to assign probabilities to possible future states and evaluate the expected value of the investment. Williams felt that diversification would result in an elimination of security risk premia, a view that does not deal adequately with security covariances.

Markowitz (1999) reviews many contributions dealing with aspects of diversification, the risk-return tradeoff and the like appearing in the two decades before Markowitz (1952, 1959). The general assessment of prior contributions is that the discussion did not provide much beyond general terms and "did not clearly indicate why it is desirable." Yet, contributions such as Fisher (1930) receive no mention. In a discussion of "Taking Risk from Speculation" (pp. 204-7) Fisher clearly deals with the issue of diversification:

A little reasoning permits of a startling corollary. It is this: If we can, by sufficient diversification in investments, get a greater certainty and thus run less risks from our speculation, then the more unsafe the investments are, taken individually, the safer they are taken collectively, to say nothing of profitability, provided that the diversification is sufficiently increased.

This paradox is derived directly from exploiting the old-fashioned fear of common stocks and the consequent refusal to deal in them, except well below their "mathematical value."

What follows is a delightful discussion of the fair game model that is used to motivate the notion of the "caution coefficient" – Fisher's term for the cost of risk, a concept developed in Fisher (1906).

Fisher measures the cost of risk as the difference between the expected value ("mathematical value") and the price that will be paid for the gamble: "a sound minded investor will pay less than the mathematical value for a chance to gain money on a risk. That is, he will trim the price by means of a 'caution coefficient'" (p. 205). It is clear that Fisher was advocating the use of mean-variance expected utility functions to model investor choice:

The "caution coefficient" becomes, in practice, greater and greater as the risk grows. If my chance of getting a dollar is a certainty, there would be no reduction on account of the caution factor. If it is like the chance of betting on "heads" or "tails," the caution factor may trim the price of the chance down from fifty cents, in mathematical value, to say, forty cents for the chance to win the dollar. That is a reduction on account of caution to 20 per cent. But if one bets on two heads in succession, the reduction on account of caution would be correspondingly greater, so that instead of paying twenty-five cents, the mathematical value, the investor might insist on a reduction of more than 20 per cent to say, fifteen cents. It is both normal and proper that the higher the risk the cheaper the chance of winning can be obtained, compared to its mathematical value.

What remains is for Fisher to translate this risk-return tradeoff into a portfolio context.

A key result of modern portfolio theory is that the market does not reward the total variability of a security's return, only that part which cannot be eliminated in an efficiently diversified portfolio. Whether Fisher grasped this point is unclear from the key part of the discussion:

Hence, the more risky the investment would be to a lone individual playing the game, the safer it is, if, by pooling in an investment trust with wide diversification in investment, the individual risk is thereby absorbed. For as the (individual) risk grows it can be constantly absorbed by corresponding increases in diversification. Thus the individual investor of the trust may gain more on the riskier investments, bought by the trusts at much less than their mathematical value, than if he played the market alone with less risky investments, but bought at much nearer their mathematical value.

Fisher goes on to observe that the aggregate risk reducing benefits associated with increasing use of "investment trusts, investment counsels and other skilled means of diversifying" contributed to the overall rise in stock prices during the 1920s.

Fisher (1930, ch. 13) contains a number of other intellectual gems. For example, Fisher (p. 206) seems to anticipate what Markowitz was to do over two decades later: "This principle (of higher expected return for the same level of risk through diversification), so far as I know, never has been definitively formulated in the investment market." Fisher directly ties the benefits of diversification to the "principle of constant inspection." Portfolios have to be actively monitored – "rebalanced" in modern terminology – in order to achieve the anticipated portfolio expected return. Bond portfolios require less monitoring than stock portfolios. Fisher explicitly identifies the value of "scientific appraisals of the stock market" to increasing the value of stocks in general and spoke favorably about the benefits of what has come to be called "fundamental analysis." Fisher recognizes the differences between the various entities using the moniker "investment trusts" – some of which were "avowedly of the most speculative type . . . because they may heavily concentrate their holdings." Finally, Fisher explicitly recognized the diversification benefits of holding foreign securities.

As for the identification of an historical starting point for diversification models, Markowitz proposes Shakespeare's *Merchant of Venice* (1600). As discussed in Poitras (2000, p. 110), this choice is somewhat misguided. A more appropriate starting point would be the 1770s in Geneva. By this time, security markets had achieved a remarkable level of sophistication about the notions that Markowitz and others were to explore almost two centuries later under the guise of "modern portfolio theory." In particular, an investment scheme appeared in the early 1770s that reflected intimate understanding of the gains accruing to portfolio diversification (Alter and Riley 1986; Velde and Weir 1992). The scheme, colloquially referred to as "*trente demoiselles de Geneve*" involved a number of Genevan banks creating "investment trusts" that were formed by pooling life annuities issued by the French government. At this time the French government was still using flat-rate pricing of life annuities, that took little account of the age of the nominee in setting the price. Using actuarially sound pricing methods, the flat-rate prices were fairly priced for an adult about age 50 (Velde and Weir 1992).

Even though there was an expected gain to purchasing life annuities written on young nominees, there was still the risk of unforeseen events. According to Velde and Weir (1992), the Genevan banks:

developed lists of young girls from Genevan families to name as the contingent lives. The families were selected for their record of health and longevity. The girls were mostly between the ages of five and ten, and were selected only after surviving smallpox . . . The Genevan banks purchased large amounts on each life to reduce transactions costs, but pooled together annuities on enough different lives to reduce the risk. The most common number of lives in a pool was 30, hence the name of the scheme.

The banks then "resold small fractions of their pools of annuities to individual investors." Sometimes the cash flows from the life annuities were passed-through directly to investors, in other cases the cash flows were repackaged in other forms, such as tontines.

All this reflects a relatively modern state of financial sophistication. In addition to capturing the gains from risk pooling, claims against the pools were "an easily negotiated asset . . . because the bank's dispassionate selection of lives eliminated problems of asymmetric information and moral hazard" associated with life annuities written on single lives (Velde and Weir 1992). This process was facilitated by the substitution of "the paper of the investment trust for the paper of the annuities themselves." In addition to capturing the French government's sizeable mispricing of life annuities written on young, healthy lives, the pools were able to capture the risk premium available from portfolio diversification. The result was that the claims against the pools could be sold at yields well below those directly paid on individual life annuities issued by the French government (see end of chapter questions).

Over time, the investment technology developed by the Genevan banks spread to other countries, most notably the Dutch republic. The Dutch schemes, often organized by important brokers instead of banks, introduced an additional wrinkle. This involved using the surplus of interest received from the French government over interest paid to claim holders to buy back shares in the pool. In some cases, the allocation of surplus was not complete, with the residual cash flow going to the brokers who originated the scheme (Alter and Riley 1986, p. 28). In any event, the "share buyback" feature would act to reduce the number of claims on the fund, thereby increasing potential future returns of pool claimholders. In summary, the pooling scheme involved many modern notions including: the gains to diversification; investment trust/mutual fund origination; security pass-through; and share buybacks. This combination of these features provides strong support for the selection of the "*trente demoiselles de Geneve*" as the most appropriate historical starting point for the theory of portfolio diversification.

*Old Finance, modern Finance and New Finance*²⁷

While the "*trente demoiselles de Geneve*" investment scheme is of historical interest, it is not possible to date the beginnings of modern Finance from this date. Not only is this

date far removed from the institutional context of modern financial markets, the subject of modern Finance is much more than a collection of notions such as "the gains to portfolio diversification." The various notions are connected by a philosophical approach – logical positivism – that unifies these notions to create a coherent and persuasive school of thought. The relevance of this school is clarified by considering the process by which modern Finance was able to supplant during the 1950s and 1960s the "Old Finance" school epitomized by the "Graham and Dodd approach" that emphasized the security selection aspect of investment. By shifting focus onto the portfolio diversification problem, modern Finance argued for the elimination of the firm specific risk that was the stock in trade of the Old Finance adherents. In this process, a new philosophy of investment analysis emerged.

As discussed in section 1.3, a range of philosophical issues need to be addressed in order to develop insight into the prevailing approaches to security analysis and investment strategy. It was argued that modern Finance has an inherent positivist bias that is reflected in both the rhetoric and the prescriptions of academics and, to a lesser extent, practitioners. This bias has resulted in a methodological approach to the subject that seeks to emulate the natural sciences. Yet, being concerned with variables that are the outcome of human interaction, Finance is a human science. While the inductive methods of the natural sciences are necessary to the progress of knowledge in Finance, these techniques are insufficient in the human sciences. Knowledge about phenomena in the human sciences is not rigidly cumulative. Events are historical and, as such, require interpretation in the context of the times. The process of interpretation and prediction is complicated by having to deal with the "uncertainty" of future events. Unlike in the natural sciences, it is possible for writers of the past, working with less data and knowledge, to have insightful understandings of a specific phenomenon that compares favorably with the views of contemporary writers.

This chapter has been concerned with developing the intellectual history of security analysis. This also required some selected discussion of financial history. The time line incorporates Graham and Dodd (1934), a text that is heavily influenced by the historical events which preceded its publication. Yet, the text stands as an example of how writers from a previous era, working with less data and "knowledge," produce results that have a timeless quality. To be sure, Graham and Dodd (1934) has to be read in the context of the time the book was written as do other such books from that period, e.g., J.M. Keynes (1936). However, given this, Graham and Dodd (1934) acts like a beacon that can be used to determine where modern Finance is now situated on the intellectual landscape – how far positivism has come to dominate the approach to the subject. As a consequence of recognizing the biases in modern Finance, even basic results such as "stock returns will outperform bond returns in the long run" can be given a more useful interpretation in terms of predicting what type of investment strategy to employ or which particular securities to purchase.

Haugen (1999a,b) provides a refreshing description of the academic evolution from the "Old Finance" of Graham and Dodd to the world of "Modern Finance" (modern Finance) associated with modern portfolio theory, the CAPM and the EMH. Haugen proposes that the evidence against modern Finance, in terms of anomalies and the poor predictive ability of the models, is so strong that a "New Finance" is emerging to

replace modern Finance. For Haugen (1999b, p. 8), the New Finance represents complete supremacy of the inductive method:

And now Modern Finance begins to teeter.

And a New Finance appears.

Discard those theories that obviously have *no* predictive power. Discard the requirement that all explanations must be based on rational economic behavior. Look carefully at the data and measure accurately without preconception. Discard the tradition that you must model *first* without looking and *then* verify. Carefully measure behavior first, and then find *reasonable* and *plausible* explanations for what you see. Ascension of the *ad hoc*, expected return, factor model. The measure of any model's relative merit: the *unmined, out-of-sample, relative accuracy of its predictions*.

For those unable to see whether this is sincerity or sarcasm, the next sentence is telling: "Go back to teaching students a *craft* rather than a *religion*." For Haugen, the New Finance achieves complete supremacy for the inductive methods of the natural sciences.

Putting aside Haugen's enthusiastic views concerning the emergence of the New Finance, Haugen (1999b, pp. 3–8) does give a useful analysis concerning the progression of Finance from the time of Graham and Dodd (1934) to the present. Haugen obtained his education in Finance in the early 1960s, "when Modern Finance was relatively young and when the Old Finance was dying." Accounting and law were the basic foundations of the Old Finance and the professors of the time were experts in those fields. The theme of the Old Finance was the analysis of financial statements and the nature of financial claims. Classic texts were Graham, Dodd and Tatham (1951) and Dewing (1953). "Graham and Dodd spent most of their book showing us the painful process of adjusting accounting statements so that earnings and assets of different companies could be directly compared . . . In (Dewing), we learned the legal rights of financial claims – *in great detail*. We learned the laws relating to merger and acquisition as well as those governing bankruptcy and reorganization."

Haugen describes Graham and Dodd as "very *dry* stuff and not too interesting." Dewing, on the other hand, made Graham and Dodd "look like a Stephen King thriller." Haugen views the professors of the Old Finance as teachers of a craft. "As possible future financial executives, we needed to know the rules of the game if we had to merge or go bust, as well as the legal impediments on our firm's behavior created by the financial claims that were there today or might be there tomorrow." The time of Haugen's graduate finance education, the early 1960s, was "an interesting time indeed" as modern Finance was breaking onto the academic scene, doing battle with and, eventually vanquishing the Old Finance. Though the birth of modern Finance can be traced to the portfolio optimization model of Markowitz (1952, 1959), the model was largely unnoticed until the emergence during the late 1950s and early 1960s of the other pillars of modern Finance: the Modigliani-Miller irrelevance theorems; the capital asset pricing model; and the efficient markets hypothesis. In contrast to the accounting and law foundations of the Old Finance, modern Finance was a product of financial economics. The central theme was that securities could be valued using models assuming rational economic behavior.

The emergence of modern Finance represented a direct attack on the teachings of the Old Finance. Haugen (1999b, p. 6) observes: "The craft of finance and the teachings of my old professors had been rendered *obsolete*. *It's not nice to be obsolete*. The professors of the Old Finance fought very hard to retain their relevance. The battles of this intellectual war are still recorded in the pages of the old issues of the *Journal of Finance* and the *American Economic Review*. But the professors of the Old (Finance) lost most of these battles, and eventually they lost the war itself." The winning of the rhetorical intellectual battle brought a wave of new professors into Finance programs, trained in graduate programs that emphasized theorizing using the assumption of rational economic behavior. The position of the proponents of modern Finance was buttressed by the emergence of option pricing theory: "Modern Finance took off. It became the dominant discipline in business schools, and it carried great influence in the real world." Having gained a position of intellectual superiority, proponents of modern Finance actively promoted the paradigm.

The intellectual history of modern Finance from the mid-1960s until the present makes for an interesting case study in the process by which knowledge is created in an academic environment. The developments are similar to those in economics where the assumption that economic agents are rational also became the central theme of economic theory, e.g., Kindleberger (1989, p. 29). Even though rationality is only an assumption that may or may not be an accurate description of the world, Haugen, Kindleberger and others observe that the validity of the assumption was "intellectually enforced" by the younger network of academics. This enforcement process took place in the journals and in the classrooms. Given the substantial investment of human capital that had been made by the younger network in the techniques and knowledge associated with the rational maximizing models, such enforcement activities are not surprising. However, as Haugen puts it (1999b, p. 7), "even when the mud is thick, truth always makes its way to the surface."

Haugen provides an interesting description of the enforcement process:

Those who would dare to question the validity of the (Modern Finance) paradigm - especially that of efficient markets - were summarily dismissed as *gauche*.

Those who dared to publish papers contradicting the paradigms were ridiculed. Their studies were supposedly replete with bias. And their methods, of course, were naive.

Their studies included only firms that survived the study period - survival bias. They used earnings numbers that may not have been publicly available at the time they bought the stocks - look-ahead bias. They spun the computer countless times until they got an interesting result - data mining. They didn't take transactions costs into account. They didn't risk adjust their returns. They didn't test for statistical significance. Their results weren't robust in different time periods.

On and on ...

Haugen is quick to point out that the early studies that were critical of the paradigms of modern Finance did turn out to be on the mark: "But (were) summarily *dismissed*, in any case." Haugen traces the emergence of the New Finance to the accumulation of empirical results that invalidated the main propositions of modern Finance. New Finance

is based on the theme of inefficient markets. The main paradigm, for what it is worth, is inductive ad hoc factor models. The operative techniques are inductive methods from statistics and econometrics. There is a substantial overlap, if not a formal equivalence between Haugen's New Finance and behavioral Finance, e.g., Shefrin (2000).

While Haugen's description of the progress of modern Finance is helpful, the notion that there is a "New Finance" emerging is suspect. It seems to be predicated on a misunderstanding of the positivist philosophy that underpins modern Finance albeit with less emphasis on the formal logic of model development. The New Finance is just an evolutionary branch of modern Finance. Even an individual as jaded as Haugen about modern Finance still clings to the belief that the inductive process will lead to an accumulation of knowledge that progressively uncovers the true nature of the subject. There are physical laws of nature governing financial activities. Given enough data, these laws can be identified and used to make valid predictions about optimal portfolios or security prices. Whatever the philosophical basis, chapter 3 is concerned with developing the elements of modern Finance that are applicable to security analysis and investment strategy.

Modern Finance approaches security analysis and investment strategy within the context of models that assume rational economic behavior. A strong belief in market efficiency provides a basis for arguing that traditional security analysis, along the lines of Graham and Dodd, will not be able to consistently earn abnormal returns. Given this belief about the analysis of individual securities, rationality dictates that investment strategy focus on the identification of optimally diversified portfolios. Assuming that the capital asset pricing model is an accurate description of security market equilibrium, it follows that the rational investor will hold portfolios that are composed of the riskless asset and the market portfolio. The weights in which these two assets are held depends on the risk attitudes of the investor. For example, investors with a high level of risk tolerance would borrow at the riskless rate (negative weight on the riskless asset) and leverage up in the market portfolio (positive weight greater than one). Those with low levels of risk tolerance would hold both the riskless asset and the market portfolio (both weights positive and less than one).

In section 1.3, it was argued that: "It is naive to believe that the route to knowledge and truth about the subject at hand is unproblematic, providing that one adheres to the prevailing positivist ideology." Chapter 3 takes a different slant. In much the same way that it is inappropriate for adherents of the prevailing positivist ideology to suppress contrary notions, it is equally inappropriate to dismiss the insights that the positivism of modern Finance has provided. Once the philosophical biases and rhetorical approach of the subject have been accurately assessed, there is much of value in modern Finance that is relevant to security analysis and investment strategy. For example, there is the notion that rational investors are well advised to avoid the hazards of selecting individual securities and, instead, invest in risky assets by purchasing the market portfolio. This prescription is intuitively persuasive and insightful. Another useful insight is the notion that investment strategy needs to focus on the weights for the riskless asset and the market portfolio. This idea is readily extended to the practice of fund managers periodically rebalancing the fixed income and equity proportions in the model portfolio.

Positivism strives to achieve a scientific approach, divorced from normative values, emphasizing quantification, measurement and empirical verification of hypotheses. As such, modern Finance is a combination of theoretical hypotheses and the accumulation of empirical results aimed at testing those hypotheses. Initially, considerable effort was expended in developing models, based on rational maximizing behavior of economic agents. Included among the most important models are the Markowitz portfolio optimization model and the capital asset pricing model. The theoretical framework employed to model the rational decision making process usually involved agents, subject to a budget constraint, choosing among available securities or capital assets in order to maximize the expected utility of terminal wealth. Because the value of terminal wealth depends on the prices of securities or assets that are not known at the time the optimization decision is being made, the models of modern Finance are examples of the more general decision making under uncertainty problem.

Conquering the Old Finance: from Markowitz to Fama

A number of candidates are available for selection as the intellectual beginning of modern Finance. Numerous sources identify Markowitz (1952, 1959) as the starting point, e.g., Brealey (1991), Rubinstein (2002), Markowitz (1999). In contrast, Rubinstein (2003) suggests an earlier beginning, tracing the roots back to Fisher (1906, 1907, 1930a) and Williams (1938). Accepting that the Markowitz approach was not widely recognized until after the contributions by W. Sharpe (Sharpe 1963, 1964), the contributions of Modigliani and Miller (Modigliani and Miller 1958; Miller and Modigliani 1961) (MM1; MM2) are arguably an appropriate starting point. This position is supported by a close reading of the literature at the time. For example, in launching a "hostile review" of MM1 (Bernstein 1992, p. 175), Durand (1959) represented a broad consensus of academic opinion at the time that MM1 appeared. Durand (1960) demonstrates that, at the time, the Markowitz model had not received the close scrutiny that was given to MM1. Initial criticisms of the evolving modern Finance approach included individuals that, at first glance, would seem to be disposed to MM1, MM2 and the Markowitz approach, e.g., Durand (1957).

As Rubinstein (2003) recognizes, the attribution of ideas to specific individuals is a difficult task, particularly where the individuals involved are no longer living. As such, the task of identifying the origins of modern Finance has been simplified significantly by Bernstein (1992) who provides a wonderful collection of first hand insights into the individuals involved at the beginnings of modern Finance in the 1950s and early 1960s. While it is tempting to push back the time line to individuals writing prior to this period, such as L. Bachelier, J.B. Williams and I. Fisher, there is too much of a temporal gap separating these contributors from the widespread recognition of the "bombshell assertions" (Bernstein 1992, ch. 9) that modern Finance adherents used to supplant the Old Finance from the core curriculum of business schools. In this interpretation, the modern Finance revolution begins with Modigliani and Miller (1958), gathers steam during the 1960s and reaches fruition by the middle of the 1970s. Though Markowitz (1952) appears at an earlier date, it is Markowitz (1959) that more appropriately fits into the time line suggested here.

The selection of MM1 for the beginning date of the modern Finance revolution is not intended to imply that MM1 was the most theoretically significant of the early contributions. Bernstein (1992, p. 41) reflects the generally accepted view among modern Finance adherents about the relative significance of Markowitz's contribution:

The most famous insight in the history of modern finance and investment appeared in a short paper titled: "Portfolio Selection." It was published in the March 1952 issue of the *Journal of Finance*, the only journal then in existence for scholars in the field. Its author was an unknown 25-year old graduate student from the University of Chicago named Harry Markowitz.

Having said this, Bernstein proceeds to recognize a time line that supports the primacy of MM1:

No one, including Markowitz, was aware that his paper would turn out to be a landmark in the history of ideas. Although his achievements would earn him a Nobel Prize in economic sciences 38 years later, the paper languished for nearly ten years after publication attracting fewer than twenty citations in the academic literature until after 1960. By that time, Markowitz had written his dissertation on the subject and had converted it into a full-length book.

In contrast to the slow acceptance of the Markowitz theory of portfolio optimization, MM1 gained almost instant notoriety.

Markowitz (1952, 1959), ultimately, became the theoretical foundation for the "modern portfolio theory" that is at the center of the modern Finance approach. In contrast, MM1 and MM2 did not make such a wide reaching contribution. This is, at least partly, due to the nature of the results being presented. MM1 demonstrated that, in perfect capital markets, the capital structure of the firm will be irrelevant to the market value of the firm, i.e., there is no optimal capital structure. Similarly, MM2 demonstrated, again in perfect capital markets, that the dividend policy of the firm was also irrelevant to the market value of the firm. In the case of the firm's capital structure, MM1 proposes that the market value of the firm (= market value of debt + market value of equity) is determined by the assets side of the balance sheet. The liabilities plus equity side of the balance sheet only determines the division of the asset cash flows between security claimholders. It is not possible to change the market value of the cash flows from the assets by reorganizing the division of those cash flows between claimholders.

In addition to the basic demonstration that the value of the firm is determined by the assets side of the balance sheet, the MM1 argument also had to deal with investor preferences for a specific type of capital structure. Given the random behavior of asset cash flows, firms with more debt on the balance sheet will have a higher variability in the payments made to equity claims. While this would seem to indicate that the common stock in firms with higher debt levels is riskier and, as a consequence, will have a different market value than the common stock of an otherwise identical firm with a lower debt level, MM1 demonstrates that by engaging in borrowing or lending activities in conjunction with purchases of the common stock, individual investors are able to create a "synthetic capital structure" for the firm that is consistent with the

desired portfolio cash flow variability associated with holdings of the firm's securities. Because the individual investor is able to synthetically achieve a desired capital structure through portfolio allocation, the market value of the firm's debt and equity claims will not be priced to reflect differences in firm capital structure.

MM2 follows lines similar to MM1. The dividend policy of the firm is irrelevant because individuals are able to create a synthetic dividend that is consistent with the individual's desired dividend payout. From the firm's perspective, dividend payments made to shareholders represent forgone retained earnings. In cases where retained earnings are insufficient to sustain the capital requirements needed to fund the firm's growth, the dividend payments are recouped through new share issues. Where the dividend policy is lower than dictated by the firm's capital requirements, then the excess retained earnings will be used to repurchase the firm's common stock. Within this context, if the individual finds the firm's dividend policy is lower than desired, then a fraction of the share holdings can be sold each period to obtain the desired level of "synthetic dividend" cash flow. Similarly, if the dividend payout is higher than desired, the surplus can be used to purchase shares. While, over time, the number of shares outstanding will differ between otherwise identical firms with different dividend policies, the market value of the equity claims will be the same. As in MM1, this occurs because the value of the firm is determined by the assets side of the balance sheet.

Though MM1 and MM2 did not go on to play a central role in the theoretical development of modern portfolio theory – the core of modern Finance – MM1 and MM2 did play a central role in the attack on the Old Finance. Dividend policy and the capital structure of the firm are key concerns in traditional security analysis. The theoretical claim that such concerns are irrelevant is potentially devastating. More importantly, the irrelevance results were made by exploiting the analytical properties of perfect capital markets. The rational, maximizing individual operating in a "frictionless" market environment – a central feature of the theories that characterize modern Finance – represented a metaphor that was to prove irresistible compared to the institutionally and legally driven model of the Old Finance. However, the topics that concerned MM1 and MM2 were focused largely on the central issues of Old Finance and did not play a crucial role in the evolution of the core theory of modern Finance.

What early contributions did play a key role in the evolution of the core theory of modern Finance? The general consensus among adherents of modern Finance, e.g., Rubinstein (2002), is that at the head of the list are the seminal contributions that led to the capital asset pricing model (CAPM) and the market model (see section 3.2): Markowitz (1952, 1959) and Sharpe (1963, 1964). In addition, as recognized in Markowitz (1999), Tobin (1958) can also be given some credit for containing the essence of the two fund separation result, albeit within the context of modeling the demand for money in a portfolio optimization framework. Markowitz (1999, p. 10) observes: "At a meeting with Tobin in attendance, I once referred to his 1958 article as the first capital asset pricing model." Apparently Tobin did not accept this interpretation. In any event, while making an important contribution to monetary economics, Tobin (1958) did not have a similar impact on Finance. It was Sharpe (1963, 1964) that recognized the key revolutionary result: "the expected return on each security is linearly related to its beta and only its beta."

The core theory of modern Finance is not limited to the Markowitz mean-variance optimization framework and the CAPM. Running roughly in parallel with the development of these concepts was the work on the random character of stock market prices that culminated in Cootner (1965) and Fama (1965). While interesting in itself, this work also laid the foundation for the efficient markets hypothesis (EMH), and the modeling of stock prices (returns) as conditional expectations with information sets characterized as weak form, semi-strong form and strong form (see section 1.2).²⁸ This progression was aided considerably by Fama et al. (1969) which introduced a novel statistical methodology, based on cumulative abnormal residuals, that could be used to empirically test the semi-strong (and strong) form of the EMH. In turn, development of the EMH strengthened the argument for using the CAPM and Markowitz model. More precisely, under the EMH, it was not possible to use available information to earn systematic, risk-adjusted abnormal returns. This substantively undermined the basis for doing Old Finance security analysis, strengthening the rationale for the elimination of diversifiable risk through portfolio optimization methods.

While circa 1965 modern Finance was still in the process of evolving into a coherent package, Fama (1970) illustrates that by the end of the decade modern Finance had developed into something resembling a coherent whole. With the appearance of Fama (1976) (*Foundations of Finance*), the revolution against the Old Finance was largely completed, the corpus of modern Finance was solidified and the program of future research was well defined. In addition, by the mid-1970s, attention of the modern Finance school was shifting to extending and exploring the seminal contribution of Black and Scholes (1973). Though a connection can be made between the CAPM and the Black-Scholes formula, it is difficult to meld the notion of pricing by arbitrage with that of pricing by expectation. Though there were substantive efforts to exploit the continuous time pricing technology used in Black and Scholes (1973) to the CAPM framework, e.g., Merton (1969, 1973a), a disconnect between these two streams of modern Finance survives to the present day.

Consistent with the positivist approach, modern Finance has adopted the rational, maximizing individual as the central abstraction upon which theoretical knowledge about security pricing can be obtained. Inductive methods – especially variants of regression analysis – are used to determine whether a particular version of a theoretical model is consistent with observed data. If the null hypothesis is not empirically supported, the model is restructured, typically by altering an assumption, and retested. While sharing this general epistemological approach, there have been three distinct tracks in modern Finance: the *CAPM* and Markowitz mean-variance portfolio optimization model; the *EMH*; and, the *contingent claims pricing models* that emerged following Black and Scholes (1973). Though there has been some complementarity between each of these tracks, each evolved somewhat differently and, as a consequence, modern Finance cannot be viewed as a coherent doctrine of interlocking parts. Questioning of one part – such as the EMH being questioned by the “New Finance” – does not necessarily involve questioning of another part – such as contingent claims pricing models.

The lack of initial coherence between the inductive EMH and the theoretical CAPM created a number of confusions that, at the time, puzzled those seeking to understand the emerging school of thought. Some of these confusions still survive to puzzle those

being introduced to the dictates of modern Finance. This is illustrated by the use of the term “efficient frontier” to define a central concept in the Markowitz approach. The “efficiency” in this case is only loosely connected to the informational “efficiency” that concerns the EMH or the Pareto “efficiency” that arises in microeconomic theory. Similarly, the different tracks in modern Finance each lead to somewhat different implications for security analysis and investment strategy. For example, while the CAPM leads to two fund separation as the appropriate investment strategy, contingent claims pricing technology suggests that dynamic portfolio insurance is an appropriate strategy. In the end, what binds the strands of modern Finance together is the underpinnings provided by the positivist approach.

Questions



1 In discussing the investment mantra, “never put all your eggs in one basket,” Withers (1911) observes that “expert advisers of the public are fertile in schemes for scientific distribution of risks by climate, or by geography, or by industries, etc., etc.” Explain the connection of this statement to the development of modern portfolio theory.

2 Ben Graham made the following observation in the *Intelligent Investor*: “The distinction between investment and speculation in common stocks has always been a useful one and its disappearance is a cause for concern. We have often said that Wall Street as an institution would be well advised to reinstate this distinction and to emphasize it in all dealings with the public. Otherwise the stock exchanges may some day be blamed for heavy speculative losses, which those who suffered them had not been properly warned against.”

Comment on the implications of this statement for the valuation of securities. In your answer be sure to provide an assessment of the validity of the statement as well as a discussion of how security valuation would have to be conducted if the statement were correct.

3 In chapter 12 of *The General Theory* J.M. Keynes described the process of valuing common stocks as: “a game of Snap, of Old Maid, of Musical Chairs – a pastime in which he is victor who says *Snap* neither too soon nor too late, who passes the Old Maid to his neighbor before the game is over, who secures a chair for himself when the music stops.” Comment on the implications of this statement for the valuation of securities. In your answer be sure to provide an assessment of the validity of the statement as well as a discussion of how security valuation would have to be conducted if the statement were correct.

NOTES

- 1 This section is based on Poitras (2000), chapter 6.
- 2 An usufruct is the right of temporary possession, use or enjoyment of the advantages of property belonging to another, so far as may be had without causing damage or prejudice to the property.
- 3 Prior to this time, English government debt was almost exclusively short term. Tracy (1985) examines the implications of this for the relatively slower development of English financial markets, relative to those in northern Europe.
- 4 A major part of the success of the English public debt system is due to the allocation of control over taxation to the Parliament, arising from the Glorious Revolution. With this reform, Parliament was able to ensure that the funding of interest payments with specific taxes was removed from the meddling of sovereigns.
- 5 The tontine has an interesting connection to the early history of the NYSE. The signatories to the Buttonwood Agreement of 1792 required a meeting place suitable to their needs. Banding together with other merchants and commercial interests, the brokers formed the "New York Tontine Coffee House Company" in which 203 subscribers contributed \$200 each for the construction of the Tontine Coffee House at the corner of Wall and Water Streets. The construction was finished in 1793 and the Tontine Coffee House acted as a meeting place for "merchants, brokers and various commercial bodies, till 1827" (Eames 1894, p. 17) when the first Merchants Exchange was constructed at Wall and Hanover Streets. The name of the coffee house came from the tontine associated with the original articles of the corporation that called for the property to be held by the corporation until only seven members remained alive at which time the property would be sold and the proceeds distributed to the survivors.
- 6 Material in this section requires fixed income concepts that are developed in chapter 4, especially section 4.1.
- 7 Daston (1987, n. 5) quotes James (1853) for a 14% rate on English life annuities, for any age, issued by the state under William III. This translates into approximately 7 years' purchase.
- 8 It was common at this time for a number of spelling variants to be used, all of which can be considered correct spelling. The spelling Jan de Witt is found in Hald (1990), Coolidge (1990) and Pearson (1978). Hald also gives the variant Johan de Witt while Pearson reports John de Witt. Heywood (1985) uses Johannes de Wit while Hendricks (1852-3) uses John de Wit. In the *Valuation*, the author is listed as "J. de Wit."
- 9 Karl Pearson, who had strong views on a number of individuals involved in the history of statistics, depreciates de Witt's work by claiming: "the data are uncertain and the method of computation is fallacious" (Pearson 1978, p. 100). This is at variance with Hald (1990), Alter and Riley (1986) and others. Pearson (1978, p. 702) also appears to have been unaware of Hudde's contribution, "I was unaware that [Hudde] had contributed to the theory of probability." Hecksher (1955, v. 1, p. 214) also raises the possibility that de Witt might not have written all the works which are credited to him by referring to "the Dutchman, Pieter de la Court, whose main work often went under the name of the well-known statesman Jan de Witt." The practice of contracting-out of intellectual contributions was not uncommon around this time, e.g., Joshua Child and the work of Philopatris (Letwin 1963). However, it is highly unlikely that there were more than a handful of individuals both informed and capable enough to appreciate the relevance of Huygens's contribution on mathematical expectation to pricing life annuities. De Witt must be included in this handful of individuals.
- 10 There are various sources on the valuation of life contingencies, e.g., Alter and Riley (1986), Hald (1990) and Pearson (1978).
- 11 De Witt's submission to the States General was "a prime minister's attempt to convince the States General that the price of annuities should be raised from 14 to 16 years' purchase. Typical of other prime ministers in critical situations, de Witt was short of time, and he had presumably

no hope of getting the price raised to more than 16 years' purchase. This may explain the inconsistencies in the paper" (Hald 1990, p. 130). This situation speaks to the importance of Hudde's contribution in checking and expanding the original work of de Witt. In a modern setting, it is possible that de Witt and Hudde would have combined to produce a finished publication in which both were co-authors.

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- 13 Halley's paper also did not have any impact on English government borrowing practices as life annuities continued to be sold at seven years' purchase without reference to the age of the annuitant (Hald 1990, p. 139).
- 14 This section is based on Poitras (2000) chapter 8. The discussion in section 2.2 focuses on early trading of equity securities with little attention being given to the development of debt securities that have a much longer history than common and joint stocks. The history of debt securities is discussed in more detail in section 2.1.
- 15 This evidence, quoted in Kellenbenz (1957, p. 128) is not claiming that Jews owned 85% of the stock. Rather, Jews, as the brokers, market makers and gamblers, did 85% of the trading.
- 16 De Marchi and Harrison (1994, p. 62) appear to claim that de la Vega proposed a model where stock prices were a random process, quoting de la Vega as saying: "shares are enveloped in a veil of almost religious mystery such that the more one reasons the less one grasps, and the more cunning one tries to be the more mistakes one makes." The solution, according to de la Vega, is to trade randomly. Is it possible to claim de la Vega was a precursor of the random walk model of stock prices?
- 17 Modern security analysis has a much more refined treatment of firm profitability, based on exploiting the much more elaborate accounting information now available. Graham and Dodd's dictum that security analysis involves the use of financial statements would have been lost on Mortimer because, at his time, accounting information was quite rudimentary and was often proprietary.
- 18 Though Edgar Smith was also a financial analyst and investment manager during the 1920s, he is included in the academic group as many of his contributions were targeted at the academic audience, e.g., Smith (1927, 1931). In McCloskey's terminology, Smith was actively involved in conversations with academics.
- 19 Wendt (1982) discusses the history of the *Wall Street Journal*.
- 20 The complete history of changes in the Dow Jones Averages can be downloaded from the Dow-Jones website: www.dowjones.com.
- 21 The life of Irving Fisher extended well beyond the world of academics, e.g., Klein (2001, pp. 86–8). Born in 1867, the son of a Congregationalist minister, Fisher studied mathematics and political economy at Yale University. The claim that Fisher was a self-made business success has to be tempered by the fact that in 1893 Fisher married Margaret Hazard, daughter of Rowland Hazard, a wealthy woolen manufacturer. As a wedding gift, the happy couple was presented with a palatial abode in New Haven. It was not until 1912 that Fisher developed his card index system that he marketed through his Index Visible Company. In 1926, this company was merged with its major competitor to form what was eventually to become the Remington Rand Company. During the 1920s he was able to turn part of the house into a home for his Index Number Institute, staffed by more than a dozen people. The institute prepared a weekly newsletter that was distributed to various newspapers around the world. Having suffered and survived tuberculosis in 1898, Fisher was for the rest of his life devoted to pursuing and promoting clean living. This part of his life found him to be a confirmed prohibitionist and one of the founders and organizers of the American Eugenics Society. This Society was an active promoter of the cause of "race betterment."
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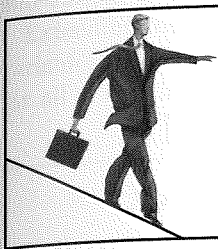
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- 23 While it is tempting to extend the discussion to notions of individual liberty and freedom, this would take the discussion too far afield. However, it is worth observing at this point that this concept of uncertainty "requires a social matrix for its existence" (McKenna and Zannoni 1993, p. 405). This is almost diametrically opposed to the neo-classical approach, of which the modern portfolio theory is an extension. In this approach, decisions are absolute and social conventions and institutions are not required to situate the optimal solution, which is conceived to be immutable.
- 24 If this interpretation is correct, then long-term high grade corporate bonds would also belong to this category. In any event, this discussion does not deal in a substantive fashion with a key element of Keynesian analysis set out in Keynes (1936): the empirical relationship between the cost of capital (marginal efficiency of investment) and the development of economic activity.
- 25 For example, Graham, Dodd and Cottle (1962) explicitly state that fundamental analysis is only applicable to securities which are non-speculative. The determination of whether a security is speculative depends on the assets owned by the firm, the presence of tangible cash flows from those assets and the like.
- Railways, textile companies, shipping companies and the like would typically fall within the scope of fundamental analysis.
- 26 To the uninitiated, security analysis brings to mind visions of the Cold War or the war on terrorism. Graham and Dodd are to be credited for this seeming misnomer that has been chiseled into the syllabus of Finance. A potentially more attractive title would be "securities analysis," though this could be misconstrued to mean the analysis of combinations involving more than one security.
- 27 Haugen uses upper case letters for New Finance, Old Finance and Modern Finance. In this text, the classifications roughly correspond to behavioral Finance, traditional Finance and modern Finance. Even though there is more than substantial overlap between the two classification schemes, when reference is being made to Haugen's notions, then upper case will be used, e.g., New Finance. Otherwise, when notions being developed in this book are being referenced, lower case letters will be used, e.g., behavioral Finance.
- 28 Though Fama (1970) can be credited with popularizing the weak, semi-strong and strong form terminology, Fama credits the origination of these terms to a colleague at the University of Chicago, Harry Roberts.



Chapter Summary

Chapter 3 *Theoretical Developments in Modern Finance*

- 3.1 Basics of Mean-variance Portfolio Analysis
 - The analytical preliminaries
 - The optimization model
 - Capital allocation lines: introducing a riskfree asset
 - The capital market line and market equilibrium
 - Criticism of mean-variance portfolio analysis
- 3.2 Separation, the CAPM and the market model#
 - Two fund separation
 - The capital asset pricing model*
 - The market model*
- 3.3 Decision making under uncertainty*
 - Expected utility theory*
 - Cost of risk and risk aversion properties*
 - Expected utility and moment preference*
- 3.4 Financial Engineering with Derivative Securities
 - The derivative security renaissance
 - The history of portfolio insurance
 - Dynamic portfolio insurance

Questions

Notes

Indicates some sub-sections contain advanced material

* Indicates complete section is advanced material