Financial Analysis, Asset Allocation, and Portfolio Construction: Theory & Practice

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[1] Denis has many years of experience in the financial services industry. He graduated from the mathematics and business double degree program at University of Waterloo in 2009. He worked as a cross-asset fund structurer at Barclays Capital in Tokyo, Japan.

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Chapter 1

Preface

Whether for the sake of trying to make a fortune or for the sake of knowledge, both practitioners and academicians have had interests in studying the behavior of financial time series data since the existence of financial markets. Not only their motives were different, but also their practices. On one hand, financial practitioners **believed** that financial time series can be forecasted. Driven by their financial motives, they were set to exploit profit opportunities by forecasting and predicting the behavior of financial time series in capital markets. Academicians, on the other hand, were occupied with answering the question of whether or not it is possible to forecast financial time series. Despite the fact that academicians and practitioners differ in their motives, they both enhanced our understanding of the price formation process in financial markets.

Academicians contributed equilibrium models that aim to describe the process of price formation in capital markets. Over time, two schools of thoughts were established. Proponents of the first school of thought believed that resources are efficiently allocated among participants in capital markets. In an efficient setup, capital markets provide accurate signals for firms and investors that enable them to make efficient investment decisions. In other words, the proponents of this school of though entertained the **Efficient Markets Hypothesis** (EMH), which posits that, at any point in time, security prices fully reflect all available information in the market. Empirical evidence, however, shows otherwise. The EMH does not hold all the time. Recent evidence from **behavioral finance** and **neurosciences** shows that investors (especially retail traders) exhibit irrational behavior, which can explain this violation of the EMH. This led to the formation of the second school of thought; the behavioral finance school.

Practitioners are not interested in developing models of price formation; rather they are interested in developing techniques to analyze and predict the price movements. Same as academicians, practitioners are also divided into two schools of thought: the **fundamental analysis** school and the **technical analysis** school. Although both schools of thought share the same objective, which is to give advise on what and when to buy and sell assets for the sake of making profit, they differ in their ways of analysis. The proponents of the fundamental analysis believe that any asset has a foundation value or **intrinsic** value. Due to market conditions, the actual price of the asset fluctuates continuously around this intrinsic value; it could fall below or rise above this value. This fluctuation implies that the actual market price of the asset will eventually reach its intrinsic value but will rarely remain at it. This, in turn, creates buying and selling opportunities when the asset is undervalued or overvalued respectively. Finding the intrinsic value of the asset under consideration is the main objective of fundamental analysts. The proponents of technical analysis, on the other hand, believe that the study of past price movements helps in predicting its future movements. The general consensus among technical analysts is that fundamentals are irrelevant because all market information are reflected in the price process, and thus, studying the past behavior of the price series is the best way to predict its future movements. Practitioners in the finance industry usually entertain the views and methods of both schools in developing their strategies. I can safely argue, with a 95% percent confidence, that most of the financial analysis strategies use a combination of the fundamental and the technical approach.

The objective of this paper is to describe the process of constructing portfolios of assets in practice. In particular, we are interested in answering questions like: How the portfolio theory, which is at the core of finance theory, is applied in practice? Or in other words, how a financial portfolio of assets is constructed in practice? How the individual assets forming the portfolio are selected and allocated? And is the process of constructing portfolios unique? Although the answers to these questions might appear to be simple and straight forward, they are, in fact, quite complicated. The complication lies not only in making the theory, which is based on certain restrictive and unrealistic assumptions, work in practice, but also in the simultaneous use of a variety of tools and financial concepts in forming a sound investment strategy. The process of asset allocation and portfolio construction in practice is a multidimensional one for it involves the simultaneous application of fundamental and technical analysis of various asset classes, industry analysis, macroeconomic analysis, risk assessment, mean-variance optimization, arbitrage, hedging, performance evaluation, and planning. Each concept is a topic by itself that has its own theoretical foundation and practical implementation. The challenge is to make the best use of all these topics together in the form of a strategy that yields a higher rate of return than that offered by the market. This strategy is not unique; it varies from one practitioner to the other. A successful strategy that leads to a portfolio of assets that beats the market is the result of the developer's talent, years of experience, and knowledge. This combination is what distinguish one successful financial planner or portfolio manager from another in the finance industry. But, although the process of portfolio construction is complicated, we can still at least break it down into three main stages: **Portfolio Planning, Portfolio Construction, and Portfolio Evaluation,** in that order**.**

This paper is organized as follows: Chapter 2 is an introduction. It sets the stage to the portfolio management process. Chapter 3 discusses thoroughly the portfolio planning phase, which is the first stage in portfolio construction. Chapter 4 discusses the two main pillars of portfolio construction: Financial analysis and asset allocation. The theoretical foundation and the practical applications of both subjects are discussed and analyzed thoroughly in this chapter. Also this chapter discusses the implementation of the portfolio. Finally, the last stage of the portfolio management process, which is portfolio evaluation, is discussed in Chapter 5.

Chapter 2

Introduction to Investment Management

At the outset and before analyzing the portfolio management process, it is constructive to begin with a brief discussion on the economics of investment management. The objectives of this discussion are two fold: First, to familiarize the readers with the investment management business and, second, to give a clear outline of the portfolio management process. Before we begin, it is worth mentioning that there are several terms commonly used to refer to the **investment management** business, such as **asset management**, **wealth management**, **fund management** or **portfolio management**. Likewise, there are several ways to refer to the practitioners of the investment management profession, e.g., **investment manager**, **asset manager**, **wealth manager**, **fund manager**, **portfolio manager**, or simply **money manager**. All of these terms will be used interchangeably throughout the text.

2.1 The Economics of Investment Management

2.1.1 The Meaning of Investing

To understand the economics of investment management, the starting point is to clearly understand the word "**investment**." Any economy consists of three main sectors: the household sector, the business sector, and the government sector. In economic theory, households are known as consumers and businesses are known as producers. To serve our purpose, we will set aside the role of the regulatory sector and focus more on the role played by consumers and producers in the financial system.

Economic theory defines investment as the accumulation of capital stock of a firm. It is basically the amount of money spent on machines, equipment, or any other form of capital. Thus, investors, in economics, are seen as producers or businesses who raise funds to invest in order to increase their profits. They usually finance their investment expenditures through **borrowing** either directly by issuing bonds or stocks in the financial market or indirectly by requesting loans from a financial intermediary, e.g., a commercial bank. This implies that investors as economic agents are technically the borrowers in the financial system as shown in Figure 2.1. But, what about the lenders? Who are the economic agents that are considered lenders in the financial system? Lenders in the financial system are individuals or institutions who have saved some money and want to achieve a return on their savings in order to smooth their consumption.[1] Thus, the **lenders** in

[1] Over the life cycle of any individual, the process of generating income is not the same as consumption spending;

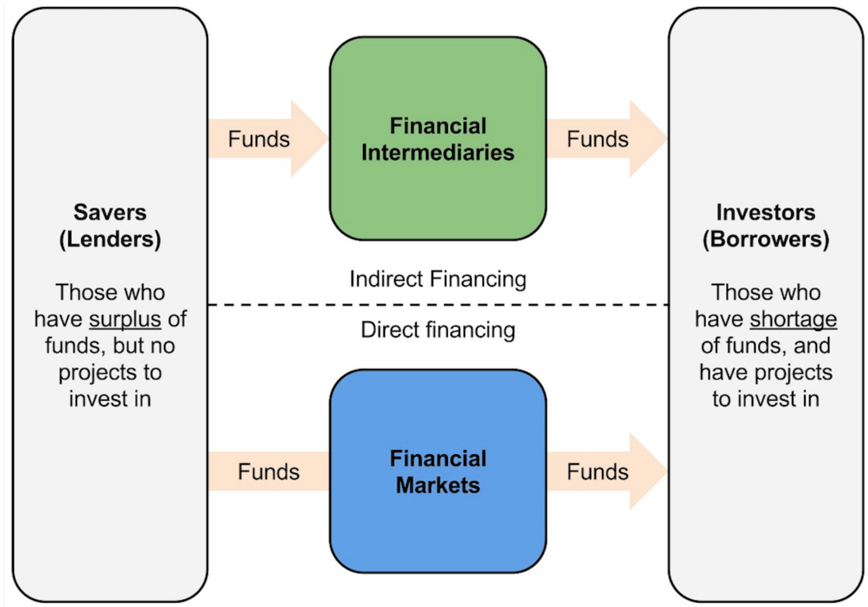

Figure 2.1: An overview of the financial system.

the financial system represent the **consumers** or the **household sector** of the economy. The funds is channeled from the lenders to the borrowers either directly through the financial market or indirectly through the financial intermediaries as shown from the financial system depicted in Figure 2.1.

The previous discussion suggests that the borrowers, or the **investors**, in the financial system raise funds directly or indirectly to finance their **investment** expenditures in the hope of making more profits. In finance, however, the word "**investment**" and the term "**investor**" have different meanings and therein lies the confusion. Investment, in finance, means setting, presently idle, money to work now in hopes to achieve a return in the future. Moreover, an investor is an individual,[2] with some savings beyond his or her needs, who chooses to invest these savings either directly in the financial market by buying bonds and stocks or indirectly by opening a saving account in a financial intermediary. So, technically speaking, investors in finance are considered savers or consumers in economic theory. Since the focus of this workshop is on asset allocation and portfolio construction, which is at the core of finance theory, we will entertain the finance definition of investment. It should be clear, however, that the term "investors" in this context refers to the savers of funds in the financial system.

Now, since we are clear about the definition of investment. The next item on the investment management agenda is to understand how investment is carried out. Once an entity, i.e., an individual investor or an institution, has made the decision to invest, it chooses one of two options; either to **invest by itself** for itself or to **hire a professional money manager** to invest on its behalf. Both options are explored in the following two sections respectively.

income is received at discrete dates, i.e., weekly or monthly, while consumption is, in a way, continuous (daily). Since individuals like to maintain the same standard of living over their life cycle, they prefer **smoothing** their consumption over time.

[2] In finance theory, a financial institution or a legal entity could also be seen as an investor.

2.1.2 Proprietary Investing

Proprietary investment is a term used when an entity decides to engage in investment management process by itself for its own benefit. All of the gains or losses resulting from proprietary investment remain with the entity itself. Any entity that is about to engage in proprietary investing must understand that there are a number of challenges involved. First, the entity will have to hire people and put in place systems to be able to carry out effective proprietary investment. The cost of developing and maintaining proprietary investment capabilities will have to be taken into account when calculating the net gains or losses from investing. Second, proprietary investment activities come with significant potential for conflict of interest with the entity's core business, so precautions must be taken to avoid negative impact of such issues. **Proprietary trading**, or **prop trading** for short, is a notorious example of proprietary investing that is practiced by many financial institutions in order to generate additional profits via very short-term buying and selling of securities. This practice has received much criticism from the financial regulators for its alleged role in the recent financial crisis.[3]

2.1.3 Investment Managers

Alternatively to proprietary investment, an entity can decide to hire a third-party investment management company. In such arrangement, the entity providing the money for investment is the **client** or the **investor**, and the investment management company is the **service provider**. To help manage client's money, investment management companies can provide a very comprehensive set of services ranging from simple investment advice to full-service investment management and reporting. Gross gains or losses from the investment still remain with the client. However, the net gains or losses are reduced by the compensation paid to the investment manager and the other service providers (if any).

Investment managers are compensated for their work by the client via an **investment management fee**. An investment management fee is usually calculated periodically as a fixed percentage of **assets under management**, which is the total amount of money that the investment professional is responsible for managing. In addition to management fees, there are often also **performance fees**, which are usually calculated as a percentage of a new gain achieved in a given period by the investment manager. Performance fees arguably better align the incentives of the investment managers with the incentives of the clients, because the investment managers only receive performance fees if they were successful in making money for their clients. Performance fees are particularly common for hedge funds. The most well known compensation structure for hedge funds is the "2/20" structure, which consists of 2% investment management fee charged on the average assets under management and 20% performance fee charged on any new gain in a one-year period. It is worth noting that compensation arrangements are not fixed; they vary according to the arrangements between clients and investment managers.[4] Ultimately, however, assets under management, investment fees, and performance fees are the basic drivers of profitability for investment management companies.

What separates asset management from regular service is that asset managers have a **fiduciary duty** towards their clients. **Fiduciary** is a legal term that describes an agent who has decision-making authority over another party's property or assets and who is obligated to act in the best interest of that party. This is significant because fiduciary relationship legally binds investment managers to act with trust, good faith, and honesty for the sole benefit of their clients. This is legally binding and, consequently, makes them liable if this duty is breached. Now, we are ready to discuss the portfolio management process.

[3] For more details on the regulation of proprietary trading systems, see Nyquist (1995) and Merkley and Levin (2011) and the references therein.

[4] For more details on investment management fee structures, see Whitwell (2013).

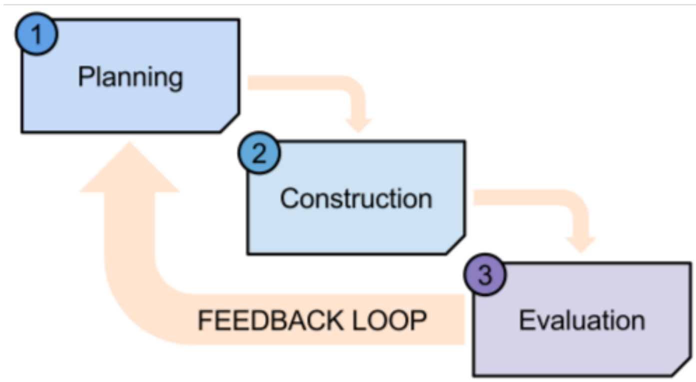

Figure 2.2: The portfolio management process.

2.2 The Portfolio Management Process

The process of asset allocation and portfolio construction in practice is a multidimensional one for it involves the simultaneous application of fundamental and technical analysis of various asset classes, industry analysis, macroeconomic analysis, risk assessment, mean-variance optimization, arbitrage, hedging, performance evaluation, and planning. Each concept is a topic by itself that has its own theoretical foundation and practical implementation. The challenge is to make the best use of all these topics together in the form of a strategy that yields a higher rate of return than that offered by the market. This strategy is not unique; it varies from one practitioner to the other. A successful strategy that leads to a portfolio of assets that beats the market is the result of the developer's talent, years of experience, and knowledge. This combination is what distinguish one successful financial planner or portfolio manager from another in the finance industry. The process of developing, executing, and monitoring the previous strategy is known as the **portfolio management process**, or PMP for short.

Describing and explaining the PMP is the main of objective of this workshop. To this end, we break it down into three main steps as shown in Figure 2.2: **Portfolio Planning, Portfolio Construction, and Portfolio Evaluation;** in that order. The PMP should not be viewed as a one-off service, but rather a continuous process. Hence, the feedback from the evaluation step to the planning step in Figure 2.2. The PMP is analyzed thoroughly in the proceeding chapters.

Chapter 3

Portfolio Planning

Portfolio planning is considered the first stage in the PMP. In this stage, investment professionals create a roadmap that they then follow to reach the investment **goals** of their **clients**. It is crucial in this early stage to make a clear distinction between the clients' investment goals and the portfolio manager's personal goals. The main objective of constructing any portfolio is to achieve the former rather than the latter. In the end, the money invested is the client's own savings and not the manager's. Being experts in their fields, portfolio managers help their clients achieve their investment goals rather than achieving their personal goals.

The recipe for a successful portfolio manager is a formal document known as the **Investment Policy Statement** (IPS). In general, this recipe, which is also known as the **portfolio mandate**, consists of two main ingredients: thorough understanding of the **clients' needs and wants** and outstanding grasp of the various **markets of assets** in which they invest. In order to ensure that the client's needs and wants are satisfied, portfolio managers must profile their clients by gathering information on some key factors such as investment objectives, time frame, tax status, and the clients' attitudes towards risk. Among the previous factors, risk tolerance is considered the most important factor in choosing the right portfolio for the investor. A portfolio manager who recommends a risky portfolio for a conservative investor for the sake of personal gain, e.g., achieving a higher return on the fund or higher commission, is committing a serious offense by violating the code of ethical principles and rules of conduct. As for understanding financial markets, investment professionals, especially those working for large wealth management corporations, are supported by an army of financial analysts whose job is to pour over all sorts of market informations to track trends and conduct analysis. The reports provided by those analysts to portfolio advisors and managers help them better understanding the market and its trends and enable them to form rational expectations about the behavior of asset prices. The result of understanding what is desired by the clients with what is possible given the market environment is the IPS, which is considered the roadmap that outlines how portfolios are to be managed now and in the future.

This chapter is organized as follows: First, the key components of any investment management business are discussed. In particular, we focus on understanding the different types of investors and the different types of markets. Once all of the necessary investor information has been collected and analyzed, investment professionals, using their expertise and their up-to-date market information, begin to formulate the investment objectives and define the investment constraints entailed by the investor's profile. The result is an investment policy statement that outlines the investment strategy, which is tailored specifically for the investor under consideration. This is the subject matter of the last section in this chapter.

3.1 Understanding the Investor

Asset management is considered a client-focused business, and therefore, understanding the investor is the key component that can determine the success or failure of an investment management business. First, we will discuss the two basic types of investors, then, we will look at the types of investor information relevant for investment management process, and finally we will briefly discuss how such information is gathered.

3.1.1 Investor's Type

There are two basic types of investors: individual investors and institutional investors. **Individual investors**, also known as **retail investors**, are people who invest their own savings on a small scale. Individual investors can create their own financial portfolios by opening personal trading accounts with certified **brokers**. They can either manage these accounts by themselves or hire investment professionals such as **personal financial planners** or **investment advisors** to carry this task on their behalf. Individual investors who do not feel comfortable selecting individual assets themselves or with the help of personal financial planners, can invest via **collective investment schemes** (CIS) managed by asset management companies. In a CIS, each investor has a claim on the collective investment assets, proportional to the amount invested. CIS have different names and legal structures around the world. Each economic region or country usually has specific regulations governing the creation, administration and distribution of CIS within its jurisdiction. **Mutual funds**, **hedge funds**, and **pension funds** are examples of CIS because they pool funds from many investors and manage them collectively by investing in various assets. Mutual funds are usually regulated and are available to both individual and institutional investors. In Canada, mutual funds are regulated on a provincial level by the **Investment Industry Regulatory Organization of Canada** (IIROC) and the **Mutual Fund Dealers Association of Canada** (MFDA). In the United States, mutual funds are regulated by the **Investment Company Act** (1940) and, in Europe, by set of directives known as the **Undertaking for The Collective Investment in Transferable Securities** (UCITS). Hedge funds are less regulated and less transparent than mutual funds. Therefore, to protect individual investors from making risky investment decisions, investment in hedge funds is usually only allowed for professional institutional investors. Pensions fund is another example of a CIS that is widely used by individual investors. In a pension fund, contributions from employees are pooled and managed on their behalf to provide funds for their retirement. Anyone with a pension also owns a piece of a financial portfolio. Therefore, basic understanding about how investments are made and how assets are combined to create portfolios is useful even for individuals who do not plan to become professional investors.

Institutional investors are organizations with money to invest either on behalf of their clients or themselves, i.e., their owners or shareholders. In order to manage their investment portfolios, institutional investors either employ investment professionals directly or outsource investment professional services to asset management and investment advisory companies. Institutional investors vary widely by the source of funds and the purpose for managing them. Common types of institutional investors are listed in Table 3.1, which summarizes the major types of institutional investors and briefly describes their primary business activities as well as their typical sources of funds and investment goals. The table also provides prominent examples of these institutional investors in Canada. The top 5 largest institutional investors for each category are also summarized after the table.

Essentially any legal-entity that pools and invests money can be considered an institutional investor. As a result, investment professionals are employed in many parts of the economy. In general, institutional investors can be categorized as either **buy-side** or **sell-side**, depending on the nature of business they do. Buy-side and sell-side are really just two sides of the same industry. Buy-side institutions, work on behalf of themselves or an end client who has the funds for investment and seeks to identify worthy securities to buy. Examples of buy-side firms include asset management companies, pension funds, foundations, endowments, sovereign wealth funds and others. Sell-side institutions on the other hand, are concerned primarily with promoting, creating and facilitating the issuance of securities, and ultimately finding buyers to whom to sell those securities. Investment banks are the primary example of sell-side firms. Each type of institutional investor has different characteristics like sources of funds, main purpose for investing, end clients that they invest for, and thoroughly understanding these characteristics as well as investor-specific nuances is important for providing adequate investment management services.

3.1.2 Investor's Profile

A PMP usually begins with portfolio managers meeting with investors, who have interest in investing their savings in the financial market. The service provided by portfolio managers is to manage the funds on behalf of their investors, and therefore, it is crucial for portfolio managers to fully understand their investors in order to formulate sound investment plans. Table 3.3 summarizes some of the key information that are necessary to understand investors. The importance of taking the time to fully understand the investor cannot be overstated. It is analogous to a doctor diagnosing a patient before prescribing treatment. Incorrect diagnosis can result in disastrous consequences and bring financial ruin to the investor and, consequently, to the investment manager.

Retail investors are typically asked to fill out a detailed questionnaire, in which, among others, they are asked to give details regarding their risk tolerance, target rate of return on their investments, time frame of their investment, and their tax and legal status, as shown from Table 3.3. The questionnaire is then followed by an interview with an investment professional. Institutional investors, on the other hand, may have to follow a similar process that is usually more thorough and more specific, or tailored, to the nature of the institution itself.

Institutional Investor	Description of Business Activities	Common Sources of Funds	Common Investment Goals	Examples in Canada
Retail and Commercial Banks	accept deposits and make loans to individuals and businesses	deposits, debt, equity	preservation of capital, protection against inflation, asset stability throughout business	CIBC, TD, BMO, RBC, Scotia Bank
Investment Banks	research, create, underwrite, promote and sell various se- curities to institutional buy- ers	client accounts, borrowings, own revenues	market making, generating gains for clients, proprietary gains	CIBC World Markets, TD Securities, BMO Capital Markets, RBC Capital Markets, Scotia Capital
Asset Management and Investment Advisory Companies	manage hedge funds, mu- tual funds, Exchange-Traded Funds (ETFs), separate ac- counts and other investment vehicles for the end clients; provide investment advice to clients	institutional or individual clients	achieving investment goals of clients	RBC Asset Management, Investors Group, TD Asset Management, CIBC Asset Management, CI Mutual Funds
Pension Funds (for DB pensions only)	administer and invest retire- ment funds for regular em- ployees	pension contributions by em- ployees and plan sponsors (employers)	meeting retirement obligations	Canada Pensions Plan Investment Board (CPPIB), Ontario Teachers' Pension Plan (OTPP)
Insurance Companies	provide insurance products	insurance premiums	maintaining sufficient funds for paying out claims	Manulife Financial, Great-West Lifeco, Sun Life Financial
Foundations	fund a specific cause with regular spending (usually humanitarian, environmen- tal or political)	donations, contributions	sufficiently funding the cause	The MasterCard Foundation, Fondation Lucie et André Chagnon
Endowments Funds	provide income and pro- vide long-term stability, usu- ally to non-profit institu- tions such as universities, colleges, and museums	donations, contributions	generating income to sup- plement budget, providing long-term stability to parent institution	UW - Math Endowment Fund (MEF), UW - Waterloo Engineering Endowment Fund (WEEF), UofT Endowment Fund
Sovereign Wealth Funds (SWFs)	invest government's savings (budget surplus) and provide fiscal stabilization for the budget throughout an eco- nomic cycle	commodity export revenues, foreign exchange reserves, tax revenues	providing fiscal stability, funding budget deficits	none
Corporations	provide various goods and services	revenues	generating value for share- holders, protecting idle funds against inflation, hedging business risks	Suncor Energy, Canadian National Railway, Enbridge, Potash

Table 3.1: The major types of institutional investors; their primary activities, and their typical sources of funds and investment goals.

Institutional Investor Type	Rank	Name	Country	Relative Size (in USD, billions)
Retail and Commercial Banks	1	ICBC	China	$2,789
	2	HSBC	UK	$2,693
	3	Mitsubishi UFJ Financial Group	Japan	$2,660
	4	Deutsche Bank	Germany	$2,655
	5	Credit Agricole	France	$2,650
Ranked by Total Assets reported in 2013 Source: Fitch Solutions				
Investment Banks	1	J.P. Morgan & Co	USA	$3.87
	2	Goldman Sachs	USA	$3.77
	3	Morgan Stanley	USA	$3.71
	4	Bank of America Merrill Lynch	USA	$3.52
	5	Citigroup	USA	$2.75
Ranked by total fees from all underwriting/advisory activities in 2013 Source: Bloomberg				
Asset ManagementCompanies	1	BlackRock Inc	USA	$3,560
	2	UBS	Switzerland	$2,280
	3	Allianz	Germany	$2,213
	4	The Vanguard Group,	USA	$2,080
	5	State Street Global Advisors,	USA	$1,908
Ranked by total Assets Under Management as of June 30, 2012 Source: www.relbanks.com				
Defined Benefit Pension Funds*	1	Government Pension investment	Japan	$1,222
	2	Government Pension Fund	Norway	$858
	3	ABP (Stiching Pensionfonds ABP)	Netherlands	$416
	4	National Pension Service	Korea	$406
	5	Federal Retirement Thrift	USA	$375
Ranked by total assets as of year end 2013 Source: P&I/Towers Watson				
Insurance Companies	1	Japan Post Insurance	Japan	$3,550
	2	AXA	France	$948
	3	MetLife	USA	$731
	4	Allianz	Germany	$625
	5	American International Group Inc	USA	$541
Ranked by total non-banking assets in 2010 Source: BestLink, A. M. Best Research				
Foundations	1	Bill & Melinda Gates Foundation	USA	$37
	2	Stichting INGKA Foundation	Netherlands	$36
	3	Wellcome Trust	UK	$23
	4	Howard Hughes Medical Institute	USA	$15
	5	Ford Foundation	USA	$14
Ranked by the size of endowment Source: www.ranker.com				
Endowments Funds	1	Harvard University	USA	$32

	2	Yale University	USA	$21
	3	The University of Texas System	USA	$20
	4	Stanford University	USA	$19
	5	Princeton University	USA	$18
Ranked by the size of endowment as of June 30, 2013 Source: 2013 NACUBO-Commonfund Study of Endowments				
Sovereign Wealth Funds (SWFs)	1	Government Pension Fund - Global	Norway	$893
	2	Abu Dhabi Investment Authority	UAE	$773
	3	SAMA Foreign Holdings	Saudi Arabia	$738
	4	China Investment Corporation	China	$653
	5	SAFE Investment Company	China	$568
Ranked by total assets under management as of August 2014 Source: Sovereign Wealth Fund Institute				
Corporations	1	Fannie Mae	USA	$3,270
	2	ICBC	China	$3,125
	3	HSBC Holdings	UK	$2,671
	4	BNP Paribas	France	$2,481
	5	Mitsubishi UFJ Financial	Japan	$2,459
Ranked by total assets calculated on May 2014 Source: Forbes				

* There are two major types of pension funds - defined-benefit (DB) and defined-contribution (DC). In DB plans, workers are promised they will be paid a certain amount in the future when they retire. DB funds have to be actively invested and managed in order to meet predefined retirement obligations, so they typically have a high need for investment professionals. With DB pension, the risk of the shortfall is with the company (plan sponsor), so if the pension plan does not save enough money to pay promised retirement benefits, plan sponsor will be expected to cover the difference. On the other hand, DC plans promise that a certain contribution for retirement will be set aside on a regular basis. DC pension administrators often recommend individual participants a number of standard options, but the final decision of what to invest in is with the individuals. Thus, with DC pension, the risk of insufficient funds for retirement also remains with the individual employees. As a result, DC plans are cheaper to administer and they have less need for investment professionals than DB plans. Historically, DB funds have been some of the largest institutional investors in the world. However, more recently, there is a growing trend for employers to offer DC plans instead of DB plans.

Investor Information	Description
Objective and target return	The objective from investing typically is either appreciation of capital or generation of income or a combination of the two. Investors usually have a target rate of return that they seek to achieve on their portfolio.
Risk tolerance	Risk tolerance is about how much capital the investor can afford to lose. Risk tolerance is usually a function of the investor’s target return, available capital, time frame, and liquidity preference.
Time frame	Time frame is the time horizon over which investment is to be made. It could range from 1 to 2 years (short-run) to 10 or more years (long run).
Available capital	This refers to how much money the investor is willing to invest and when that capital will be invested. For example, it could become available for investment immediately or build up over time through regular increases.
Liquidity preference	This is the preference with respect to when investments should be withdrawn and money used for consumption.
Tax status	Tax status determines how various investments will be taxed. Some investors, like many pension funds are exempt from taxation, however most other institutional investors are faced with various tax rates, rules and regulations in their local jurisdiction.
Legal Status	Information on client’s legal status is important because it can sometimes limit the allowable investments, tax status, spending requirements, etc.

Table 3.2: The Characteristics of investors.

3.2 Understanding the Market

Financial market is a forum where buyers and sellers come together to exchange financial products. There are many different types of financial markets and each market is characterized by a distinct set of information. Since the PMP deals with all types of financial markets, it requires a significant amount of up-to-date information in order to be executed properly. Up-to-date information on a particular market help the investment manager to fully understand that market and, in turn, enhance the PMP process. Overwhelmed with the amount of information and its substantial cost, in terms of both time and money, some investment managers choose to become experts in only a few markets and to focus their investment activities in those markets. To them, the gains from specialization outweigh the costs of diversification.

3.2.1 Types of Financial Markets

Financial markets are the part of the financial system where financial instruments are bought and sold (see Figure 2.1). Financial markets can be grouped into different classifications according to their characteristics. For instance, they can be classified according to product type, liquidity, time period, size, geographical focus, trading schedule, and many other attributes. Four conventional classifications of financial markets usually appear in most finance and economic textbooks, namely: (1) **primary and secondary markets**, (2) **debt and equity markets**, (3) **exchange and over-the-counter** (OTC) **markets**, and (4) **money and capital markets**. Below is a brief description of each category.

Markets where financial securities are issued for the first time are called **primary markets**. In primary markets, securities are bought and sold only at their face value. Markets where securities are resold by investors after they have already been sold on the primary market are called **secondary markets**. In secondary markets, securities are traded at their market values, which are different than the face values for they are determined based on the market demand and supply forces. Most of traditional investing activities take place in secondary markets.

Financial markets can also be classified according to the type of products traded into debt and equity markets. **Debt markets** are markets where debt instruments, e.g., bonds, are traded. **Equity markets** are markets where equity instruments, e.g., stocks are traded.

A third classification of financial markets is according to the way they are organized. **Exchange markets** are markets where buyers and sellers, or their brokers, meet together in one central location to trade, i.e., buy and sell, securities at market prices. Exchange markets are transparent and regulated. **Over-the-counter markets**, on the other hand, are considered decentralized markets, where dealers quote prices that they are willing to buy and sell at. Thus, in an OTC market, prices are not determined by demand and supply forces. These types of markets are less transparent and less regulated as opposed to exchange markets.

Finally, financial markets can be classified in terms of liquidity into **money markets** and **capital markets**. The former are markets where short-term debt instruments are traded whereas the latter are markets where longer term debt and equity instruments are traded.

Aside from the previous four conventional classifications, in practice, financial markets are usually grouped by the **asset classes** that are traded on them. Asset classes are broad categories of securities with similar characteristics. With the proliferation of **financial engineering**, financial instruments are becoming more complex, and some financial instruments possess characteristics of multiple asset classes, in which case they are often called **hybrid instruments**. Nevertheless, many practitioners tend to group instruments into five primary asset classes—**public equity**, **fixed income**, **money market**, **foreign exchange**, and **alternative investments**. The following is a brief description of the markets corresponding to the previous asset classes.

Public Equity

This asset class refers to the traditional stocks traded on **stock exchanges**. The largest stock exchanges are the New York Stock Exchange (NYSE), NASDAQ, and Japan Exchange Group. Other prominent exchanges include London Stock Exchange, Euronext, Hong Kong Stock Exchange and Toronto Stock Exchange. There are nearly 60 exchanges all around the world.[1] Some of the smallest stock exchanges include Mauritius Stock Exchange, Ljubljana Stock Exchange, Malta Stock Exchange and Cyprus Stock Exchange. Stocks traded on the largest exchanges are very liquid and could be bought and sold in large quantities relatively easily. Stocks listed on smaller stock exchanges trade more thinly and may be expensive to buy in large quantities. Moreover, exchanges use different languages, rules, trading hours and holiday schedules. For example, some stock exchanges prohibit short-selling of stocks.

Fixed Income

Fixed income markets trade bonds, interest rate swaps, credit default swaps and other instruments associated with debt. These markets are also sometimes referred to as **debt**, **credit**, or **interest rate** markets. In contrast to public equities, most of which trade on the exchanges, the majority of Fixed Income markets consist of institutions trading directly with each other—a practice known as **over-the-counter** market. Despite being over-the-counter mostly, global Fixed Income asset class is larger than the Public Equity Market. There are often significant minimum trade size requirements for bonds and bond trading necessitates having a good network of many counterparties who hold inventories of bonds for sale. Absence of large centralized exchanges and large trade size requirements make direct investment in bonds rather prohibitive for retail investors. This stands in contrast to the equity markets, where many individuals can participate via discount brokers with small initial investment. Usually the best way for individuals to invest in the bond market is via numerous fixed income mutual funds or exchange traded funds.

Money Markets

Money markets are OTC markets that trade in safe short-term debt instruments known also as **cash instruments** or **money market instruments**. Cash instruments can have time horizon ranging from less than a day to one year. Financial institutions and corporations lend and borrow on short-term basis from one another in the money market. In fact, money market is considered a subset of Fixed Income asset class, but it is worth mentioning separately because it is perceived to be one of the lowest risk asset classes, and therefore, it is frequently used to invest any idle principal. Money markets are generally very liquid, except during a market shock when every market participant is worried that other market participants may not be able to repay even short-term debts. The so-called **"liquidity crunch"** that happened in 2008, where money markets became significantly less liquid than usual as a result of the sub-prime mortgage crisis, is a case in point.

Foreign Exchange

Foreign exchange market, or **forex** for short, is a decentralized market where foreign currencies are traded. Since it is decentralized it is often possible to trade currencies in forex around the clock. Spurred by globalization and international trade, forex is actually the largest market in the world by daily volume with over $5 trillion traded daily.[2] The four most commonly traded currency pairs are EUR/USD, USD/JPY, USD/GBP, and USD/CHF.

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[1] Source: www.world-exchanges.org.

[2] Source: www.reuters.com/article/2013/09/05/bis-survey-volumes-idUSL6N0GZ34R20130905

Alternative Investments

Alternative investments is a "catch-all" category. Although this asset class is the smallest compared to the other asset classes, it represents the greatest variety of markets. It includes markets like **commodities**, **private equity** and **venture capital**, **real estate**, **hedge funds**, and other markets whose performance is uncorrelated with traditional asset classes.

3.2.2 Market Information: Sources & Types

Market information is at the core of financial analysis and wealth management. Investment management businesses compete to acquire the most accurate and timely market information. Large wealth management firms have armies of analysts who pounce on even the smallest informational advantage at their disposal. On the other hand, due to the large volume of information that is required for proper asset management, it is convenient for some small scale investment management businesses to use the service of third party **financial data vendors.** These companies make a living by providing financial information to different players in the financial system. Examples of these companies are **Bloomberg**, **Thompson Reuters**, **Fact Set**, **Markit**, **Morningstar**, **S&P Capital IQ**, **SIX Financial Information,** and many others.[3] Nowadays, an abundance of information is available for free from **financial websites** such as **Google Finance** and **Yahoo Finance**.

Regardless whether information is provided by an in-house team of analysts or by a third party, it is essential in asset management and portfolio construction. In other words, information is a key element in the PMP. In the following two sections, we will discuss briefly the general **sources** of market information and the different types of market information that are relevant for the PMP. We begin with the former.

Sources of Market Information

There are many avenues a financial analyst can pursue when shopping for information. In general, market information can come from one of two different sources: **primary sources** or **secondary sources**. The former sources include information and data from the **annual and quarterly reports** prepared publicly traded corporations as well as from the **public conferences calls** hosted by these corporations after the publication of their reports. The latter sources include data provided from third parties, e.g., Bloomberg and Standard & Poor, sell-side analysts' reports, and industry reports. Below is a brief discussion on both sources.

Annual and Quarterly Reports are among the primary sources of data for financial analysts. **Annual Reports** are prepared by the company management for the purpose of providing investors and other stakeholders information on the company's operations, financial numbers and business conditions. Some of these reports are mandatory, i.e., enforced by regulators, whereas others are prepared solely for the shareholders of the corporation. The purpose of the mandatory reports is to ensure full disclosure and transparency of information. This results in a healthy investment environment; a well informed investor tends to make rational investment decisions, which, in turn, guarantees the existence of an efficient capital market. For corporations listed in the United States, mandatory Annual Reports enforced by U.S. regulators are called **10-K Reports**. For those listed in Canada, mandatory reports are called **Annual Information Forms**, or **AIF** for short. For companies cross-listed on both Canadian and U.S. exchanges, the regulatory form used is called **40-F**. In addition to the 10-K or AIF Reports, most corporations often prepare **Annual Reports** for their owners (shareholders). Those reports contain a **letter from the firm's Chief Executive**

[3] Bloomberg is by far the most commonly used financial market data vendor. For more details on the functionality of Bloomberg terminal and how it is used by financial analysts, see Fahmy (2013).

Officer or Chairman, a **Management Discussion & Analysis** (MD&A) section, and a **full set of financial statements**, i.e., balance sheet, income statement, and cash flow statements.[4]

A **Quarterly Report** is just a detailed version of an Annual Report. In the U.S., a Quarterly Report is called **10-Q** Report. In Canada, there is no equivalent of a Quarterly Annual Information Form. Usually the Quarterly Report is much shorter and contains less detailed discussions on the business conditions or operations. Financial disclosure in Quarterly Reports is less thorough than the disclosure in Annual Reports. For instance, an Income Statement in a Quarterly Report might display depreciation expense as part of the cost of goods sold and not as a separate entity as in the case of a detailed Annual Report.

In addition to Annual and Quarterly Reports, the management of public companies usually hosts a **Public Conference Call** after reporting the company's quarterly results. During the conference, the management presents its own remarks on the quarterly results and then holds a question & answer session for the public. Management's remarks involves its own assessment of the company, the trends in the industry, and the expected future outlook of the company, e.g., future growth plans. The management's remarks and statements given during these conferences provide investors and analysts some sort of insight regarding the effectiveness of the corporation, its financial soundness, and the transparency of the management team in acknowledging the challenges that the company is facing and the actions taken to overcome these challenges. In addition to the management's remarks, the question & answer session is of crucial importance as it allows sell-side analysts, e.g., those who are employed by broker-dealers such as Goldman Sachs or Morgan Stanley, to ask the Chief Financial Officer of the company questions regarding the company's finances or operations. By listening to their answers, financial analysts gain further insight regarding the company's prospective plans and, consequently, adjust their financial model of the company accordingly. That's why public conferences are considered a valuable source of information for investors and financial analysts. Conference calls are usually scheduled on the same day as when the company reports its quarterly results. The public can call in and listen to the conference call using the phone number published in the press release. Some companies offer a webcast version of the conference call on their investor relations webpage.[5]

As for the secondary sources of information, third party providers, such as **Bloomberg**, **Thomson First Call**, and **Standard & Poor,** provide consensus forecasts for public companies. These consensus predictions include forecasts of the company's earning per share and revenue in the next fiscal year. Depending on the company, consensus numbers may include forecasts for gross margins, operating margins, production, effective tax rates, interest expense, and so on. Furthermore, third party providers offer downloadable financial statements in Excel format and other financial ratios that may be of interest to the financial analyst. It is worth mentioning that sometimes the calculations of financial ratios differ from one provider to the other, e.g., using ending inventory versus average inventory in the computation of inventory turnover ratio, and, consequently, it is paramount for the analysts who are using these ratios to verify how they have been calculated.

Another type of secondary sources of information is sell-side reports, which can be either on an industry or on a specific company. These reports are particularly useful for financial analysts who are new to the industry under consideration. Although these reports are useful, they must be treated with caution. The analyst should not put too much emphasis on the final investment recommendations that these reports provide; the focus, however, should be on the key **drivers** mentioned in the report. These drivers are considered useful for the analysts when they formulate their own models. Also, it is worth noting that sell-side analysts frequently write general **industry reports** on the industry they cover. These reports contain information on the latest trends in the industry under consideration, the major players, and the market structure. Industry reports are

[4] In order to reduce the cost of disclosure, some corporations issue a more detailed 10-K or AIF designed to meet the regulatory disclosure requirements and, at the same time, provides the necessary information for shareholders.

[5] Only limited companies provide free-transcript of their conference calls but Bloomberg users can find the transcript of the quarterly conference calls under the <**EVT**> security function.

considered another valuable secondary source of information. Below is a list of general industry reports:

- Canadian Association of Petroleum Producers for oil and gas data.
- Energy Information Agency for energy/oil and gas data.
- World Gold Council for gold mining data.
- Office of the Superintendent of Financial Institutions (OSFI), Basel Committee on Banking Supervision, and the Federal Reserve for data on banking.
- Statistics Canada (Statscan) and U.S. Census Bureau for consumer related data for retail companies.
- Mining Journal for mining data.
- Canadian Real Estate Association (CREA) for real estate.

Types of Market Information

Market information could be classified in many ways. From a PMP perspective, one can identify three distinct types of information that are relevant to this process. These three types of information are data, news and research.

Data It is possible to distinguish between three types of data that are commonly used for financial analysis. The first type of data is **market data**, which are historical observations on the behavior of certain financial variables in the market such as prices, rates of return, risk measures, and volatility of different assets and market indices. These observations are recorded daily, hourly, and even every second. Portfolio managers use such historical data extensively to backtest their strategies, to attribute investment strategy performance to individual securities, and also to forecast future price movements. There are many providers of market data including individual stock exchanges, e.g., TSX, NYSE, and NASDAQ, financial websites, and financial data vendors. Market data is available continuously throughout the day when trading is taking place in the market.

The second common type of data is **financial data**, which is also known as **micro data** for it includes financial information about individual companies or issuers of securities such as, earnings, dividends, financial ratios, and so on. This data is used for financial analysis and stock valuation. Both are at the core of fundamental analysis.[6] Primary sources of financial data are the periodic company disclosures such as the **Annual Report** and the **interim financial statements**. Key financial data is usually also available from secondary sources such as the same financial websites and data vendors that provide market data. Financial data is only available at certain times[7] throughout the year when companies report their results to the market.

Finally, the last type of data used in financial analysis is **economic data**, which is also known as **macro data** for it includes information about the state of the economy such as GDP, interest rates, money supply, unemployment, and other economic indicators. Economic data is used extensively in identifying drivers of stock market performance. This is particularly useful for asset allocation as the aggregate performance of each asset class is usually linked to the performance of certain sectors of the economy. Primary sources of economic data include central banks, e.g., **Bank of Canada**, as well as numerous **economic bureaus** and **research institutes**, better known as **think-tanks**, e.g. **Statistics Canada**. Like financial data, some economic data is only available

[6] Fundamental analysis is discussed thoroughly in Chapter 3.
[7] Usually on annual or quarterly basis.

at regular intervals through the year, e.g., quarterly or semi-annually. For instance, the national GDP in Canada and US are published quarterly.

Often times, when building predictive models for asset prices, financial analysts and investment professionals use the previously-mentioned three types of data as inputs in their models. Extra care, however, must be taken when using historical data to predict future prices. This is due to the difference of the release times of the different types of data. Moreover, data sources and formats tend to change frequently in practice, so it is important for investment management firms to maintain consistency in the usage and processing of these data in their models.

News Professionals, practitioners, academicians, and any one really who has interest in the behavior of financial markets, follow its news. The reason is that news give signals to the public regarding the expected behavior of asset prices, which enable them to form rational expectations regarding the future behavior of these assets. News are particularly important to portfolio managers—so important to the extent that some managers choose to pay third parties for expensive news services in order to get the most accurate and up- to-date version of it. However, the primary sources of news in the largest financial centers, e.g., New York, London, Tokyo, Singapore, and Hong Kong stock exchange, remain the daily newspapers. According to data from International Federation of Audit Bureaux of Circulations,[8] the four largest daily business newspapers by circulation are: The Economic Times (India), The Nikkei (Japan), Financial Times (UK), and The Wall Street Journal (US).[9] There are also some less frequent publications that synthesize news and provide valuable perspectives on business news such as The Economist magazine, Bloomberg Businessweek, and Forbes and Fortune.

Research Research is information that analysts synthesize from other information. There are two basic types of research used in the finance industry: **sell-side research** and **buy-side research**. Sell-side research is prepared by the **sell-side analysts** working at financial services companies like brokerages or investment banks, and is usually available to investment managers for a fee or through some other compensation arrangement. Sell-side analysts often issue **analyst recommendations** for individual securities. Caution must be exercised, however, when following recommendations issued by sell-side analysts because they have incentives to give higher ratings to companies to maintain good business relationships (Beshears and Milkman, 2011).

Buy-side research is prepared by the **buy-side analysts** working at investment management companies and is proprietary. The research is usually kept secret and not shared with anyone until it has become obsolete. Investment management firms need to decide what research to perform in-house and what research can be outsourced to third-party sell-side analysts.

Due to the rise of the Internet and to various blogging platforms, several independent research sources have gained popularity. For example, Chen et al (forthcoming) show evidence that crowd-sourced stock opinions on popular financial website, e.g., **Seeking Alpha**, outperform professional analysts in making their predictions.

The result of understanding the investor and the market is a formal statement, where the investment manager outlines the investment objectives, constraints, and the overall strategy of managing the portfolio. This statement is known as the **Investment Policy Statement** (IPS), which we now turn to.

[8] Source: www.ifabc.org

[9] Although this may not accurately reflect relative importance since most of the content is also increasingly published on-line.

3.3 Investment Policy Statement

Once all of the necessary investor information has been collected and analyzed, investment professionals, using their expertise and their up-to-date market information, begin to formulate the investment objectives and define the investment constraints entailed by the investor's profile. The result is an investment policy statement that outlines the investment strategy, which is tailored specifically for the investor under consideration.

The investment policy statement is extremely important for any investment manager and the reasons are two fold: First, it enables the investment manager to further define the way in which the assets will be managed and allocated in the portfolio. Second, the goals and objectives defined in the policy serve as a benchmark against which the investment manager can assess whether or not investor's goals were met.

Different jurisdictions may have different disclosure practices for different investment groups, but there should always be a document describing investment objectives and restrictions for a particular situation. While each specific situation dictates specific objectives and constraints, portfolio managers prefer to have considerable flexibility in the way they are defined to ensure that they are realistic and achievable. Many investors, however, often prefer to have clear and precisely defined investment policy statement to allow greater predictability and accountability. As a result, investment objectives can vary significantly on case by case basis.

Setting the degree of flexibility aside, it is clear that correctly specified investment objectives and investment constraints are essential for a sound investment policy statements and, for that reason, we devote the following sections to their discussion.

3.3.1 Investment Objectives

Investment objectives are what the investment professionals aim to achieve for their investors and should closely correspond with the needs of the investors. Investment objectives create a reference point, against which portfolio performance is evaluated. Investment objectives can be broadly categorized as **return objectives** and **risk objectives** (also known as **risk tolerance**). Return objectives specify the target return or income that an investment strategy aims to achieve, while risk objectives specify the acceptable levels and types of risks that a portfolio can be exposed to.

Return Objectives

The return realized on any asset, e.g., bonds or stocks, is the sum of the current yield and the capital gain realized from the appreciation of the asset value. Investment objectives often clarify what combination of the two types of return is the goal of a particular portfolio.

Return objectives can be stated in **absolute** or **relative** terms. Achieving a minimum annual return of 4% is an example of the former whereas performing at least as good the NYSE is an example of the latter. Absolute return objectives are becoming increasingly less common as portfolio managers face pressure from the regulators to not misrepresent their abilities and not to make promises to investors that they can not fulfill. Naturally, achieving any specific return target is difficult for any unexpected change in economic conditions can significantly disrupt the performance of any portfolio. As a result, relative return objectives, that tie the performance of the portfolio to a specific benchmark or asset class, are more commonly used.

Risk Objectives

Same as return objectives, risk objectives can also be stated in **absolute** or **relative** terms. An acceptable annualized volatility of at most 5% is an example of the former whereas an acceptable annualized volatility not exceeding the annualized volatility of the NYSE in a given period of time is an example of the latter.[10] For individual investors, risk objectives or risk tolerance is usually defined by two separate factors: their ability and their willingness to be exposed to risk. For institutional investors, willingness is not typically a factor, so they tend to follow rigorous evaluation of their risk tolerance primarily with respect to their ability to bear risk.

Combining Risk and Return Objectives

Risk and return objectives are usually supplied in the context of a time frame. This time frame should represent a relevant investment horizon over which portfolio performance is to be reviewed and evaluated. A typical time frame spans over one year, but it could be longer or shorter depending on the needs of the investor. While investment objectives can be stated as risk or return objectives, only one can be executed. The process of executing the investment objectives is known as the **portfolio optimization process**, which is a key element in portfolio construction; the second step of the PMP. The optimization could either seek to maximize the rate of return on the portfolio subject to a target level of risk, or alternatively, to minimize the portfolio risk subject to a target rate of return.[11] For instance, consider the following comprehensive investment objective statement that aims to maximize the rate of return on a particular portfolio subject to a target risk level: "The objective is to maximize return in excess of the money market rate with less than 5% risk." Alternatively, an investment objective statement aiming to minimize risk reads as follows: "The objective is to minimize volatility while targeting return similar to that of S&P/TSX 60 Index." Often in practice, many formulations of investment objective statements may include elements of investment constraints and investment strategy. The format, however, depends on the particular industry standards.

3.3.2 Investment Constraints

Investment constraints are the restrictions that investment managers have to work with in order to achieve investment objectives. Investment constraints are usually fitted to each investor to match his or her needs. Moreover, investment constraints and investment objectives must be mutually consistent — the constraints must be realistic and the objectives must be achievable. Investment constraints are typically stated in such a way as to provide the manager as much flexibility as possible to allow them to achieve an investment objective. If investment constraints are too restrictive there is a danger the manager will not be able to achieve investment objectives. For example, in the current market environment it would not be realistic to achieve 15% annualized rate of return by investing only in investment grade bonds of developed countries.

According to Maginn et al (2007), investment constraints could be classified in general into 5 main categories, namely: **liquidity** constraints, **time** constraints, **tax** constraints, **legal and regulatory** constraints, and **other constraints**. Below is a brief discussion on each category.

Liquidity Constraints

Liquidity constraints arise from the liquidity needs of investors. For example, an investor may require specified amounts to be withdrawn from his or her investment every year to supplement income or finance purchases. Also, an investor may also need to have emergency reserves that have to be accessed on short notice by liquidating a portion of the investment. These needs restrict

[10] The risk of a portfolio can be assessed in a variety of ways. The most common measure of portfolio risk is its volatility, which is commonly defined as the annualized standard deviation of the rate of return on the portfolio. For more details, see Fahmy (2014).

[11] The portfolio optimization process is discussed thoroughly in Chapter 3.

what instruments can be included in the investor's portfolio in order to achieve the investment objective.

The overall mix of investment instruments in a portfolio must match the liquidity constraints of investors. For example, publicly traded stocks and bonds are considered to be very liquid instruments because it is relatively easy to buy and sell these securities on short notice. On the other hand, many private equity funds impose long lock-up periods, during which the money invested in them can not be redeemed.

Time Constraints

Investment time horizon is another factor influencing the investment objectives. Shorter time horizons limit the portfolios' ability to recover from significant losses and, consequently, reduce the investors' ability to take risk. The investment time horizon is usually tied to the investor's age and stage of life. This is especially true for individual investors. For example, an individual investor may be inclined to take more risk and seek higher returns before retirement and then gradually switch to a more conservative portfolio that has less risk and generates regular income upon retirement. As for institutional investors, various investment stages may also exist depending on their needs. However, since many corporations are expected to survive indefinitely. In other words, they are operating under the assumption that the business is a going concern, institutional portfolios often do not have an expiration date. Instead, their investment objectives and constraints evolve over time.

Tax Constraints

Whether it is a capital gain or a return on investment, any income is subject to taxation. Therefore, from an investor's point of view, portfolio returns are evaluated on an after-tax basis. After all, the investor care about his or her disposable income.[12] Taxation effectively gives the government power to change effective after-tax returns on various investments, which, creates incentives to invest in certain types of investments and disincentives to invest in other types. This, in turn, results in imposing tax constraints on investment. There are various strategies, however, which can be used to minimize the effect of taxes on investment portfolio performance.[13]

Legal and Regulatory Constraints

Regulations are imposed to ensure the fairness and stability of the financial system. Regulations themselves act as constraints on financial portfolios. Here are some examples that illustrate the effect regulations can have on financial portfolios. In Canada, the Canada Pension Plan Investment Board (CPPIB) is not allowed to invest more than 10% in securities of the same issuer, and can not have more that 30% of the voting rights for a corporation that is not its subsidiary. On the other hand, investments made by CPPIB and other pension funds in Canada are exempted from taxation.[14] In Europe, The UCITS directive allows creation of mutual funds that can be marketed and sold across the European Union member countries, but prescribes strict guidelines to ensure investor protection. An example of such regulations is the diversification requirements prescribed by UCITS, which is known as the "5/10/40 rule." The rule states that a maximum of 10% can be invested in any one issuer's stock, and the proportion of investments that make up more than 5% of a certain issue must not exceed 40% of the whole portfolio.[15] In US, private foundations are

[12] Disposable income is the income after tax. It is the part of income that is available for consumption.

[13] Taxation and its strategies is a topic by itself and is beyond the scope of this workshop. For an classical reference on Canadian taxation principles, see Byrd and Chen (2014).

[14] See article 19 of Canada's Pension Plan Investment Board regulations on the following link: http://laws-lois.justice.gc.ca.

[15] Source: http://www.alfi.lu/investor-centre.

exempted from some federal income taxes, but are required to pay out 5% of its assets per year to retain preferential tax treatment.

Other Unique Constraints

In addition to the previous constraints, a variety of distinct situations and preferences pertaining to individual and institutional investors can also create constraints for the portfolio. These constraints include, but are not limited to, geographical constraints, asset class or instrument restrictions based on company's by-laws or area of expertise, socially responsible investing considerations such as focusing on green-energy and other investments with perceived social benefit or avoiding alcohol, tobacco, or gambling-related and other investments that are perceived as harmful to society.

3.3.3 Investment Strategy

Once the investor's profile has been properly analyzed and converted into investment objectives and constraints, the investment manager then begins to device an appropriate investment strategy that meets these objectives and constraints. A successful investment strategy does not only depend on properly defining the investor's profile, but also on the expertise of the investment manager and the overall economic outlook of the economy.

An investment strategy is a set of rules and procedures pertaining to the universe of investable assets from which the portfolio is constructed. In other words, we can simply say that the **investment strategy** is the **approach** followed by the portfolio manager in **constructing a portfolio**. Notice how investment strategy is closely linked to portfolio construction; investment strategy is the outcome of **portfolio planning**, which is the first step in the PMP, whereas portfolio construction is the core of the second step of the PMP, which is the subject matter of Chapter 4. Thus, a rigorous investment strategy is paramount for the construction of a sound portfolio. Therein lies the benefit of planning in the PMP.

The investment strategies, or the approaches to portfolio construction, can be classified from different perspectives. In general, there are numerous ways to approach portfolio construction, each has its advantages and disadvantages. The convention in the wealth management profession is to classify portfolio managers according to the type of approach, also known as the **manager's style**, they use in constructing their portfolios. The following discussion highlights the most common decisions that portfolio managers are faced with when selecting an appropriate investment approach that are sometimes documented in the IPS.

Active versus Passive Approach

This is a fundamental distinction between the different approaches to asset management. Portfolio managers following the **active** approach believe they can outperform the market and derive value by selling over-priced and buying under-priced securities and thus relentlessly seek out the best investment opportunities in the ever-changing financial markets. On the other hand, proponents of the **passive** approach, believe the markets are already too efficient to allow mis-pricing and simply buying and holding the market index or **blue-chip** stocks will provide better net-of-fees results than active management.

Active investment is usually implemented as a **discretionary** strategy, which means that, supported by careful analysis, active managers rely on their judgment to make asset allocation and security selection decisions. Part of the investment returns that is attributable to discretionary allocation rather than general market movement is known as **alpha**, and it can be either positive or negative. Since positive alpha is the goal of all active managers, active approach is sometimes referred to as the "**alpha approach**." Active management provides a lot of flexibility, but at the same time requires a high degree of expertise. The financial analysis required for active management is also usually more time consuming and expensive than that its passive counterpart. An asset manager must maintain a very high-quality research team and purchase additional research as needed to help analyze the market and identify investment opportunities. There have been very few well-known successful investors, e.g., Warren Buffet, who were able to pick stocks in such a way that their portfolio consistently outperformed the market over a long period of time. Active management is inherently non-transparent, because portfolio managers try not to disclose their active trades and current positions to prevent other market participants from taking advantage of that information. Therefore, from the point of view of investors, performance of active strategies is typically highly unpredictable and can not be easily explained until historical holdings information is made available by the manager. Due to a series of recent high-profile scandals, e.g., **Madoff's Ponzi scheme,**[16] institutional investors increasingly demand more transparency and accountability from portfolio managers who invest on their behalf. As a result, actively managed portfolios are increasingly under pressure to prove that they add value over passive management. Many individual investors chose to actively manage their own portfolios through a personal brokerage account, and invest using their discretion. The majority, however, are not able to beat the market, which shows, as suggested by Barber and Odean (2000), that, on average, the active approach provides little or no value over the passive approach.

Passive investors simply try to copy the performance of a market, typically by buying a **broad market index**, which is an index that includes as many of the securities traded in the market as possible, and holding it for the duration of the investment horizon. A portfolio **beta** measures how similar the portfolio performance is to the performance of the general market. A portfolio with a beta equal to one means that it is moving perfectly in-line with the market and, therefore, it is a good passive investment. Correspondingly, passive approach to investing is sometimes also called the "**beta approach**." Passive management is usually implemented via a **systematic** strategy, which means that all investment decisions are made in accordance with a well-defined algorithm. As a result, passive investing is less time consuming and does not require maintaining a research team as large as that needed for full-scale active investment. Consequently, in terms of fees for the investor, passive investing is significantly cheaper than active investing. It is also more transparent since the performance can be easily compared to that of an observable market index. The focus of passive managers is typically on minimizing the cost of investing in a passive strategy, while still maintaining broad market exposure. The downside of a passive strategy is that it does not have a chance to produce any alpha.

In practice, many managers try to combine the two approaches in some proportion to get some of the benefits from both worlds: the lower cost and higher transparency from a passive approach, and the potential for alpha from an active approach. Their attempts result in hybrid approaches that receive a variety of catchy names such as **semi-active**, **smart beta**, **beta plus**, **advanced beta**, **beta with a portable alpha overlay**, and many others. In reality, we must remember that both approaches are fundamentally different and combining them will have advantages as well as drawbacks, so the optimal approach will depend on the investor's talent of design.

Systematic versus Discretionary Approach

One decision that an investment manager can make when deciding on an investment strategy is either to rely on an algorithm or on an ad-hoc analysis to make investment decisions. As mentioned previously, the former is known as **systematic** or **rule-based** approach and the latter as **discretionary** approach, and they are usually associated with passive and active investing respectively. Nevertheless, discretionary and systematic approaches are subtly different concepts

[16] The report of investigation of failure of the SEC to Uncover Bernard Madoff's Ponzi Scheme (Case No. OIG-509) provided by the United States Securities and Exchange Commission Office of Inspector General can be accessed online through the following link: http://www.sec.gov/spotlight/secpostmadoffreforms/oig-509-exec-summary.pdf.

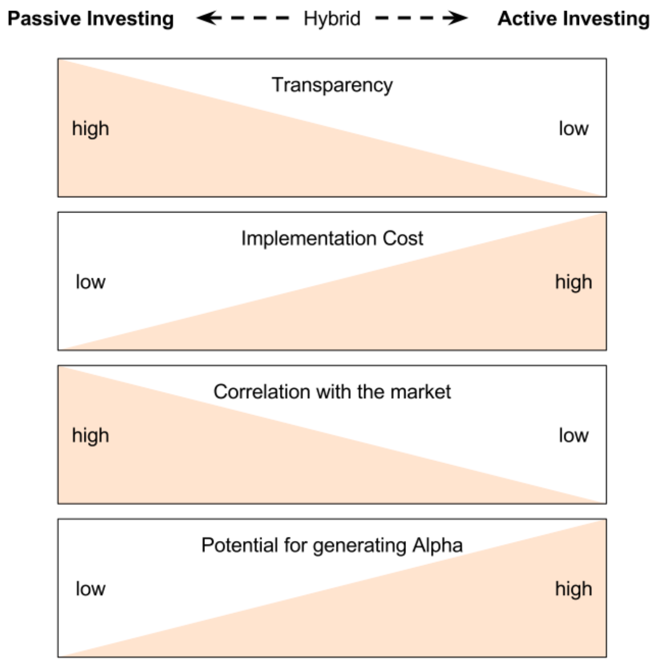

Figure 3.1: Active versus passive approaches.

from passive and active investing. Consider, for instance, the case of an alpha seeking mutual fund that systematically invest at the beginning of every month in equal proportions in 10 stocks that pay the highest dividends over the past year. This is an active strategy, where the fund manager uses a systematic approach in which all investment decisions are made in accordance to a well-defined algorithm. Conversely, a passive investor may use a discretionary approach to select a small number securities that, together, closely resemble the performance of a broad market index.

The benefit of using a systematic strategy is that if it is consistently defined, it can be **back-tested** to see what the returns would have been if it was used in the past. The problem with the purely systematic approach is that if a particular strategy is found to be significantly profitable, it could be easily copied by other portfolio managers, which will eventually reduce the profitability of the strategy to the point it no longer outperforms the general market.[17] The benefit of using passive approach is that it gives manager flexibility with respect to making investment decisions. However, it is not transparent and may result in **style drift**; a problem that arises when a manager's investment approach deviates too significantly from the original investment goals and the end investors no longer receive the risk exposure they intended to have.

As with active and passive investing, fund managers can combine discretionary and systematic approaches into a new hybrid approach. For example, managers can use systematic models to produce investment recommendations, but then apply their experience and judgment to adjust the result to produce a final portfolio.

[17] That's why when backtests are shown to clients, a disclaimer is always displayed, e.g., "past performance may not be indicative of future results."

Long versus Long-Short Approach

To **go long** in finance mean to buy. For example, to "go long THI" means to buy Tim Hortons stock. After a portfolio manager buys a stock, he is said to **be long** the stock or to have **positive exposure** to it, which means that the value of his position in the stock will vary directly with the change in the price of the underlying stock. When someone is long a security, they make money when the price of that security rises. Going long is used to express a **bullish** view that a security is undervalued and its price is expected to rise. Likewise, to **go short** means to sell, and to **be short** or to have **negative exposure** means to be in a position to profit from the drop in the price of the underlying security. Going short expresses a **bearish** view that a security is overvalued and its price is expected to fall. When a value of a portfolio does not react to a price movement of a security, it is simply said to have **no exposure** to that security. Analogously, when all positions in a portfolio are aggregated, and the net result is that portfolio benefits when the market as a whole moves higher, portfolio is said to have positive exposure to the market. The opposite is true for a portfolio that has a negative exposure to the markets. Finally, if the portfolio is immune to the overall up or down market moves, it is said to be **market neutral**, which happens when the combined long and short positions negate each other.

If portfolio manager wants to sell a security to express a bearish view, but does not already own it, he must borrow the security, sell it, and then buy it back at a later date to return to the counterparty he borrowed it from in the first place. This is known as **short-selling**. Short selling is inherently more risky than buying, because you can loose more than the value of the stock you short-sold, and consequently many IPSs for conservative investors prohibit or limit short-selling. Strategies that only take long positions are known as **long-only**, or **long-bias** if a small amount of **negative** exposures is permissible. If a strategy can have both long and short positions in equal proportions, it is called **long-short**. Strategies focusing exclusively on short-selling are known as **short-only**, or **short-bias** if a small amount of **positive** exposure is allowed.

Long-only is the more traditional and the most wide-spread approach. However, with the proliferation of financial derivatives and deregulation of financial markets over the past several decades, short-selling has become more common. Long-short strategies allow managers to have the most flexibility with regards to isolating and selecting individual exposures in their portfolios. Due to the risks involved in short selling, there are very few short-only strategies and they are used primarily by highly specialized hedge funds. Long-only approach is well suited for passive investing, whereas long-short approach is best suited for active investment.

Before we proceed to the discussion on portfolio construction. A few concluding remarks are in order. First, as the previous discussion suggests, it is clear that there is a wide variety of possible investment strategies. In practice, the successful investment strategy is usually the result of a series of trials and errors performed by the investment professional over time. Second, different strategies may be more suitable for different markets and different clients. Therein lies the importance of portfolio planning. Third, the previous different approaches to portfolio construction, which stem from the investment strategy, define, in a broad way, two processes: financial analysis and asset allocation. Both processes are analyzed thoroughly in the following sections.

Chapter 4

Portfolio Construction: Financial Analysis & Asset Allocation

In this chapter, we continue our discussion of the PMP. In particular, we focus on the second step in the process, which is portfolio construction. Some investment strategies, as defined in the IPS, restrict investment to one asset class, while others allow multiple asset classes. From the point of view of end investors, investing is a multi-asset-class problem, because investing in different asset classes provides diversification and reduces overall risk. Nevertheless, many investment managers specialize in a single asset class, because end investors tend to divide their portfolio by asset classes and outsource management of each individual asset class to investment managers specializing in that single asset classes. When portfolio can invest in multiple asset classes, asset allocation is usually considered the first step in portfolio construction phase followed by security selection performed within each individual asset class. On the other hand, if a portfolio has a mandate to invest in a single asset class, security selection is the first step. But, aside from how asset allocation is performed, the seminal study of Brinson et al (1986) and its update (1991) showed the importance of asset allocation on the portfolio performance. In particular, the study found that investment policy with regards to asset classes explains 93.6% of variation in total plan returns. The issue of whether investment policy with regard to asset classes has more impact on the portfolio performance than the manager selection of assets is still debated among practitioners in the industry.[1] However, this debate did not deter large institutional investors from continuing to focus most of their attention on their asset allocation policy.

The first step of portfolio construction is **asset allocation**. In this step, the investment manager sets out to define an overall allocation between different asset classes that optimally satisfies all risk and return objectives as stated and entailed by the investment strategy in the planning phase. For individual investors, the process of asset allocations answers questions like: how savings are allocated between stocks, bonds, and mutual funds? How much equity should be in the portfolio? How much cash should be in the portfolio? As for institutional investors, the process of asset allocation determines how much of their portfolio should be allocated to equities versus fixed income instruments versus alternative investments and how their portfolio fits in within the context of other assets and liabilities they might have. Some investment managers may be restricted to investing in just one asset class, by either choice or by the IPS, in which case their priority will be exclusively security selection. Nevertheless, for the majority of investment managers who are not restricted to one asset class, determining the appropriate mix of assets is their first order of business. Once the proportions of asset classes are determined, the next step is to populate each class by **selecting individual securities** within each class. The process of

[1] For a recent review, see Hood, R. L. (2005).

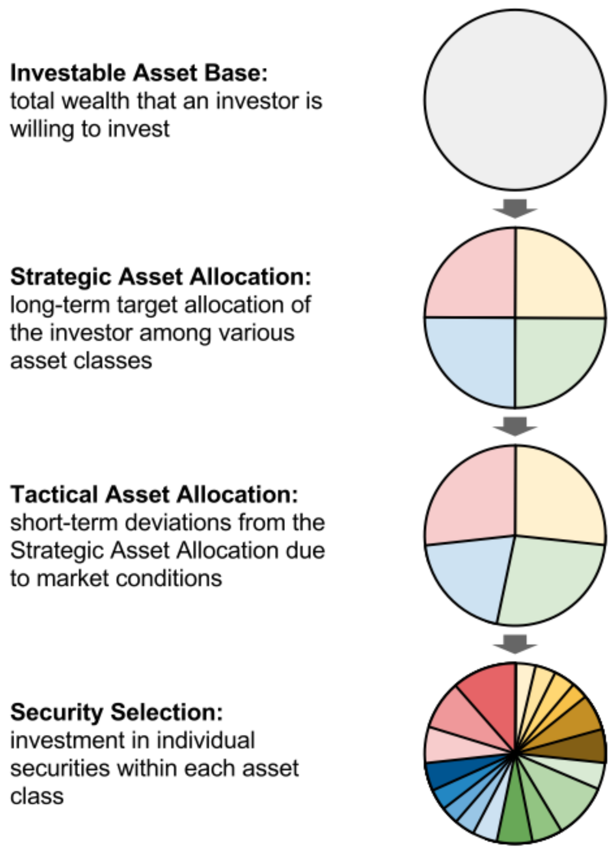

Figure 4.1: A typical portfolio construction: Asset Allocation and Security Selection.

asset allocation and security selection, which is summarized in Figure 4.1, is discussed thoroughly in Sections 4.1 and 4.2. Section 4.3 is devoted to the last step of portfolio construction, which is **portfolio implementation**.

4.1 Asset Allocation

In this step, the investment manager sets out to define an overall allocation between different asset classes that optimally satisfies all risk and return objectives as stated and entailed by the investment strategy in the planning phase. Due to the obvious link between asset allocation and the portfolio planning phase, some authors, e.g., Maginn et al (2007), prefer to discuss the process of asset allocation as part of the planning phase of the PMP. This is, however, a matter of taste and should not cause any confusion.

For individual investors, the process of asset allocations answers questions like: how savings are allocated between stocks, bonds, and mutual funds? How much equity should be in the portfolio? How much cash should be in the portfolio? As for institutional investors, the process of asset allocation determines how much of their portfolio should be allocated to equities versus fixed income instruments versus alternative investments and how their portfolio fits in within the context of other assets and liabilities they might have.

Some investment managers may be restricted to investing in just one asset class, by either choice or by the IPS, in which case their priority will be exclusively security selection. Nevertheless, for the majority of investment managers who are not restricted to one asset class, determining the appropriate mix of assets is their first order of business. Once the proportions of asset classes are determined, the next step is to populate each class by selecting individual securities within each class. We will describe the process of asset allocation in practice thoroughly. But, first, we begin with the theoretical foundation of asset allocation.

4.1.1 Asset Allocation in Theory

Before we introduce the theory of asset allocation, we begin by introducing some definitions and notations. Let $\widetilde{r}_i$ denote the rate of return on asset i. The expected rate of return on asset i, or its mean, is denoted by the Greek letter μ_i and its variance is denoted by σ_i^2 as

$$\mu_i \equiv E\left[\widetilde{r}_i\right] \tag{4.1}$$

and

$$\sigma_i^2 \equiv var\left[\widetilde{r}_i\right] = E\left[\left(\widetilde{r}_i - E\left[\widetilde{r}_i\right]\right)^2\right] \tag{4.2}$$

respectively.

A portfolio is a mix of assets with different weights that sum to one. The rate of return on a portfolio p that consists of n assets is the weighted sum of the rates of return on the assets forming it; that is, if $\widetilde{r}_p$ denotes the rate of return on portfolio p, then

$$\widetilde{r}_p = w_1\widetilde{r}_1 + w_2\widetilde{r}_2 + \cdots + w_n\widetilde{r}_n, \tag{4.3}$$

where w_i is the weight of asset i in the portfolio, for $i = 1, ..., n$. The expected rate of return and the variance of the rate of return on the portfolio are denoted by $\mu_p \equiv E\left[\widetilde{r}_p\right]$ and $\sigma_p^2 \equiv var\left[\widetilde{r}_p\right]$ respectively, and are computed by applying the expectation operator and the variance operator, respectively, to the expression in (4.3).

The theory of asset allocation is due to the work of Harry Markowitz (1959), who studied the investor's portfolio decision problem, which, according to Markowitz, is to choose the optimal weights of individual assets in a given portfolio such that the variance of the rate of return of

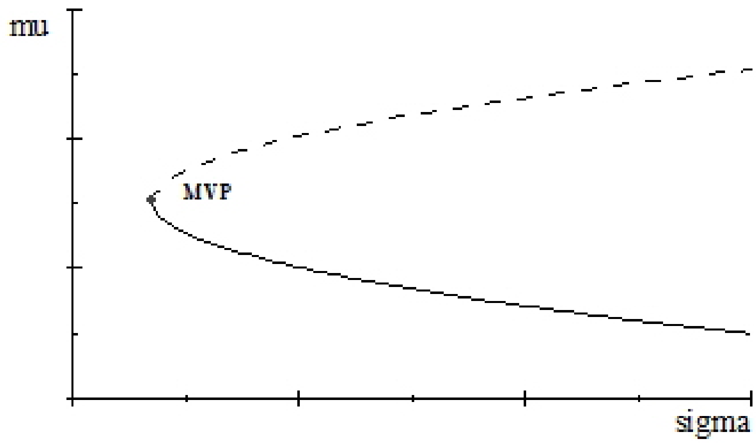

Figure 4.2: In case of n risky assets, the minimum variance frontier is the hyperbola drawn in $\mu_p - \sigma_p$ space. The dashed part of the hyperbola is the efficient frontier. The point MVP is the minimum variance portfolio.

the portfolio is minimized for a given expected return. Mathematically, this is an optimization problem, where the objective function that needs to be minimized is the variance of the portfolio σ_p^2, the constraint is $E[\widetilde{r}_p] = \mu_p$, where μ_p is a given expected return, and the decision variables are the portfolio weights w_i, for $i = 1, 2, ..., n$, where n is the number of assets in the portfolio. Thus, the portfolio optimization problem is

$$\min_{\{w_i\}_{i=1}^{n}} \sigma_p^2 \quad \text{subject to} \quad E[\widetilde{r}_p] = \mu_p. \tag{4.4}$$

Harry showed that the solution to this problem is a locus of risk and return combinations that yield the minimum portfolio variance for a given rate of return. This set of minimum variance portfolios is known as the **minimum variance frontier**, which can be generated by solving the Markowitz problem in (4.4) for different values of μ_p. The result is a **hyperbola** in the **mean-standard deviation space** as depicted in the Figure 4.2.

First notice that any point inside or along the hyperbola in Figure 4.2 is a portfolio of assets. However, not all points are desirable. Since any rational investor prefers more expected return for the same risk or less risk for the same return, i.e., any investor will be better off if he or she chooses portfolios located to the North West in Figure 4.2, and since the minimum variance frontier is the solution to Markowitz's problem, then all portfolios located on the upper leg of the minimum variance frontier, i.e., the upper leg of the hyperbola in Figure 4.2, are more preferred than any other portfolios. That's why that part of the minimum variance frontier is called the **efficient frontier** for it gives the set of mean-variance choices from the **minimum variance frontier** where, for a given portfolio variance, no other investment opportunity offers a higher expected return. Note also that there is only one portfolio in the set of efficient portfolios that yields the absolute minimum variance. This portfolio corresponds to the vertex of the hyperbola and is known as the **minimum variance portfolio** (MVP).

Adding a risk-free asset, e.g., a government bond, to the n risky assets makes the **minimum variance frontier** linear instead of a hyperbola drawn in $\mu - \sigma$ space. In particular, the minimum variance frontier in case of one risk-free asset and n risky assets is the straight line originating from the risk-free rate, which is point A on the vertical axis in Figure 4.3, and going up to the tangency portfolio T, i.e., the point of tangency between the line AT and the hyperbola.

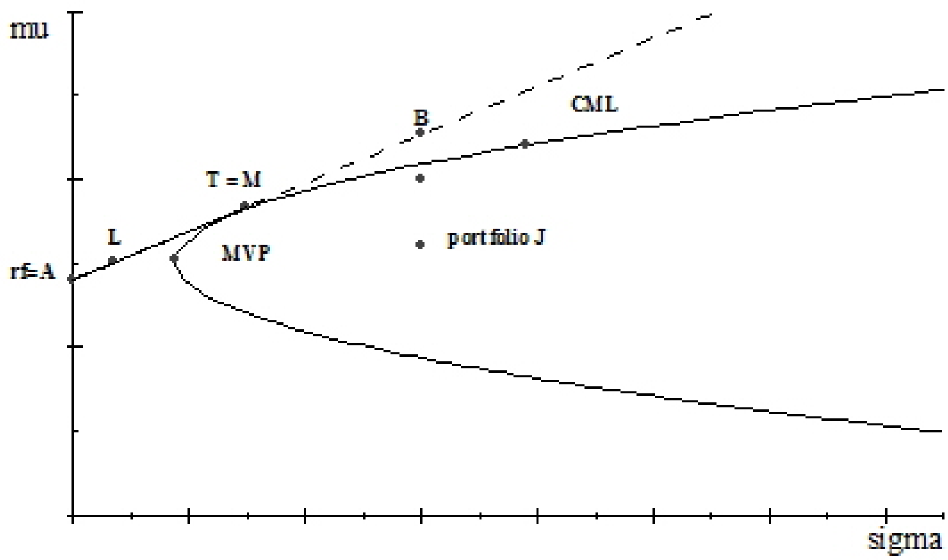

Figure 4.3: The efficient forntier is the upper leg of the hyperbola originating from the minimum variance portfolio (MVP) in case of n risky assets. Adding risk-free borrowing and lending turns the efficient frontier into a straight line originating from the risk-free rate on the vertical axis and going up to the left as far as possible to the tangent portfolio T

To see why AT is the minimum variance frontier in case of n risky assets and one risk-free, note that once we introduce the risk-free asset, any investor is faced with the choice of combining the risk-free asset (point A) with any portfolio of n risky assets of his or her choice. Since the points on the upper leg of the hyperbola correspond to efficient portfolios, any investor will definitely combine A with one of these points. This creates potentially many possible portfolios, each is represented by a straight line originating from point A and ending at one point on the upper leg of the hyperbola in Figure 4.3. However, since any investor will be better off if he or she moves to portfolios located on the North West, then all investors will be willing to combine the risk-free asset with the farthest North West efficient portfolio, which is the tangency portfolio T. This means that only line AT dominates all other combinations and, therefore, it is the **efficient frontier** in this case. It is worth mentioning that, in practice, the efficient frontier is known as the **Capital Market Line**.

To sum up, the Markowitz analysis is based on **two assumptions**: (1) Investors are **risk averse** and (2) Investors care only about the **mean** and **variance** of their **one period** investment return. In case of n risky assets, the minimum variance frontier is a hyperbola when drawn in $\mu - \sigma$ space and the **efficient frontier** is its upper leg originating from the point of the MVP as shown from Figure 4.3. Any portfolio in the opportunity set, e.g., portfolio J, is dominated by a point on the efficient frontier to its North West. Adding a risk-free assets turns the efficient frontier into a **straight line** originating from the risk-free rate on the vertical axis and going up to the left as far as possible to the tangent portfolio T.

The point that we did not discuss so far is the reason behind introducing a risk-free asset in the portfolio analysis. The risk-free asset is introduced in order to create an exchange or a market economy in which agents are able to borrow and lend unlimited amounts at the risk-free rate. The idea here is that in order to model a market where investors can borrow and lend, we need a rate of return at which the borrowing and lending operations can be conducted. This rate is the risk-free rate of return. The introduction of the risk-free asset implies that investors in the capital market must mix one risk-free asset with a portfolio of n risky assets to construct their efficient portfolios. **Every investor**, regardless of his or her degree of risk aversion, would choose to mix the risk-free asset with the tangent portfolio T. This is true for any rational investor in the capital market. If we assume that all investors are rational, then all of them will try to combine portfolio T with the risk-free asset. This implies that the tangent portfolio T is the market portfolio, which will be denoted by M.

If we further assume that investors in this capital market can borrow and lend at the risk-free rate, then we must extend the efficient frontier all the way up and above point M (see the dashed extended part in Figure 4.3) to allow for possible choices for borrowers.

To understand why the efficient frontier is the entire straight line when borrowing and lending are allowed, consider combining the risk-free asset one time with portfolio L and another time with portfolio B. By constructing portfolio $[rf + \text{L}]$, the investor is investing a percentage of his or her wealth, w_{L}, where $w_{\text{L}} < 1$, in the market portfolio M and the remaining wealth $(1 - w_{\text{L}})$ in the risk-free asset. The investor is a lender in this case as shown from point L on the efficient frontier. On the other hand, an aggressive investor, who wishes to achieve a rate of return above the market, will borrow $(w_{\text{B}} - 1)$, where $w_{\text{B}} > 1$, of the available amount of wealth that he or she has at the risk-free rate and then, invest everything (the original wealth plus the borrowed amount) in the market portfolio M. This leads to the construction of portfolio $[rf + \text{B}]$, where point B is on the extended efficient frontier. Therefore, in short, adding a risk-free borrowing and lending to the Markowitz analysis extends the linear efficient frontier AM all the way up and above M to accommodate borrowing choices.

If the previous assumptions hold, any risk averse investor who combines a risk-free asset with n risky assets can solve the Markowitz problem and find the optimal portfolio weights that minimize the variance of his or her portfolio. In practice, the n risky assets are first selected by conducting some sort of **financial analysis**, e.g., fundamental or technical or a combination of both, as discussed in the previous section. The next step is to run Markowitz's optimization problem. The solution to this problem yields a vector of optimal weights of the assets forming the portfolio. This second step is the **asset allocation** step in the process of constructing a portfolio.

After analyzing the mean-variance portfolio theory and demonstrating the asset allocation in theory, one question comes to mind: How the theory works in practice? To test the empirical validity of any theory, one could test the validity of its predictions or the validity of its assumptions. The mean-variance portfolio theory is based implicitly on the EMH, which, as discussed in the previous section, does not hold all the time. Therefore, in practice, the inefficiency in the market and the irrational behavior of some retail investors create profit opportunities that can be harvested by any savvy financial manager.

This suggests that some portfolio managers are able construct portfolios that lie North West even further than the market portfolio located on the efficient frontier AM in Figure 4.2. In other words, they are able to beat the market. In practice, portfolio or fund managers report a measure of their performance known as the **Sharpe ratio.** This ratio, which is named after its developer: the economist and Nobel prize winner William Sharpe, is simply the slope of the linear efficient frontier. Consider any efficient portfolio p on the efficient frontier AM in Figure 4.2 with expected return $E\left[\widetilde{r}_p\right]$ and risk σ_p. The Sharpe ratio is the slope of the linear combination of the risk-free asset and that efficient portfolio expressed as

$$\frac{E\left[\widetilde{r}_p\right] - rf}{\sigma_p}. \tag{4.5}$$

It is easy to see that the Sharpe ratio is a **measure of the portfolio's excess expected rate of return per unit of risk**. The higher the sharpe ratio, the better is the constructed portfolio. Note that, in theory, the maximum Sharpe ratio is achieved by combining the risk-free asset with the market portfolio M; that is, the maximum Sharpe ratio is

$$\frac{E\left[\widetilde{r}_{\mathrm{M}}\right]-rf}{\sigma_{\mathrm{M}}}.$$

However, due to market inefficiencies, some successful portfolio managers achieve an even higher Sharpe ratio on their portfolio. Those few successful bunch proudly report their Sharpe ratio at the end of each year as a reflection of the value added of their services.

4.1.2 Asset Allocation in Practice

Having looked at the theory, one may wonder: if the goal of investment professionals is to create the best optimal portfolio that delivers the best possible return for their clients, then how come there are so many investment professionals looking for the optimal portfolio? And has anyone found the 'ultimate optimal portfolio' yet? The reality is that portfolio optimization does not take place in a vacuum, but rather in specific context defined by the specific type of investors, their investment objectives, and their constraints. Therefore, even if all investors select securities from the same financial markets, there are still as many unique optimal portfolios as there are unique investors. This highlights why understanding the investor is the first and the most crucial phase of the portfolio planning process.

In general, it is common to distinguish between two types of asset allocation. The first, which is known as the **asset-only** asset allocation, focuses exclusively on investments and does not explicitly account for other assets or liabilities that the investor might have. On the other hand, the second type of asset allocation, known as **asset liability management** (ALM), does consider the total financial position of the investor and analyses investments in the context of how those investments would perform in combination with other assets and liabilities that the investor might have.

Asset-only allocation is the traditional asset allocation that we are all used to. It is simpler than ALM, requires less data, and is the most useful approach when other liabilities and assets are unknown and can not be predicted or estimated ahead of time. For example, consider a mutual fund with a specific investment objective that has many different clients invested in it. The fund manager of this mutual fund would not typically have precise information about other investments, assets, and liabilities of all investors in the fund. Therefore, the fund manager will have to focus exclusively on optimizing risk and return of the assets entrusted to him by the clients in accordance with the fund's investment objectives and constraints. Asset-only approach is most often used by individual investors, endowments, foundations, and most other investors.

ALM is a more comprehensive approach, because it emphasizes the need for investors to consider all of their financial position on an aggregate basis, and therefore it is also more complex. ALM focuses on optimizing risk and return of the **surplus**, which is the difference between assets and liabilities of the investor. In order to effectively implement ALM, accurate and timely information about both assets and liabilities is required, so investors who use it tend to be the more sophisticated investors who have the necessary systems in place for collecting and analyzing relevant data. ALM is used most often at banks, insurance companies, and large DB pensions funds. All three share the common objective of investing their assets in order to cover their projected liabilities. For example, banks are concerned with having enough money to meet the needs of their depositors, insurance companies invest insurance policy premiums to fund potential payouts from insurance policies, and DB pension funds invest employee pension contributions to match projected future benefit obligations owed to retirees. Due to its complexity, portfolio management under ALM is a topic by itself and its discussion is beyond the scope of this text. For that reason, we will focus more on the asset-only type.

As the name suggests, asset allocation is done with respect to individual asset classes. To be considered an asset class, a group of securities must be similar and react consistently to the same macroeconomic drivers. For example, overall equities react positively to strong nominal GDP growth. Likewise, bonds typically perform best during when interest rates are low. Maginn et al (2007) gave the following main characteristics of assets classes: (1) assets within an asset class should be homogeneous. (2) Asset classes should be mutually exclusive. (3) Asset classes should be diversifying. (4) All asset classes as a group should make up a significant fraction of all investor's wealth. (5) The asset class should have the capacity to absorb a significant fraction of investor's wealth.

One will notice, that according to these 5 criteria, if international equities and bonds are considered asset classes, then foreign currencies should not be considered an asset class in their own right, for they are not mutually exclusive with foreign stocks and foreign bonds denominated in local currencies. However, whether or not foreign exchange is an asset class is still up for debate, and some practitioners argue that if it provides **diversification**, then it can be considered a separate asset class.

The main point for defining asset classes is that if they are carefully selected, then combining them will result in **diversification benefits**; that is, the risk-adjusted returns will be higher for optimal portfolio of combined asset classes than the risk-adjusted returns of any asset class taken individually. One other consideration for choices of asset classes is that they must be **investable**, which means there must be a sufficiently large market for securities which can be purchased to gain **exposure** to an asset class. For example, exotic instruments like **weather derivatives** may not be investable for individual investors because they usually require high minimum notional amount and are illiquid and, therefore, can not be easily resold once they were purchased by one client from anther. Some **emerging equity markets** are also not considered investable from the point of view of large institutional investors because they may not be allowed to access those markets due to local regulations, or because these markets are not large enough to accommodate a minimum investment amount that a large institutional investor may want to commit. However, sometimes, it may be possible to select **proxies**; securities that behave similarly to securities in a particular asset class, but are more liquid and therefore investable. For example, it may not be feasible to buy several properties in order to get exposure to real estate asset class. However, it is possible to use **Real Estate Investment Trusts** (REITs) as proxies because they have good liquidity and their performance is similar to that of direct real estate assets. Some investors may be restricted in their ability to invest in specific asset classes for variety of reasons, which would be stated in the IPS. All of these factors must be taken into account when deciding which asset classes will be included in the asset allocation step.

Ultimately, the definition of asset classes is decided between the client and the asset manager. Pension funds commonly separate domestic equity, foreign equity, domestic fixed income, foreign fixed income, cash equivalents and alternative investments. **Barclays Wealth** is another example. The division of **Barclays Bank**, which provides investment services to **high-net-worth individuals**, uses the following 9 asset classes in their asset class allocation decisions:[2] (1) Cash and Short-maturity Bonds, (2) Developed Government Bonds, (3) Investment Grade Bonds, (4) High Yield and Emerging Markets Bonds, (5) Developed Markets Equities, (6) Emerging Market Equities, (7) Commodities, (8) Real Estate, (9) Alternative Trading Strategies.

Performance of asset classes is captured by various market **indices**, which are just time series of values corresponding to the systematically combined performance of all securities in a particular group. Perhaps, the most well-known index among practitioners in the finance industry is the **Standard & Poor's 500** (S&P 500), which represents cumulative performance of 500 largest companies listed on NYSE or NASDAQ weighted by the market value of their traded stock, **market capitalization**. Table 4.1 summarizes some of the other most prominent indices used for various asset classes.

Asset allocation can also differ with respect to the time frame for which it is used. **Strategic**

[2] www.wealth.barclays.com

Asset Class	Index
Equities	S&P 500 Index
	NASDAQ Composite Index
	Wilshire 5000 Total Market Index
	S&P TSX Composite Index
	EURO STOXX Index
	FTSE 100 Index
	CAC 40 Index
	DAX Index
	IBEX Index
	Nikkei 225 Index
	Hang Seng Index
	KOSPI Index
	MSCI World Index
Fixed Income	Barclays Aggregate Bond Imdex
	Citi World Government Bond Index
	J.P. Morgan Emerging Market Bond Index
	CDX Index
	iTraxx Index
Cash Equivalents	Barclays U.S. Short Treasury Bond Index
	*money market rates are frequently used to simulate cash returns
Alternatives	Goldman Sachs Commodity Index
	Dow Jones-UBS Commodity Index
	Rogers International Commodity Index
	Thomson Reuters/Jefferies CRB Index
	FTSE EPRA/NAREIT Global Real Estate Index
	Credit Suisse Hedge Fund Index
	HFRX Global Hedge Fund Index
	Lyxor Hedge Fund Index
	Barclay CTA Index

Table 4.1: Some indices used for various asset classes.

asset allocation (SAA) focuses on the long-term and defines the optimal allocation that should help investors reach their goals in the medium to long run, which is typically anywhere from 2 to 5 years and longer. SAA relies on long-run economic data to make long-term predictions about the optimal portfolio. **Tactical asset allocation** (TAA) on the other hand, focuses on the shorter term from a month to a year. TAA relies on short-term market information to find where short-term mis-pricing opportunities exist in the market. A common practice among many pension funds, for example, is to establish a SAA, also called the **target allocation** or the **policy portfolio**, and then tweak it to come up with TAA in line with their short-term views on the market. Ideally, if SAA is properly constructed, TAA should only slightly deviate from SAA and should on average resemble SAA, nevertheless, it may be possible to pick up short-term gains with TAA.

Two methods are usually used for asset allocation: quantitative and qualitative. As the name suggests, the quantitative methods, such as optimization and simulation, are disciplined approaches with formal foundation in mathematics and statistics, so they should be preferred over qualitative methods in most situations. Qualitative methods, on the other hand, are rather crude and should mainly be used as to provide "reality check" in simple asset allocation situations. In any case, whether qualitative or quantitative, these methods are just tools and the reliability of the results they produce will depend, among many factors, on the quality of the data supplied, how well the problem was framed and whether all of the relevant factors were adequately considered.

At the core of many quantitative approaches to asset allocation is an optimization procedure based on the theory first developed by Harry Markowitz, that was described in the previous section. **Mean-variance optimization** (MVO) is the most well-known optimization technique. In its basic form, it can produce the efficient frontier and determine the optimal mix of assets that would yield the maximum expected Sharpe ratio, which is the most common measure of **risk-adjusted return**. MVO requires several inputs to get started. But, first, the manager must decide what asset classes should be included in the MVO procedure. Selecting all of the major asset classes is usually a good starting point. Adding alternative asset classes may further improve diversification. Blume (1984) suggested a simple formula that can be used to decide whether or not adding an asset class to an optimal portfolio of existing asset classes will result in improved efficient frontier and new maximum Sharpe ratio. Blume's simple result says that, in order to add a new asset class N to an existing optimal portfolio P, the sharpe ratio of the new asset class, S_{N}, must be larger than the Sharpe ratio of the optimal portfolio, S_{P}, times the correlation ρ between the rates of return of the new asset class and the optimal portfolio; that is,

$$S_{\mathrm{N}} > S_{\mathrm{P}} \times \rho(\widetilde{r}_{\mathrm{N}}, \widetilde{r}_{\mathrm{P}}).$$

Some other factors that should be taken into account when deciding whether or not to add a new asset class are the tradeability of the asset class, the costs for investing in it, and the managers' ability to analyze and make predictions with regards to that new asset class. It is important to note that the selection of asset classes to be included in the MVO must be done in accordance with the IPS and can only include asset classes allowable within the mandate approved by end investor.

Next, the manager must define specific constraints with respect to each of the asset classes. If leverage is not allowed, then there must be a so-called **budget constraint** restricting the sum of the weights of all individual asset classes to one. For long-only portfolios, where all weights must be positive, the **non-negativity constraint** should be applied to all asset classes. Other constraints are possible based on the circumstances of a particular investor. Sometimes, when a portfolio must maintain some level of liquidity for distributions to investors, illiquid asset classes, e.g., physical real estate, are assigned a **maximum weight constraint**. In other cases, when a manager wants to maintain a minimum allocation to an asset class to ensure it is represented in the final allocation, a **minimum weight constraint** may be appropriate. Once the list of asset classes has been established, MVO requires two inputs: a **vector of expected returns** for each

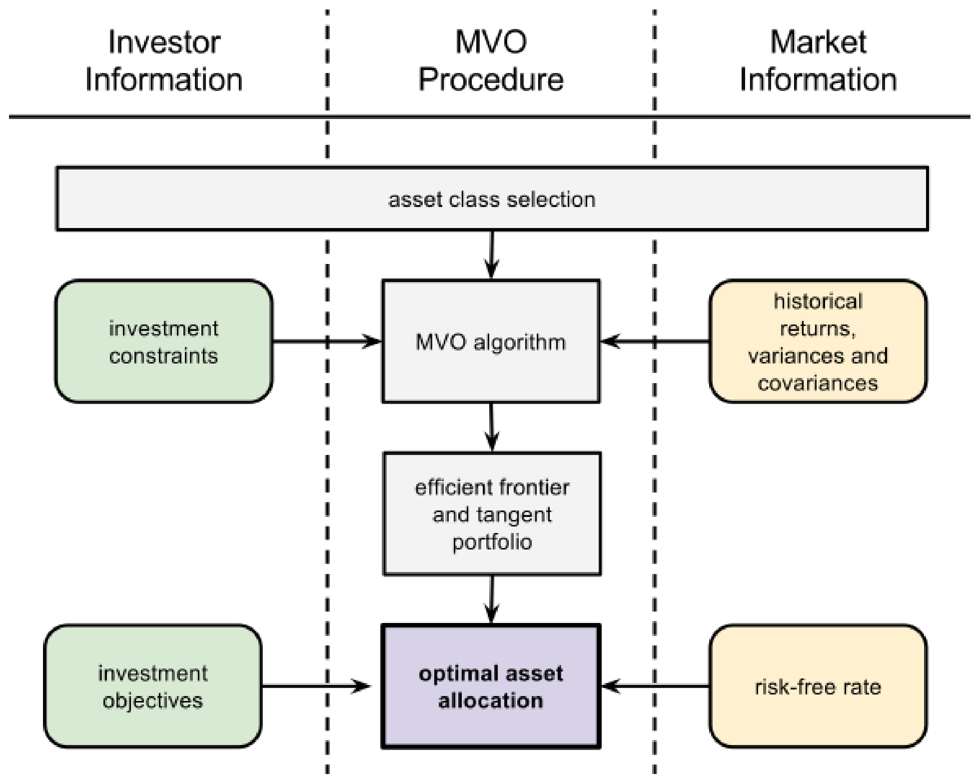

Figure 4.4: Mean-Variance Optimization.

of the asset classes and the expected **variance-covariance matrix**. The easiest approach is to use historical average returns over a sufficiently long period as estimates of the expected returns as well as historical variances and covariances over the same period as estimates for the expected variance-covariance matrix. However, these estimates can and should be adjusted if the investment manager believes he can improve them, because the accuracy of the inputs is the key to a successful outcome of optimization. At this point, the inputs can be passed to MVO procedure. Executing MVO produces the efficient frontier from which the tangency portfolio and the Capital Market Line can be determined. The final step, is to select an appropriate portfolio. The choice of an optimal portfolio must directly address the investment objectives from the IPS. Investment objectives are most often translated into one of three optimization problems: **maximize expected return** given maximum allowable risk, or **minimize risk** given a target expected return, or **maximize Sharpe ratio**, that is maximize expected return per unit of risk. The tangent portfolio is the optimal portfolio for the latter problem. The optimal portfolio for the former two problems depends on whether or not investing in risk-free assets or borrowing is allowed. If the investor is not able to invest in risk free assets or borrow money for investment, then the optimal portfolio will lie on the efficient frontier. Otherwise, if the investor is able to hold risk free assets and can also borrow for investment, the optimal portfolio will lie on the CML. Figure 4.4 summarizes the procedure involved in basic MVO.

Despite being a very disciplined approach, MVO has a number of downsides. The main problem is that MVO is very sensitive to the expected returns and variance-covariance inputs. In order to produce reliable forecasts from historical data, a sufficiently large time-series of observations is needed. However, financial data for certain asset classes, particularly more exotic ones can be limited. For example, the market for **dim sum bonds**, which are bonds denominated in Chinese Yuan, was only formed in July of 2007. Another significant drawback of the simple MVO approach is that if one of the asset classes has significantly better historical risk-adjusted returns than the others and, consequently, it could be significantly over-represented. This behavior may be desirable, but often it results in under-allocation to other asset classes and overexposes the portfolio to systematic risks of the over-allocated asset class. Since past performance does not guarantee future performance, it may be unwise to put all savings in one asset class, even if it has the best risk-adjusted returns based on historical performance.

Due to the deficiencies of the traditional MVO approach, numerous ways to improve the MVO procedure to produce more reliable and diverse allocation have been proposed by practitioners in the industry. One way, is to experiment with different inputs and build several efficient frontiers instead of one. This procedure is often known as **MVO with resampling**. The result is a range of optimal outcomes based on different return and variance-covariance inputs that would allow portfolio managers to gage the sensitivity of the MVO approach to those inputs. This procedure allows to better understand the effect of measurement error in the inputs on optimal allocation and may enable portfolio managers to come up with a more robust asset allocation that would perform well in a variety of potential scenarios.

Another popular way to improve on the traditional MVO is the so-called **Black-Litterman Model** (BL), which was first published in 1992 by Fisher Black and Robert Litterman. BL recognizes the weakness of using historical estimates in order to arrive at the optimal allocation for the future and tries to address it indirectly. The approach first reverse engineers the implied expected returns, also known as **equilibrium returns**, for assets assuming the markets are in equilibrium and the current proportional market capitalization of each asset class represents the equilibrium weights. Then, BL approach provides methodology to adjust equilibrium returns up or down in accordance with the portfolio manager's views, taking into account the level of conviction for each view. The adjusted equilibrium returns are then fed back into an MVO procedure. The result, is usually a well diversified portfolio where allocation is more intuitive, and, in the absence of any views, consists simply of the equilibrium market weights. Figure 4.5 illustrates the basic flow of the BL procedure.

Finally, several qualitative allocation "short-cuts," also referred to as experience-based approaches, have become quite well known in the industry. These apply primarily to individual investors and are popular for their simplicity. One such approach, which is known as the **60/40 rule**, is to assume that the allocation of 60% in equity and 40% in bonds is the neutral allocation, suitable for an average investor. If an investor has above average ability and willingness to take risk, then the initial 60/40 could be adjusted to have more equity and less bond exposure. Conversely, if the investor has below average risk tolerance, 60/40 could be adjusted to have less equity and more bond exposure. Another popular "rule of thumb," is the **"100 − age" rule**. This rule suggests that the allocation to equity in percent terms should be equal to 100 minus a person's age, and the rest should be allocated to fixed income. This implies that with time, as the person ages, the optimal allocation to fixed income should increase and allocation to equities decrease. This makes intuitive sense because as people age, we expect their risk tolerance to decrease.

Once asset allocation has been determined, it is time to decide how to populate individual securities within each asset class. This is the subject matter of the following section.

4.2 Security Selection

Whether for the sake of trying to make a fortune or for the sake of knowledge, both practitioners and academicians have had interests in studying the behavior of financial time series data since the existence of financial markets. Not only their motives were different, but also their practices. On one hand, financial practitioners **believed** that financial time series can be forecasted. Driven by

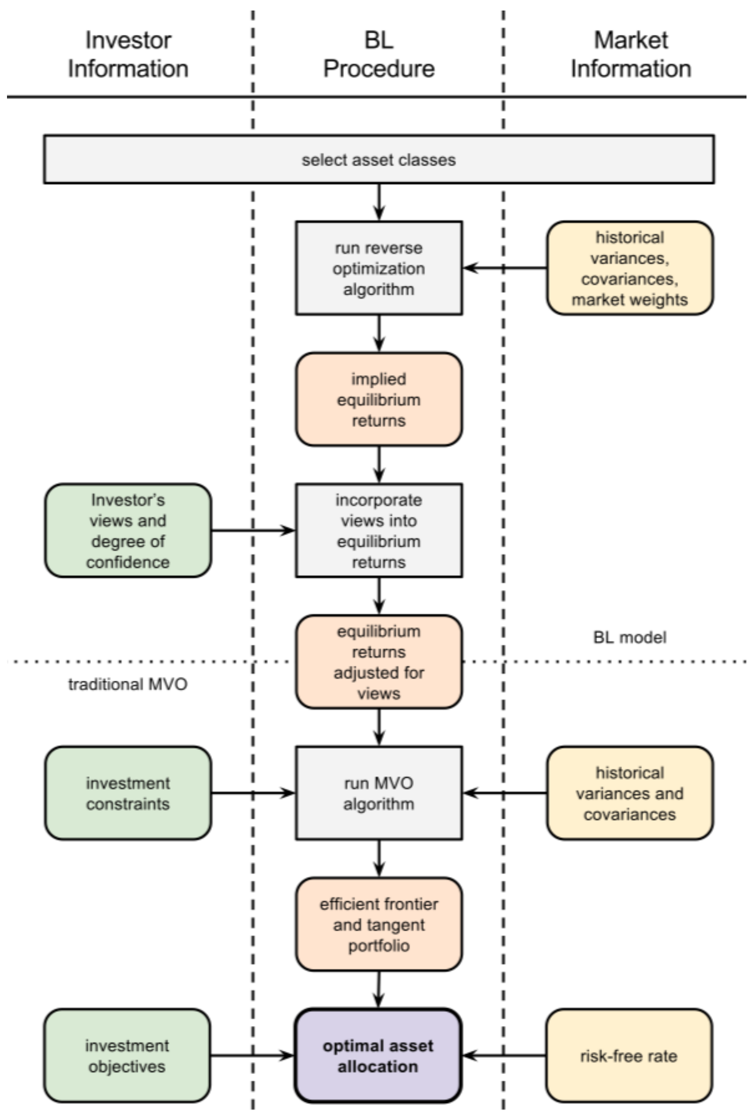

Figure 4.5: A diagram for Black-Litterman model.

their financial motives, they were set to exploit profit opportunities by forecasting and predicting the behavior of financial time series in capital markets. Academicians, on the other hand, were occupied with answering the question of whether or not it is possible to forecast financial time series. Despite the fact that academicians and practitioners differ in their motives, they both enhanced our understanding of the price formation process in financial markets.

Financial analysis can be viewed, in general, as the process of analyzing and understanding the behavior of financial time series in capital markets. **On the theoretical frontier**, academicians contributed equilibrium models that aim to describe the process of price formation in the financial markets. Over time, two schools of thoughts were established. Proponents of the first school of thought believed that resources are efficiently allocated among participants in capital markets. In an efficient setup, capital markets provide accurate signals for firms and investors that enable them to make efficient investment decisions. In other words, the proponents of this school of though entertained the **Efficient Markets Hypothesis** (EMH), which posits that, at any point in time, security prices fully reflect all available information in the market. Empirical evidence, however, shows otherwise. The EMH does not hold all the time. Recent evidence from **behavioral finance** and **neurosciences** shows that investors, especially retail traders, exhibit irrational behavior, which can explain this violation of the EMH. This led to the formation of the second school of thought; the behavioral finance school.

On the practical frontier, practitioners were not interested in developing models of price formation; rather they were interested in developing techniques to analyze and predict the price movements. Same as academicians, practitioners were also divided into two schools of thought: the **fundamental analysis** school and the **technical analysis** school. Although both schools of thought share the same objective, which is to give advise on what and when to buy and sell assets for the sake of making profit, they differ in their ways of analysis. The proponents of the fundamental analysis believe that any asset has a foundation value or **intrinsic** value. Due to market conditions, the actual price of the asset fluctuates continuously around this intrinsic value; it could fall below or rise above this value. This fluctuation implies that the actual market price of the asset will eventually reach its intrinsic value but will rarely remain at it. This, in turn, creates buying and selling opportunities when the asset is undervalued or overvalued respectively. Finding the intrinsic value of the asset under consideration is the main objective of fundamental analysts. The proponents of technical analysis, on the other hand, believe that the study of past price movements helps in predicting its future movements. The general consensus among technical analysts is that fundamentals are irrelevant because all market information are reflected in the price process, and thus, studying the past behavior of the price series is the best way to predict its future movements. Practitioners in the finance industry usually entertain the views and methods of both schools in developing their strategies. I can safely argue, with a 95% percent confidence, that most of the financial analysis strategies use a combination of fundamental and technical analysis. In the following two sections, we discuss, respectively, the theoretical frontier and the practical frontier of financial analysis.

4.2.1 Security Selection in Theory

The process of price formation in capital markets attracted the attention of academicians for decades. The first formal financial model was due to Harry Markowitz (1959), who studied the investor's portfolio decision problem, which is an optimization problem where investors choose optimal weights of individual assets in a given portfolio such that the variance of the rate of return on the constructed portfolio is minimized subject to an expected rate of return given by the investor.

Soon after the introduction of Markowitz's portfolio theory, a simple price formation model that explains the risk-reward relationship for individual assets or portfolios of assets was introduced.

The model, which is known as the Capital Asset Pricing Model (CAPM), was originally developed independently by Treynor (1961) and Sharpe (1964), then it was further extended and clarified by Lintner (1965). The CAPM is considered an **equilibrium** theory that has its roots in Markowitz's (1959) **portfolio theory.** The **equilibrium** that I am referring to here is the financial equilibrium in the capital market, where the demand for financial assets is equal to the supply. In fact, both Markowitz's model and CAPM assume that all asset prices clear the markets of **all** assets. The models, unfortunately, do not explain or derive this financial equilibrium; rather they assume that it is the result of market **efficiency**. This hypothesis is known as the **efficient markets hypothesis** (EMH), which posits that capital markets are ideal in the sense that, at any point in time, security prices in **any** market fully reflect all available information in that particular market.

In 1976, the economist Stephen Ross suggested another more general and more testable alternative to CAPM. Unlike CAPM, which suggests that the rate of return on any security is linearly related to a single factor, which is the rate of return on the market portfolio, Ross's theory, which is known as the Arbitrage Pricing Theory (APT), asserts that the **variation** in the rate of return of a security can be explained by its sensitivity to a number of **factors**. This last statement is a statement about **factor models**. These models summarize the main factors that can explain the rate of return on a given security. Factor models represent the building block of the APT. The idea here is that the rate of return on a security depends on **market variables** and **firm-specific variables**. Market variables are economic variables that have influence on the economy, the market, and, in turn, the rate of return on the security under consideration. These economic variables include changes in interest rate, changes in inflation, technological changes, and business cycle fluctuations. Market variables represent the **systematic component** of the rate of return on any given security. On the other hand, **firm-specific** variables are firm related shocks affecting the rate of return on the firm's stock such as defective products, harmful products, bad publicity, reputation, and poor management. These types of shocks are known as **idiosyncratic** shocks[3] and they represent the second type of factors influencing the rate of return on a given security.[4] The APT is considered a more general and testable alternative to CAPM as it takes into account all the previous factors. The APT, however, is also built under the assumption that all markets are efficient, and thus, suffers from the same drawback of the CAPM; it assumes equilibrium, but it does not explain it or derive it.

The previous concern led many economists to seek asset pricing models that are capable of deriving equilibrium in financial markets. Advancements on this frontier made use of various types of micro-founded models in explaining the behavior of investors and in deriving equilibrium conditions in all markets. (See, for instance, Campbell and Cochrane (1999), Constantinides (1982), Epstein and Zin (1989), Lucas (1978), Mankiw and Zeldes (1991), and Mehra and Prescott (1985).)

The previous recent attempts, elegant as they were, did not attract the attention of practitioners in the financial market. To this very day, despite its poor empirical performance, the CAPM is the most favorite asset pricing model among practitioners in the finance industry industry. This is due to its simplicity and intuitive appeal as opposed to the fairly complicated recent general equilibrium models. But, as mentioned above, adopting the CAPM implies entertaining the EMH. Thus, one way to test the validity of the CAPM is simply to test whether or not the EMH holds. So, the question is: Does the EMH really hold? Before we answer this question, perhaps it is best to discuss the EMH first.

[3] The word "idiosyncracy" is a Greek word. In general, it refers to an unusual trait of a person. It can also be used to express eccentricity or pecularity of a person. In linguistics, the term "idiosyncratic" refers to one thing for an individual. In the economic context, idiosyncratic shock of a security is a security-specific shock, i.e., a shock due to some specific factors relevant to the corporation or the financial entity that issued that particular security.

[4] Note that in addition to market factors and firm-specific factors, there are also other factors that seem to have an explanatory power in explaining the variation of the expected rate of return on a stock such as **trading volume**, **book/Market value**, and **liquidity of the stock**.

The EMH posits that at any point in time, security prices **fully reflect** all market information. The previous statement is so general in the sense that it has no empirical testable implications. To make an asset pricing model testable, the process of price formation must be specified in more detail. In particular, we must define the meaning of "**fully reflect.**" If we entertain the possibility that equilibrium prices and, consequently, expected returns, on securities are generated according to the standard CAPM of Sharpe (1964) and Lintner (1965), then the hypothesis of efficient markets, where asset prices fully reflect all available information, must be explicitly defined. In the finance literature, entertaining the EMH generated three models of price formation: (1) The **expected returns**, also known as **fair game**, models, (2) the **submartingale** models, and (3) the **random walk** models. The last two models can be seen as special cases of the fair game model.[5]

Focusing on the fair game model and following the notation given in Fama (1970), the expected price of an asset or a security at time $t+1$ contingent on the information set available at time t is expressed as

$$E\left[\widetilde{P}_{i,t+1}|\mathbf{\Phi}_t\right] = P_{it}\left(1 + E\left[\widetilde{r}_{i,t+1}|\mathbf{\Phi}_t\right]\right), \tag{4.6}$$

where P_{it} is security i's price at time t, $\widetilde{P}_{i,t+1}$ is its price at $t+1$ with reinvestment of any intermediate cash income from the security, $\widetilde{r}_{i,t+1} = \frac{\widetilde{P}_{i,t+1} - P_{i,t}}{P_{i,t}}$ is the one period percentage return, and $\mathbf{\Phi}_t$ is an information set at time t; it reflects whatever information assumed to be fully reflected in the stock price at time t. The previous expected returns model is based on two assumptions: (1) the conditions of market equilibrium can be stated in terms of expected returns and (2) the information set $\mathbf{\Phi}_t$ is fully utilized by the market in forming equilibrium expected returns and, thus, current prices. The previous two assumptions immediately rule out the possibility of trading systems based only on information in $\mathbf{\Phi}_t$ that have expected returns in excess of equilibrium expected returns. In other words, if we let the sequence $\widetilde{X}_{i,t+1}$ be the **excess market value** of security i at time $t+1$, which is the difference between the **observed** price at period $t+1$ and the expected value of the price at time $t+1$ that was projected at time t on the basis of the information set $\mathbf{\Phi}_t$, i.e.,

$$\widetilde{X}_{i,t+1} = P_{i,t+1} - E\left[\widetilde{P}_{i,t+1}|\mathbf{\Phi}_t\right], \tag{4.7}$$

then the previous two assumptions imply that

$$E\left[\widetilde{X}_{i,t+1}|\mathbf{\Phi}_t\right] = 0, \tag{4.8}$$

which means that the sequence $\{\widetilde{X}_{it}\}$ is a **fair game** with respect to the information sequence $\{\mathbf{\Phi}_t\}$. Thus, the EMH as expressed in this expected returns model implies that **no** stock could be **overvalued** or **undervalued**. The expected excess market value of any stock should be zero.

Fama (1970) summarized the market conditions consistent with efficiency in three conditions: (1) there are no transactions costs in trading securities, (2) all available information is costlessly available to all market participants, and (3) all agree on the implications of current information for the current price and distributions of future prices of each security. In such a market, the current price of a security obviously "fully reflect" all available information.

Now, since we have a clear understanding of the EMH, we turn to the question of whether or not it really holds in practice. Is there really an efficient financial market? The answer to this question involves testing empirically the validity of the hypothesis. In doing so, researchers were divided into two schools of thoughts: Proponents of the first school of thought believed that resources are efficiently allocated among participants in capital markets. In an efficient setup, capital markets provide accurate signals for firms and investors that enable them to make efficient

[5] For an excellent survey on the theoretical and empirical literature on efficient capital markets models, the interested reader is advised to consult Fama (1970) and the references therein.

investment decisions. In other words, the proponents of this school of though entertained the EMH. The second school of thought brought recent evidence from behavioral finance and neurosciences to demonstrate that the market is inefficient. Their rationale is that investors, especially retail traders, exhibit irrational behavior in constructing portfolios and conducting their trades in the market. This irrational behavior causes asset prices to over or under value their efficient, or fundamental, values rendering the market inefficient. Andrew Lo (2004) surveyed the literature on the debate between the advocates of the EMH and behavioral finance and suggested a reconciliation between both approaches. His Adaptive Markets Hypothesis (AMH) posits that the inefficiency in the market is due to the irrational behavior of investors, but since investors adapt to the changing environment, their adaptability over time brings the market back to efficiency.

4.2.2 Security Selection in Practice

Practitioners in the finance industry **believe** that financial time series can be forecasted. As opposed to academicians, practitioners are not interested in developing models of price formation; rather they are interested in developing techniques to analyze and predict the price movements of financial assets in order to seize any profit opportunity that might arise from overvaluation or undervaluation of asset prices. Thus, we can safely argue that practitioners in the finance industry do not believe in the EMH.

First, it should be noted that are two ways to go about security selection in practice. **Top-down** approach to portfolio construction involves first determining the high-level allocation to various categories or subgroups of securities and then determining allocation to individual securities within each subgroup. For example, economic analysis of macroeconomic drivers could be used to identify sectors of the S&P 500 that will outperform over a specific forecast horizon. Specific securities would then be selected from those sectors. **Bottom-up** approach is the opposite: analysis is first performed on individual securities and then an overall portfolio is constructed based on the outcome of that analysis. Top- down approach is more common with passive strategies, because it allows to select exposures to different sectors of the market in the same proportion as in the market. Doing so, ensures that the portfolio is exposed to the same risks in the same proportion as the market, making it more likely that portfolio will closely track the market. On the other hand, bottom-up approach is more suited for active investing, because it allows to identify mis-pricing opportunities among individual investments. It is possible to try using both approaches together in order to get a more complete picture for the security selection process.

Next, focusing on the techniques adopted by practitioners in the finance industry in performing financial analysis, one can observe two schools: the **fundamental analysis** school and the **technical analysis** school. Although both schools of thought share the same objective, which is to give advise on what and when to buy and sell assets for the sake of making profit, they differ in their ways of analysis. The proponents of the fundamental analysis believe that any asset has a foundation value or an **intrinsic** value. Due to market conditions, the actual price of the asset fluctuates continuously around this intrinsic value; it could fall below or rise above this value. This fluctuation implies that the actual market price of the asset will eventually reach its intrinsic value but will rarely remain at it. This, in turn, creates buying and selling opportunities when the asset is undervalued or overvalued respectively. Finding the intrinsic value of the asset under consideration is the main objective of fundamental analysts. The proponents of technical analysis, on the other hand, believe that the study of past price movements helps in predicting its future movements. The general consensus among technical analysts is that fundamentals are irrelevant because all market information are reflected in the price process, and thus, studying the past behavior of the price series is the best way to predict its future movements. We begin by analyzing the first school of thought,−the fundamental analysis school.

Fundamental Analysis

Fundamental Analysis has its roots in the **firm-foundation theory** which asserts that any asset, i.e., a common stock, a real estate, or even an investment project, has a foundation value or an **intrinsic** value. Due to market conditions, the actual price of the asset fluctuates continuously around this intrinsic value; it could fall below or rise above this value. This fluctuation implies that the actual market price of the asset will eventually reach its intrinsic value but will rarely remain at it. This, in turn, creates buying and selling opportunities when the asset is undervalued or overvalued respectively.

Since many people during the early 1930s contributed to the idea of comparing the actual value of an asset to its true underlying value, i.e., its intrinsic value, the firm-foundation theory was not accredited to one individual. The first formal version of the theory was due to the economist John Burr Williams, who proposed in 1938 a theory of **investment value**, which postulates that the intrinsic value of an asset can be determined by discounting all its expected future cash flows. In particular, Williams pioneered the **dividend valuation** of stocks by proposing the **rule of present worth**, which states that intrinsic worth of a common stock is the present value of all its future expected **dividend payments** (cash flows). Later in 1956, Myron J. Gordon formulated Williams' theory into a valuation equation known as the **Gordon growth model**. Today, Gordon model is considered the standard model for stock valuation among practitioners in the finance industry.

Surprisingly, when Williams published his work in 1938, it did not get much attention at that time. It did not really become popular until Ben Graham and David Dodd developed their **value investing** approach and published their book **Security Analysis** in 1934. Their idea of **value investing** is to perform some sort of fundamental analysis that reveals whether or not the asset under consideration is undervalued or overvalued. Their recommendation is to buy the undervalued asset and sell the overvalued one. In this book, Graham suggested to perform fundamental analysis for each individual security by analyzing all the micro variables affecting the firm itself and the industry in which it is operating. Later, in 1949, Graham published a second book titled **The Intelligent Investor**, where he refined his own old views and advised to focus more on trying to buy groups of stocks that meet some simple criterion for being undervalued regardless of the industry and with very little attention to the individual company.[6] Graham's value investing view, which has the idea of buying stocks that are traded at less than their intrinsic value at its core, was celebrated by many successful financial practitioners in the industry including Warren Buffett, the chairman of Berskshire Hathaway.

Fundamental Analysis is nothing but a **valuation** method of an asset, which is usually taken to be an **investment project** or a **corporation**. Therefore, when we talk about fundamental analysis of a stock, a firm, or an investment project, we are referring to the process of valuing such assets.

Valuation is a key concept in finance. It is used in **finance theory**, **portfolio management**, **corporate finance**, and **capital theory**. Valuation is at the core of **finance theory**. Computing the intrinsic or fundamental value of an asset, which is basically its fundamental price, and seeing whether this value is above or below the market value is a simple test of the EMH, which is the fundamental hypothesis in any financial model of price formation. Valuation is also used in **portfolio management**, which is the focus of this workshop. When the difference between the intrinsic value of an asset and its market is negative (positive), the asset is said to be undervalued (overvalued). The price of an undervalued asset is expected to increase and, therefore, it is recommended to be included in the portfolio The opposite is true for overvalued assets. In **corporate finance**, computing the fundamental value of the corporation through **ratio analysis**

[6] Actually this statement was Graham's own words. It was recorded in an interview in March 1976 in Graham's home in California. The interviewer, Mr. Hartman L. Butler, sat for an hour with Graham talking, among many things, about his new book. The interview is known as "An Hour with Mr. Graham."

and comparing it to its peers in the industry or to the corporation's historical value is a mean to assess its performance. Such comparison can provide the management with useful insights on how to increase the value of the corporation by restructuring the corporation's investment, financial, and dividend decisions. In **capital theory**, valuation is also used to rank alternative investment projects.

In a broad sense, the **approaches to valuation** can be categorized into three general approaches: (1) The **Discounted Cash Flow (DCF) Approach**, were the asset under consideration is valued by discounting its future expected cash flows using an appropriate discount rate. (2) **The Accounting valuation or Liquidation Approach**, where the corporation is valued by assessing its existing assets using accounting estimates. (3) **The Relative Valuation Approach**, where the value of an asset is calculated by looking at the value of "comparable" assets relative to a common variable such as earnings or sales. The second and the third approaches are used in specific circumstances whereas the first approach is the most widely used and, for that reason, it will be the focus of our analysis.[7]

The DCF Approach to Valuation: Historical Development and Variants The DCF Valuation approach treats an asset as a going concern and aims to find the present value of its **expected** future cash flows discounted back at a rate that reflects their riskiness. Out of the previously mentioned valuation approaches, the DCF approach is the most comprehensive, well developed, and extensively used among practitioners and academicians in the finance industry. Before we introduce the DCF approach and discuss its variants, below is a survey of its historical development.

The roots of the DCF approach can be traced back to the development of the rule of present value and interest tables. In a survey of the development of the DCF criteria before 1950, Parker (1968) argues that one of the early interest tables, which was developed back in 1340, is due to Francesco Balducci Pegolotti, who prepared them for Florentine firm of the Bardi in a manuscript that was not published until 1766. The early formal study that laid the basis of the present value rule, which was basically a text in financial mathematics, is due to the mathematician Simon Stevin in a book titled "Tables of Interest." The book was published in Antwerp in 1582. Simon explained and defined simple and compound interest rates and laid out the basis of the present value rule in the Appendix of his textbook.

Although many contributions to the concept of discounting future cash flows in various applications came from different disciplines such as engineering and actuarial science,[8] it is the work of Marshall (1907), Bohm-Bawerk (1903), Wicksell (1954), and the notable work of Fisher (1907) on **capital theory** that shaped our understanding of the DCF valuation. Marshall (1907) explained the usefulness of the present value rule in discounting future outlays and receipts of an investment in capital. He pointed that when discounting these cash flows, allowance should be made to the risk of failure of the investment capital under consideration. Bohm-Bawerk (1903) used the problem of buying a house for the payment of 20 installments of $1,000$ florins each to illustrate the application of net present value. The most notable work on capital theory and DCF valuation is due to Fisher, who published his work in a Book titled "The Rate of Interest" in 1907. The book was extensively revised in 1930 and published under the title "The Theory of Interest." In these two books, Fisher suggested four ways of choosing between investment alternatives. According to Fisher, when faced with investment alternatives, one should (1) Choose the project that yields the highest net present value; or (2) choose the project that achieves the highest difference between the net present value of future returns and the net present value of future costs; or (3) choose the

[7] I should also mention that there is a fourth approach to valuation, which is the contingent claim valuation approach, where the value of an asset is measured using derivative or option pricing models. This approach, however, is a topic by itself and is beyond the scope of our analysis. For more details on the second and third approaches to valuation, the interested reader is advised to consult Damodaran (2006).

[8] For more details, see Parker (1968) and the references therein.

project that, when compared to others, yields a rate of return over cost greater than the market rate of interest; or (4) choose the project that, when compared to others, has a **marginal** rate of return over cost greater than the market rate. Fisher argued that the previous four approaches will yield the same result. In the finance and economic literature, the first two approaches are now known as the **net present value** (NPV) criterion for projects selection. The third approach led to the development of what is now known as the **internal rate of return** (IRR) criterion for selecting projects.[9] Nowadays, the NPV and IRR criteria are routinely used among practitioners in the finance industry. They are also among the standard material covered in any basic corporate finance course.

Although Fisher discussed a variant of the IRR, he did not derive it thoroughly. Boulding (1935) derived the IRR for a single investment by equating the initial investment cost to the present value of the expected cash flows of the single investment. Boulding pointed out that the IRR of a single investment could be calculated from the following equation

$$V_0 = \frac{E\left[\mathrm{NCF}_1\right]}{(1+\mathrm{IRR})^1} + \frac{E\left[\mathrm{NCF}_2\right]}{(1+\mathrm{IRR})^2} + \cdots + \frac{E\left[\mathrm{NCF}_n\right]}{(1+\mathrm{IRR})^n}, \tag{4.9}$$

where V_0 is the initial investment or the current value of the enterprise, $E\left[\mathrm{NCF}_i\right]$ is period i's expected net cash flow or period i's expected net revenue (positive or negative) for $i = 1, ..., n$, where n is the total number of periods. Boulding argued that any rational investor should choose the project that maximizes his or her IRR. Boulding recognized that the solution of the previous equation is not mathematically simple and thought that a single solution could be found. He did not regard the existence of multiple internal rates of return as problematic.[10]

Keynes (1936) gave the, now familiar and widely known, definition of IRR as the discount rate that makes the present value of the returns on an asset equal to its current price. Keyens referred to this definition of IRR as the **marginal efficiency of capital**. However he mistakenly argued that this IRR definition is the same as Fisher's (1907 and 1930) rate of return on cost.

Samuleson (1937) discussed the contributions made by Keynes (1936) and Boulding (1935) and noted that Boulding's internal rate of return and Keynes' marginal efficiency of capital are equivalent. Samuelson also examined the differences between the NPV and the IRR criteria and argued that rational investors should maximize the former and not the latter. In other words, he rejected Boulding's view of maximizing IRR. Samuelson also pointed out the possibility of no rate of return or of multiple rates, which is considered a major drawback of the IRR criterion.

Interest in DCF methods started to become more significant in the 1950 and became widespread in the 1960s. Parker (1968) reviewed the history of the DCF methods and their use in the 1950s and the 1960s. Nowadays, DCF methods are extensively used in financial valuations as well as a wide variety of applications in finance, business, and economic.

Asset valuation is a method of computing how much an asset is worth today, or in other words, how much investors are willing to pay for a particular asset today. This requires discounting the expected future **risky** cash flows generated by the asset over its future life **time**. Notice that the **two** key elements of asset valuation are the life **time** of the asset and the anticipated **risk** in its expected cash flows. This is not surprising since time and risk are the two key ingredients of making any financial decision. In general, the present value, V_0, of any asset today is the sum of all expected cash flows in the future discounted at the risk-free discount rate as

$$V_0 = \frac{CF_1}{(1+rf_1)} + \frac{CF_2}{(1+rf_2)^2} + \cdots + \frac{CF_n}{(1+rf_n)^n}, \tag{4.10}$$

[9] Note that the principle of return over cost is not the same as the internal rate of return; rather it is considered a variant of the internal rate of return crieterion.

[10] One of the drawback of the conventional IRR method is that it yields multiple rates of return, which could be ambiguous and confusing sometimes.

where CF_t is the asset's **certain** cash flow in period t, for $t = 1, .., n$, rf_t is the risk-free rate of return in period t, and n is the lifetime of the asset.

This way of asset valuation with **certainty** is straight forward; just add the future cash flows after discounting them by the period's risk-free rate of return. The valuation problem is more complicated when the future cash flows are subject to **random events**, i.e., the debt issuer's ability to pay the interest payment in case of bonds, the equity issuer's ability to pay dividends in case of stocks, and the project's ability to generate revenue in case of commercial projects. Thus, **solvency**, **financial strength**, and **commercial success** are considered random events that affect the future cash flows in case of bonds, stocks, and commercial projects respectively. Since these random events are in play, their associated outcomes, i.e., their associated cash flows, are considered random variables with probabilistic realizations. Hence, their **expected values** is what should be considered in their valuations. If we let rf_t be the risk-free rate of return at time t and $\widetilde{CF}_t$ denote the random variable representing the cash flow[11] of a given asset at time t, for $t = 1, ..., n$, where n is the total number of future periods, or the expected life time of the asset, then the value of this asset today must follow the following net present value formula

$$V_0 = \sum_{t=1}^{n} \frac{E\left[\widetilde{CF}_t\right]}{(1 + rf_t)^t}. \tag{4.11}$$

The formula (4.11) is the reference formula for any DCF model. Since randomness implies uncertainty, the only thing remaining is to incorporate such uncertainty, or risk, in the previous formula. Incorporating uncertainty in equation (4.11) produced the following variations of the basic DCF formula.

One way to incorporate risk in equation (4.11) is to **increase** the risk-free rate by a premium that takes into account the risk associated with the future uncertainty of the expected cash flows. This **risk premium**, which is denoted by π in the text, varies from one asset to another. The adjustment of the discount rate in this way produces the following variation of the basic DCF formula:

$$V_0 = \sum_{t=1}^{n} \frac{E\left[\widetilde{CF}_t\right]}{(1 + k)^t}, \tag{4.12}$$

where $k = rf_t + \pi$ is the **risk-adjusted discount rate**.

An alternative way of incorporating uncertainty in the basic DCF formula is to keep the risk-free rate as the discount rate but to **decrease** period t's cash flow by a factor γ_t that represents some risk or insurance premium. This factor takes into account the riskiness of the future cash flow. The adjustment of the cash flows in this way produces the following variation of the basic DCF formula:

$$V_0 = \sum_{t=1}^{n} \frac{E\left[\widetilde{ACF}_t\right]}{(1 + rf_t)^t}, \tag{4.13}$$

where $E\left[\widetilde{ACF}_t\right] = E\left[\widetilde{F}_t\right] - \gamma_t$ is the **risk-adjusted cash flow** at time t.

A third approach in the same spirit of the second is to also keep the risk-free rate as the discount rate but distort the probability distribution of future cash flows to incorporate risk or uncertainty, and then take expectations of the modified cash flows. Thus, this modification leads to the following variation of the basic DCF formula:

$$V_0 = \sum_{t=1}^{n} \frac{E\left[\widetilde{MCF}_t\right]}{(1 + rf_t)^t}, \tag{4.14}$$

[11] Following the convention in the finance literature, a tilde on top of a variable is used to signify that the variable is random.

where $\widetilde{MCF}_t$ is the modified, or distorted, cash flow at time t.

The notion of uncertainty can also be captured by projecting the cash flows of the asset over different **states of nature,**[12] and then finding a price of the asset today conditional on the realized state in the future.

Among the previous four approaches, the first two are the most frequently used among practitioners in the industry. The third and fourth approach are more methodological and technical in nature and are based on certain restrictive assumptions, which makes their implementation difficult in practice. But, regardless whether the approach is easy or difficult to implement, it should be noted that the transformation of the basic DCF formula that resulted in the previous variations is guided by financial theories. The first two variations are implemented using financial theories on modelling risk-reward relation and computing risk premia such as the Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Theory (APT). The third variation is based on the martingale approach in finance. The fourth variation is the result of a methodological theory of financial equilibrium known as the **state preference theory** or **Arrow-Debreu (A-D) General Equilibrium Theory**. Since the third and fourth variations are beyond the scope of this workshop, we will focus our attention on analyzing the first two variations of the basic DCF formula thoroughly. It should be noted that we will be conducting the DCF analysis for an **enterprise**.[13]

The DCF Approach to Valuation: Equity Valuation Models The DCF Valuation approach for an enterprise uses variations of the DCF formula to find the fundamental value of an enterprise. The valuation method can be executed in two ways: either to value the entire enterprise or to focus only on valuing the investors' stake in the firm. The former way is known as **Firm Valuation** whereas the latter is known as **Equity Valuation**. We will focus on the latter since it is more relevant to the PMP.

In **Equity Valuation**, the focus is on the business equity. The idea is to value the stake of equity investors in the business by discounting the **expected cash flows** to these investors at an **appropriate discount rate**. Notice that equity valuation, like any other valuation, depends on two inputs: (1) the definition of the equity holders' **expected cash flows** and (2) the appropriate **rate of return**, i.e., the discount rate, that reflects the riskiness of these cash flows. The first and most straight forward definition of expected equity cash flows is expected dividends. Broader definitions of expected equity cash flows have been also suggested in the literature, e.g., expected equity cash flows that include buybacks in addition to dividends. Whether the basic or the broader definition is used to define the expected equity cash flows, certain assumptions regarding the firm's expected future growth rates in earnings and payout ratios must be made. Thus, the definition of expected cash flows varies according to the assumptions made regarding their formation.

As for the appropriate rate of return, which is the second input in equity valuation, it is taken to be the **required rate of return on equity**. The idea here is that the discount rate or the cost of equity used in the Equity Valuation Model should reflect the riskiness of the equity cash flows, or in other words, the riskiness of the stock under consideration. The required rate of return on a security is a measure that reflects its riskiness. It is the rate of return required by investors to purchase the security under consideration. This rate varies according to the riskiness of the security; the higher the risk of the security, the more the return required by investors to hold it. The measure of risk differs according to the financial model used in its computation, e.g., the market beta in the CAPM or the factor betas in the APT. This, in turn, implies that the required rate of return is not unique for it varies according to the definition of risk.

From the previous discussion, one can conclude that there is not a unique Equity Valuation Model. Different expected cash flows definitions and assumptions and different ways of measuring risks and required rates of return give rise to variants of the Equity Valuation Model. Each

[12] The state of the economy is uncertain in the future; it ranges from prosperity to depression.

[13] The same analysis could be performed to appraise or assess the financial viability of a project.

variant has its advantages and disadvantages. The first and oldest Equity Valuation Model defines expected equity cash flows as expected dividends. Historically, the link between equity values to expected dividends can be traced back to the work of John Burr Williams (1938) on the theory of investment value, where he argues that the value of a stock is the present value of all the dividends ever to be paid upon it. Thus, the simplest and the oldest Equity Valuation model, which is also known as the **Dividend Discount Model**, or DDM for short, can be expressed in the following **basic stock valuation formula**:

$$V_0 = \frac{D_1}{(1+k_s)^1} + \frac{D_2}{(1+k_s)^2} + \frac{D_3}{(1+k_s)^3} + \cdots , \tag{4.15}$$

where V_0 is the present value of the stock, D_t is the expected dividends in period t, for $t = 1, ..., \infty$, and k_s is the required rate of return or the cost of equity. Notice that the previous formula is a perpetuity, i.e., it continues indefinitely, because publicly traded firms, at least in theory, can last forever and, therefore, their dividends are expected to last forever too.

As mentioned earlier, different assumptions regarding the firm's future growth and different ways of measuring the cost of equity gave rise to variants of this basic formula. In the following few paragraphs, we give a brief discussion on these variants and their advantages and disadvantages. We begin by the constant dividend growth model.

The **constant dividend growth model** assumes that dividends grow at an expected constant growth rate, which we will denote by g, for ever. If we let D_0 be the last dividend paid in period 0, then $D_1 = D_0(1+g)$ is the dividend expected to be paid in period 1, which is D_0 grown by the constant rate g. Following the same rationale, $D_2 = D_1(1+g)$, which can also be expressed as

$$D_2 = \underbrace{D_0(1+g)}_{D_1}(1+g) = D_0(1+g)^2$$

and, in general at any period t,

$$D_t = D_0(1+g)^t. \tag{4.16}$$

Following the constant growth assumption, the basic stock valuation formula in (4.15) can be expressed as

$$V_0 = \frac{D_0(1+g)}{(1+k_s)} + \frac{D_0(1+g)^2}{(1+k_s)^2} + \frac{D_0(1+g)^3}{(1+k_s)^3} + \cdots . \tag{4.17}$$

Taking D_0 common factor and letting $\gamma = \frac{(1+g)}{(1+k_s)}$ for simplicity, the expression in (4.17) is expressed as

$$V_0 = D_0\gamma\underbrace{\left(1+\gamma+\gamma^2+\gamma^3+\cdots\right)}_{\frac{1}{1-\gamma}},$$

where $\left(1+\gamma+\gamma^2+\gamma^3+\cdots\right)$ is a sum of a geometric progression, which can be reduced to $\frac{1}{1-\gamma}$. Therefore,

$$V_0 = \frac{D_0\gamma}{1-\gamma}.$$

Using the definition of γ and simplifying the previous expression yields

$$V_0 = \frac{D_1}{k_s - g} \tag{4.18}$$

Equation (4.18) is the result of the constant growth model. The equation states that the value of a stock is the expected dividends next period divided by the cost of equity minus the expected growth rate in perpetuity.

The origins of the constant growth model can be traced back to Durand (1957), who was the first to link the appraisal of stocks with dividends growing at a constant rate to the Petersburg Paradox, a problem in valuation presented by Daniel Bernoulli in the eighteenth century.[14] Although Durand (1957) was the first to mention the constant growth valuation, it was Myron Gordon (1962) who made the model popular. Nowadays, the constant growth model, which is sometimes referred to as Gordon model, is a standard Equity valuation model in any corporate finance textbook.

Although the constant growth model is simple, it is only limited to firms growing at stable rates that are expected to remain for ever. In practice, this situation is highly unlikely. Moreover, as pointed out by Damodaran (2005), practitioners should use the constant growth model with caution. Damodaran noted two insights when appraising constant growth stocks. First, since the firm's dividends are assumed to last forever, their growth rate should not exceed the growth rate of the economy in which the firms operates. Second, In a steady state, the firm's other measures of performance, e.g., earnings, are also expected to grow at the same rate as dividends. So, analysts should be able to substitute the expected growth rate of dividends with the expected growth rate of earnings and get precisely the same valuation.[15]

In practice, the assumption of constant growth of dividends could be entertained for Blue Chip corporations. However, suggested growth rates should be around 4 to 5 percent or, at most, 6.5%. This is true because the reasonable growth rate of any steady economy is around 4%. Notice that, from equation (4.18), higher growth rates of 7% and more causes the denominator of the equation to approach zero, which makes the stock value approaches infinity. This last observation that a growth rate of 7% or more makes the issue worthy of infinity was noted by Benjamin Graham (1962) and I quote:

"It is important for the student to understand why this pleasingly simple of method of valuing a common stock or group of stocks had to be replaced by more complicated methods, especially in the growth-stock field. It would work fairly plausibly for assumed growth rates up to, say, 5 percent. The latter figure produces a required dividend return of only 2 percent, or a multiplier of 33 for current earnings, if payout is two-thirds. But, when the expected growth rate is set progressively higher, the resultant valuation of dividends or earnings increases very rapidly. A 6.5% growth rate proceeds a multiplier of 200 for the dividend, and a growth rate of 7 percent or more makes the issue worthy of infinity if it pays any dividends."

The previous concerns about the constant growth model led practitioners, more so than academicians, to come up with more realistic versions of the constant growth model. This resulted in variable growth models or mutli-stage dividend discount models,[16] which we now turn to.

The classical simple form of the **variable growth or the multi-stage growth model** is a **two-stage dividend growth** model, where the first stage features variable growth of dividends and the second stage is a steady state, where expected dividends are assumed to grow at a constant growth rate for ever. This model is more suitable for firms experiencing supernormal growth, variable growth, or even negative growth in the short-run, but are expected to reach a steady state in the future and remain there indefinitely. More formally, if we let the first stage consists of n

[14] Bernoulli's paper, which was originally written in Latin in St. Petersburg in 1738 and later translated into English in 1954, is considered a breakthrough in the analysis of decisions under uncertainty. Bernoulli presened the paradox and suggested a solution. According to Bernoulli (1954), the rule of mathematical expectations used in valuing risky outcomes, e.g., outcomes of a lottery or gamble, should be discarded. His rationale is that two people facing the same lottery may value it differently because of a difference in their psychology; a thousand dollars gains is more valuable to a poor fellow to a rich one. Although the gain is the same, but the value is different for different people. Thus, the value of an item must not be based on its price, but rather on the utility that it yields.

[15] To see why in a steady state, the growth rate of earnings must be the same as the growth rate of dividends, assume otherwise and see the effect on the payout ratio. In particular, if earnings growth exceeds dividends growth, the payout ratio in the long-run converges to zero, which is inconsistent with a steady state.

[16] For an extensive categorization of multi-stage discount models, see Damodaran (2006) and the references therein.

periods and if we further assume that starting from period $n+1$, dividends are assumed to grow at a constant rate g, then the value of the firm's stock today is computed as follows:

$$V_0 = \frac{E[D_1]}{(1+k_s)} + \frac{E[D_2]}{(1+k_s)^2} + \cdots + \frac{E[D_n]}{(1+k_s)^n} + \frac{V_n}{(1+k_s)^n}, \tag{4.19}$$

where

$$V_n = \frac{E[D_{n+1}]}{k_s - g} \tag{4.20}$$

is the value of the stock at the beginning of the steady state, which is computed using Gordon's constant growth model, $E[D_t]$ is the expected dividend at time t, and everything else is defined as before.

In principle, the classical two-stage variable growth model in (4.19) can be extended to more than two stages, each with different growth rate. In addition to extending the number of stages, restrictions could be imposed on the assumed growth rate in every stage. For instance, Fuller and Hsia (1984) assumed a two-stage growth model, where the firm witnesses a supernormal growth in the first stage and a steady growth in the second. They further assumed that the growth rate of dividends in the first stage is high but not constant; it declines linearly over the supernormal growth period reaching the stable growth rate by the end of first stage. Although their model avoids the abrupt change of the growth rate from one period to the other, the linear decline assumption is restrictive. Extensions of the classical two-stage variable dividend growth model suggested by practitioners are many; each has its own assumptions, which are tailored to suit the firm under consideration. But, aside from the variations in growth rates, the number of stages, and the assumptions made, dividends growth models share the common feature of discounting future **forecasted dividends** for valuing equity.

This approach of forecasting dividends to value equity has its advantages and disadvantages. The proponents of using forecasted dividends in equity valuation argue in favor for the following reasons: (1) Using dividends in valuing stocks is logical and intuitive from any investor's perspective for they are considered the only relevant cash flow generated on stocks. (2) Forecasting dividends require fewer assumptions as opposed to forecasting free cash flows for instance. The latter require making assumptions regarding the firm's capital expenditures and working capital whereas the former only requires making an assumption regarding the growth rate of dividends. (3) A third advantage noted by Damodaran (2006) is that unlike cash flows, which fluctuates following the volatility of the firm's earnings and reinvestments, dividends remain stable and are considered less volatile. The reason behind the stability of dividends lies in the managers' tendency to set them at a level that the firm can sustain during good and bad earnings.

The opponents of using forecasted dividends as cash flows in equity valuation argue that this approach tends to under value firms with low payout ratio and overvalue firms with high payout ratio. The idea is that if the dividend policy of the firm entails holding back cash for future growth or for any other reason, the actual dividends paid to shareholders will not reflect the true ability of the stock to generate cash and, therefore, using dividends as cash flows in the dividend discount model tends to under value the firm. On the other hand, if the dividend policy of the firm is to over pay dividends, i.e., if dividends payments exceed the available cash flows such that the difference is financed through new issuance of debt or equity, the resulting value from the dividend discount model will be over estimated.

The previous criticism led to the use of an estimate of dividends rather than the actual dividends in the Equity Valuation Models. The idea here is that in the constant and the variable dividend growth models that we discussed above, we implicitly made the assumption that firms pay all their free cash flows as dividends. In practice, however, this is not always the case; some firms choose to accumulate cash in the form of retained earnings to meet their future expansion plans and other firms find other ways to return cash to shareholders, e.g., buybacks. Therefore, using actual dividends in the Equity Valuation Models might not reflect the true value of the firm in certain cases. Using the cash that could have been paid out in dividends, i.e., potential dividends, rather than the actual dividends is recommended in such cases.

Although the previous recommendation seems reasonable, it raises the question of how to accurately estimate potential dividends? Many answers were given to the previous question, which led to variants or extensions of the Equity Valuation Model. One suggestion was to include buybacks in the definition of cash returned to stockholders. This suggestion gave rise to an equity valuation model with buybacks as dividends. A second suggestion was to estimate the firm's free cash flow after paying debt holders and meeting all investment needs and use this estimate instead of the actual dividends to value the firm's equity. This suggestion resulted in the **Free Cash Flow to Equity (FCFE) Model**. A third suggestion was to use the firm's earnings as a proxy for its potential dividends. This suggestion resulted in a variety of **Earnings Models**. For a good reference on the variants of the Equity Valuation Model, see Damodaran (2006) and the references therein.

Technical Analysis

Technical analysis is the second type of analysis that is performed by many practitioners during security selection process to identify potential profitable opportunities. Unlike fundamental analysis, which aims to find the true fundamental value of a security based on the characteristics of the underlying asset, technical analysis aims to predict future price movements of a security, based only on market data such as **price action**, **trading volume** and **open interest.**[17] While technical analysis, in one form or another, is certainly as old as the markets themselves, most agree[18] that the modern technical analysis came out of the **Dow Theory**; a set of principles concerning market behavior developed by **Charles H. Dow** in late 19th and early 20th centuries. Charles Dow is also credited with the creation of the **Dow Jones Industrial Average** (DJIA) in 1896. Since the early days of modern technical analysis, practitioners have been extensively using **charts** to depict and analyze price movements. As a result, people using this type of analysis are sometimes also referred to as **chartists**. Chartists believe that some **trends** and **patterns** tend to repeat themselves and they carefully monitor the movement of security prices looking for the early signs of these trends and patterns. They also believe that these patterns reveal information about other market participants that could be useful for predicting how the market as a whole will behave. Due to the often subjective nature of observable patterns, which to a large extent depend on how the observer sees them, the validity of fundamental analysis is often questioned by the academic community. Nevertheless, there is some evidence that certain technical analysis does provide useful incremental information and could be somewhat successful in specific domains such as foreign exchange and futures markets. (See, for instance, Lo, Mamaysky, and Wang (2000) and Park and Irwin (2007).)

While there are many different charts that can be used in technical analysis, the most common charts are the **line chart**, **bar chart** and **candlestick chart**. Line chart is most often used to plot the historical closing price time series over long periods of time. When the time period to be plotted is short enough for individual days to be easily distinguishable, a bar chart or a candlestick chart is preferred. Both bar charts and candlestick charts show open, close, min and max prices on any particular day. The added advantage of a candlestick chart is improved readability, since the candlestick representing each day is color-coded depending on where the open and close prices are in relation to each other. For example, if the price rose during the day and the close was above the open, the candlestick is shown white or green, otherwise, it is shown black or red. A bar and a candlestick are compared in Figure 4.6.

[17] Open interest applies primarily to exchange-traded futures and options contracts. It is the number of contracts oustanding at a given point in time.

[18] See Kirkpatrick and Dahlquist (2011) and the references therein.

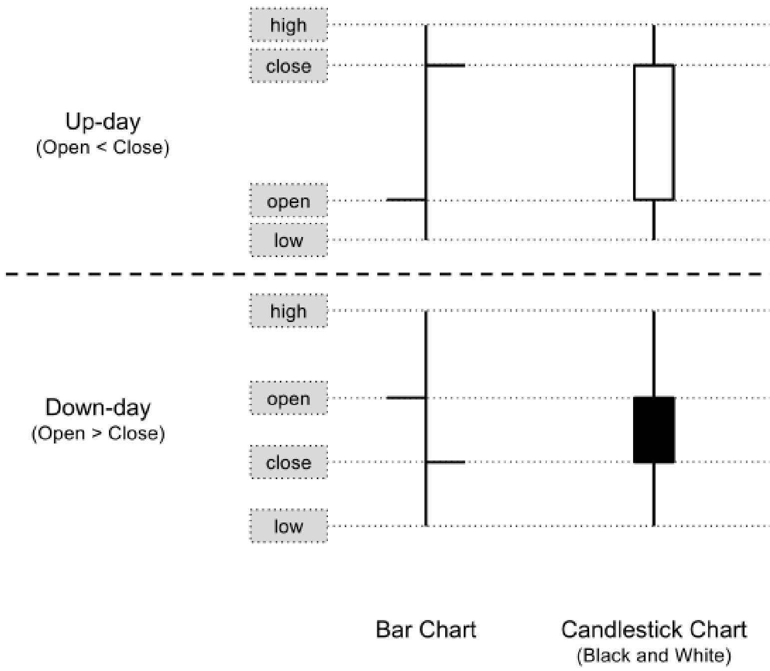

Figure 4.6: Bar chart versus Candle chart.

A simple bar chart is commonly used to show the volume information and is usually placed right underneath the stock price chart next to the time axis. Figure 4.7, 4.8, and 4.9 show an example of line, bar, and candle stick chart with volume information.

Chartist scrutinize charts for many different patterns. The most common patterns are trends, which could be either **up-trends** or **down-trends**. A market that does not exhibit any particular trend is known as a **sideways** market. In a sideways market, the price usually zigzags within a relatively narrow range. When the price approaches a certain level from above several times in a given period, but never crosses it, that level becomes known as **support** level. This usually happens when many market participants are willing to buy at the support level. Similarly, when the price approaches, but does not surpass, a certain level several times from below, that level becomes known as **resistance** level. This happens when there are many sellers in the market at the resistance level. The presence of support and resistance levels in charts is a very important concept. Every time prices approach these critical levels, they are said to **test** them, with the outcome usually being either a **trend reversal** if the critical level holds or a **breakout rally** if the critical level is **breached**. For example, it can sometimes be observed that, when a resistance level is breached, it becomes a support level and an up-trend forms, especially if the breach is accompanied by an increase in trading volume. Thus, a breach of a resistance level is often seen as a **bullish** or **buy signal**, indicating that the price may be about to rise more. Likewise, a breach of support is often seen as a **bearish** or **sell signal**, indicating that the price may be about to fall further. Figure 4.10 shows the resistance and support chart for Blackberry stock in early 2014.

One frequently observed pattern is the **head and shoulders** pattern, and it is used as a bearish signal. It consists of three peaks, two lower and roughly symmetrical peaks known as shoulders on either side and one higher peak known as the head in the middle. In a typical head and shoulders pattern, the trading volume observed when the first shoulder forms is relatively higher that the trading volume observed during the formation of the head peak. The lower volume

Figure 4.7: Line chart with volume.

Figure 4.8: Bar chart with volume.

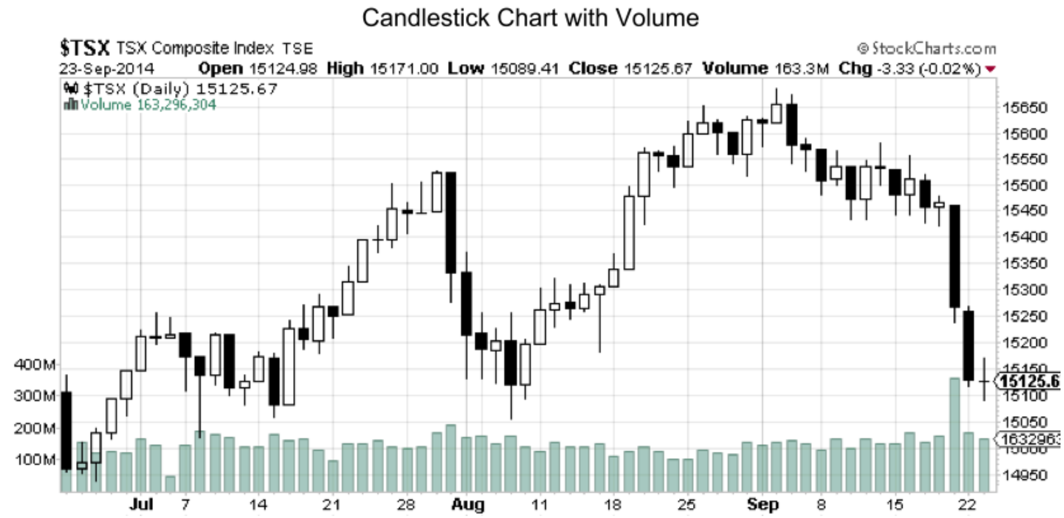

Figure 4.9: Candlestick chart with volume

during a higher peak signals lack of confidence in the sustainability of the upward trend, so after the second shoulder is formed, the down trend commonly ensues. Figure 4.11 shows a typical head and shoulder pattern for Blackberry stock during the period between end of June and beginning of August of 2014.

Charts can often be enhanced by plotting various **technical indicators** together with the price time series. Technical indicators, also known to as **technical studies** or just **indicators**, are metrics derived from the market data. Perhaps the most basic indicator is the **moving average** (MA), or more specifically, **simple moving average** (SMA). As the name suggests, SMA is the average price, over a specified time period, calculated on a rolling basis. SMA is usually calculated using the close prices. When plotted next to the price chart, SMA can be particularly useful for highlighting long-term trends that are often obfuscated by the short-term fluctuations in the price. Selecting a longer time period for SMA will clearly result in a smoother trend. Any period can be used depending on the purpose of the analysis. For short-term trends, 10-day SMA is quite common, for medium and long-term trends, 50-day and 200-day SMAs are frequently used. Often SMAs for periods of different lengths are plotted together to better understand the interaction between short-term, medium-term and long-term trends. **Golden cross** is a well-known chart pattern observed when the short-term SMA crosses the long-term SMA from below, and is considered to be a bullish signal. Figure 4.12 shows the 10, 50 and 200-day SMAs for the S&P/TSX Composite Index during 2014.

Sometimes, SMA is too slow to react to changes in trends because it weights all past prices equally. **Exponential moving average** (EMA) addresses this problem by applying larger weight to more recent observations in the averaging process. Figures 4.13 compares 50-day SMA and EMA for the S&P/TSX Composite Index during 2014.

Oscillators are a class of indicators that transform market data into a time series that oscillates around or fluctuates between specific values. For example, **Moving Average Convergence/Divergence** (MACD) is an oscillator that allows to detect a potential shift in the long-term trend by comparing it to the short-term trend. To calculate MACD, first, a slow (longer-term) EMA is subtracted from fast (shorter-term) EMA, then a simple moving average is applied to the difference, and the resulting time series is the MACD. Therefore, If MACD is greater than 0, the fast EMA has surpassed the slow EMA and there is a potential up-trend. Thus, when MACD

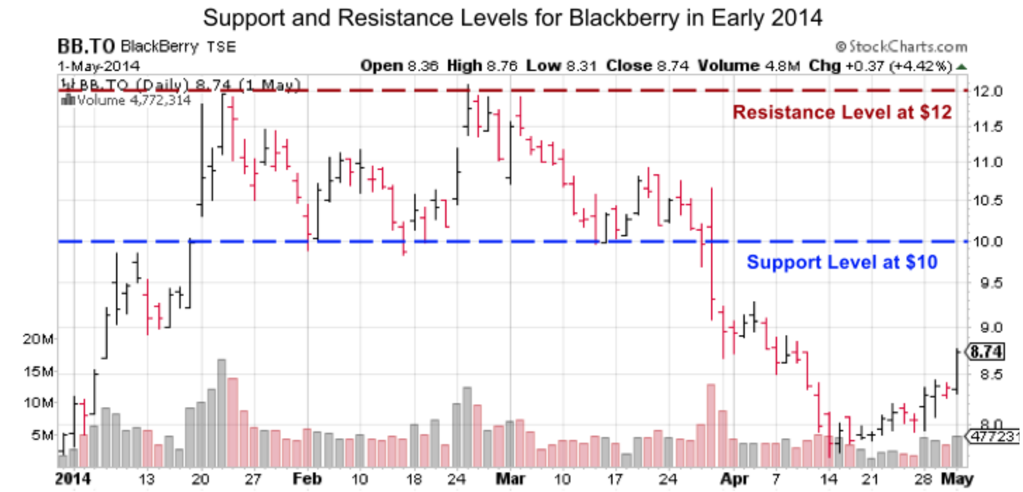

Figure 4.10: Resistance and support chart for Blackberry stock in earyly 2014.

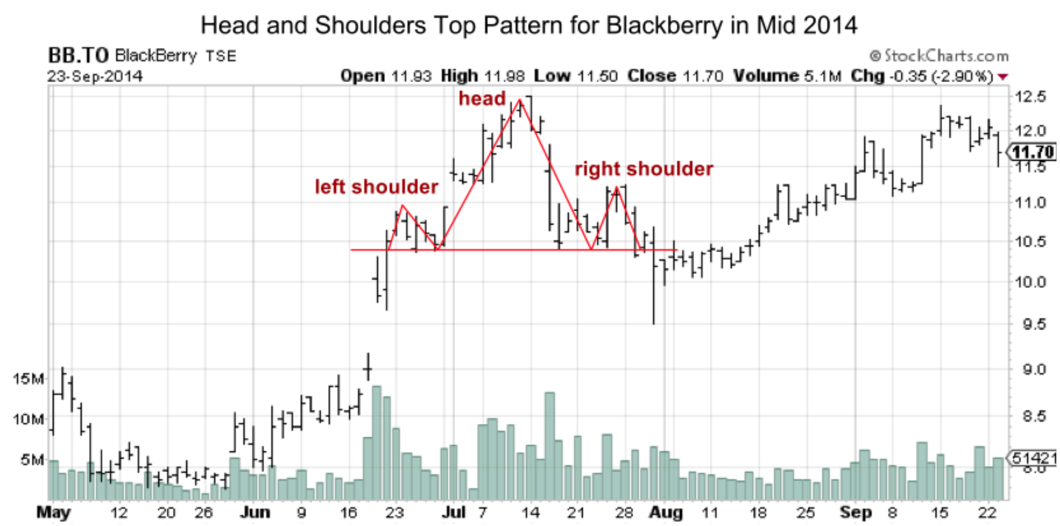

Figure 4.11: Head and shoulder pattern for Blackberry stock during the priod between end of June and beginning of August of 2014.

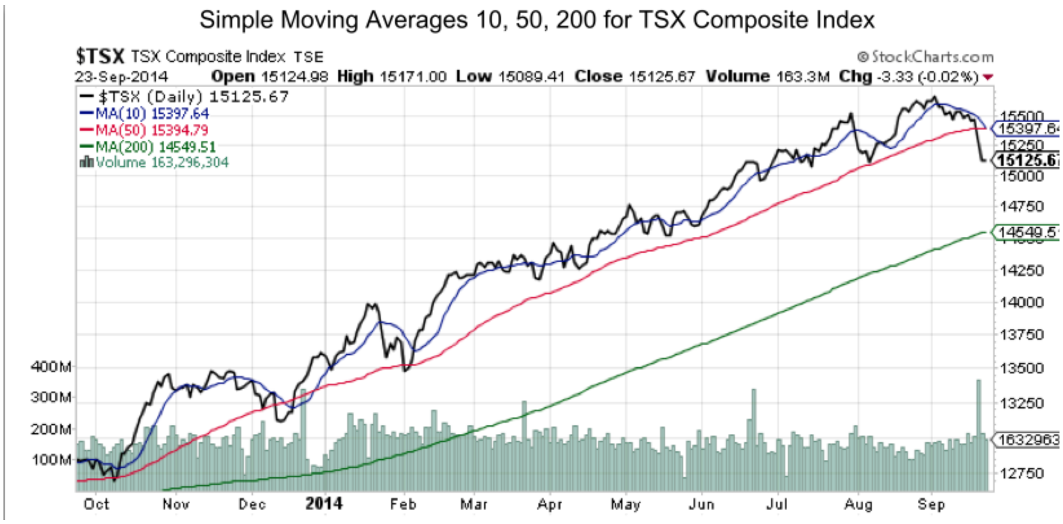

Figure 4.12: The 10, 50 and 200-day simple moving averges for the S&P/TSX Composite Index during 2014.

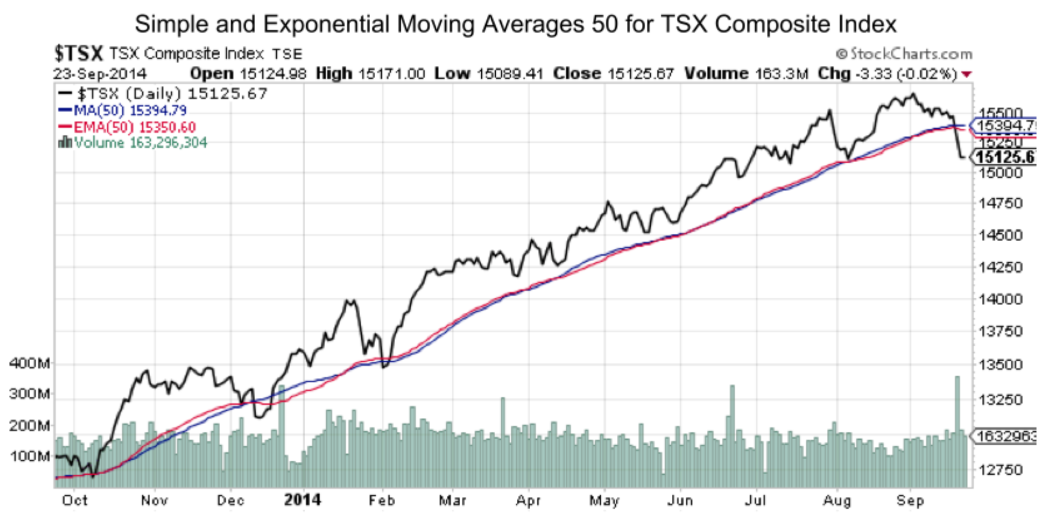

Figure 4.13: A 50-day simple moving average versus an exponential moving average for the S&P/TSX Composite Index during 2014.

crosses 0 from below and increases, it is usually viewed as a bullish signal. Conversely, if MACD is less than 0, the fast EMA is lower than the slow EMA, and we are witnessing a down-trend. Likewise, when MACD crosses 0 from above and decreases further, it is viewed as a bearish signal. Clearly, the value of MACD will fluctuate around 0 depending on the momentum of the price movement. Figure 4.14 shows a MACD oscillator chart for the TSX composite index during the period between October and September 2014.

Another very popular oscillator is the **Relative Strength Index** (RSI). Like MACD, RSI is an oscillator that describes the momentum of a security's price. It is calculated in such a way that it varies between 0 and 100, and gives an indication of a relative strength between up an down price moves over a set period, most commonly 9, 14 or 25 days. By convention, the two critical levels for RSI are typically 70 and 30. When RSI is over 70, it is a bearish signal, the average up moves are dominating greatly the average down moves and the security is deemed to be **overbought**. On the other hand, when RSI falls below 30, it is a bullish signal, so the security is deemed to be **oversold**. Because of this, RSI can be particularly useful for spotting potential tops or bottoms in price trends. Figure 4.15 shows a relative strength index for the TSX composite index during the period between October and September 2014.

Another frequently used index is the **On Balance Volume** (OBV). Like MACD and RSI, it can be an indicator of momentum. It is popular, because it combines volume with price change information. In particular, OBV is a running total of daily trade volume. Volume on days when close is above open is added to OBV total and volume on days when close is below open is subtracted from OBV. As a result, OBV fluctuates around 0, and indicates when the money flows into or out of a particular security. OBV chart is analyzed for patterns and compared with the price movement to better understand the dynamic of money flows. Figure 4.16 shows an OBV chart for the TSX composite index during the period between October and September 2014.

Finally, it is worth mentioning that this section is by no means meant to be a comprehensive review of technical indicators. It is only limited to the most well-known indicators. There are hundreds if not thousands of other indicators and chart patterns that can be analyzed in practice.[19] At the end of the day, these are considered tools in the financial analysis toolbox of an investment manager, and their usefulness and effectiveness depend on the skill with which they are applied. Whether or not following purely technical analysis can result in a consistently profitable strategy at all is up for debate. Nevertheless, many practitioners continue to turn to technical analysis in their work, most often combining it with thorough fundamental analysis to get a more complete picture. Traders in particular, favor technical analysis as a means of timing the entry and exit points. Timing as we will see, plays a particularly key role when it comes to the implementation step, which is the last step in the portfolio construction phase.

4.3 Implementation

Knowing what you need is sometimes only half of the challenge, the other half is actually getting a hold of it at a reasonable price. After portfolio managers decide how to allocate the funds across different asset classes and which securities to select within each asset class, they pass the instructions to **buy-side traders** for the **implementation** step, also known as **execution**. It is then up to the buy-side traders to generate and **execute** buy and sell orders in order to construct the final portfolio. Due to the fiduciary duty that asset managers have toward the clients, they must always use "**best execution**," which, in a nutshell, means that they must execute client trades at the best net price under the circumstances.[20] This should be documented and could,

[19] For a comprehensive review on the subject of technical analysis, interested readers are ecouraged to consult the book by Thomas N. Bulkowski (2005).

[20] For more on "best execution," see the short article by Mr. Lemke; a partner in the Washington, D.C. office of Morgan, Lewis & Bockius LLP, on the following website: www.morganlewis.com.

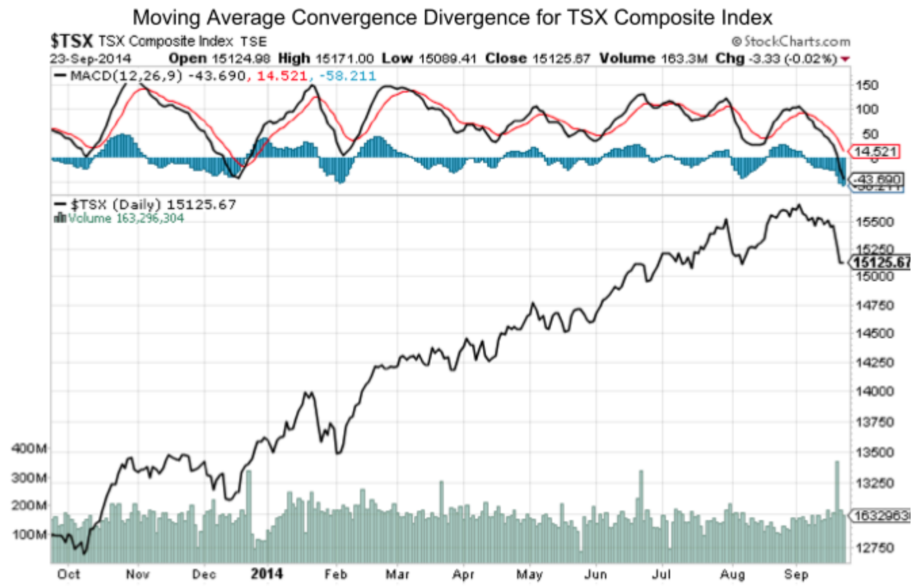

Figure 4.14: Moving average convergence divergence chart for the TSX composite index during the period between October and September 2014.

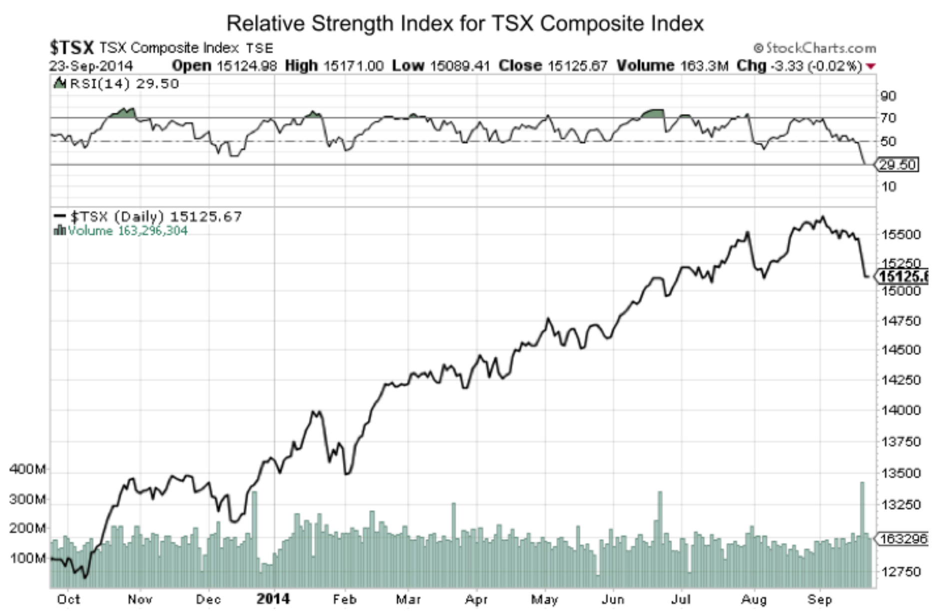

Figure 4.15: Relative strength index for the TSX composite index during the period between October and September 2014.

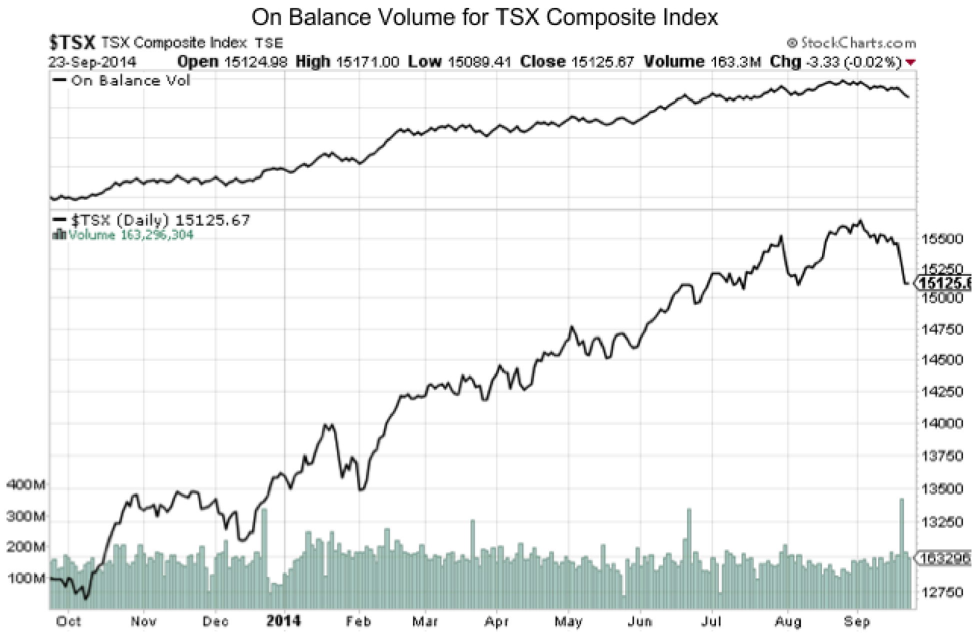

Figure 4.16: An on balance volume chart for the TSX composite index during the period between October and September 2014.

for example, be a process of obtaining three separate quotations and selecting the best one. At smaller firms, portfolio manager and trader roles are often combined, and it is common to see the same person performing both functions. Sometimes the execution function can be outsourced all together to a third party. At bigger firms, there can be large separate teams of portfolio managers and traders, each specializing in particular markets or types of securities. This Chapter is divided into two sections: the first discusses the costs and trade-offs associated with implementation and the second introduces a generic trade life-cycle.

4.3.1 Implementation Costs

When portfolio managers make investment decisions with respect to a security, the expected profitability of those decisions depends both on the price of the security and the costs associated with trading it. Therefore, it is critical that portfolio managers do not make their decisions based on price alone, but also take implementation costs into account as much as possible and adjust their analysis accordingly. There are two basic types of implementation costs, **explicit costs** and **implicit costs**.

Explicit costs are agreed on ahead of time and have a predefined formula. Thus, incorporating these costs into the analysis is relatively straight forward. These costs include commission, interest on margin, taxes, levies, stamp duties, market-specific trading fees, and potentially other fees. **Commission** should be familiar to individuals who undertake personal investment with a discount broker. Commission is a fee paid for each transaction to broker-dealers, sell-side traders or other counterparties who help to facilitate those transactions. Commission could be a flat fee or it could be a fee tied to the trade size or a combination of the two. For example, Questrade, a Canadian discount brokers, has a pricing plan that allows individuals to trade stocks for \$0.01 per share, with a total commission minimum of \$4.95 up to a maximum of \$9.95.[21] As a basic illustration, if you trade 100 shares of a stock that is currently trading at \$4.95, it will cost you 1% to buy and another 1% to sell the stock. Therefore, the final return would be reduced by 2% due to commission. **Interest of margin**, is only a cost when the investor borrows money in order to invest. For example, if your debit balance in your Questrade account is less than \$100,000 and you decide to buy stock denominated in Canadian dollars on margin, you will be paying interest at a nominal annual rate of 6%. Again, expected gains must be large enough to make using borrowing worthwhile. **Taxes**, **levies** and **stamp duties** are costs payable to the government. Taxes can sometimes have significant impact on the profitability of a trade, so they need to be carefully considered in the portfolio construction phase. Many professionals in the investment industry make a living by specifically managing investments in a tax-efficient manner for their clients. Finally, each market or exchange has a set of **trading fees** that they charge to all market participants who use their network to trade. For example, it is free to purchase equities priced over \$1.00 on TSX, but it actually costs \$0.0008 per share to sell. Individually, explicit costs may not seem like much, but they do add up and, therefore, should also be taken into account.

Implicit costs are costs that are not explicitly defined, and they generally can not be calculated ahead of time. They include the bid-offer spread, market impact, missed trade opportunity costs and slippage costs. The **bid-offer spread**, also known as the **bid-ask spread** or simply the **spread**, is equal to the difference between the **ask or offer price** and the **bid price**. The ask price is the price that an investor wishing to buy a security is willing to pay. The bid price, on the other hand, is the price that an investor wishing to sell a security is willing to receive.[22] The average of the ask and the bid is known as the **mid price**. Due to the supply and demand economics at play in the financial markets, the bid price is always greater than the ask price. Consider markets with **high liquidity** that have many active market participants as well as high volumes of transactions. Such markets naturally have more competition between buyers and sellers, which causes the bid and ask prices to be closer together resulting in **narrow** or **tight spreads**. On the other hand, markets with **low liquidity**, which means fewer participants, fewer transactions and less competition, have **wider spreads**. The reason that the spread is considered a cost in the execution step is because the actual value of a security at any point in time is best represented by the mid price. Imagine that the price for a particular security does not change for two days and the ask, bid, and mid prices all remain constants with bid < mid < ask. If an investor was to buy that security in the market, he would pay the ask price, and if he then sold it the next day he would pay the bid price. Even though neither the value of security nor the mid-price changed, the investor nevertheless lost the amount equal to the bid-ask spread. Buying at the ask, selling at the bid and, thus, incurring the full cost of the spread is known as **crossing the spread**. In addition, it should be noted that, even though bid-ask spreads tend to be relatively stable during normal market conditions, they can become considerably wider during market shocks, which makes predicting them more difficult.[23] The next implicit costs is **market impact**, which arises when a trader attempts to execute quickly an order that is relatively large for a given market. Because there is a limited number of market participants willing to transact at each price, larger orders can not usually be filled all at once and have to be broken down in smaller blocks. If those blocks are traded consecutively, the market price will rise slightly due to the increase in demand, and the blocks that are traded later will be executed at a slightly higher price than the ones that were traded

[21] The values in this paragraph are taken from Questrade Canadian Discount Broker.

[22] To avoid confusion between the ask (offer) and the bid, it helps to remember that these names were given from the point of view of the market makers and other sell-side participants. When buy-side participants, including retail investors, buy a security, such as a bond or a stock, they buy at the ask price, because that is the price sell-side participants are asking to receive in exchange for that security. Similarly, ask price is also the price at which sell-side participants "offer" security to buyers. Conversely, when investors sell a security, they sell at the bid price, because that is the price that the sell-side participants bid to pay for that security.

[23] For examples on US equities, see Angel, Lawrence, and Chester (2010).

earlier. This effect is called market impact and its effect on profitability can be very damaging. Whenever possible, traders try to minimize market impact during execution by splitting up and spreading out large orders as much as possible. Next, **missed trade opportunity costs** are the opportunity costs incurred when market limit orders do not get executed.[24] Finally, **slippage costs** or **delay costs** are the costs of spreading transactions over longer periods during which market prices can move and adversely impact the average price at which the trade gets executed. Sometimes, slippage costs are used more generally to describe the difference between the price at which the decision to buy or sell was made and the price at which the transaction took place.

Smaller orders on highly liquid markets can be executed almost instantaneously with negligible implicit costs. However, for large orders and illiquid markets, implicit costs can be rather large. In such conditions, there exists a fundamental trade-off: one could either target a specific time for execution or a specific price range, but not both. This trade-off is best illustrated by the relationship between market impact and delay costs. Executing a large order immediately will result in an adverse market impact for the investor, but investor will know at what specific time, his entire order has been filled. On the other hand, trading a large order over many days, may not produce large market impact, and will allow the investor an opportunity to wait for favorable prices. This introduces uncertainty with regards to the timing when the execution of the order will be complete, but may result in negative slippage costs if the market moves against the investor during the execution window. This also demonstrates that not all of the implicit costs are necessarily present at the same time.

Implicit costs can be quite substantial, and in many situations could be larger than explicit costs. Here is an example from Maginn et al (2007):

> "The Plexus Group estimates that average implementation shortfall costs in 2004 for institutional traders in Asia, excluding Japan, were 153 bps, with just 22 bps from commissions. Of the implicit costs, market impact costs were 18 bps, delay costs were 84 bps, and opportunity costs from missed trades were 29 bps."

Many institutional clients focus on trying to measure and reduce their implementation costs. Calculating implicit costs that were incurred during the execution step is not as straight forward as implicit costs, nevertheless there are a few approaches to analyzing them. The easiest approach is to use the half of the spread at the point when the trade was executed, or the **bid-mid spread**. However, this only accounts for the spread costs and ignores other potential implementation costs. Another, more popular way that was first introduced in 1988, is to use the **Volume-Weighted Average Price** (VWAP) as a benchmark and compare the actual average execution price to observed VWAP (Berkowitz, Logue, and Noser (1988)). VWAP, as the name implies, is just the average price of a security throughout the day weighted by volume at each price point, and it represents the average price of all executions in the market on that day. By comparing the actual achieved average execution price to VWAP, the investor will be able to tell if he was more or less successful than average and by how much. Finally, another popular method, also first introduced in 1988, is the **implementation shortfall** (Perold (1988)). Implementation shortfall is an approach that is considered to be more sophisticated than the other two because it attempts to be more comprehensive. Implementation shortfall is calculated as the sum of explicit and implicit costs. However it requires more granular market data to actually capture the different components of implicit costs.

If implicit costs can be so large for illiquid markets, then why not invest only in liquid markets? While there are many asset managers who specialize specifically in liquid markets for that reason, empirical research, see, for instance, Amihud and Mendelson (1986), supports the hypothesis that

[24] This is a potential problem when limit orders are used. Limit orders are orders sent to the market in the form of buy/sell security A only once the price reaches X, where X is called the limit price. Such orders have a predefined period during (typically one day) which they have to be executed before they are discarded.

if you can hold illiquid investments for a long time, then it may actually be possible to get better returns. In summary, both implicit and explicit costs impact the profitability of the trade and could ultimately render an investment unprofitable. Therefore, they should be carefully monitored and mitigated where possible.

4.3.2 Trade Lifecycle

Behind the scenes, processing of each trade is a every complicated process that involves many internal and external stakeholders. Moreover, this process is different for different organizations, markets and jurisdictions. Thanks to the advent of technology, the process has been undergoing significant transformation and is increasingly becoming more automated. The ultimate goal of this trend is to achieve **Straight-Through Processing** (STP), which basically means complete automation of trade-related processes from start to finish. While some markets such as the public equity markets are well on their way towards complete automation dream of STP, many other markets, especially OTC derivatives markets still rely heavily on many manual processes.

Although it may seem that way at times, trade lifecycle is not instantaneous and actually takes place over a period of several days. The typical time line for trade completion is **T+3**, which is also the time line Canadian and US equity trades. T+3 means that the whole process competes three business days after the **Trade date**, i.e., the date when the order was first executed. The end of a trade lifecycle is typically marked by the **Settlement date**, i.e., the date when the exchange of money for securities actually occurs.

While each specific trade lifecycle may be different, the generic trade lifecycle stages consist of the following general steps: pre-trade checks, order, execution, booking, matching, confirmation, post-trade checks, clearing and settlement. **Pre-trade checks** are often performed by the front-office teams to ensure that the trade that is about to be proposed does not violate any portfolio constraints, and is consistent with the investment strategy. Once the trade has been approved, an **order**, which is an instruction specifying what to buy/sell and at what price, is generated by the front-office team and sent to the trade counterparty. Orders are usually managed within an Order Management System (OMS). Once the order has been accepted by the trading counterparty, the trade is said to have been **executed**. At this point, the risks of owning a security are assumed by the buyer. Once the trade has been executed, details of the trade, such as price/quantity/amount/commission, will be recorded by both sides in a step known as **booking**. Front-office traders usually record trades in a system called the **trade blotter** that only records the most recent trades for convenience, while back-office teams may use other systems to simultaneously book the trade in a more permanent database. After booking, the back-office teams of the parties to a trade perform **matching** to identify the same trades before comparing their details. Matching may seem like a trivial step, but given the large daily volumes transacted between a multitude of counterparties, it is clearly essential. Once the trades have been identified, they are compared, and **confirmation** details are exchanged by the trade parties. There can be errors during this stage, especially for less automated types of transactions, so this check is critical. Any errors have to be resolved manually before the trade lifecycle proceeds. Significant errors may have to be reported to management or even the regulators depending on the rules of a local jurisdiction. Once the details of the trade are confirmed, it is sometimes prudent to do **post-trade checks** to verify that the trade is still in compliance with the specific investment constraints and objectives. This is often integrated into the risk management functions typically performed by the middle-office. When everything is in order, **clearing** takes place, which is a series of checks that ensure details about the buyers and sellers, e.g., the seller has the title to a security and buyer has the funds. Finally the **settlement** takes place whereby the security is delivered to the buyer and the money is delivered to the seller. Clearing and settlement usually take place within large dedicated service provider companies. For example, most of the clearing and settlement in Canada is han-

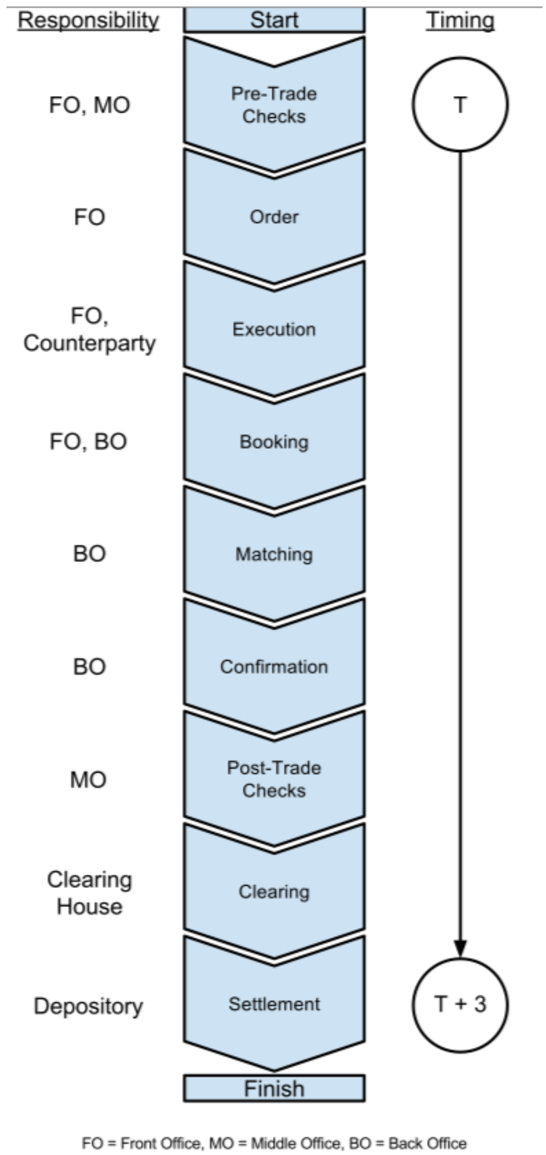

Figure 4.17: The trade lifecycle flow diagram.

dled by the CDS Clearing and Depository Services Inc., which is a subsidiary of The Canadian Depository for Securities Ltd. Figure 4.17 summarizes the generic steps and stakeholders of the trade lifecycle flow.

Factors such as types of financial instruments, use of collateral, use of derivatives, cross-border and cross-currency transactions, OTC transactions, and many others, could complicate the settlement cycle. The trade lifecycle is a potential source of operational risk, so it must be thoroughly understood to facilitate accurate execution.

Chapter 5

Evaluation

Finally, after the IPS is created, the allocation is decided, and portfolio is implemented, the evaluation stage begins, where the outcome of all of the preceding steps is thoroughly evaluated. Evaluation phase involves monitoring the changes in allocations and rebalancing the strategy to ensure it is properly implemented, as well as evaluating performance and reporting back to create a complete feedback loop with the planning and implementation phases. Ultimately, based on the outcome of the evaluation phase, the client will decide whether or not performance of the asset manager is sufficiently acceptable to continue paying them for their services.

5.1 Monitoring and Rebalancing

Once the allocation has been implemented, the actual relative **weights** of different investments within a portfolio must be monitored on a regular basis, usually at least daily for active strategies or monthly for more passive strategies. These actual weights tend to change overtime, either due to the difference in performance between various assets, new cash flows, or other reasons. The difference in performance could cause some position weights to exceed their maximum allowable weights as defined by the investment constraints. When this happens, it is called an **inadvertent breach**, and typically needs to be revolved within a predefined period of time to avoid deviating from investment guidelines. Cash flows, also cause the relative weights of instruments to change. Using the terminology of mutual funds, cash inflows are called **subscriptions** and cash outflows are called **redemptions**. It the duty of mutual fund managers to their clients to ensure that they provide equal proportional exposure to the portfolio for all of their investors. Therefore, when subscription cash comes in, it must be reinvested into the strategy right away to ensure all investors continue to have correct exposure to the underlying strategy and it does not get diluted by idle excess cash. For redemptions, the exposure has to be reduced and all the weights of underlying instruments should be adjusted downwards to generate cash to pay for redemptions and avoid creating excess leverage in the fund. The process of adjusting the positions to target weights after they have began to deviate is called **rebalancing**. How frequently asset managers need to rebalance is a choice that depends on the investment strategy. For example, a **buy-and-hold** approach is when securities are added to the portfolio at the beginning of the investment horizon and not sold for a long time. Buy-and-hold approach is most appropriate for investors with long-term investment focus who use passive investment strategies or deal with very illiquid investments. Alternatively, **periodic rebalancing**, is rebalancing on a regular basis according to a predefined schedule, it is more suitable for active investing and investors with short-to-medium term investment horizon. Frequent periodic rebalancing allows investment managers to maintain the allocation very close to the target allocation at all times. The downside of frequent rebalancing

Measure	Notes
Return	average return for a given period (daily, monthly, annual)
Volatility	standard deviation or returns
Downside deviation	standard deviation of only the negative returns in the time series
Sharpe Ratio	return in excess of the risk free rate per unit of volatility
Sortino Ratio	return in excess of the risk free rate per unit of downside deviation
Jensen's Alpha	return in excess of the return predicted by CAPM
Treynor Measure	return in excess of the risk free rate per unit of assumed market risk
Maximum Drawdown	maximum drop from a historical peak
Maximum Drawdown Duration	maximum length of time to recover from a drawdown
Value at Risk	the expected value

Table 5.1: Some popular Ex-post measures for evaluating historical performance of a portfolio.

is that additional implementation costs are incurred each time. Trading too often may reduce the profitability of a strategy and thus should be avoided. On the other hand, pure buy-and-hold strategy incurs implementation costs only at the start but is not responsive and does not react to updated market expectations. This trade-off between buy-and-hold and periodic rebalancing approaches should be carefully managed.

5.2 Performance Evaluation

Performance evaluation step consists of measuring performance, comparing the performance to expectations, understanding attribution of performance to various factors and finally making decisions based on this information.

Timely and accurate measuring of performance has always been a critical process for asset management industry. However, according to Detamore-Rodman (2007), universal calculation and presentation standards did not exist until 1980s. In 1987, the first set of guidelines was introduced that eventually evolved into the Global Performance Investment Standards (GIPS). GIPS is maintained and promoted by the CFA Institute. It sets out to create a unified global standard that would allow investors to have confidence in the reported numbers and enable straight-forward comparison between performance reported by different asset managers. In order to claim compliance with GIPS, investment managers must obtain independent verification that their firm adheres to numerous standards concerning valuation, calculation, disclosure, advertising, presentation and reporting. Nevertheless, compliance with GIPS, although preferred by many clients, is still not mandatory.

When evaluating historical performance of a portfolio, there is a number of metrics that can be calculated from a time series of historical returns. When these statistics are backward-looking, i.e., when they are calculated from realized historical observations, they are described as **ex-post**.[1] Some of the most popular ex-post measures are summarized in Table 5.1.

The above measures are calculated for a number of specified time periods, usually 1, 3, or 6 months and 1, 2, 3, 5 years. Year-to-date periods are also common. Return, volatility and most other measures are almost always annualized in practice to simplify comparison across periods.

After performance of investment managers is measured, it is frequently compared to the performance of their **benchmarks** or other competing managers, their **peers**. Benchmark selection is a topic in itself. Selecting the appropriate benchmark is crucial, because performance will be judged in relation to that benchmark. When the investment objective is to track the benchmark is closely as possible, the key metric is **tracking error**, which is the standard deviation of the difference

[1] Ex-post means "after the fact" in Latin.

between portfolio returns and the benchmark returns. The smaller the tracking error, the closer the portfolio performance tracks that of the benchmark. **Information ratio**, is the measure of how much return in excess of the benchmark return the manager generated per unit of tracking error. Information ration is similar to sharpe ratio and the higher values are considered more favorable. The manager's **active return** is the difference between manager's achieved return and the return on the benchmark. Likewise, manager's **active risk** is defined as the standard deviation of active returns. If the benchmark used by the investor is not the same as the benchmark that the manager follows, then from the point of view of the investor the active return could be further divided into **true active return**, the return in excess of the true benchmark and **misfit active return**, the return between true benchmark and incorrectly specified benchmark. The concepts of misfit and true apply to active risk as well. Overall, the goal is to maximize active return by concepts of misfit risk and misfit return are introduced.

The final stage of evaluating performance is **attribution**. Attribution is the process of breaking down the performance during a particular period by different **exposures** or **factors** that drove the return of the portfolio Attribution analysis allows portfolio managers to identify which investments had the best performance during a particular period and how they contributed to the overall return of the portfolio. Attribution analysis is also very helpful for communicating with the investors and explaining the effect of various allocation decisions and increasing the transparency of the fund management process and may produce some valuable insights for improvement.

Investment managers have to regularly report their performance to the clients. Based on these reports, investors will then make a determination if they are satisfied with the returns provided by the asset managers. If the clients deem the performance of the investment managers unsatisfactory, they can simply redeem their money and invest with another investment manager. In order to prevent this from happening, investment managers have to carefully analyses the feedback from the portfolio evaluation phase and strive to continuously improve the portfolio management process. In conclusion, it is worth emphasizing that portfolio management process is a continuous cycle and each off the three phases is critical to the overall success of the asset management company.

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