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***PART I: A SHORT OVERVIEW OF VALUATIONS***

**Chapter 1. Introduction**

Adam Smith, the renowned philosopher once wrote: “all money is a matter of belief.”[[1]](#footnote-1)

In 1906, Marcus Goldman took this insight and monetized it, when he sought to raise capital for the [United Cigar](https://www.goldmansachs.com/our-firm/history/moments/1906-united-cigar.html) company. At that time, Goldman gave a more concrete definition to valuation, with his development of the ground-breaking technique of using a company’s future earnings potential to establish a valuation of a firm and attract long-term equity investments.

The successful sale of United Cigar’s common shares based on this principal became a model for future industrial and retail transactions, and was used by the leading retailers at the time. After World War I, financial valuation grew into an academically and market-validated concept, becoming the gold standard for establishing the value of and raising capital for new companies in industries that were asset-poor and precedent-lacking, yet rich in potential.

Decades later, and valuations have become a standard in almost all financial activity, from mergers and acquisitions of publicly traded firms to the allocation of shares in a private firm and for the meeting of basic needs. In recent years, with technology companies emerging and becoming a vital part of investors’ portfolio, the challenge has arisen of adapting valuation tools to be able to evaluate these assets and assess the potential of new developments.

From the viewpoint of large companies, valuation is based on forecasts of free cash flow. In technologically-driven industries, the pipeline or the products that a given firm has in its portfolio can represent a large fraction of market capitalization. The situation is even more critical for small companies committed to a single idea, as all of their value is linked to a single project and based on their intellectual property (IP). Any business transaction in which innovative projects or products are being valued or exchanged requires a realistic valuation of those items, as does any internal proposal to initiate or terminate an R&D project. Moreover, different projects have very different dynamics. Pharmaceuticals have very long lead times and are dependent on patents as well as on out-licensing deals. And while software can be developed very quickly, IP is difficult to value.

This work is intended to provide a practical guide for entrepreneurs, investors and financial advisors for constructing and understanding valuations of technology companies, mainly startups, in rapidly shifting industries, focusing on life sciences (pharmaceuticals), cybersecurity and renewable energy.

While this book focuses primarily on the financial aspects of valuation, it also draws on a number of interdisciplinary approaches, especially with respect to the issues encountered when evaluating early-stage ventures. Of particular importance is our analysis of psychological insights into investor and entrepreneur behavior at different intervals throughout the valuation process. Until now, the normative approach to economic modeling has been based on traditional assumptions of economic rationality. This approach is now being increasingly tempered by new insights into the psychological aspects of decision making.

The many traditional models of rational decision making view the mind as if it were an omnipotent being. However, the perceptions of all human creatures about the world, and their ensuing decisions are affected by limitations of time, knowledge, and decision-making abilities. Most “real-life” areas, such as capital markets, involve uncertainty, which leads to investors’ “bounded rationality,” meaning that they actually can see and assess only an incomplete and possibility even misleading snapshot of reality. If one seeks to understand how human minds work, one must look not only at how our reasoning is “limited” in comparison to an ideal model, but also at how our minds are adapted to real-world environments.[[2]](#footnote-2)

Herbert Simon, Nobel Prize Laureate and father of behavioral finance, viewed bounded rationality as consisting of two elements that are inextricably intertwined. The first is the inherent limits on the way the human mind functions, and the second is the nature of the environments or areas in which the individual must make judgements. With respect to the inherent limits of the human mind, the argument is that models of human judgment and decision making should be built on what we actually know about the mind’s capacities rather than on conjectures that may have no basis in reality. In many actual situations, it is impossible to know what the optimal strategy is. Even in a game such as chess, where an optimal (best) move does in fact exist at every point, there is no strategy, whether generated by a person or a machine, for determining the perfect move in a reasonable amount of time, despite the well-defined nature of the possibilities to be searched. There is even less of a possibility of finding an optimal strategy in the real world with less defined and more dynamic conditions. As a result of this and the mind’s inherent limitations, people use approximate methods to handle most tasks.

These methods include recognition processes that largely allow people to eliminate the need to search for further information. The second method involves decision-making processes for making a search and determining when sufficient information has been accumulated to make a determination. Finally, people turn to and even subliminally use simple decision-making rules that they apply to the information found. After clarifying the elements of a valuation and how they are applied to a company, the general issues that need to be addressed when making a valuation about the company itself and its market environment, and the special challenges of making valuations for new technology and startup companies, it becomes clear that not all valuations “are created equal,” given that emotional and irrational factors influence the judgements made by everybody, including financial professionals.

To help professionals and laymen alike, this book presents some examples taken from actual valuations of life science, cybersecurity and renewable energy companies. These examples illustrate how the rules and theories discussed throughout the first part of the book are put into practice when making valuations in new technology companies in the life sciences, cybersecurity and renewable energy fields.

While all these valuations are based on deep and thorough investigations of financial, market, sector and technology factors, they also reflect the inevitable limitations of human psychology and behavior. As discussed, the human mind is not capable of even approximating perfection when constructing its states of knowledge and beliefs There are numerous reasons for this, and they affect the work of valuations done by professionals.

For example, hindsight bias, or our inevitable preference to see the world as predictable and stable, as well as our overestimation of our ability to overcome our limitations and predict outcomes is a ubiquitous trait. It enables all of us, including professional analysts, to understand and cope in unpredictable environments, like those of startup companies. But hindsight bias can cause decision makers to underestimate volatility and consequently invest more than they would have had they been able to accurately assess the risk. Therefore, the financial performance of a hindsight-biased individual is likely to be lower than that of one without this trait.

Other problems afflicting valuations are confirmation bias, whereby an individual interprets evidence in accordance with his or her initial beliefs, beyond the level justified by the evidence. Confirmation bias is more likely to arise when evidence contains alternative interpretations and is ambiguous, which is common in innovative ventures, or when there has been selective collection and analysis of evidence, forcing individuals to judge the relationship between distinct events, despite the fact that individuals require the aggregation of data from different sources, which is not always available in these young industries. This also presents a challenge to the professional analyst, as can been seen in the practical examples offered in the book.

This book explores the proposition that cognitive resource scarcity influences investors when analyzing early stage firms and their technology. If we can accept and understand this in theory and in practice, we will be better equipped to overcome our resource scarcity.

## Chapter 2. Understanding Financial Valuation Foundations and Basic Traditional Techniques

***2.1 Background***

This chapter aims to clarify the concept of valuation in general, and in R&D-intensive industries specifically. It also seeks to demonstrate the importance of valuations, and their significance for the fate of entrepreneurs, their companies, and technologies.

Assigning a single figure valuation to a company is challenging for financial analysts and daunting for entrepreneurs. Analysts have the arduous task of making difficult assumptions and determining the numbers, while entrepreneurs understand that a valuation represents the market’s judgement of a lifetime’s work, sometimes even several lifetimes in cases of family businesses. Can a single sum reflect the true worth of an innovation or the entirety of the business behind it?

The short answer is no, it cannot. But that is no reason to put this book down just yet! It may prove helpful to consider corporate valuation just as Churchill considered democracy: “…the worst form of government except for all the others.”[[3]](#footnote-3) While valuation is by no means perfect, it is the best known and most widely tested method we have.

This chapter begins by asking what is a corporate valuation. To address this question fully, we examine the often ignored issue of the value of money, which is critical for understanding the importance of monetary valuations, particularly from a behavioral perspective. We then explain some critical definitions. The chapter continues by discussing the advantages and some of the drawbacks of valuations. This includes the importance of, and need for, valuations, how they are used, and some of their consequences in the market. We conclude with a preliminary explanation of how valuations are not created equal but come in numerous shades and stripes, especially in the high tech sectors.

### *2.2 It’s All About Trust*

Much like money, which at face value is nothing more than a piece of paper, valuations have become standard “currency.” This is because market actors accept them as the optimal representation of a company’s value. This process mirrors what Niall Ferguson has called the “ascent of money:”[[4]](#footnote-4) a system of exchange that is accepted across all human societies despite the good itself being inherently worthless.

In this section, we discuss the relationship between money and valuations. It is important to first understand from where money comes and how it works. In his bestselling book *Sapiens, a Brief History of Humankind*, Dr Yuval Noah Harari of the Hebrew University of Jerusalem describes money as a “figment of our collective imagination:”

Today, the whole of humankind has become a single network of cooperation. Though even today not all people believe in the same god or obey the same government, they are all willing to use the same money. Osama bin-Laden, for all his hatred of American culture, American religion, and American politics, was very fond of American dollars*.*[[5]](#footnote-5)

Harari, like Adam Smith centuries before him, concludes that trust is the true value in money. So, too, a financial valuation is only as meaningful as the credibility of the person who constructs it. While an analyst must have a strong general financial background, valuations are credible only if the analyst has a moderate to advanced understanding of the company’s business model, its corporate strategy, the market in which it seeks to compete, and, most importantly, the product it is offering.

**Just as money is an instrument based on trust, so too are corporate valuations.**

***2.3 What is a Valuation?***

Valuation is defined in many different ways, but keeping things simple is likely to be the most helpful approach. Accordingly, valuation can be defined as follows:

**Valuation is the amalgamation of all the different valuable elements of a certain entity while taking into account the variables which may impact the value of those elements to arrive at a single encompassing figure.**

A corporate valuation is a valuation performed on a business. There are four types of corporate valuations.

1. **Fair market value:** This is the business value of enterprise as determined by a party interested in buying and a party interested in selling under conditions of perfect information and zero coercion.
2. **Investment value:** This refers to the price of a company for a particular investor, with the synergy between the investor’s profile and the company’s business representing a major determinant of the valuation.
3. **Accounting value:** This refers to the net assets of the business according to its balance sheet.
4. **Intrinsic (or economic) value:** This is the measure of a business’s value as reflected by an investor with a deep understanding of the company’s economic potential.

This book examines intrinsic economic valuations of firms. At times, these may involve consideration of fair market, investment, and/or accounting valuations, but never only one of these and seldom a single amalgamation of all three.

### *2.4 The Advantages and Disadvantages of Corporate Valuations*

The usefulness of a corporate valuation varies depending upon the perspective of the potential audience. Corporate valuation techniques can be useful to credit sources, equity investors, management, potential acquirers, auditors, and competitors, each of which may have a particular interest in distinct aspects of information. This suggests that there is not just one way to examine and analyze a company that is appropriate or reasonable for all clients. It should always be borne in mind that providing a company valuation is significantly different than performing a detailed audit. The analyst making the valuation is not entirely interested in questioning the given finances. Nor is the analyst performing a comprehensive diagnostic of all the company’s operating activities and their industries. Rather, the analyst will focus on the most important areas that will show where the company’s value lies.

In the absence of a transactional activity or precedents, financial valuations can be used to define the fair value of a business for a variation of reasons, including for the sake of a sale, entering into a partnership ownership, or even personal proceedings, such as divorce. Share owners will often approach outside professional business valuators to receive an objective value of their company. Valuations are often carried out by analysts to reflect the interests of the recipient. For example, analysts could use a method that delivers a low valuation for buyers and a method that delivers a higher valuation for sellers. Similarly, valuations for those with a financial interest in the company are likely to be higher, while valuations for those with a financial interest in a competing company may be inclined to devalue the company under examination. Indeed, in such cases, these figures might be publicized. A truly independent valuation is difficult to achieve. However certain regulations in recent years have sought to address this. Under the new European **MiFID II** reform legislation to protect investors and increase transparency, for example, brokers in Europe must choose between charging for investment research or performing as investment bankers.[[6]](#footnote-6)

### *2.5 What Does a Corporate Valuation Reflect?*

Any corporate valuation needs to remain focused on its primary purpose of determining and integrating all the different “valuable” elements in a single commercial entity in order to assess the overall value of the business. For example, it would not be possible to determine how competitive a company is within its sector simply by using financial statements to gather and analyze information about it. A company’s value is strongly affected by its competitive position, and a highly saturated market is a major risk factor that can have a serious impact on the value of a business. Only by considering all the elements that contribute to or impede a company’s value is it possible to specify a credible value range. The value range represents an informed opinion of what the company in question could be worth.

It should be emphasized that corporate valuation is just one type of valuation. Consider property valuation, for example. When evaluating a property, a property appraiser could simply walk through a house and add together the number of bricks, pipes, light bulbs, floor panels and so on, then account for their depreciation, and add the cost paid for the land. Such an appraisal, assigning a value to the property as if it was located on a deserted island in the middle of an uninhabited planet would be of little use in the market. In fact, failing to account for the drivers and constraintsof value in the property market renders such an appraisal meaningless.

Now imagine that since this property was placed on the market, its location has become a war zone, scientists have discovered that it is earthquake-prone, and several outbreaks of epidemic diseases have been recorded among residents. Would you still be willing to pay the total value of its raw materials? Of course not! You would naturally expect the value of the property’s elements to be discounted.

In contrast, imagine that since this property was placed on the market, a densely populated cosmopolitan city has sprouted around it, offering an attractive lifestyle and environment and resulting in soaring land rents. Such a property would never be sold for the composite value of all its building inputs and original land price because individuals would be willing to pay more to enjoy the advantages in the area. These elements have value, too.

Consequently, information is gathered about a firm and models are constructed about its activity in order to provide objective projections of a firm’s financial performance in its sector. These projections and the interpretations of them then provide the basis for valuing the firm as a whole and then for any securities it has issued. This remains the bread and butter of any corporate valuation, but there are many additional courses that the analyst needs to consume before finishing the entire valuation meal.

**Time as a Variable in the Value of Money**

The value of a unit of currency does not deviate in absolute terms. Nonetheless, money actually flowing into the company in the present is clearly more valuable than funds that have yet to be received, regardless of the value of the money anticipated in the future. Therefore, when valuing the firms, the funds expected to be received in the future are converted into equivalent current values. The factors taken into account in evaluating the value of a firm and its assets include:

* **Present Value (PV)** refers to the value of current cash intakes or the equivalent value of funds expected in the future based on a defined rate of return.
* **Net Present Value (NPV)** refers to the differential between the current incoming revenues and outgoing payments and costs over a period of time.
* **Future Value (FV)** refers to the future value of a current asset at a specific date in the future based on a reasonably anticipated rate of growth.

As with a property valuation, the analyst needs to assess the firm in the context of its environment. What is the company’s current and projected market share? Are there several possible scenarios for this projection? What is the projected revenue for each scenario? What factors might influence these possible variances?

Consider the example provided in the figure below. Here we are looking at just one element in the valuation process: the value of the company’s projected revenues for the coming years. The analyst may estimate this based on company data, but understands that a positive forecast is dependent not only on the company executing its strategy as planned (itself a point of uncertainty) but also on the market responding to the execution of its strategy in the fashion that the company anticipates. One way to mitigate the uncertainty this engenders is to take into account several possible scenarios.

**Company’s Revenue Projection**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | |  | | | | | | | |
|  | **Y 1** | **Y 2** | | **Y 3** | **Y 4** | **Y 5** | **Y 6** | **Y 7** | **Y 8** | **Y 9** |
|  |  | |  |  |  |  |  |  |  |
| Value of future revenues | | | | | | | | | | |

**Market Scenario Revenue Projections**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | |  | | | | | | | |
|  | **Y 1** | **Y 2** | | **Y 3** | **Y 4** | **Y 5** | **Y 6** | **Y 7** | **Y 8** | **Y 9** |
|  |  | |  |  |  |  |  |  |  |
|  | | |  | | | | | | | |
|  | **Y 1** | **Y 2** | | **Y 3** | **Y 4** | **Y 5** | **Y 6** | **Y 7** | **Y 8** | **Y 9** |
|  |  | |  |  |  |  |  |  |  |
|  | | |  | | | | | | | |
|  | **Y 1** | **Y 2** | | **Y 3** | **Y 4** | **Y 5** | **Y 6** | **Y 7** | **Y 8** | **Y 9** |
|  |  | |  |  |  |  |  |  |  |
| Value of Future Revenues | | | | | | | | | | |

*x: market size*

*Y: Year*

*PV: Projected Value*

*Fig. 2.1: Models for Valuing a Company’s Projected Revenues*

The above example is simply a numeric illustration of the concept of uncertainty. But how can one arrive at these values? There are several methods, all of which involve examining the market, similar companies, historical success rates at different milestones, regulatory barriers, rates of adoption of new technologies, and many other factors. A business, like a property, doesn’t exist in a vacuum. It is part of a dynamic market where real people exchange goods and services. These people have needs, wants, preferences, biases, and values — all factors that create uncertainty when it comes to forward-looking statements and figures.

***2.6 Different Valuation Methods***

The multitude of valuation methodologies to choose from is both an advantage and a disadvantage. As mentioned, the choice of method may be informed by a bias. However, the range of methods to choose from also provides an opportunity to corroborate valuations that somehow seem inaccurate.

Some of the better valuation methods include:

1. **Market Capitalization:** This is the most common financial valuation technique. The evaluator calculates the value of the company by multiplying its share price and the total number of outstanding shares. It is the most common technique used to value public companies, the shares of which are traded freely on the stock market. Valuation of a public company that significantly deviates from its market capitalization without providing specific justifications for this digression should be treated with scepticism.
2. **Times Revenue Method:** This technique applies a multiplier that is specific to an industry or economic sector to the streams of revenues generated by a company over a certain time period. For example, a new technology manufacturing firm may be valued at three times its income, while an auditing firm in the service sector may be estimated using a multiplier of five. The times revenue method is a quick way to determine if a stated valuation range is “in the ballpark.” However, this method is difficult to apply to companies that operate in a variety of industries, like Amazon, or companies aspiring to create new industries, like Airbnb. Moreover, scholars fail to agree on the extent of the multipliers. Consequently, a sensitivity analysis should be conducted along several intervals of a suggested multiple and generate either an average or, ideally, a weighted average of the results.
3. **Earnings Multiplier:** With the Earnings Multiplier approach, a more accurate evaluation of the actual value of the firm can be made, since profits are clearer indicators of the performance and success of a company than its sales revenue. The earnings multiplier adjusts the projected profits of a company against the cash flows it can generate if the money is invested using the current interest rate over the same period. It adjusts the current Profits to Earnings (P/E) ratio to account for current interest rates. This method is almost impossible to employ for a private company or any other firm that does not compete with a publicly listed competitor of a similar profile and size. Nevertheless, under the correct circumstances, it is a very sound way of determining the accuracy and credibility of a particular valuation.
4. **Discounted Cash Flow (DCF) Method**: The DCF method is similar to the earnings multiplier method, as both techniques are based on future cash flow projections, which are adjusted to determine a company’s current market value. However, the two methods are different in that calculating the present value using the DCF method must take inflation into account. The main impediment to using this technique as a validation method for testing the accuracy of a given corporate valuation is the extensive amount of labor involved. and the necessary information gathering required to construct a comprehensive DCF model. As a result, the DCF method is more often used to perform valuations “from scratch” rather than to corroborate the credibility of a stated valuation.
5. **Book Value:** This refers to the value of the owners’ share of a company’s assets as indicated in the financial reports. It represents the differential between a company’s total liabilities and its total assets. This method is an extremely efficient way to determine the value of a firm. However, because its use is limited to public companies, it must be used together with another method to determine total company value, as book value considers only a company’s accounting value and not its economic value, which most valuations aim to capture.
6. **Net Asset Value (NAV) Method:** This method shows a company’s net value and is computed by deducting the total liabilities of a business from the total value of its assets. Book Value and NAV method have similar limitations with regard to assessing the complete and accurate value of a listed company.
7. **Gordon Model:** The Gordon Growth Model evaluates the innate value of a stock based on a projection of future dividends that increases at a constant rate. It is a common and simpler variation of the dividend discount model and is mostly used as an important element at the start of the overall valuation process. It is particularly popular for use as a quick tool to corroborate a valuation in the fixed income sector. It is calculated as follows:

Current stock price

Constant cost of company’s equity capital (return rate)

Value of next year’s dividends

Constant growth rate expected for dividends in perpetuity.

The above methods represent commonly used valuation techniques and not an exhaustive list of all the possible methodologies. Other methods include breakup value, asset-based valuation, replacement value, and still many more.

**All valuation methods, regardless of the factors they employ, have inherent advantages and disadvantages**

With such significant limitations, such as potential bias and conditions of limited information constantly constraining both the performance and accuracy of corporate valuations, it is certainly legitimate to question what possible advantages corporate valuations have that justifies their current pervasive use in both academic and capital market circles today. Once again, an historical lens may be helpful to gain understanding.

|  |
| --- |
| **Goldman Sachs and the Discovery of Corporate Valuation**  There may be no other financial services firm that has had as great an impact on the concept of valuation as Goldman Sachs. Established by Marcus Goldman and his son-in-law Samuel Sachs in New York City in 1882, the Wall Street firm joined the New York Stock Exchange (NYSE) in 1896 under the leadership of Henry Goldman, Marcus’s son. It would change the financial industry forever.  Goldman Sachs and other Jewish-owned firms had struggled to grow because they had not been permitted to underwritecertain types of businesses like railroads, utilities or banks. These were the big businesses at the turn of the century, the tech unicorns of their day. However, Jewish firms could underwrite retail businesses, so Goldman began to focus on what were then niche services, like investment banking and securities trading.  In 1906, Goldman made his break in what was then termed industry financing,principally for the retail sector. In seeking to raise capital for the [United Cigar](https://www.goldmansachs.com/our-firm/history/moments/1906-united-cigar.html) company, Goldman developed the ground-breaking concept of using a company’s future earnings potential to establish a valuation of a firm and attract long-term equity investments.  The successful sale of United Cigar’s common shares based on this principal became a model for future industrial/retail transactions, including for the biggest retailers at the time, such as Sears, Roebuck and Co. ([1906](https://www.goldmansachs.com/our-firm/history/moments/1906-sears-roebuck-ipo.html)), Underwood Typewriter Co. (1910), B. F. Goodrich, and F. W. Woolworth (both in [1912](https://www.goldmansachs.com/our-firm/history/moments/1912-woolworth-ipo.html)). After World War I, financial valuation grew into an academically and market-validated concept, becoming the gold standard for establishing the value of, and raising capital for, new companies in industries that were asset-poor and precedent-lacking but rich in potential. |

This historical look at the beginnings of corporate valuation in the modern financial market underscores a key benefit of the technique: it can establish value for firms under conditions of uncertainty and when returns are expected only in the future.

Before the use of corporate valuation, people only conceptually understood that enterprises with uncertain future earnings actually had value. Until the early twentieth-century, this value remained largely unstructured and had certainly never been instrumentalized. Without such changes in thinking about value as those first introduced by Goldman Sachs, many industry leaders would not have had their ventures financed and would probably have never emerged to be the drivers of economic growth that they are today. This applies equally to retail enterprises, such as supermarkets, fashion, food and beverage, as it does to more technologically advanced enterprises, such as pharmaceuticals, medical devices, software and alternative energy.

The same constraints that existed in the retail markets in which Goldman Sachs applied its early corporate valuation techniques still exist today:

* Time: involving valuing today something that has only future potential;
* Resources: referring to a company without any capabilities today looking for investment to acquire resources and generate business in the future; and
* Information: relevant for industries that are technologically complex or radically innovative.

However, these constraints are far more significant in industries developing the disruptive technologies with which today’s analysts have to contend.

## 2.7 What are Capitalization Rates? Why are They Important?

One of the main factors in evaluating technology firms is the capitalization rate. This refers to examining the level of uncertainty about how much future cash the company will be able to generate. The capitalization rate is determined using the cost of equity model, calculated by calculating the return a company needs to earn in order to assess whether an investment meets its capital return requirements.

The cost of equity for a firm is the remuneration the market demands in return for purchasing it and taking on the risks that come with proprietorship. The dividend capitalization model, also known as the capital asset pricing model (CAPM) is usually used to calculate the cost of equity. Companies with debts such as loans or bonds have diverse capital structures, and in these cases, the weighted average cost of capital (WACC) needs to be calculated.

The WACC could involve determining a firm's cost of capital, weighting each category of capital proportionately. A WACC calculation assesses all sources of capital, including bonds, credits, stocks, and more are included in. Analysts calculating the WACC will calculate the relative weight of the cost of each capital component. The sum of these factors is increased by the corporate charge rate, or “1.” The formula for calculation the WACC includes the following values:

* Re = equity cost
* Rd = debt cost, which can be the company’s bonds’ or loans’ rate
* E = the firm’s equity’s market value
* D = the firm’s debt’s market value
* V = E + D = the firm’s financing’s total market value
* E / V = equity percentage of financing
* D / V = debt percentage of financing
* Tax = corporate tax rate

*2.7.1 Explaining the Formula Elements*

There are difficulties associated with calculating the cost of value (Re) which can be somewhat challenging to calculate because share capital, a definitive value, cannot be attributed to share capital. When paying a debt, the amount the company pays represents a predetermined but variable rate that can vary depending on the estimate and term of the debt, in spite of the fact that, for the most part, the value has been settled. However, in contrast to debt, there is no concrete cost to value that the company must pay. Nonetheless, equity does entail a cost. Since shareholders expect to receive a certain return on their investment in a company, the company can consider that expected rate of return a cost, because if the company does not provide this anticipated return, shareholders will basically reduce or withdraw their funds. As a result, both the share price and the company value will fall. At that point, the cost of equity is essentially what the company must spend to preserve a share cost that will be sufficient for its investors.

In contrast, calculating debt cost (Rd), is comparatively more logical. Simply, analysts use the rate a company is presently paying on its debt to determine debt costs.

E = the firm’s equity market value, is determined by stock exchange reports. The firm’s debt’s market value is found in the company’s financial reports. Debt is found under the liabilities section within the balance sheet and the corporate tax rate can also be found in the financial reports. Then, equity and debt combined represent the total market value of the firm’s financing. The remaining parameters can be calculated from the figures found in the financial reports, such as what percentage of financing is equity and what percentage is debt.

The inclusive required return for a company is its WACC. It can also be considered the discount rate that should be applied to cash flows regarding a risk similar to that of the company overall. Thus, in making decisions, company management will often refer to WACC to make decisions and to help them determine the economic feasibility of certain opportunities.

In most cases, early-stage companies do not have debt, as most financing is not received from banks. Financing in most cases is based on capital raising rounds. As a result, there is no need to calculate WACC. Nonetheless, liquidity is highly important for early stage companies, as time to market can be long.

Finance literature describes what is called the “liquidity trap,” when investors can invest money in a company but, due to low demand, are not able to later sell the stock. Thus, investors are taking some discount for their investments in dream companies. Liquidity is also an important issue for small-sized firms. Generally, firms from rounds A through D are all considered small-sized firms. Consequently, this discount or size premium must be taken into account when evaluating a dream company. In finance literature, size premium relates to the documented tendency of stocks of what are termed small-cap firms, or firms with smaller market capitalization, to outperform stocks of what are called large-cap firms, or firms with larger market capitalizations. That can be attributed to the higher risk perceived by investors which results in a discounted purchase price.

To that end, we need to add size premium to our capital asset pricing model (CAPM). We will delve into this more thoroughly using real-life examples later in the book.

***2.8 Valuations in New Technology Industries***

The financial significance of lead time when a firm engages full-time in product Research & Development (R&D)is perhaps the most difficult parameter when it comes to the valuation of high tech companies. In the retail industry, financing is primarily used to purchase or create inventory which could be sold almost immediately. A fashion business secures financing in order to produce a certain number of garments and to cover the costs of the first few months of rent for a store front and a staff. The business, if successful, would quickly generate revenues that could be used to purchase raw materials, create more inventory and pay for further operating expenses. If the business is unsuccessful, that lack of success would also be apparent very quickly and the investor would know to ignore further capital-raising efforts, and move on.

The process in R&D-intensiveindustries is somewhat different. Even when a project is often simply an idea, entrepreneurs are already looking for funding. Sometimes that idea has been substantiated by research, as in the case of academic technology transfer (often in life sciences, but also increasingly in information technology). More often though, the idea is simply an idea. It might be presented in a nice PowerPoint deck, but it is still just a concept. Initial funds are used by co-founders to pay for the expenses necessary to create aMinimal Viable Product (MVP). More funds might be needed to perfect this product. Further funds are then raised to release the product to the market and may be spent on advertising, sales teams, and more operating expenses, including rent, legal and accounting fees.

However, in certain highly regulated industries, like life sciences, an MVP is insufficient to bring an innovation to market. Depending on the regulatory environment and industry, approval of these products can take anywhere between a few years to nearly a decade. Invariably, companies willing to undertake this arduous commitment, and the investors willing to take the risk of backing them, are rewarded with a grant of market exclusivity for a specified period. In industries like renewable energy, where the lead time does not involve running trials to meet regulations, but rather the time and effort needed to construct facilities that connect with national grid infrastructure, firms are often rewarded with fixed feed-in tariffs, thus reducing the risk for investors and making the company a more attractive investment.

The key advantage of corporate valuation with respect to R&D-intensive industries is the ability of corporation valuation techniques to evaluate the long lead times employing a series of metrics based on market precedent. This valuation provides the company with some underlying quantitative value in the eyes of investors, and simultaneously protects investors against regulatory risk and recognizes the time value of their funds.

### *2.9 Conclusion*

In this section, we have examined why valuations are important, what they are, some of the factors they examine, and the different methods used. We have also seen how the multitude of possible methodologies for conducting valuations is at once a disadvantage, given the biases that might inform methodology choice, but also an advantage, as it allows for the corroboration of a given valuation through alternative methods. The multiple methods available are also advantageous in industries where information is imperfect, like high tech. Nevertheless, the ultimate underlying advantage of corporate valuation lies in its fundamental ability to depict the value of future revenues, whether the lead time is a matter of months, as in retail, or of years, as in R&D-intensive industries.

Earlier in this section, it was established that trust is the essence of any valuation, and that an arguable disadvantage of valuation techniques is their potential subjectivity. Valuation is not an exact science. In the next section, we will begin to introduce the details of the principle valuation methods, remaining conscious of the distinction between scientific and non-scientific methods. It will become apparent that valuation is at best a “quasi-scientific method,” and students, professionals, academics, investors and others should always be mindful of the limitations of corporate valuations.

***PART II:* *OVERCOMING VALUATION HURDLES: HOW TO CONDUCT VALUATIONS UNDER UNIQUE CIRCUMSTANCES***

## Chapter 3. Understanding the Basic Elements of Stockholder Statements and their Use in Valuations

***3.1 Background***

For publicly traded companies, stockholder statements contain information that is critical for performing a valuation. The balance sheet, cash flow statements, profit and loss (P/L) or income statements, and the valuations of non-operating assets in stockholder statements are critical financial statements that every public company must generate and present. These four financial statements provide an overview of the organization’s equity and financial performance, which is essential information for investors and creditors. This section will discuss and analyze these different reports.

***3.2 The Balance Sheet***

The balance sheet, or the explanation of an organization’s monetary status, contains a listing of the firm’s assets and liabilities. From the balance sheet, investors and creditors can view a company’s financial position at a specific time. The document has two parts, listed side by side, with assets on the left and liabilities on the right. The left side of the balance sheet containing the assets includes the organization’s inventory, cash, property, and the company’s investments, plant, and equipment. The right side of the balance sheet containing the liabilities shows the company’s financial obligations. The stockholders’ equity is also listed as a liability in the balance sheet. The stockholders’ equity is the difference between the company’s assets and liabilities, and reflects the organization’s net worth.

The assets recorded as assets on the balance sheet indicate how the company utilizes its capital and investments, while the liabilities recorded as liabilities provide a summary of the sources of capital and strategies the firm applies to raise funds when required.

*3.2.1 The Balance Sheet Identity*

The balance sheet identity is represented by the elements below.

**Assets**

Current assets are cash or assets that can be converted easily into cash in the near future, generally one year. Current assets include:

1. Cash and liquid securities and other short-term investments with low risks and that are easily disposable or converted into cash. An example of a marketable security is federal debt, since it matures within 12 months.
2. Accounts receivable, which are categorized as current assets. These are uncollected debts from the firm’s creditors.
3. Inventories refer to the company’s existing raw materials, works in progress and finished goods.
4. Other current assets that are listed in the inclusive category that consists of elements such as prepaid expenses, which include insurance or rent paid in advance.

Clearly, during the early stages of a firm’s development, only cash and other marketable securities are critical for the firm’s evaluation process, since most startup companies do not have inventory or accounts receivables during the early stages. The entry of the differential between how much was paid for the asset and the value on the balance sheet book represents the value of the intangible asset obtained by the company during the acquisition. Other intangible assets listed in the balance sheet include patents, trademarks, know-how, employees, and customer relationships. After an assessment, if there is a decrease in value over time of such assets, then the balance sheet’s value will be reduced through an impairment charge or amortization that reflects the changes in the acquired assets’ value. Neither amortization nor depreciation, are reflected as actual cash expenses.

An organization’s long-term include property that is not used on a daily basis, long-term securities investments, startup costs related to the establishment of a new business, and property that is expected to be sold. The total value of all the firm’s asset categories is indicated as the total assets as stated on the left side at the bottom of the balance sheet.

*3.2.2. Liabilities*

Current liabilities are defined as the liabilities that can be met or satisfied within one year. The current liabilities include.

1. Accounts payable, which refers to the amount owed to creditors or suppliers by the company for the purchase of goods or services on credit.
2. Notes payables, short-term debt, and the long-term debt’s current maturities with a repayment period within one year.
3. Payables, such as taxes and salaries that have not yet been paid, and unearned or deferred revenue, which refers to undelivered products or income that has not been received.

The firm’s working capital is determined by determining the differential between its current liabilities and assets, and represents the capital available that is needed to run the company in the short term of one year, with long-term liabilities extending longer than one year. The main types of long-term liabilities are:

1. Long-term loans, referring to debt obligations or loans with a maturity period of over one year. Firms tend to acquire long-term loans when raising funds needed to make an investment or acquire an asset.
2. Capital leases, that obligate a firm to make regular, long-term payments for use of a property or other physical asset are also long-term liabilities. By entering into a capital lease agreement, a company is able to gain access to an asset through leasing rather than by directly purchasing it.
3. Deferred taxes are long-term liabilities and they refer to owed taxes that have not yet been paid. The two sets of financial statements that companies serve two different purposes: financial use and tax purposes. Occasionally, the rules for preparing the ­­­­­­two sets of financial reports are not identical. Deferred tax liabilities are created by an increase in the financial income that exceeds the income level used by the firm when calculating the tax. The balance sheet defines deferred taxes as liabilities because the organization will eventually need to pay them.

For startup companies, most of the items usually appearing on a balance sheet’s liability side are not relevant during their early stages, just as most of the assets generally are not. Most startup companies or new world firms are not eligible to receive bank loans or to issue bonds. For example, drug development companies during their early business development stages do not have a need for working capital. However, firms that deal with the development of medical devices or those that deal with the development of renewable energy might have minimal working capital needs. Therefore, this book discusses the evaluation of established companies.

**Stockholder Equity**

The overall liabilities are defined as the total value of a company’s current and long-term liabilities. In contrast, the difference between a company’s total resources and liabilities represents the stockholders’ value.

Stockholder equity is also referred to as the equity’s book value. As stated earlier, the stockholders’ equity or book value of equity is an accounting measure that is used to determine the company’s net worth. Ideally, the balance sheet needs to provide a precise valuation of the company’s equity’s real value. However, the balance sheet is unlikely to provide an accurate assessment of the organization’s financial position and value of equity. One reason for this is that most of the firm’s assets are usually valued according to their past cost and not according to the current market value. For example, when valuing a building, the balance sheet reflects the building’s value according to its original cost or value minus its depreciation.

However, the actual cost or the current market value of the building may be different from the amount or value indicated on the balance sheet. Similarly, other assets such as property, goodwill, plants, and equipment may have different current market values than those indicated on the balance sheet. Therefore, the current market value of an asset may differ from and even exceed the value recorded in the balance sheet. A second reason for the possible inaccurate picture presented by the values in a balance sheet and the challenge of using the balance sheet to define the firm’s equity value derives from the lack of definition of the company’s valuable assets that are not reflected in the financial statement. For example, an organization’s intangible yet valuable assets, such as employee expertise, brand reputation, customer and supplier relationships, research and development innovation, and the level of the firm’s management are not reflected in on the balance sheet despite the fact that they add value to the firm.

*3.2.3. Book Value versus Market Value*

From an accounting perspective, the balance sheet provides an accurate evaluation of equity or stockholders’ equity. However, because of its limitations, the balance sheet’s showing of book value or the stockholders’ equity does not provide a complete or accurate picture. As a result, even successful companies may borrow amounts higher than their assets indicated on the balance sheet because creditors recognize that the current market value and the book value differ. Therefore, there may be a substantial disparity between a company’s book equity value and the amount prospective investors are ready to invest to acquire an interest in the company. Consequently, a firm’s equity’s market value of is determined by calculating the total worth of the company’s value per share and the number of outstanding shares.

The market value of equity is additionally known as the showcase cap or the market capitalization of a firm. Consequently, the actual evaluation of the firm’s resources currently or in the past, or even the evaluation financial experts anticipate the assets will produce in the future is not determinative of the market value.

For most successful firms, the price-to-book ratio considerably exceeds the value “1.” A ratio higher than 1 indicates that the current market value of the asset when utilized exceeds its historical cost. The differences in the price-to-book ratio reflects the differences in the company’s significant elements and features and the value addition provided by company management.

In 2015, Citigroup’s price-to-book ratio was 0.76. This number indicates that the book value of the firm’s assets stated in the balance sheet, such as market securities, was far higher than the assets’ current market value according to investors. During the same period, large organizations in the United States received ratings of price-to-book ratios of 1.9 and 2.9 from major financial institutions. In contrast, IBM and PepsiCo had price-to-book ratios of 8.3 and 11.3 respectively. Financial analysts classify organizations as those with value shares and growth stocks, which indicate a low and high price-to-book ratio, respectively.

*3.2.4 Enterprise Value*

A company’s equity value or value after its debts have been paid represents its market capitalization. However, it is still necessary to determine values for the business as it is operating.

A firm’s enterprise value is also known as the total enterprise value (TEV), which measures a business’s assets’ values without taking into consideration the business debt. TEV is usually separate from any marketable securities and cash.

For example, in 2020, a hypothetical organization’s market capitalization could be $60.8 million while its debt stands at $106.6 million. The debts include notes payable of $2.5 million, current maturities of long-term liabilities of $12.2 million, and long-term debt of $89.9 million. Therefore, if the cash balance of the company is $20.1 million, the enterprise value can be calculated as the sum of the debt and market capitalization minus the cash balance, $60.8 + $106.6 - $20.1 = $147.3 million. When defining the firm’s enterprise value, the cost of acquiring the business must be determined. Consequently, it would cost an investor the debt plus the market value of equity, i.e., $167.1, to purchase an organization’s equity and pay its debt. However, since the investor could acquire the firm’s cash amounting to $21.2 million, the net cost would be $145.9.

***3.3 The Profit and Loss (PL) Report or Income Statement***

The essence of an organization’s financial position is reflected in the income statement. The income statement, also termed the statement of financial performance, covers a specific period of time with details about the firm’s expenses and revenues. Accordingly, the income statements’ actual bottom line states the company’s net income, which is one way of showing the firm’s profitability during a specific financial period. The income statement is also considered a profit and loss statement. An additional element, net income, represent the company’s earnings. This section examines the income statement components in detail and the ratios applied in the analysis of data are introduced.

*3.3.1 Earnings Calculations*

As discussed, a balance sheet is essentially a list of a company’s assets and liabilities for a specific financial period. The income statement expands on this information, presenting the revenue and expenses flow generated by the liabilities and assets during that period.

* Gross Profit: In the income statement, the first two lines represent the revenues received from the sale of products or services and the costs incurred in the manufacture of the products. The cost of sales are those costs deriving from the production of goods and services, manufacturing costs being one of them. Other company costs, such as R&D and administrative costs, and interest expenses are not included in sales costs. The third line describes the gross profit, obtained by subtracting the cost of sales from the revenue derived from the sales.
* Operating Expenses: The operating expenses are the next items in the income statement following the gross profit. Operating expenses represent expenses incurred from the normal business operations but do not completely correspond to the production of the goods and services generating the sales. Operating expenses include overhead and administrative costs, marketing costs, salaries, and expenses incurred during research and development. In addition, operating expenses include amortization and depreciation, which are not actual cash expenses, but are an estimate of the expenses incurred due reductions in value of the firm’s assets. Operating income represents the difference between gross profit and operating expenses.
* Pre-Interest and Tax Earnings: After presenting a firm’s operating expenses, the income statement contains the earnings before interest and taxes, representing income or expenses generated from activities that are not central to the firm’s operations. An example of income of this type are the returns generated from the company’s financial investments. Accordingly, the earnings before interest and taxes (EBIT) are calculated from the adjustments from other sources of income or expenses.

Pre-tax and Net Income: After generating the EBIT, any interest incurred from outstanding debt is deducted to determine the company’s income before taxes. After computing the pretax income, the corporate tax is then deducted to ascertain the net income of the company. Therefore, the net income reflects the total earnings of the company’s equity holders. The net income, usually reported on a per share basis, is referred to as the earnings per share (EPS). To calculate value per share, the net income is divided by the outstanding shares, as shown in the equation below.

*3.3.2 The Statement of Cash Flows*

While income statements identify what a company’s income amounts to over a specific financial period, it does not offer any information about how much cash was generated during this same period. A company’s net income does not correspond to the cash generated for two reasons. First, the income statement does not have a provision for the entry of non-cash elements, such as amortization and depreciation. Second, the income statement does not identify specific cash usages, such as the expenditures on inventory and the purchase of assets, such as buildings. As a result, the statement of a company’s cash flows contains data not found in other financial statements.

Because the statement of cash flows is much more detailed in its analysis of the company than is the balance sheet, from an investor’s perspective, the statement of cash flows provides critical information not otherwise obtainable. The cash flow statement has three sections covering operating, investment, and financing activities. The analysis of the operating activity looks first at the net income as found on the income statement. This is then adjusted by the inclusion of non-cash items related to the organization’s operational activities. The section covering investment activity records cash utilized in investments, while the financial activity section indicates the cash flows between the investors and the company.

*3.3.3 Non-Operating Assets*

**Investment Operations**

The investment activity section indicates the cash flows involved in investment activities, such as the purchase of plant, equipment and property, also known as capital expenditures. While these are not listed as an expense in the income statement, but are recognized as depreciation expenses incurred over time. When determining the company’s cash flow, depreciation is added since it is not an actual cash flow. As a result, the actual capital expenditure must be subtracted. Similarly, other long-term investments and asset purchases made by the firm are also deducted.

**Financing Operations**

Financing operations include cash received from financing, as well as dividends paid, which are cash outflows.

*3.3.4 Notes to the Financial Statements*

Organizations offer wide-ranging notes in the statements providing further facts. For example, a firm may document the important accounting assumptions applied during the preparation of the financial statements. In addition, the notes provide information describing the company’s subsidiaries and single product lines and describe in detail the organization’s stock-based employee payment plans for and its outstanding debts. The notes also provide detailed information about acquisitions, leases, taxes, risk management activities, and debt repayment schedules. The information is critical in interpreting the company’s financial statements.

*3.3.5 Financial Statement Analysis*

Financial statement analyses are used by investors to evaluate a firm by examining past data about the firm and determining how it has altered over time, as well as by comparing the firm with similar firms that apply the same financial ratios.

The following discusses the frequently used ratios, such as profitability, working capital, liquidity, and others, as well as their applications.

* *Profitability Ratios*

In the income statement is critical information about the firm’s profitability and its relation to the shares’ value.

The company’s gross margin illustrates its ability to sell its products at a price higher than its cost of production. However, since there are other expenses involved in business operations, the operating margin is an important profitability ratio.

The operating margin is used to determine the company earnings before taxes and interest from each unit of sale. For example, if in 2020, a company’s operating margin was 5.79%, this represents an increase from 4.03% in 2019. Similarly, the EBIT margin can be computed by dividing the EBIT with the sales. The comparison between the operating and EBIT margins allows for the assessment of the firm’s operations efficiency.

* *Liquidity Ratios*

The firm’s liquidity or monetary dissolvability is evaluated utilizing the balance sheet. Banks and other investors examine the company’s current assets and liabilities in making a determination as to whether the company has enough capital on hand to meet its short-term needs.

The quick liquidity ratio also assesses the firm’s liquidity and compares the cash and short-term assets that can easily be liquidated, such as accounts receivables and short-term investments, to the company’s current liabilities. It is important to note that these ratios are not applicable to new, startup firms.

* *Valuation Ratios*

Financial analysts apply several ratios to determine a firm’s market value, the most commonly used being the price-earnings (P/E) ratio.

The price-earnings ratio represents the ratio of an organization’s equity value to earnings, whether on a per-share or a total basis. For example, if in 2019, the firm’s P/E ratio was 10, then investors would be eager to spend more than 10 times the earnings to acquire a share. The ratio assesses whether a stock is undervalued or overvalued and varies widely across industries, with those that have high expected growth rates having the highest ratios.

* *Net Present Value (NPV)*

Present value (PV) refers to the price of a benefit or a cost with respect to currently available cash. Similarly, the net present value (NPV) of the investment is the difference between the present value of an investment’s profits and costs.

When the benefits are reflected by a positive cash flow and costs are reflected by negative cash flows, NPV is defined for the purpose of estimating the present value.

For example, assuming a firm is offered an investment opportunity costing $500 today, with a value of $550 guaranteed in one year, as well as an 8% risk-free loan, then the present value would be the amount required to generate $550 in one year. Therefore, the present value is how much money is needed to invest at the interest rate set in order to generate the anticipated cash flow. As such, the net present value is $550 divided by 1+8%, i.e., $509.

However, if the company cannot raise the initial project cost of $500, is its value the same? Since the value was computed applying the competitive market prices, then the value should not depend on cash on hand at the bank. If the company cannot raise the required $500, it can take a loan of $509 from the bank, with an interest of 8%, and then invest in the project.

The calculation leaves the firm with extra cash of $9.26 and no future financial obligations. Therefore, investing in the project means that the firm has an additional $9.26 in cash. The NPV defines an investment value as the amount of cash as currently evaluated. A positive NPV value indicates that the decision to invest increases an organization’s value and indicates that the investment or project represents a good decision, despite the existing cash requirements or preferences regarding the spending of company resources.

NPV simplifies decision making in a firm because it is expressed in terms of current cash. As long as the project’s costs and benefits are correctly captured, the decisions with positive NPVs increase the firm’s wealth.

Rejecting or accepting a project is a common financial decision in a firm. Rejecting an investment has a NPV of zero, indicating that there are no benefits or costs for not investing. Consequently, the NPV decision assumes that an organization should:

1. Accept a project with positive NPV values;
2. Reject a project with negative NPV values.

If the NPV value of an investment is “0”, a firm will neither gain nor lose if they accept or reject the project. In such a case, the investment is not a “one,” since it neither reduces the value of the firm nor increases it.

* *Determining Free Cash Flow and NPV*

Earnings are applied to measure a firm’s performance from an accounting perspective but do not represent the organization’s actual profits. Thus, the firm cannot use its earnings for its business operations, such as payment of employees, purchase of goods, such as raw materials, payment of dividends to investors and shareholders, and funding of new investments. To carry out its operations, the firm requires cash. Therefore, during the capital budgeting decision evaluation, a firm must determine the impact of a decision about a project based on the cash it has available. A project’s free cash flow represents the incremental impact on the firm’s available cash and not the financial decision. However, most startup companies do not have the cash to forecast using the net present value technique.

## Chapter 4. Valuation Methods: The First Chicago Venture Method and The Use of Real Options

***4.1 The Use of Multiples with The First Chicago Venture Method***

Multiple**s** measure some aspect of a company's financial status, determined by dividing one metric by another metric. While multiples can be very useful, in most cases, in R&D companies they can be used only as a benchmark. Still, multiples can be used for revenue multiples as similar businesses may sell in similar ways. Research and development multiples are more commonly applied to mature companies than to early-stage companies. For example, R&D expenditures in a mature company may amount to 100 while the company’s market value is 1,000; thus, the R&D multiple would be 10. If a young company’s R&D expenses are 20 and it is expected to reach sales in three years, taking the mature company as a benchmark, the multiple can be 10/(1+r)^3, where r represents the capitalization rate. Assuming the capitalization rate is 10%t, over a time frame of seven years, the young company’s market value would be seven multiplied by its expenses, estimated at 20, resulting in a market value of 140. This method, called the First Chicago Venture Method, provides a quick and basic benchmark for startup knowledge companies, for which there is little comparable data.

A separate numerator that can be used is an employees multiple. This is based on the assumption that the startup R&D company can hire the optimal number of workers and mainly highly skilled R&D employees. Thus, taking into consideration the market value of publicly traded technology businesses and the number of employee in a startup can also serve as a type of benchmark. In addition, the number of users or any other working factors can also serve as indicators for young companies. Whatever factors are considered when evaluating a young company’s multiples, their use enables the multiples of mature corporations to be discounted in the young company’s evaluation.

***4.1 Finding Similar Companies***

The main challenge can be to find specific similar companies with which to compare the young company. For that purpose, in-depth knowledge about the technology and the market is needed. A good example would be a young cybersecurity company with its primary objectives being markets such as Managed File Transfers, Cloud Access Security Brokers, and Software-Defined Perimeter as outlined below:

|  |  |
| --- | --- |
| Data Access Competitors | Data Usage Competitors |
| *Vidder* | *One Drive* |
| *Cryptzone* | *Accellion* |
| *Zscaler* | *Cyberark* |
| *Akamai* | *Box* |
| *Microsoft* | *Bitglass* |
| *F5* |  |

*Fig. 4.1: Cybersecurity*

A number of publicly-traded companies are functioning in the hypothetical young company’s targeted markets: Axway Software SA is a France-based company involved in software development. AMPLIFY, its core product, is a cloud-enabled data integration and engagement platform, which enables industries to manage their customer experience networks. Attunity delivers Big Data control software answers that can provide access, control, sharing, and distribution of information throughout heterogeneous company platforms, companies, and the cloud. Attunity’s software offers solutions including information replication and distribution, tests records’ management, facts connectivity, employer file replication, managed file transfer, information warehouse mechanization, statistics usage analytics, and cloud information delivery.

Today, the company Globalscape also provides secure data trade capacities for organizations and customers through the extension and dissemination of specialized computer platforms designed primarily to improve a company’s record exchange. Among the software program items it offers are overseen record exchange arrangements, secure substance versatility arrangements, wide-zone record administrations, overseen mail connection arrangements, consumer-based record exchange arrangements, and master administrations. As stated by the company, its reply portfolio enhances basic insights transmission, such as budgetary information, clinical records, benefactor records, merchant records, staff records, bargain side interest, and other comparable documents.

Another company currently operating, CyberArk, offers software that delivers information security arrangements that offer protection from cyberattacks to organizations. The company states that its products offer a confidential solution for account security and a solution for managing sensitive information. Its confidential solution for account security enables users to enter and to take action to secure, control, and monitor privileged accounts. The Company's confidential solution for account security includes a private company password, an SSH key manager, a confidential company password, an SSH Key Manager, a confidential session management system, confidential threat analyses, an app identify management system, on-demand services and other features.

This detailed level of research into the operations of competing companies is essential in order to make an accurate assessment of the young company trying to enter the field. The following Table illustrates the numerous factors that are taken into account in such an analysis:

**Table 4.1:** **Comparative Market Sector Analysis of Competing Applications\***

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ticker | Market Cap ($M) | Revenues ($M) |  | R&D expenses ($M) | Employees | Revenues per employee ($K) | | | R&D expenses per employee ($K) |
| EPA: AXW | 636 | 284.61 |  | 48.162 | 1,930 | 147 | | | 25 |
| NASDAQ: ATTU | 101 | 54.49 |  | 11.139 | 235 | 232 | | | 47 |
| NYSE: GSB | 87 | 33.34 |  | 2.562 | 854 | 39 | | | 3 |
| NASDAQ: CYBR | 1,558 | 216.61 |  | 14.4 | 644 | 336 | | | 22 |
| Average |  |  |  |  |  | | **189** | **24** | |
| Our Company | 21 | 0.8 |  | 1.085 | 34 | | **25** | **32** | |

**(\*Data as of December 31, 2018)**

The assessment above provides a glance into the young company`s operational activity. The company revenues per employee were $23,000 as of the end of 2016, whereas the average for the four established companies, as stated above, was $189,000. However, as the company is a young firm, its R&D expenses per employee of $32,000, which characterize the company's investment in future operations, is higher than the $24,000 average of the four publicly traded companies. In this case, we can multiple the $24,000 average research and development expenses with our company’s expenses and obtain its market value: in this case, approximately $25 million.

## 4.2 Valuation through the Use of Real Options. What is It and When is It Used?

Real options valuation is a method for pricing options based on the well-known Black and Shultz option model (1973). This model simulates several scenarios for the company's growth and market, meaning that once the evaluation refers to peak sales, the value will correspond to the market’s growth, unlike DCF (discounted cash flow), where there is no change in the market.

Whatever occurs in reality, there is a 50% chance that the actual result lies below or above the assessed number. Therefore, on average, the sales figure is often equivalent to the one projected. Accordingly, DCF assumes a static scenario that can prompt over-dependence on this situation, which is still just an estimate. In addition, the oversimplification of the future to just a single outcome limits the need to consider alternative options if the issue is incorrect or requires adjustment because of new data.

Analysts commonly take a few scenarios into consideration, such as optimistic, realistic, and pessimistic scenarios. However, market size and company growth in most cases do not change. DCF values the task as though the management will make only one or no choice. It is reasonable to assume that the organization adjusts its plans if one basic measure possibly deteriorates or improves beyond expectations. Therefore, DCF is unable to capture all adaptable scenarios during the evaluation stage.

The Real Option Valuation (ROV) considers the fact that some choices in a project or an organization’s operations can or should be taken during the last stages of decision making, contingent upon future economic situations. Otherwise, the decision could be made when current conditions would not be relevant or useful in the future. The uniqueness of ROV contrasted with DCF is that with ROV, some future choices about the continuing project or business are adapted to the individual economic situation. DCF presumes that the course of the task is predefined, regardless of what actually occurs.

To accurately demonstrate ROV’s results, it is important to identify the conditions or parameters upon which they rely. The ROV hypothesis utilizes broad research in the field of financial options that manage similar scenarios. When managing startup companies, it is imperative to model a variety of approaches to respond to changes in the market environment.

These distinctive types of responses characterize the diverse and inherent real options in a venture or an organization. We suggest six classifications of genuine alternatives dependent on the adaptability of the management: options to concede, extend, forsake, switch, arrange investments, or develop.

The majority of these choices are straightforward. The alternative that is most challenging for most technology companies is the one to arrange investments, or mobilizing financial resources and investing. A few ventures require an arranged speculation, as at every stage, the firm’s purposes and activities can reveal further vulnerabilities. Given the parameters, the undertaking is revalued and accordingly continued or halted after each stage. These organized speculations are considered compound choices. After every stage, the organization has the alternative to proceed or abandon the project. Proceeding compares to the securing of another choice. In cybersecurity organizations, an organization can create one solution and, depending on an effective adaptation, it can proceed or discontinue the project. In life sciences, an organization may out-permit its intellectual property dependency during its clinical as well as administrative stages.

The majority of analysts using the ROV method use tree models for making evaluations. Trees are an oversimplified model of future market developments and are utilized to estimate monetary alternatives. Binomial trees subdivide an opportunity into its small individual time period steps, anticipating that in each time step, the market or the peak deals can either increase or decrease, with a specific likelihood for each situation. The value of the choice is obtained by ascertaining again all the elements of the tree, from concluding leaves to the roots.

Let’s examine the hypothetical case of an early stage startup biotechnology firm that operates using a classic business model and focuses on a singular product line or a specific treatment that it intends to develop and sell. With the goal of creating new versions of antibodies through proof of concept clinical trials, this hypothetical company in-licenses antibodies, primarily from institutions of higher learning. The goal of the company is to out-license or sell these technologies for further development and commercialization to large biotechnology and pharmaceutical companies. The market in which the company is operating is hematologic malignancy within the oncology therapeutic area.

The first step is to explore the addressable market. The American Cancer Society (ACS) reports that in 2011, at least 140,000 Americans were diagnosed as suffering from a hematologic malignancy, and approximately a little under half a million people were living with, or were currently in remission from myeloma or leukemia. The figures from the United States represent approximately 50% of patients with malignancies of the blood in the seven major markets in the world. The value of the therapeutic market for leukemia and multiple myeloma treatments was estimated at approximately $8 billion in 2011 and, by the year 2021, is expected to reach $15 billion. Therefore, one can understand that the competitive analysis needs to focus on future treatments that will reach the market when the products of our hypothetical company will emerge.

The last few decades have witnessed an improved understanding of each blood cancer’s different subtypes, and of the suitable treatment to match each subtype. In the past decade, new drugs, which are often combined with chemotherapy or radiation therapy, have significantly improved blood cancer cure and remission rates. Among the over 50 drugs used to treat blood cancers, the newer classes of drugs for treating the disease include tyrosine kinase inhibitors, immunomodulators, monoclonal antibodies, and antibody-drug conjugates.

In addition, patients with certain blood cancers also receive stem cell transplants to restore bone marrow function. New stem cell technologies are being developed to address the needs of almost 70% of the patient population in need of a stem cell transplant, but lacking a suitable donor.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Drug (generic name) | Company | Class | Indication | Sales (2018)\* |
| **Rituxan (rituximab)** | Roche | Monoclonal antibody | B-cell NHL | $6.8 billion |
| **Revlimid (lenalidomide)** | Celgene | Immunomodulator | Myeloma; MDS | $3.2 billlion |
| **Velcade (bortezomib)** | Takeda/ Johnson & Johnson | Proteasome inhibitor | Myeloma; Mantle cell lymphoma | $2 billion |
| **Gleevec (imatinib)** | Novartis | Tyrosine kinase inhibitor | CML; Ph+ ALL\*\*; MDS/MPN | $1.5 billion |
| **Sprycel (dasatinib)** | Bristol-Myers Squibb | Tyrosine kinase inhibitor | CML | $803 million |
| **Vidaza (azacitidine)** | Celgene | Demethylating agent | MDS | $760 million |
| **Treanda (bendamustine)** | Teva | Alkylating agent | CLL | $523  million |
| **Dacogen (decitabine)** | Eisai/ Astex | Demethylating agent | MDS | $260 million |
| **Zolinza (vorinostat)** | Merck | Histone deacetylase inhibitor | Cutaneous T-cell lymphoma | $224 million |
| **Adcetris (brentuximab)** | Seattle Genetics | Antibody-drug conjugate | HL#; sALCL## | Approved in 2011 |
| **Cytarabine  (cytosine arabinoside)** | Generic | Anti-metabolic agent | AML; NHL | $40 million |
| **Leustatin (cladribine)** | Generic | Immunomodulator | Hairy cell leukemia | N/A |

\* - Sales column shows income from all approved therapeutic indications.

\*\* - Philadelphia chromosome-positive acute lymphoblastic leukemia

# - Hodgkin lymphoma

## - Systemic anaplastic large cell lymphoma

*Fig. 4.2: New Stem Cell Technologies*

Although many hematological malignancies cases are managed effectively with the current standard of care, disease persistence remains a problem, as the disease progresses quickly once treatment ends. Therapies directed at defined subsets of patients with high unmet needs, such as elderly patients and patients with certain genetic characteristics, are still needed. Furthermore, research is still seeking novel therapies that target the leukemia stem cells while sparing the ordinary blood-forming stem cells inside the bone marrow.

Having examined the hypothetical company’s market, we now turn to understanding the product itself and its clinical, regulatory and financial pros and cons. Let us assume that this treatment, should it reach the market, will be targeted at EphA3-positive cancer patients (the name of the antibody). We also assume, based on clinical data, that EphA3 levels are elevated in about 50% of blood cancer patients.

Now that we have examined the company’s market, competition and specific data about the product, we can now turn to valuation. The company is currently assessing the antibody's efficacy in several hematological malignancies in a Phase 1 study. Therefore, we cannot specifically assess the size and competitive landscape of our company target market within the hematological malignancies sector. Thus, we use the ROV (Real Options Valuation) methodology for analyzing the value. The main valuation parameters are:

* Clinical/regulatory progress: The ongoing Phase 1 will end by late 2019, followed by a Phase 2 study that is scheduled to end in late 2021. We assume submission in 2025 and launch in 2026, based on the company`s assumptions and our estimations on regulatory progress.
* Target market: As explained above, we cannot currently assess which specific cancer indication will be chosen for further clinical development. Therefore, we cannot specifically evaluate the relevant competitive landscape and exact addressable market for this drug candidate. For that reason, in order to valuate this program, we will use the combined leukemia and myeloma markets as the target market, and presume very low market penetration and peak sales values.
* R&D costs: R&D costs are based on common R&D costs for early stages.
* Volatility: This parameter is based upon clinical development attrition rates within the blood cancer therapeutics area. In the Black-Scholes (B&S) model, volatility is determined according to the historical stock price volatility. If no historical data can be extracted, we can use similar companies’ data.
* Capitalization rate: The product is in its early clinical development stage, which corresponds to a higher rate of market uncertainty, as mentioned above. We therefore base our risk-adjusted analysis with a higher capitalization rate (+5%) compared to the company’s other programs.
* Patent time-to-market: We base the evaluation on the patent expiration with no additional extension.
* Out-licensing agreement: We estimated future out-licensing following completion of Phase 2 studies, based on similar deal structures as follow: $40 million every year over the years 2023–2025, and, upon success, $320 million in 2026.

Using the ROV method is especially useful when assessing programs that are in their initial, pre-clinical or early-stages, and which are evaluated only using a binary method, based only upon a scientific-regulatory appraisal (binomial showing of Black & Scholes model with certain alterations).[[7]](#footnote-7)

One more reason to use ROV is behavioral. Using a multiples method is not possible, as the time-to-market is too long, amounting to 10–15 years in most cases, depending on the regulatory path and therapeutic area. Using the Risk-adjusted Net Present Value rNPV in most cases can lead to an over-estimation of the company’s value, as numerous parameters need to be taken into account. ROV is in some ways a valuation with a minimum degree of freedom, as the company is evaluated using conservative assumptions on future markets and time-to-market, while basing its main assumptions on several elements as displayed below. This method, based on very conservative assumptions, can be viewed as inhibiting our natural human optimism. If we are aware of this, early stage valuation will, in most cases, be more conservative and will reflect all the risks as well as all the opportunities.

***Table 4.2: Valuation Parameters***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Territory | Current  Development Stage | Phase 1 Success Rate | Phase 2 Success Rate | Phase 3 Success Rate | Launch | Patent Period |
| All countries | Phase 1 | 70 % | 35 % | 70 % | 2022 | 2031 |

|  |  |
| --- | --- |
|  |  |
| Market (in 1000s) | **8,200** |
| Share from Market (Peak Sales) | **6%** |
| Estimated Peak Sales (in 1000s) | **390** |
| Firm`s Royalties | **12%** |
| Volatility (Attrition rate) | **79%** |
| Growth Rate (market) | **2.2%** |
| Discount Rate | **22.3%** |

The binomial tree is based completely on the parameters, determining peak market penetration and sales in 2026, and evaluating the specific probabilities for pass or no-move decisions in each time unit until the product is released to market and thereafter. Values are capitalized according to the valuation date.

The first parameter is the attrition rate (instability), based on B&S conditions for assignment valuation as follows:



We can estimate eight leading time units until the marketplace launch of the product. Each factor has its own singular probability, according to the attrition rates of clinical trials. It is possible that there could be a 24% chance of the organization being ready for market launch by 2026, with a likely income of $4.9 billion, taking into consideration all the risks. The valuation is made from the launch date until the end of the patent period in 2035.

***Table 4.3: ROV Valuation***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
| **Phase 1** | **Phase 2** | **Phase 2b** | **Phase 2b** | **Phase 3** | **phase 3** | **Phase 3** | **Submission** |
|  |  |  |  |  |  |  | 192,579,541 |
|  |  |  |  |  |  | 79,687,224 | **0%** |
|  |  |  |  |  | 32,973,667 | **0%** | 32,973,667 |
|  |  |  |  | 13,644,128 | **0%** | 13,644,128 | **0%** |
|  |  |  | 5,645,785 | **1%** | 5,645,785 | **1%** | 5,645,785 |
|  |  | 2,336,162 | **3%** | 2,336,162 | **3%** | 2,336,162 | **3%** |
|  | 966,677 | **9%** | 966,677 | **8%** | 966,677 | **6%** | 966,677 |
| 400,000 | **30%** | 400,000 | **19%** | 400,000 | **13%** | 400,000 | **10%** |
| **100%** | 165,515 | **42%** | 165,515 | **27%** | 165,515 | **19%** | 165,515 |
|  | **70%** | 68,488 | **44%** | 68,488 | **31%** | 68,488 | **23%** |
|  |  | **49%** | 28,340 | **41%** | 28,340 | **32%** | 28,340 |
|  |  |  | **34%** | 11,727 | **36%** | 11,727 | **32%** |
|  |  |  |  | **24%** | 4,852 | **30%** | 4,852 |
|  |  |  |  |  | **16%** | 2,008 | **24%** |
|  |  |  |  |  |  | **11%** | 1,177 |
|  |  |  |  |  |  |  | **8%** |

We then continue to run eight scenarios of total revenues until the patent expiration in 2035.

***Table 4.4 Pre-Patent Expiration Scenarios***

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 | 2034 | 2035 |
|  |  |  |  |  |  |  |  |  |
| **Market** | **Market** | **Market** | **Market** | **Market** | **Market** | **Market** | **Market** | **Market** |
| 192,579,541 | 192,579,541 | 192,579,541 | 192,579,541 | 192,579,541 | 192,579,541 | 192,579,541 | 192,579,541 | 192,579,541 |
| **19,257,954** | **19,257,954** | **19,257,954** | **19,257,954** | **19,257,954** | **19,257,954** | **19,257,954** | **19,257,954** | **19,257,954** |
| 32,973,667 | 32,973,667 | 32,973,667 | 32,973,667 | 32,973,667 | 32,973,667 | 32,973,667 | 32,973,667 | 32,973,667 |
| **3,297,367** | **3,297,367** | **3,297,367** | **3,297,367** | **3,297,367** | **3,297,367** | **3,297,367** | **3,297,367** | **3,297,367** |
| 5,645,785 | 5,645,785 | 5,645,785 | 5,645,785 | 5,645,785 | 5,645,785 | 5,645,785 | 5,645,785 | 5,645,785 |
| **564,579** | **564,579** | **564,579** | **564,579** | **564,579** | **564,579** | **564,579** | **564,579** | **564,579** |
| 966,677 | 966,677 | 966,677 | 966,677 | 966,677 | 966,677 | 966,677 | 966,677 | 966,677 |
| **96,668** | **96,668** | **96,668** | **96,668** | **96,668** | **96,668** | **96,668** | **96,668** | **96,668** |
| 165,515 | 165,515 | 165,515 | 165,515 | 165,515 | 165,515 | 165,515 | 165,515 | 165,515 |
| **16,552** | **16,552** | **16,552** | **16,552** | **16,552** | **16,552** | **16,552** | **16,552** | **16,552** |
| 28,340 | 28,340 | 28,340 | 28,340 | 28,340 | 28,340 | 28,340 | 28,340 | 28,340 |
| **2,834** | **2,834** | **2,834** | **2,834** | **2,834** | **2,834** | **2,834** | **2,834** | **2,834** |
| 4,852 | 4,852 | 4,852 | 4,852 | 4,852 | 4,852 | 4,852 | 4,852 | 4,852 |
| **485** | **485** | **485** | **485** | **485** | **485** | **485** | **485** | **485** |
| 1,177 | 1,177 | 1,177 | 1,177 | 1,177 | 1,177 | 1,177 | 1,177 | 1,177 |
| **118** | **118** | **118** | **118** | **118** | **118** | **118** | **118** | **118** |

We then run an NPV evaluation for each scenario after taking into consideration R&D costs, as described below:

***Table 4.5: NPV Evaluation***

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **A** | DCF | 19,257,954 | 16,045,907 | 13,369,600 | 11,139,676 | 9,281,682 | 7,733,584 | 6,443,695 | 5,368,947 | 4,473,457 |
|  | **NPV** | **93,114,503** |  |  |  |  |  |  |  |  |
| **B** | DCF | 3,297,367 | 2,747,397 | 2,289,157 | 1,907,347 | 1,589,219 | 1,324,152 | 1,103,296 | 919,277 | 765,950 |
|  | **NPV** | **15,943,161** |  |  |  |  |  |  |  |  |
| **C** | DCF | 564,579 | 470,412 | 391,952 | 326,578 | 272,108 | 226,723 | 188,907 | 157,399 | 131,147 |
|  | **NPV** | **2,729,804** |  |  |  |  |  |  |  |  |
| **D** | DCF | 96,668 | 80,544 | 67,110 | 55,917 | 46,591 | 38,820 | 32,345 | 26,950 | 22,455 |
|  | **NPV** | **467,400** |  |  |  |  |  |  |  |  |
| **E** | DCF | 16,552 | 13,791 | 11,491 | 9,574 | 7,977 | 6,647 | 5,538 | 4,614 | 3,845 |
|  | **NPV** | **80,029** |  |  |  |  |  |  |  |  |
| **F** | DCF | 2,834 | 2,361 | 1,967 | 1,639 | 1,366 | 1,138 | 948 | 790 | 658 |
|  | **NPV** | **13,703** |  |  |  |  |  |  |  |  |
| G | DCF | 485 | 404 | 337 | 281 | 234 | 195 | 162 | 135 | 113 |

We now need to analyze all eight scenarios and the discounted valuation of each one according to the parameters described above**.**

***Table 4.6: Comprehensive Evaluation***

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 |
| **18,489** | **37,720** | **178,253** | **352,985** | **818,965** | **3,463,349** | **9,453,344** | **26,457,484** |
|  | **29,085** | **108,109** | **153,555** | **251,980** | **776,757** | **1,815,282** | **4,742,245** |
|  |  | **96,098** | **119,413** | **154,901** | **316,756** | **507,485** | **1,024,139** |
|  |  |  | **113,563** | **138,288** | **237,994** | **283,563** | **387,522** |
|  |  |  |  | **135,431** | **224,534** | **245,222** | **278,519** |
|  |  |  |  |  | **222,184** | **238,703** | **259,856** |
|  |  |  |  |  |  | **237,488** | **256,738** |
|  |  |  |  |  |  |  | **256,000** |

Based on all the above calculations, we evaluate this project at $18.5 million.

Our evaluation is somehow conservative, as we use ROV and not rNPV. In this case, rNPV will yield a higher value, as one will choose, in most cases, to value the company as a “dream company” (see Chapter 10) and will makes decisions driven by our basic human optimism, leading to a choice of a more positive scenarios.

# *PART III: BEHAVIORAL FACTORS: HOW PSYCHOLOGICAL FACTORS AFFECT BIAS IN VALUATIONS*

**Chapter 5. Introduction to Behavioral Finance**

***5.1 Background***

Richard Thaler, the 2017 recipient of the Nobel Prize in Economics, contends that behavioral finance is no longer a controversial subject because financial economists already often incorporate into their considerations theories about how human behavior affects the movement of stock prices. In fact, according to Thaler, the acceptance of the application of human behavior theories to economic behavior has become so common that past theories about economic behavior will soon become irrelevant.

Under neoclassical economic theory, the assumption is made that decision makers are subjective and rational, and seek expected utility with the benefit of limitless cognitive capabilities and following classical statistics rules. This book goes beyond this conventional view, and considers the application of human behavior in capital markets: specifically, its impact on technology evaluation. Previous studies and available literature indicate that the rationality of human behavior is limited. Consequently, bias and heuristics affect the investor’s decision making. Heuristics refer to ways in which individuals save time and effort by making decisions based on prior experiences with similar situations.

Extensive research indicates that all individuals, not only investors, apply simple heuristics when making decisions, resulting in choices that may deviate from the classical statistics rules. For example, individuals tend to believe that the statistical properties of small samples are similar to those of large samples. This tendency results in the law of small numbers, upon which is based the fallacy, or the mistaken belief that the more frequently an event occurred than normal in the past, the less likely it will be to occur in the future (or vice versa, even though it has been demonstrated that future probabilities do not depend on past occurrences. Other effects of individuals’ mistaken interpretations of small samples are representativeness heuristics, which are basically judgmental shortcuts. One example is the hot hand fallacy, which assumes that if an individual has been successful in a particular activity, such hitting the jackpot in a casino, that individual has a high likelihood of succeeding in a similar fashion in the future. However, other heuristics, or problem solving techniques do not generate the law of small numbers, but lead to additional attitudes, including the conjunction fallacy, availability heuristics, affect heuristics, anchoring heuristics, base rate underweighting, conservatism, hindsight bias, confirmation bias, and false consensus.

Ignorance of statistical phenomenon, such as regression to the mean, and failure to differentiate necessary and sufficient conditions often result in biases. Consequently, the iteration of the biases and heuristics theory is one of the major achievements of social science. This book focuses on heuristics that affect investor decisions as a phenomenon that has an impact on the business valuation process.

Kahneman and Tversky (1974)[[8]](#footnote-8) described an experiment that involved a town being served by two hospitals with a larger and smaller hospital delivering 45 and 15 babies, respectively, daily. During the course of one year, each hospital made a record of those days when boys represented over 60% of the babies delivered. The study participants were required to identify the hospital they thought had recorded the most days of having more than 60% of the babies delivered being boys. According to the researchers’ theory, the larger hospital had a larger sample and was therefore more likely to receive a precise value. Based on the mixed results, i.e., not 50% as assumed to be the number in the long term, Kahneman and Tversky concluded that the basic concept of statistics is not based on human intuition, and explained the results as an example of what they termed representativeness heuristisc, whereby people intuitively believe that the properties of differently sized samples resemble the population of the sample without taking other considerations into effect. Not only does representativeness heuristics relate to a more sophisticated human behavior, but it is also based on the weak law of large numbers, which posits that performing the same experiment a large number of times will lead to an average of results in which the tendency to move closer to the expected results increases the more times the experiment is performed.

It should be emphasized that the law of large numbers is limited, as it applies only to large sample sizes. However, individuals are believed to apply the law of small numbers if the sample size and mean are similar to the population mean. Such individuals, or investors in the case of business evaluations, believe that the sample imitates or reflects the entire population for either a large or small sample size. Kahneman and Tversky (1974)[[9]](#footnote-9) define the phenomenon in terms of probability and state that individuals tend to base their outcome calculations on the representative heuristic. For example, during financial valuations, analysts apply multiples and financial benchmarking. Company evaluations through multiples involve considering similar firms as a sample. However, the calculation may be wrong if the sample is not representative. Similarly, in heuristics, most people are not able to develop a randomized events sequence. When applying the concept in experimental studies, studies tend to change the outcomes frequently in an attempt to preserve the population proportions in small samples. As Bar-Hillel and Wagenaar (1991)[[10]](#footnote-10) have noted, assuming that random sequences lead to individuals generating negative correlations, one can conclude that they engage in the gambler’s fallacy.

Jorgensen, Forshaw, and Dougherty (2011)[[11]](#footnote-11) carried out a study on the Danish State Lottery, classifying participants into those who choose similar numbers every week, and those who avoided non-winning numbers chosen the previous week. Similarly, Powdthave and Riyanto (2015) found that people often pay others if they believe these third parties can correctly predict random numbers.

***5.2 Investors’ Behavior in the Financial Markets***

According to Dhami (2016),[[12]](#footnote-12) the gambler’s fallacy is also employed with finance. The author cites the disposition effect, which refers to investors’ likelihood of selling winning stocks but retaining loss-making stocks since the investors assume that the rising stock is due to fall.

***The Hot Hand Fallacy***

The hot hand fallacy describes how decision making is affected by optimism. The concept provides a description of an individual experiencing a successful outcome in a random event and thereby believing that they have an increased likelihood of future success. The hot hand fallacy is often applied to skill-based tasks and sports and originates from basketball, where a good shooter is perceived as having a higher probability of scoring. The previous success can change, as can the subsequent success rate and psychological attitudes. However, researchers have dismissed the hot hand concept as fallacious, since there exists no evidence of the hot hand concept in practice. Tversky, Gilovich, and Vallone (1985)[[13]](#footnote-13) first described the fallacy when they investigated the respondents’ inability to comprehend random events and randomness. Similar to the way in which innumeracy impairs an individual’s judgment on statistical information, the hot hand fallacy can result in mistaken assumptions about random events.

***The Efficient Market Hypothesis***

This hypothesis assumes that stock prices incorporate all public information. However, Michaely and Shaw (1995)[[14]](#footnote-14) have found that the stock markets consistently indicate evidence of changes in earnings after the news. The changes are not consistent with the Efficient Market Hypothesis.

***The Psychology of Tail Events***

Barberis (2013)[[15]](#footnote-15) states that the psychology of tail events is another emerging concept that describes a behavioral effect on an investor’s behavior. The psychology of tail events posits that individuals overemphasize small probabilities, thereby resulting in market discrepancies regarding asset returns. The probability individuals assign to the returns is over-weighted in favor of a low return, and therefore a premium must be paid to convince the investor to hold the asset.

In addition, Dhami (2016)[[16]](#footnote-16) notes that the deficiencies of the neoclassical model and psychological forces are applicable to experts as well. It should be noted that experts, too, can be biased and can even exhibit increased bias. Financial analysts are experts in the explanation of past financial events with the benefit of hindsight. However, analysts’ understanding of past events imbues them with the mistaken notion that they can effectively predict the future. Based on financial experts’ overconfidence in theoretical finance models, Kahneman (2011)[[17]](#footnote-17) and Gervais and Odean (2001)[[18]](#footnote-18) agree that these experts may not correctly predict the future. According to the authors, investors who excel purely by luck view their success as a result of their skills rather than good fortune. This phenomenon leads to overconfidence that might be affected by subsequent experiences.

The conjunction fallacy is the basic principle of the probability theory that holds that several particular conditions are more probable than one general condition, thus violating classical theories of rational economics. Considering the research study by Kahneman and Tversky (1983),[[19]](#footnote-19) the researchers found that the extent to which the fallacy is false is determined when the question is posed in a different way. Consequently, when the probability is posed in natural frequencies, such as multiples of hundred, and not percentages, the temptation to believe the conjunction of fallacy is broken.

***The Availability Heuristic: Why Does an Event Happen?***

In the *Foundations of Behavioral Economic Analysis*, Sanjit Dhami explains how Kahneman and Tversky (1974)[[20]](#footnote-20) approach the availability heuristic. Kahneman and Tversky (1974)[[21]](#footnote-21) state that the availability heuristic describes instances where individuals can assess the likelihood or frequency of something occurring based on the most easily accessible thoughts related to the events. For example, an individual may assess the risk of a heart attack in a specific group of people by thinking about their family member who suffered a heart attack and were of a similar age to those in the group of people under consideration. Dhami (2016)[[22]](#footnote-22) notes that the mistakes of inference are often motivated by heuristics, and cites another experiment by Kahneman and Tversky (1974)[[23]](#footnote-23) which involved two treatments, with subjects being presented with a list of names that were mixed-gender. Drawing on the experimental results, the researchers concluded that when the events in a class are easier to retrieve, the class is numerous despite the equal representation of the alternative classes. Similarly, individuals tend to assign a higher probability to one of the events they have just seen, such as a house fire or road accident. However, the challenges associated with the mental construction of risks have an impact on the perception of the events’ probability. For example, a person planning to visit the Himalayas is more concerned with the dangers of mountain climbing, since they are easy to imagine, rather than the risk of disease, which is more dangerous but harder to imagine.

Memory vividness plays a critical role in probability assessment. Lichtenstein (1978)[[24]](#footnote-24) argues that events frequently covered by the media tend to impart a higher perception of risk among individuals. Similarly, a Pew Research Institute study carried out in 2016 indicated that most voters in the United States considered the crime rate to have increased since 2008 despite a double-digit decrease in property and violent crime. The higher perception may be due to the increased media coverage on the crime events.[[25]](#footnote-25)

***Mental Accounting***

Mental accounting is described by Richard Thaler as the process applied in the evaluation and categorization of events, including financial events. Although neoclassical economics consider income and expenditure sources to be the same, people tend to assign funds to different purposes mentally. Mental accounting is a self-control technique that allows people to achieve pre-determined goals by placing different values on a similar monetary resource in a different context. In addition, individuals have an aversion for debt in mental accounts and tend to prefer mental credit accounts. For example, an individual tends to worry about the current cost of an air-conditioning unit but enjoy a buffet meal, even though the buffet’s cost is higher than the value of food consumed.

Although the mental accounting process is universal, it is also fallible. In this regard, Cheema and Soman gave an example on Mark Twain’s cigar, where the author limits himself to smoking one cigar but placed no limit on the size. As a result, the size of the daily cigar smoked increased.[[26]](#footnote-26)

Investors tend to apply the mental accounting principle in the evaluation of technology companies. The investors consider each investment as part of a similar investment domain. Consequently, investors fail to consider the opportunities and risks of each domain. Similarly, mental accounting can be applied to housing wealth. In housing wealth, the question that has to be addressed is the implication of rising housing prices on the savings and consumption behavior of households. Consequently, the mental accounting approach is applied to explain how individuals calculate an increased equity income due to an increase in home prices. Evidence suggests that the current asset account and future wealth account are applied by households to calculate housing wealth. Therefore, the marginal propensity to consume due to increased housing equity is relatively small. However, the evidence contrasts with the life cycle model, which posits that individuals generally plan their consumption and savings behavior over their lifetimes, hoping to balance their consumption in the best way possible, saving during periods when they accumulate wealth and spending when they are retired or not earning. Thus, individuals interpret an increase in housing equity as an increase in the present discounted income value. Consequently, the housing equity and present discounted income value should have a similar marginal propensity to consumers, since they are derived from current income. In addition, bonuses, when defined using the life-cycle model, are a component of income and have no effect on the individual savings and consumption behavior. As such, the marginal propensity to consume due to bonuses is lower compared to regular income.

***Stock Market Underreaction and Overreaction***

There is evidence that over the short term of 1 to 12 months, stock markets tend to underreact. However, in the long term of between three to five years, the stock markets overreact to repeated news that points in the same direction. Therefore, both the short-term and long-term underreaction and overreaction in the short run and long run respectively present a significant phenomenon in stock markets. Overreaction of the stock market occurs following a sequence of good news with the expected future return being lower compared to the stock market being exposed to a sequence of bad news.

Stock market prices are a reflection of good and bad news as expressed in the efficient market hypothesis (EMH) and classical finance, which indicate that there are no implications for returns or prices in the next period. Moreover, if the stock market anticipates news, its impact should be incorporated in the return rates prior to the beginning of the financial period. The stock market overreacts to a sequence of good news, resulting in a decline in future returns. As a result, stock market participants can use high returns in the past to predict, even if irrationally, low future returns, even though this may defy the basic EMH. Based on this argument, an investor believes that the stock market will have a mean trending or reverting. The investor considers patterns in making decisions instead of the random walk theory that posits that because stock prices are not related, past stock or market movements cannot be useful indicators of future developments, thus rendering the movement of stocks random and prediction ultimately useless.

***Investors’ Attention and Trade Shares***

Noise traders, otherwise known as idiot traders or as traders whose decisions are irrational or erratic, believe that prices in the stock market will continue to increase. The participation of a sufficient number of noise traders in the market leads to increased betting activities by arbitrageurs in the direction of price increases. The direction of the price increase in such a case indicates the departure of the stock prices from the fundamental values. In addition, it is believed that if the noise traders are bullish, they may make more money than arbitrageurs for a time. As a result, the arbitrageurs may not be able to survive in the loss-making environment.

Still, there are several other reasons associated with the inefficiencies of the financial markets. Traditional finance principles and practices are based on the foundations of EMH. EMH dictates that at any point in time, a security’s price and its fundamental value must be equal. The condition may be considered to be the present discounted value of the future income flows from the security. Several arguments and theories challenge the application of EMH. For example, the market inefficiency based on the risk generated by noise traders creates a theoretical challenge to EMH. Based on the theoretical challenge, substitute securities that guarantee EMH may not exist. In addition, the transaction costs of arbitrage might also have a negative effect on market efficiency, since the challenge associated with overcoming the stock market is proof of its efficiency. According to EMH, arbitrage opportunities do not exist. However, the absence of the opportunities does not indicate that EMH is applicable. Therefore, EMH and arbitrage opportunities create confusion between sufficient and necessary conditions.

Mutual fund managers who are professional arbitrageurs invest on behalf of investors with little or no financial knowledge and expertise. However, the financial expertise of professional arbitrageurs cannot be applied in market efficiency induction. Therefore, small investors review the end-of-year financial performance as signals of the professional arbitrageurs’ ability. As such, the arbitrageurs are forced to quickly liquidate their loss-making assets which present a challenge in competing with the noise traders, and they must invest in similar portfolios in a form of herding behavior. Herding behavior tends to result in errors accumulating in one direction.

**Anchoring, hindsight bias, and endowment effects need to be considered during business valuation.**

***Anchoring***

Anchoring consists of a wide range of contexts, frames, and domains which include price estimates, probability of nuclear war, lotteries and gambling evaluations, legal judgment issues, and price negotiation offers. Anchoring has also been applied to explain judgment heuristics such as hindsight bias, preference reversals, and probability weighting, which is non-linear in nature. In finance, the return’s standard deviation is defined as volatility. In the anchoring effect, decision makers exposed to hindsight bias infer that there is a likelihood of volatility being low rather than high. Moreover, there is a direct correlation between the degree of hindsight bias and volatility underestimation.

***Hindsight Bias***

The human mind’s general limitation is based on its imperfect inability to function in the reconstruction of beliefs and knowledge states. There are various explanations for hindsight bias and they include the preference of individuals to envisage a predictable and stable world and the exaggeration of the individual’s ability to predict and signal greater competence. Consequently, hindsight bias can be defined as a coping mechanism in the event of an unpredictable environment.

Decision makers exhibiting hindsight bias often underestimate volatility and, as a result, they invest more than they should when they are risk averse. It is therefore expected that the hindsight-biased individual’s performance is lower than that of those who are not hindsight- biased. Assuming that an individual has initial beliefs and interprets subsequent evidence in a manner that shows bias toward the belief beyond that justified by Bayesian, evidence-based hypotheses, then the individual is confirmation biased. The confirmation bias is also referred to as a biased assimilation, a phenomenon popular in psychology. Confirmation bias is more likely to arise when evidence contains alternative interpretations and is ambiguous, or when there has been selective collection and analysis of evidence, forcing individuals to judge the relationship between distinct events, despite the fact that individuals require the aggregation of data from different sources.

***Endowment Effects***

The endowment effect refers to the phenomenon applied to investors trading in shares from technology or IP companies. The experiments by Thaler indicated that when individuals assign a value to an owned asset and unowned identical asset, owners tend to assign higher values to their items.

***5.3 Do Experts Exhibit Biases?***

Market experience does not eliminate behavioral differences although it may reduce the anomalies. Evidence suggests that experts are not immune to bias, especially when predicting political events. In numerous studies, it has been shown that experts are only slightly more accurate than expected.[[27]](#footnote-27) Therefore, expertise does not translate into predictive accuracy, but merely indicates the expert’s ability to penetrate prediction explanations. As a result, experts tend to be overconfident compared to those with no experience, thus indicating that overconfidence increases as one gains experience. In the stock market, senior finance professionals predict the market returns distribution using a considerable dataset.

Consequently, expert traders in large investment companies have been found to be hindsight biased. In business valuations, people pay for expert services which are considered competent. In addition, the anchoring effect, whereby an individual places too much reliance on the first piece of information presented, plays a critical role in the listing price process by estate agents and in legal judgments. The false consensus effect is also exhibited by judges and financial professionals who exhibit the effect by imposing on others their risk preferences. Experts, such as asset and financial managers from organizations such as the World Bank also exhibit framing effects, whereby they make a valuation based on whether the underlying material is presented in a positive or negative way. The framing effects exhibited by the financial experts have a similar impact on the effects observed in student populations. As such, the experts’ opinions can change when they are presented with similar options, depending on whether the events are considered to be gains or losses, based on from what perspective they are presented.

In conclusion, investors have traits similar to all of humanity. Therefore, like all humanity, investors possess bounded rationality that they apply during the evaluation of future cash flows.

**We contend that in the valuation process, it is important to note that information available in the world and in the financial market does not provide a precise replica of reality. As such, there is a need for the application of heuristics in the determination of investor behavior in the financial markets.**

The following Table presents a compilation of the major psychological and behavioral biases that affect their economic behavior. These factors must be taken into account when making a valuation and when using it to make business decisions.

**Table 5.1: Recognized Psychology and Behavioral Biases that Can Affect Financial Decisions and Valuations**

|  |  |
| --- | --- |
| **Name** | **Description** |
| Ambiguity Effect | Avoidance of making a decision when it is not known whether there will be a positive outcome. |
| Anchoring | Relying too heavily, or "anchoring" on one piece of information when making a decision, most often the first thing one has learned about that subject. |
| Attentional Bias | The tendency of recurring thoughts to have an effect on one’s perceptions. |
| Availability Heuristic | Overestimating the likelihood of events occurring when one has a strong memory of such or similar events. This can be affected by how fresh or unusual or emotional the memories are. |
| Bandwagon Effect | Doing or believing something because enough other people have done or believed the same. |
| Bias Blind Spot | Considering oneself to have less bias than others. |
| Conjunction Fallacy | Assuming that a specific, definable condition has a greater probability of occurring than does a more generalized or less specific version of the same condition. |
| Decoy Effect | When deciding between two options there is a preference for one when a third option is presented, even though that one choice is inferior in all respects, or when presented by a third option that is only partially dominated by the alternative option. |
| Default Effect | The tendency to favor the default option when asked to choose between several options. |
| Disposition Effect | Tending to sell an asset whose value has increased and to hold on to an asset whose value has declined. |
| Endowment Effect | People will request more to give up something than they would be willing to pay to obtain it. |
| Exaggerated Expectation | The tendency to expect or predict more extreme outcomes than could actually occur. |
| Focusing Effect | Giving undue importance to one aspect of an event. |
| Framing Effect | When presented with the same information, coming to different conclusions about it depending on the way in which that information is presented. |
| Gambler's Fallacy | Thinking that past events have an effect on future although, in reality, they do not. This misperception arises from a mistaken understanding of the law of large numbers. A person could assume that because they’ve beat the dealer in blackjack five times in a row, they have a greater chance of doing so again the sixth time. |
| Groupthink | Seeking consensus in a group to such an extent that the group engages in an irrational or dysfunctional decision-making process. |
| Hindsight Bias | Also known to as the "I-knew-it-all-along" phenomenon, this refers to the tendency to see previous events as having been predictable at the time they occurred. |
| Hot-hand fallacy | The hot hand fallacy, refers to the belief that a person who has been successful in the past is more likely to succeed in the future. |
| Loss Aversion | The perceived disadvantage of giving something up is greater than the perceived advantage of acquiring it. |
| Optimism Bias | Being overly optimistic, greatly underrating the probability of poor outcomes and overrating the likelihood of positive outcomes. |
| Ostrich Effect | Failing to acknowledge an obviously negative situation. |
| Over-confidence | Disproportionate confidence that one’s replies to questions are correct, despite evidence that the majority of people’s answers are not correct. |
| Planning Fallacy | Tending to underestimate how much time is needed to complete tasks. |
| Present Bias | People’s tendency of people to give more weight to benefits that are more imminent when calculating the costs and benefits involved in two future decisions. |
| Salience Bias | Focusing on what is more obvious or emotionally striking and disregarding that which is not obvious, even though this prominence is often irrelevant. |
| Status Quo Bias | Preferring that things do not change (see also loss aversion, endowment effect). |

[[28]](#footnote-28)

## Chapter 6. An Overview of Investor Behavior in Financial Markets and Psychological Influences on Valuations

*“Pecunia non olet” (Money does not stink)*

*(Roman Emperor Vespasian (69–79 CE)*

***6.1 Background***

Money does not stink; however, it may have a different smell for different investors. A non-professional investor may see an opportunity where a sophisticated one may see a no-go investment. Also, there might be some diversity within the new investors’ group regarding an investment. The primary ground for all human beings is excessive optimism, high expectations, and limited attention to the many decisions we make during our everyday lives. In this part, we will focus on the question of how psychological elements affect bias in valuations. And more specifically, we will examine how behavioral finance aspects can affect venture capital investment drivers and uncertainties.

Traditional finance theory, relying on the utility theory, which projects the combination of commodities that a person or a society would receive to maintain a given level of satisfaction (Neumann and Morgenstern, 1944). In investing, utility expects investors to be rational in their decision making. expects investors to be rational in their decision making. Contrary to this view, behavioral finance criticizes the logical viewpoint, arguing that whenever investors make investment decisions, they tend to deviate from rationality. Over the years, several behavioral biases that may occur in investment decision making have been studied and tested empirically. Behavioral finance became a new concept in the 1990s, integrating psychological and behavioral aspects in financial and economic decision making. The efficient market perspective is challenged by behavioral finance. In addition, behavioral finance helps to explain why investors behave in a particular way when they invest in financial assets.

Many studies have been conducted on such behavioral biases, attributing them to investors’ optimism and overconfidence, disposition effect, herd behavior, and home bias (Kumar and Goyal, 2016). When investing at an early stage, usually done by venture capital (or VC) investors, the “fear of missing out” and information overload escalate the burden on VC investors. They are forced to adopt a herding behavior towards reputable and familiar firms rather than analyzing the available information for them to choose other firms that could be less risky in order to obtain potentially higher returns over time. The regrets they might have outweigh the economic benefit and potential psychological burden of acting against the trend. Investment in early-stage firms equalizes returns and risks, and venture capital is no exception. Risk perception is underweighted when herding occurs, and it results in low abnormal returns. Investors expect to earn profits from the asset they have bought, and over the time they have held it.

Despite these investments being considered as high risk because they abound with information asymmetry and high uncertainty, there are potentially high returns on investment, forcing the businesses to buy stakes that are equity-linked. Venture capital firms commit sizable funds to new technologies and markets. In addition, they also invest in early-stage and high-technology companies, where informational asymmetries are likely to help them find investment opportunities within those sectors. In cases where the market does not have useful information about the companies, a high-risk premium will be demanded by the investors, which will lead to companies requiring expensive funding.

However, the venture capital market is unable to set the market price because it is not efficient. Additionally, economic valuation is always determined by a few people. Thus, it will result in psychological effects, as described in the following sections. In an efficient market, the high and low valuations cancel each other out, but this is not the case in the venture capital market.

***6.2 Optimism and Expectations in the Financial Arena***

Over the years, it has been believed that the overall outcome of the possible gains and losses associated with any decision making can be combined to provide the general assessment of the desirability of a choice. The classical theories of decision making under uncertainties and risks have always implied risk aversion by combining mathematical principles of expectation with the assumed reduction of marginal utility. However, more and more studies have revealed that most individuals do not process information in such rational ways when making decisions. Proponents of Prospect Theory (PT) contend that contrary to popular beliefs, individuals typically value losses and gains differently (Tversky and Kahneman, 1991), and that is one of the fundamental explanations for optimism.[[29]](#footnote-29)

Individuals tend to base their decisions more on the perceived gains rather than on potential losses. A person having two choices involving a possible profit and a possible loss is more likely to choose the former even when all the choices lead to the same result economically. This is particularly so because, according to PT, losses are considered to have a more emotional impact on the decision makers compared to the effects of an equivalent amount of potential gains. Several studies by Kahneman and Tversky (1979) required the subjects to make judgments and choose one of the two monetary decisions in which either a prospective loss or gain was involved. Thaler (2006) argues that, in a conventional way of thinking, it is generally expected that the utility gained from making $50 is equivalent to the one in which $100 is obtained before $50 is lost because both situations result in a net gain of $50. However, this is not usually the case, because most individuals are likely to choose gaining $50 rather than the options involving gaining $100 and then losing $50.

The results of the studies suggest that individuals are often more willing to make choices involving reasonable gains even when the alternative option offers a chance to achieve more. On the other hand, they are also more willing to adopt risk-seeking behaviors when they believe they can limit their choices. Hence, it can be argued that individuals tend to judge losses more heavily than an equivalent amount of gains. Decision making in situations which involve a prospective loss or gain is usually a function of the represented difference in utility that can potentially be achieved from the profit or loss.

The tendency of individuals to disregard the elements shared by all the choices under consideration is often viewed to be the leading cause of inconsistent preferences in situations where the same prospect is presented to the decision makers in different forms. It is regarded as a general trend in most decision-making situations involving elements of risk and uncertainty. As a result, it is arguable that when multiple events involving potential gains and losses occur, individuals tend to value each event distinctly and then collectively develop a cumulative understanding.

In respect to its economic relevance, some of the illogical financial behaviors are explained using PT. Individuals are usually reluctant to bank their money where they can earn interest. Others are sometimes unwilling to work overtime to avoid paying more taxes. According to PT, although most of such individuals would benefit from the bank interest or the additional after-tax income, the value realized through extra income can be considered insufficient in overcoming their perceptions of loss.

In the editing phase, when people are thinking about the decision the need to make, the outcome of the decisions made is well-ordered according to the various heuristics. At this stage, individuals always tend to decide on the results in their utility decisions. These individuals also tend to set a reference point. Thus, they finally consider more outcomes as gains and fewer outcomes as losses. The phase dealing with editing also proposes doing away with any framing effects. Mainly, the editing phase tries to resolve the isolation outcomes arising from the tendency of individuals to isolate consecutive probabilities rather than frequently dealing with them collectively. The other phase dealing with evaluation consists of behavior that is aimed towards computing value by individuals or the utility. This behavior is founded on their respective probabilities and the potential outcomes. Various individuals, therefore, tend to choose the alternative offering higher satisfaction ability.

Additionally, PT can also be effectively used to explain the prevalence of the phenomenon of investors willing to keep their valueless stocks while at the same time selling their valuable shares as soon as possible (disposition effect). However, the most significant rational decision is to keep their winning stocks to allow additional proceeds and sell their less valuable shares to avoid further damages. Studies by Kahneman and Tversky (1979) reveal that individuals are more likely to choose a lower but specific gain than choose a riskier option, even if it would result in more gain. However, the illogical behavior in exhibited by most investors being willing to hold on to their stocks, even when they are losing. The idea can be explained by the fact that individuals are usually willing to take higher risks to avoid any negative value attributed to a potential loss.

However, it is essential to note that many investors who hold on to their stocks often continue to incur losses with little possibility of recovery. Thaler (2006 argues for the disposition effect whereby investors are often unwilling to sell their losing stocks. Yet, they are ready to sell their winning stocks too soon. He argues that this effect can be prevented by using hedonic framing, making gains feel stronger and losses less strong, to change the mental approach of individuals. For example, under some circumstances, individuals have a choice of deciding the terms of a sizeable cumulative gain or conditions of several small benefits. Such individuals may be encouraged to think of their situations in terms of lower profits. It will help them if they can maximize the amount of their positive utility. On the other hand, in circumstances where making a choice involves considering the outcome as a substantial cumulative loss or an amount of lesser losses, decision makers should be encouraged to frame the potential consequences as a significant loss. This will potentially create a relatively less harmful utility because smaller losses cause less pain compared to the pain caused by combined losses.

***6.3 Attention and Its Effect on Valuations***

Cognitive psychologists have conducted extensive research over the last few decades. The studies have challenged the rationality paradigm, and these result have started to infiltrate economic modeling. The research documents vast experimental results on the limitations of cognitive theory and the questions that have since emerged. Among these questions are whether models of behavioral decisions help us understand the behaviors of investors in financial markets. What role does investor attention play in real market situations? To what extent makes investors’ attention influence market decisions?

*6.3.1. Psychology Framework: Attention Theory*

During the 19th century, attention emerged as a concept of discussion, with its effects becoming an interesting topic of discussion during this time. However, the situation had changed by the late 1950s, when attention became the main topic of new rational psychology. In this novel conceptualization, the ability of an individual to resist distractions was defined as selective attention.

Post-behavioristic psychology defines attention as a term that has a primary function of providing definitions to some mechanisms that are internal but determine how significant stimuli are. Thus, the concept is challenging for predicting investor conduct by considering only the stimulus. In cognitive psychology, attention posits a central idea of an organism appearing to take over the allowed choice of a stimulus. The stimulus will, in return, control its behavior. In this respect, the body responds to a particular stimulus in preference to others.

In addition, the concept can also be explained by focusing on individual attention. In an organized fashion, it changes from instance to instance. The following provides an example of how careful consideration is defined. The earth is spherical, with vision extending to only about 210 degrees. However, only two degrees are covered by perception, and that narrow beam of perception can be moved only at a rate of once every three to five seconds. The question is; which direction should the pole be facing?

*6.3.2 Selective Attention and Information Processing*

The memory is a massive and durable collection of nodes that are increasingly and complexly becoming interrelated via learning. A most significant number of these nodes are generally inactive and passive (Gervais et. al., 2001). When in the dormant state, they are termed long-term stores. A group of presently active nodes is called a short-term store. Thus, these stores are passive and permanent repositories (Grullon et. al., 2004). The temporary state is a short-term store. The type of encoding present in the short-term store may be forgotten during its movement to the dormant phase through the active period. The system of information processing may be controlled by manipulating the flow of information in and out of the temporary stores. The system includes coding, rehearsal and temporary and permanent store searches.

The permanent accumulation of information is composed of learned sequences of processing information and are initiated through a control processor that has internal or environmental information input. However, the process is automatically executed, whereby few demands are made upon the short-term capacity store. The process is automatic and may be triggered by a particular configuration response. In addition, this process may also be activated automatically without the active control systems or subject attention (Huberman and Regev, 2001). A good example is when a traffic light which signals red initiates an automatic braking response where the person receiving the signal is the driver. Additionally, pedestrians receiving the same message respond by walking, halting their traffic scanning. The process operates automatically by sending long-lasting connections to a long-term store. An automatic method that is new needs the right amount of consistent training for it to develop fully. However, this process is difficult to overturn, modify, or ignore once learned (Engelberg et. al.,).

According to Schneider and Shiffrin, there is another type of ongoing automatic sequence responsible for modifying the controlled processing. It does this by drawing attention to a definite locus. In such cases, the subjects are always taught to identify specific targets. Therefore, the targets attain the capability to start the reactions attached to automatic attention. Afterwards, the automatic attention reactions send attention spontaneously towards the object irrespective of simultaneous memory load. They also enable the right detection to occur.

Concerning skill acquisition, automaticity is also an important phenomenon. With respect to this, it is believed that skills consist mainly of collections of automatic procedures and processes. An example is when typewriting skills involve automatic recognition of words, being able to translate the words into keystrokes and their execution (Logan, 1988). The phenomenon is therefore viewed as a special topic of discussion with regard to the study of attention. It considers the occurrence of automatic processing without attention. Additionally, it interprets the acquisition of automaticity as a process that slowly withdraws attention.

*6.3.3 Attention Theory Mechanisms*

Attention is described by cognitive psychology in two main ways. First, it is described as a mental filter (Treisman, 1969). The theory of attention, according to Treisman, is a feature-integration attention theory. According to Treisman, features are registered early, automatically and parallel to the area of vision. During this time, the objects can be recognized distinctly at a large point where fixed attention is a requirement.

Treisman’s work accepts the idea that the visual act is first dispersed along many dimensions, such as color, brightness, direction of movement, orientation, and spatial frequency. Thus, to recombine the separate representations to achieve the correct synthesis of the features, areas where the stimulus are detected are registered by the focal attention. All the landscapes found to be similar fundamental visual points are combined and processed to produce a distinct object. Therefore, this theory provides a framework for how separate features are combined into one. The moment they have been properly recorded, complex objects that have been observed are preserved.

Yuan (2015) argues that, according to the theory, without focused attention, features cannot be related to each other. There is a need to apply this approach to behavioral economics to define the evaluation of the firm in layers or as many dimensions that are detachable to a clear estimate of financial sectors or size or earnings. This is because, under this theory, investors can see firms only partially. They also see the objects recognized separately at an advanced stage. According to Triesman, firm valuation requires investors’ focused attention.

Furthermore, Khaneman describes attention as a pool of mental resources: an individual’s limited attention capacity. While there is quite a bit of literature about this topic, this work focuses on two aspects: “arousal” and task-overload effect. It can be postulated that the level of arousal is related to the intensity of attention. The mechanism highlights that the more that incentives occur, the more arousal there is. Arousal is related to a theory that identifies task overloads as the attention suffering from effort and limited space. It is comprised of predictions regarding interference and concurrent activities. First, interference will arise even in cases where two businesses do not share any mechanisms (either perception or response). Second, the extent of intrusion will depend in part on the activity which each of the events imposes. That is, competing businesses will exert more demand for effort or attention.

*6.3.4 The Role of Attention in Capital Markets*

The main governing rule for an attention hypothesis in the financial markets is that stock returns during the short term and post-earnings announcement drifts have a positive autocorrelation. The main reasons for this autocorrelation include underreaction due to investor sentiment, slow information diffusion and fluctuations in overconfidence. Furthermore, the investors for longer terms are inattentive while neglecting information about expected profitability in a period of more than five years.

Barber and Odean in 2008 tested whether net buyers of stocks that grab attention are individual buyers. These are stocks about which there are often discussions on the news, those with unusually high volumes of trade, or those with extreme returns. Barber and Odean also hypothesize that investors whose attention is limited only consider buying stocks that have caught their attention. This argument is based on the observation that it is recommended that individual investors never sell short. Therefore, Barber and Odean suggest that attention plays a significant role in determining what stocks individual buyers purchase but not in what stocks they sell. This has the effect of leading to the overpricing of stocks that have an association with events that are attention-grabbing.

Results of various studies actually agree with the attention hypothesis observations. The elements that garner attention include: a high volume of trading, unexpected announcements about earnings, high returns, events that are news-generating and high stock volumes. The attention-grabbers have a common denominator, which is their relatively frequent occurrence. And the occurrence of these events is mainly in the market place.

According to Yuan (2015), what predicts the trading behaviors of investors include the record levels for the Dow, the attention-grabbing events, and the front-page articles about the stock market. These, by extension, predict market returns. Another important phenomenon documented by Tversky and Kahneman (1992) is representativeness, which refers to investors’ tendency to overlook probabilities and instead consider events as being models for a specific class. It should, however, be noted that there is strong evidence that aggregate market returns can be affected by behavioral biases, although this is still the subject of debate (Li and Yu, 2011).

*6.3.5 Attention Hypothesis*

Attention has been recognized as an essential factor in agents’ decision making and learning processes, with a growing acknowledgment of the inevitability of attention being limited with respect to the vast amount of available information. There is an enormous amount of developing literature that analyzes the economic effects of agents’ attention. Researchers have explored post-earnings announcement drift and have found that purchasing stocks that have featured recent good earnings news, whereas concurrently disposing of stocks with recent bad earnings news, can generate significant profits that are not related to risk.

Lou (2014) deliberated on how managers regulate firm advertising to attract investor attention and impact short-term stock returns. Sims (2003) demonstrated the constraints related to agents’ attention to describe price and consumption tackiness. Hirshleifer and Teoh (2003) examined company’s accounting disclosure policies and the resultant price dynamics in the manifestation of unmindful investors. In addition, Gabaix et. al. (2005) studied agents’ focused attention in an attempt to respond to economic incentives. Barber and on the other hand, analyzed how notable events may grab the attention of the investors, thus affecting the way they make decisions about their stock buying and selling. The essence of these extensive experimental studies is that focus is a crucial factor that determines Odean (2008), the way investors react to information.

To explore selective attention hypothesis literature in-depth, we present here four main cognitive mechanisms: investors’ bias and heuristics (naïve or sophisticated investor), accrual anomaly, underreaction and overreaction and investors` anchoring.

Experimental laboratory studies indicate that restricted attention disturbs both sophisticated and naive discrete investors, as well as financial experts in interpreting bookkeeping data. In addition, there is evidence that attention constraints may be the source of misevaluation of information in accounting.

Another phenomenon is noted in the research based on experimental “adjustment and anchoring bias” carried out by Kahneman, Slovic, and Tversky (1982). They reported on investigations in which investors were requested to approximate the price of a quantity as an addition to an arbitrarily created number that the investor detected. Estimates were found to be higher for the items that started with high random numbers and vice versa. With respect to this, George and Hwang (2004) suggest that sellers are likely to use a high 52-week share price as a basis of evaluating their potential impact on the news. In the past year, good news means pushing the new supply’s price near a current 52-week high. This means that traders are unwilling to purchase the items at a high cost although the current market information warrants it. In essence, this means that they understand the news, but are unwilling to act out of fear. After some period of time, the information finally prevails and asset prices naturally shoot up, which leads to an extension.

Li and Yu (2011) argue that traders might use sector-based data as a basis for evaluating information. In particular, they propose an exceptional role for the Dow Index. Perhaps this is made possible because of the Dow’s visibility and the limited attention of the investors. Moreover, it is not likely to describe the analytical power of proximity to the historical high using the unobservable mean reverting state variable. Peng and Xiong (2006) also show that stockholders who have limited attention tend to develop more market and sector-wide information as opposed to industrial-specific statistics.

Another important aspect of attention is time limits as an influence on investment choices. Our last section on selective attention in capital markets presents the Myopic Loss Aversion (MLA) literature.

***6.4 The Myopic Aspect of Skewness Investment***

Benartzi and Thaler (1995) describes Myopic Loss Aversion (MLA) as an “equity premium puzzle.” The term refers to an indication that the risk on premium stocks is unaccountably high when related to the incomes on bonds. It is also irrational to assume that risk aversion alone can explain MLA. MLA integrates the loss aversion PT concept (Tversky and Kahneman, 1992) with rational bookkeeping (Thaler, 1985; Kahneman and Tversky, 1992).

The term mental accounting refers to the set of cognitive activities, implicit or explicit, which households and individuals participate in to serve a similar purpose which regular accounting serves in an institutional organization (Thaler et. al., 1985). A financial investor can be considered as someone making a series of decisions about how his or her assets are allocated as well as reviewing the time horizon as an important factor, as presented by Gneezy and Potters (1997) together with Thaler et. al., (1997). The latter two studies demonstrate that the more individuals are ready to invest more money into a risky stake, the longer the investment limit.

These questions and similar ones give answers to the same hypothetical problem of how individuals assess risks and how sequences of uncertain gambles or investment openings should be assessed. This research uses real market data to examine the framing of decisions following seminal milestone events. Specifically, the main interest is within the cycle of events throughout the drug life-cycle, where long-term aggregate investment policy is needed. However, milestone events in the cybersecurity and renewable energy sector will also be examined.

Samuelson (1963), inspired many other studies on repeated gambles. Samuelson also reported about a colleague’s decision to decline a weekly raffle. Numerous subsequent studies emphasized the normative analysis of risk aversion and how attractiveness was influenced by a number of gambling repetitions. Essential to this research is the second stream of literature. Samuelson’s study aimed at understanding why individuals made decisions similar to what their friends did in rejecting an offer. This research builds on the idea that individuals tend to perceive and evaluate changes in wealth compared to final wealth positions.

Many studies have been conducted on the reference point effect. Some study the irregular volume for Amex stocks together with NYSE that have been found to have risen or fallen in price over the past 35 months. They have found greater volume for winners.[[30]](#footnote-30) Ferris et. al. compared the present tradeoff volume with remarkable trading volume by using volume and price information for 30 U.S. shares. The two studies determined that present capacity was negatively associated with price. However, these results could have been affected by statistical items and were well explained by the other factors, such as personality effects. Another limitation to these studies was that the aggregate data used did not offer direct insight about the individual investors’ decision-making processes.

In valuations, the cognitive psychology mechanisms discuss lead to the following conclusions:

1. Investors in R&D industries, such as the drug development or cybersecurity industry, encounter complex factors of technology, science and finance, which create many distractors throughout hundreds of technology firms. According to the literature above, milestone events, such as FDA approval or capital raising announcement, ignite investors` arousal since it is attention -effortless.”
2. Based on the amount of effort needed by investors, task overload leads to greater investor attention to small-sized firms than to large-sized firms.
3. The combination of those cognitive psychology mechanisms may lead to anomaly investment behavior around seminal milestone events.

## Chapter 7. How to Overcome Investor Behavior and Psychological Influences in Valuations: How to Evaluate a Dream?

***7.1 Background***

All people, not just investors, tend to be optimistic when making decisions. As discussed in the previous section, this can be attributed to a cognitive basis inherent in all of us.

Those people with optimism bias believe that they have less risk of experiencing a negative event than do others. Numerous studies have shown that optimism bias is common and transcends gender, race, nationality and age. It is even reported in rats and birds.[[31]](#footnote-31) People have been found to believe that they are less at risk of being crime victims, smokers believing that they are less likely to contract lung cancer or disease than other smokers, first-time bungee jumpers believing that they are less at risk of an injury than other jumpers, or traders thinking that they are less exposed to losses in the markets.[[32]](#footnote-32)

Together with our optimism, we also tend to pay attention to the things that catch our eye at a given moment. In fact, we then tend to ignore other things happening around us at the same time. The combination of the two phenomena creates an integrated situation in which investors can read some positive information about a public company and subsequently invest in the belief that the share price will rise. The price may indeed rise, but how was the decision to invest in this company made? Was it based on preliminary research? Was there an early awareness of the investment? How did the investor ever come to read the news about that company?

There are many questions, but the very realization that there is a basic psychological component in making decisions, including making sophisticated decisions such as investing in companies, is a good start.

The effect of optimism on companies’ valuations has been studied in the past. Researchers have examined many valuations and have found that more than 80% of those valuations deviated upwards from the actual assessment of the company in practice during the first year of forecast. Another study found that there is no agreement as to why the book-to-market (BTM) ratio demonstrates a positive relationship to future stock returns. According to behavioral finance, low BTM stocks should have optimistic expectations reflected in their prices and that high BTM stocks should express less optimism reflected in their prices.[[33]](#footnote-33)

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As investors seek to evaluate shares, mainly in small-sized companies in distributive sectors, we contend that these psychological biases should be taken into account from the outset. If we all have an optimistic bias, we need to correct it by adding the risk to the valuation.

Discount rates resemble the risk for systematic risk or, in other words, the risk of macro-level changes like regulation, market changes and other issues not related to the specific firm. Small-sized firms should have a size premium added to the CAPM model. We assume adding an additional risk premium, at least 10% of size premium, should act as a restraint to investors’ behavioral fallacies.

Attention bias in investors should be restrained by structured shares selection; that is, choosing the shares to invest in top-down using financial measurements and not picking them because of news reported in the media. In most cases, we found that the saying “buy in rumor, sell when it is reported,” is very true, as in most cases, when there is news on a company, sophisticated investors have already bought the share.

The prevailing view in capital markets is that an evaluation of a company’s value is necessary in order for “fulfil a dream” and prevent it from becoming a nightmare. It should first be realized that not all ideas are created equal, and that startups come in a range of forms that change and hopefully develop. The classic image of a pre-seed company is one of two entrepreneurs meeting in a garage investing some currency from friends, family, or fools. The seed companies may find themselves in an accelerator that helps them gear up or that supports the firm in the financing, mentoring or any other associated areas.

The next level startups are post-seed companies that are still seeking funding through different funding round levels: round A, which usually refers to raising several millions of dollars; round B, which refers to raising capital of up to $100 million; round C to inject more money into an ongoing enterprise; and round D and higher for even more funds to keep an enterprise operating prior to an IPO. In addition, some startups can become advanced companies after round D funding, either because there is a greater possibility of their being sold, or of their issuing an IPO, or of growth within the existing business. An evaluation may be performed at any point from the seed phase to the round D phase, with the valuation taking their rate of growth into account, which makes valuations challenging.

Firms designated as “dream” companies, usually have a negative cash flow, and, in some cases, they could take years before earnings are realized. Clearly, there are many risks associated with dream companies and startups. But human nature tends to be optimistic, and this is reflected in valuations as well. The stakeholders’ self-confidence is reflected in two main elements of valuations. The first consists of overly optimistic estimates of the startup’s potential activity constituents, such as significant market growth, rapid adoption of its technology by the market, and obtaining a substantial market share of its sector in the initial years, among others. There is also excessive optimism expressed about the cost elements of valuations. The costs of research and technical progress are usually valued as minor or moderate. Expenses to be incurred in starting up are frequently estimated for too short a period, and the legal fees and other advice regularly required are usually underestimated, if made at all. The second aspect of valuation that does not receive adequate attention when assessing dream companies is the discount rate that compensates for the cumulative risk of macroeconomic factors, such as regulations, the industrial setting in the country in which the company operates, and other elements over which the company has no control.

***7.2 Valuation of Companies***

The valuation of R&D companies is challenging because many of the cases being appraised have a long time-to-market but suffer from little to no cash in the short term. More conventional approaches for company valuations, such as multiplier frameworks or resource valuation, can become confusing when evaluating R&D firms, where the corporation cannot analyze the status or value of the venture within its own adjustment sheets. In addition, in numerous cases, R&D companies have no other companies with which they can be compared, due to their unique technologies and financing characteristics. Evaluation of a non-dream firm is typically based on evaluating the company’s processes based on estimated revenues, fixed and variable expenses in the future, and the establishment of projected cash flows. In addition to the estimation of discounted future earnings, investors and analysts add non-operational properties, such as cash and cash counterparts and substrate non-operating obligations, such as loans or other relationships.

A dream company’s valuation depends mostly on a basic understanding of its technology and the impact it can make on the sector in which it is involved. Only after this evaluation is made is the business dream company’s environment as well as its ability to compete examined. In contrast, valuations are clearer for mature firms, where investors are familiar with the market and understand the potential. An additional important factor is that the dream company may actually represent a disruptive firm, essentially reinventing the market. In such a case, a disruptive firm’s valuation is based on what can be called its intellectual property valuation as well as projections about how the company will profit from it and when. Thus, assuming the likelihood and timeliness of the company’s intellectual property achievement, technology valuation methods regarding discounted cash flow can be condensed into three main ways within the discounted cash flow method: the real option, the pipeline assessment, and the discounted cash flow.

1. Real options, applicable to pre-seed firms, are established based on the valuation process and classified for initial and pre-clinical stages in life science enterprises. The real options framework utilizes capital budgeting and option valuation techniques. It applies to companies in the early-stage clinical process or those with binary valuations during the early phases and is based solely on empirical regulatory estimates, such as the binomial model with specific changes.
2. Pipeline assessment, applicable to seed to round D firms, is employed for the valuation process used for programs or businesses before the products are introduced to the market. The value of the company is determined evaluating all of the discounted cash flow and unallocated costs. Furthermore, innovative sources in technology firms can be viewed as a platform that can generate more projects, more drugs, more devices, etc., in the future. Thus, one should assess the terminal value or potential value inherent in the technology. The main method to calculate this is the feed rate, or the time interval that will take a company to develop more products based on current knowhow. Later, in the D+ round, the discounted cash flow valuation is appropriate for use in evaluating businesses with products generating positive cash flows from ongoing processes.
3. The discounted cash flow is the accepted process for evaluating companies with positive cash flows to complete technology businesses.

Technology companies are in reality holding companies of various technologies, and therefore the valuation of a technology company is, in fact. a valuation of its technology: that is, the value of the copyrights, trademarks, patents, as well as commercial viability. The company’s cost is assessed by considering it as a holding business for its existing plans. As such, the Risk-adjusted Net Present Value (rNPV) is used together with capitalization of the remaining current value, including the assessment of various possibilities to make a value determination. These scenarios include mostly assessments of the company’s revenue, calculated following scientific or technological valuations, and drawing on different sources and various estimates concerning the market share, the degree of projected market realization, and controlling risk.

A company’s income’s weighted average is based on the total market share, which is the potential market penetration of a particular product or product line. It entails the projected market share that the company will most likely acquire within a specific period after its initial entry, the peak business or product sales during the period examined in the future, as well as the rate at which the company will be able to enter the market’s sales curve until reaching its peak sales. Such a valuation requires an in-depth market and technology analysis. The annual cost of treatment in the case of human medications is a projected cost per patient per year, based on information found in the latest market studies. The success or attrition rate is denoted by the “r” in rNPV, which can be expanded below.

***7.3 The r in rNPV***

When calculating technologies, it is assumed that technology can be developed and become realty in the near future. Depending on the different sectors, these assumptions account for the probabilities for the clinical trials’ success or attrition and advancement to the next stage in the sub-field under study in the life sciences, success rates for the emergence of new forms of cyber firms, or success rates for grid-in renewable energy projects. In the perfect world of assessment, where companies are already selling products for a few years, the question is not whether the company will sell at all, but only how much they will sell. Thus, there is a need to add the element of risk to the NPV with the rNPV. As a company enters the market and profits are anticipated, the likelihood of risk can approach one hundred percent.

In the field of life sciences, knowledge about success rates or attrition rates is easily accessible based on information obtainable form the numerous clinical trials and regulatory requirements for filings with which a company must comply. This information is compiled over the years and is available in academic and or official websites like clinicaltrials.com, which is an official U.S. website including all clinical statistics, and the Food and Drug Administration authorized website. The success rates can also be defined in an example of life-science assessment.

Renewable energy firms have other markers and marks and probabilities based on plans’ development in terms of regulation, infrastructure, and financial features. Renewable energy firms must first win governmental tenders in which the government is marketing, for example, the right to sell the electricity authority future renewable energy or to connect a new firm that previously won a bid for the grid. Infrastructure and financing are vital in order for a project to participate and then carry out a tender. As with life science projects, all these phases create doubts about future cash flows. The success rates for solar and wind energy projects according to phases of the projects is described in the following table:

**Table 7.1: Success Rates of Solar and Wind Energy Projects**

|  |  |  |
| --- | --- | --- |
|  | Phase Duration | Likelihood of Success |
|  | Months |  |
| SOLAR |  |  |
| Secure land zone permit | Years | 10% |
| Tender submission | 3 | 50% |
| Tender win | 3 | 20% |
| IEC\* survey | 12 | 50% |
| Complete adm. process | 6 | 75% |
| Financial closing | 12 | 90% |
| Grid connection | 3 | 100% |
| Permanent permit | 3 | 100% |
|  |  |  |
|  |  |  |
| WIND |  |  |
| Secure land zone permit | years |  |
| Pending permit | 6 | 10% |
| Building permit | 6 | 25% |
| Tariff confirmation | 3 | 50% |
| Regulatory confirmation | 24 | 50% |
| Environmental confirmation | 12 | 50% |
| IEC\* confirmation (transmission line) | 12 | 75% |
| Financial closing (+20% equity) | 12 | 90% |
| Keep/meet installation milestones | 12 | 90% |
| Grid connection | 3 | 100% |
| Permanent permit | 3 | 100% |

\*Israel Electric Corporation

Once the ascertainable figures are available, the business model can now be understood. Renewable energy firms can be divided into two groups. The first includes opportunist companies seeking projects throughout the world and taking on specific roles in different phases of the project, thus having considerably more financial influence on the businesses. The other group includes end-to-end businesses that take on complete projects from their initial stages, and then build and operate them. Regardless of the type of renewable energy firm, there is no significant variance in assessment for the two types of companies, other than building the model of the Weighted Average Cost of Capital (WACC) differently in order to reflect differences in the debt-to-equity ratios. In other types of technology companies, the WACC depends on whether the business is sales leaning, seeking to sell its creation by itself, or whether it is seeking a strategic partner or distributer.

If the enterprise can choose to go it alone, the rNPV model is straightforward, and it examines the sales by quantities and prices. If the business seeks a partner with which to sell its products, more research is required into the business model and development effort, particularly regarding the company’s anticipation of royalties and milestones. The structure of the deal is based on market demand for the product, and the higher the evaluation, the better the deal structure the business can receive. (In contrast, in the life sciences domain, the WACC is based on previous similar deals, as well as at what clinical and controlling phase the company is currently in.) With renewable energy firms, the earlier a business enters into an out-licensing arrangement, the lower royalties and payments reflecting innovation it should expect to receive. Conversely, the later a business enters into such an agreement, the higher the payments it should expect to receive.

***7.4 Valuation of Technology***

As previously noted, technology companies are regarded as holding businesses of technology projects they are developing. Inevitably, there are challenges when the future potential value needs to be evaluated. While the dividend model can be used to evaluate non-dream companies, it is not applicable in the case of life science companies, where there is a limited time in which the company has exclusive ownership of a drug before its patent expires. When valuing a cyber company, the time in which a new version can become legal is a critical consideration. In the case of renewable energy companies, the valuation must take account of the time the technology, whether PV plates or wind turbines, have to stop operating due to the end of an official tender or due to work reasons. Thus, valuations of technology companies depend on the initial assessments of the firm’s projects using its core technology in the anticipation that further similar projects can be executed in the future depending on its market position and other factors.

*7.4.1 The Feed Rate Method*

The technology company maintains a product pipeline linking its technology based to its various business processes. The assessment of a company, which is carried out on a technical basis, is an assessment of its residual value. Generally, the feed rate technique is the most commonly used evaluation method for most technology companies, as opposed to the traditional terminal value approach that common for evaluating non-technology firms. The feed rate methodology is preferable when valuing technology companies for a variety of reasons. First, the terminal value is indicative of some stability in sales with a different growth rate (g) generated on the basis of data from past performance. However, in human medicine companies, the terminal value is based on projects in expansion. The second advantage of applying the feed rate methodology to technology company valuations is that a business’s terminal value usually amounts to between 70–80% of its actual value. However, with respect to a pharmaceutical manufacturing business, the leading element in its price is based on income earned during the years after the product’s introduction to the market, usually limited to between six to ten years, after which the product’s patent will expire or competing products will be introduced into the market.

The assessment of a company’s technological platform is based on how many new projects that a business can generate annually, on average. Assessments of future projects’ capitalization value examines expansion of prospects at the pre-clinical or clinical stage, or technology developments, calculates costs that are unallocated, and assumes a discount rate higher than that used for the forecast years, recognizing the due to the unpredictability of the business's future projects. For example, looking at the firm's technology and addressable market, projections could be given for the company’s main technology platform assessment points based on an expectation that the company would produce one new project every four years. In this hypothetical example, the average value of the current pipeline plans is $59.1 million. The main elements of the unallocated costs are General and Administrative (G&A) and the sales costs, with the project’s value given an equal value as the current pipeline plans. Statutory tax of 15% is expected, which is lower than 23% federal tax of. The capitalization rate here is higher than that applied in the pipeline assessment because the level of uncertainty is greater. Also, it is anticipated that the platform will be able to undertake various projects for a specified number of years (n). In the case of a pharmaceutical company, (n) =13, the average patent period, so all projects undertaken after this period should be deducted from the technological platform value.

The value of the technology can be calculated using the formula below:

The valuation considerations of the technological platform indicate that:

**Table 7.2. Valuation of Technology:**

|  |  |  |  |
| --- | --- | --- | --- |
| Average No. of New Projects per year |  |  | 0.25 |
| Project Value ($K) |  |  | 59,070 |
| Unallocated Costs ($K) |  |  | -40,820 |
| Unexpected Costs ($K) |  |  | -5,907 |
| Tax |  |  | 15% |
| Capitalization |  |  | 24.6% |
|  |  |  |  |
| Terminal Technology Value ($K) | |  | 10,645 |
|  |  |  |  |
| Technology Value for the years that at present are anticipated: 2019–2031 ($K) | |  | 608 |
|  |  |  |  |
| Technology Value from 2032 ($K) |  |  | 10,037 |

**/**

**The following chapters will provide details that will enable professionals to apply these parameters in the actual analysis and valuation of two different types of firms: a life-science/pharmaceutical round B firm and a renewable energy firm.**

# *PART IV**: INTRODUCTION TO VALUATIONS IN R&D-INTENSIVE INDUSTRIES*

**Chapter 8: The Pharmaceutical Sector**

During valuations, investors should look carefully at the total addressable market (TAM) and not at the market the company is telling the investors they are approaching. This is because the company itself often has ownership of or an endowment effect on its assets, which they could be over-evaluating.

## Understanding the Pharmaceutical Industry

***8.1 Background***

The pharmaceutical industry invents, manufactures, and distributes drugs to be used for medicinal purposes. It is among the world’s most profitable industries, with global annual revenues surpassing $700 billion in recent years. Giant multinational pharmaceuticals have commanded a significant share of the market for decades, selling multiple products and earning a considerable percentage of the industry’s annual revenues. For the past two decades, the pharmaceutical sector has been undergoing seismic shifts due to rapidly developing biotechnological innovations. This has led to a market gap for startup pharmaceutical firms, which are usually trying to advance a single product.

Today’s pharmaceutical sector is subject to strict laws, requiring testing and approval of new products by regulatory authorities before they can be released on the market. Such regulations were first introduced in the United States in 1962, when Congress amended the 1938 Drug, Food and Cosmetics Act requiring pharmaceutical manufacturers to demonstrate their products’ efficacy and safety. The 1938 Federal Drug, Food, and Cosmetic Act was enacted after a toxic drug was legally marketed and ultimately killed over 100 people, including children. The Federal Food and Cosmetic Act in effect took over the existing public health system and later the FDA was created to regulate the safety of medications before they are introduced to the market.

Currently, the FDA reports that it regulates products worth over $1 trillion every year. It oversees efforts to ensures that all food, with the exception of poultry, egg products, and meat, are safe for human consumption. Additionally, it guarantees the efficacy and safety of drugs, as well as organic materials, such as blood, immunizations, and tissues for transplantation, medical devices, and animal medications, and feed. The FDA also ensures that cosmetics, pharmaceutical and consumer goods that emanate radiation do not cause any human damage. The FDA assumes a fundamental role in securing and advancing the general wellbeing of the public through its guidelines on human and animal drugs, organic items, tobacco items, medical devices, and food sources.

The FDA’s Advisory Council provides independent expert opinions and suggestions to other agencies on logistical and specialized issues associated with FDA controlled items. Therefore, the Advisory Council improves the FDA’s capacity to secure and promote general safety and effectiveness, providing guidance, using, for example, the formal conference process as provided in existing laws and guidelines. Although the Advisory Council give proposals to the food and medication body, the FDA has the final decision on all issues.

FDA encourages transparency throughout the processes of decision making and approval. Advisory committees conduct various meetings, which include a forum with the public, during which anyone is free to provide relevant information, whether written or orally presented. Furthermore, the venue and time of the meetings and the open public discussion sessions are published in the Federal Register at least 15 days before a meeting.

By requiring pharmaceutical firms to demonstrate the pharmacological effectiveness of their products, the law effectively shaped the nature and activities of these firms, with the regulatory authorities becoming a major force in propelling progress in health technology. In addition, these regulations have resulted in significant increases in expenditures for R&D.

The Food and Drug Administration (FDA) is accountable for determining new pharmaceutical products’ the efficacy and safety of in the United States. The process normally starts by the companies presenting an investigational proposal to the FDA with adequate pre-clinical data to support the need and safety measures taken to ensure safe human trials. The application then is followed by an investigation, trial approval, and three phases of progressively substantial clinical trials on human subjects. The first phase normally involves investigating the toxicity of the drug, using healthy volunteers. The second phase examines the efficiency and safety of the drug in patients suffering from a disease or condition. During the third phase, the FDA extensively probes the effectiveness of the drug by investigating its impact and side effects on the target patient population. If the drug passes the third phase, the pharmaceutical company then applies to the FDA for a biologic license for a new drug application or a bioproduct. The regulatory authority will evaluate the application, and if they determine that product has a positive risk-benefit assessment, they will approve its introduction to the market (Walker, 2011).

The documentation for a new drug request must include the medical improvement history during the pre-clinical and clinical stages, its composition and reactions within the human body, as well as manufacturing, handling, and packaging procedures. An application for a permit to market a bioproduct is made according to the demands of the Public Health Benefit Act, which requires that the manufacturer must hold an interstate commerce permit for the item. The manufacturer must submit documentation for a biologic permit application with contain detailed information on the item’s composition, chemistry, pharmacology, and therapeutic effects.

This complicated drug development process means that firms require several investment streams, which become increasingly more essential as the process proceeds. As a result, most early-stage drug development companies choose to enhance their working capital by issuing securities for sale on the stock market. Indeed, by late 2019, the stocks of more than 500 pharmaceutical companies were listed on U.S. stock exchanges. Generally, stocks of healthcare companies are highly volatile and risky, reflecting ongoing information gathering from the clinical trials as well as the regulatory concerns. During the long process of seeking FDA approval, most companies often disseminate numerous samples of information, some of which reach the market abruptly and unexpectedly.

***8.2 The Drug Development Process***

Clinical studies are always directed under the guidance of a regulatory agency. While initial clinical studies can be accomplished under domestic regulation, such as that of the Israel Public Health Service, foreign pharmaceutical firms trying to introduce a breakthrough drug into the United States must also seek approval of the FDA. Consequently, pharmaceutical firms located in the European Union must test the drugs according to the procedures dictated by the. FDA as well as those required by the European Medicines Agency. In general, as noted above, there are three stages of clinical trials. In order to receive approval, a drug must pass all the required elements of each stage of the trials.

The primary goals in the first phase are to determine efficacy and safety and discover the effect of the drug on the human body. This phase examines questions such as how long drug stays in a person’s body and what percentage of the medicine reaches the intended target. Normally, the subjects for this phase are healthy volunteers. The primary goals of the second phase are assessing whether the drug is effective in achieving its planned therapeutic effect upon its patients, making further determinations as to its safety, and determining the ideal dosage. In Phase 3, extensive studies are carried out involving at least 500 and sometimes even more than 5,000 patients, depending on the disease as well as on the design of the study. Phase 3 trials indicate whether a particular medication can enhance health outcomes without adverse effects, and they provide a comparative assessment of the drug’s safety, effectiveness, and acceptability vis-a-vis a similar drug or a placebo.

Each clinical trial is different in terms of duration, size, costs, and number of trials, depending on the disease, the drug, and the regulatory framework. If after completing the third phase, the pharmaceutical company shows clear benefits and acceptable risks, it can file a new drug application, requesting approval by the regulator to market the drug. Regulatory authorities use information from various studies to understand the overall risks associated with a particular application to determine whether any potential risks associated with the drug are offset by the drug’s potential benefits.

The diagram below is a representation of the range of costs and duration of the drug approval process:

Two to Five years  
$2M-6M

0.5 - 1.5 years  
$1M-5M

One to Three 3 years  
$5M-50M

Two to Five years  
$50M-400M

0.5 -- 1 years

**IND Submission**

**NDA Submission**

*Fig. 8.1****:*** *Drug Development Costs and Duration*

The process of filing a request for conducting clinical trials in preparation for marketing approval in the United States is extensive. A clinical trial application must include a full pre-clinical package, containing an assessment of the drug’s effectiveness, toxicology, absorption, distribution, metabolism, and excretion. Details must be submitted about the quality and purity of materials used, the chemistry and industrial controls, as well as the drug’s production process and the analytical testing processes it has undergone throughout to ensure its quality.

During the new drug application procedure, the drug manufacturers receive feedback from the FDA concerning the regulatory procedure the drug investigation will undergo before being granted approval to enter the market, as well as the regulatory track it must follow. A firm developing a new drug that has not conducted clinical studies is likely to be requested by the regulatory authority to perform additional studies of the same phase it has already conducted. Preparing materials for an investigational new drug application is extensive and complicated. Nevertheless, it is necessary for the proper progression of the product’s clinical development. Moreover, going through the process gives a drug manufacturer an advantage in terms of quicker approval of patent and trading licenses.

**There are two important milestones in the course of the FDA drug application process: approval by the advisory committee and the FDA’s permission to enter the market stage. These stages in the product’s life development cycle are well known in advance and published on the FDA’s official website, as required by Federal laws.**

***8.3 Regulatory Tracks for Drug Approval***

Because the FDA reviews numerous application, the initial information submitted is critical for determining whether the pharmaceutical company has conducted extensive research and put strong safety measures in place. The reviewers then use this information to make a number of critical assessments. First, the regulators determine if the drug is safe and effective in its prospective application(s). Second, regulators investigate whether the drug’s risks outweigh its benefits. Third, the regulators assess whether the medicine’s recommended labeling and package used is suitable and determine what information should be included in the package. Fourth, the regulators help determine whether the manufacturing procedures of the drug and the quality controls applied are sufficient to secure the drug’s purity, strength, identity, and quality.

The documentation required in the process of new drug approval cannot fully provide all the information about the proposed medicine. However, it does contain other useful information, such as detailed research and clinical tests, chemical composition, and results from the previous tests on animals. It also contains information about the potential side effects to humans as well as the product’s manufacturing processes and packaging. The FDA outlines three different regulatory tracks for drug approval in accordance with New Drug Application (NDA) procedures reflecting the difficulty of the new drug application.

**Full NDA   
505(b)(1)**

**New drug –   
full clinical trials process**

**Abbreviated** **NDA   
505(b)(2)**

**Alteration of an approved drug – shortened clinical trials process**

**Generic NDA   
505 (j)**

**Generic drug -**

**bioequivalence data only**

*Fig. 8.2: The Different FDA NDA Application Tracks*

A clinical plan filed under FDA Section 505(b)(1) for a new drug approval needs to fully reveal appropriate treatment benefits with empirically supported efficacy and safety objectives for the targeted health population. Furthermore, it has to represent an innovative drug application treating a unique problem or challenge in the market. If the plan meets all the requirements, the new drug can be introduced to the market. Even if the drug is an improvement of a previous drug made by the same company, it can be introduced to the market in a new formulation, applying a new quantity form and strength if the necessary requirements are met. Section 505(b)(1) of the FDA Act also states categorically that the authority shall approve the new drug application only upon successful completion of all the required criteria in all the three phases of human trials.

A manufacturer submits a new drug application report to the FDA detailing all its study results after completing all three clinical phases. According to §505(b)(1) and the wording of the act, a new drug manufacturer cannot be a part of any other organization. However, not all §505(b (1) regulatory track medications are completely new products, and in some cases, the FDA can ask the manufacturer to conduct a full clinical procedure, following critical changes in dosages or chemical structure.

*8.3.1 New Molecular Entities for the Innovation Edge: FDA §505(b)(1)*

Drugs are categorized as new molecular entities following an FDA §505(b)(1) new drug application review determination. Most products usually contain active moieties, or molecular parts, that the FDA has not approved before, whether in combination with other drugs for a particular use or as a single component drug. In most cases, the products provide advanced therapeutic experiences for patients. The FDA sometimes classify various drugs as New Molecular Entities purely for administrative reasons since they have active moieties which closely resemble previously approved products. Furthermore, the FDA, under §351(a) of the Public Health Service, is mandated to classify biological products included in an application. The agency also must review all new molecular units to be used for a drug’s use, even if it has previously approved a similar active molecular entity for a different product.

New designations of molecular entities indicate that a drug in progress is not a derivative or version of an existing or previously assessed and approved products. Being classified as a first-in-class or entirely new molecule requires various forms of clinical trials to be performed, and utmost care must be observed to ensure that the drug is safe for human consumption. The FDA uses existing medicines and drugs to compare and verify the effectiveness of a drug under investigation. However, for diseases with no previous medical treatment, it means that there are no existing drugs for comparison in order to determine whether the new molecular entity is effective.

In these cases, the FDA needs new measures or standards by which the new molecule will be assessed. Some of the common quality scores used by the agency include quality of life scores, the drug’s direct physiological impacts, and the indicators and qualities of the disorder or disease for which it is targeted. The new molecular entities have significant economic potential as the molecule, if approved, can meet heretofore unmet patient needs in some cases, and in others cases, can fuel further drug progress.

In 2012, 39 new molecular entities, representing one percent of all its approvals for that year, received approval from the FDA’s Center for Drug Assessment and Research. These included license applications for both biologics and new drugs. Nonetheless, this reflects the highest total for 2003 through 2011, during which period an average of approximately 24 new molecular entities were approved annually.

Generally, there are an average of approximately 32 submissions for new molecular units each year. A previous high approval right was achieved in 2011, when the Center for Drug Assessment and Research approved 30 new molecular entities. The FDA identified approximately 51% of the new molecular entities accepted in 2012 as “first-in-class,” which means that its application contained a novel and exclusive action system for addressing a medical condition. First-in-class is one indicator of the advanced nature of a drug and a 51% first-in-class approval rate indicates that there were a large number of highly innovative products approved for use in 2012. Furthermore, 13 of the 39 new molecular entities in 2012, or 33%, were approved to treat rare or orphan diseases.

*8.3.2 Regulatory Track for Altering an Approved Drug: FDA §505(b)(2)*

The §505(b)(2) regulatory track is a type of abbreviated new drug application process geared for new developments of existing drugs based on an adjustment of the formula of an existing, approved drug. This is a drug approval process with a lower burn rate of capital and faster time to market. The approval process is abbreviated because existing information on safety and efficacy exists in the public domain and can be used for the §505(b)(2) new drug application approval. Thus, the §505(b)(2) application process usually does not require the wide-ranging clinical studies associated with a §505(b)(1) new drug submission. Instead, §505(b)(2) applications normally rely upon less extensive and less costly bridging clinical studies to link the safety and efficacy of the original underlying §505(b)(2) product to the associated new drug application product. However, drugs obtaining approval using this track receive a shorter period of market exclusivity.

*8.3.3 Generic Drug Application: FDA §505(j)*

An application for approval for a new generic drug under FDA **§**505(j) involves an abbreviated new drug application process (ANDA). The company must submit information demonstrating that its product is identical to a previously approved product, the referenced listed drug (RLD), with respect to, *inter alia*, its active ingredient, dosage, strength, administration, labeling, quality, performance and intended use. This type of ANDA application does not entail any clinical trials. However, the company must provide information showing that its product’s bioequivalence to the RLD.

*8.3.4 Other Types of Drug Applications*

The FDA, the European Medicines Agency and similar regulatory agencies are also advancing the assessment and development of products, known as orphan drugs, that demonstrate that they can treat rare diseases or conditions. A rare disease is defined as one that affects 0.05–0.1% of the population. Incentives for orphan drug development provided by the FDA and the European Union Commission include particular controlling protocols, extended market exclusivity, and reduced fees for regulatory activities, central application, tax credits, and an enhanced approval procedure.

An application for a new orphan drug approval must include all information that when submitted to the FDA will provide easy and quick assessment and lead to eventual approval. Upon receipt of approval, an applicant may manufacture and market the nonexclusive medication to establish a protected, compelling, minimal effort option within the larger market sector. An orphan medicine resembles a conventional medication in terms of structure, quality, and course of organization, quality, execution attributes, and expected use.

Collective drug applications are termed “abbreviated” because they usually do not need to undergo the typical preclinical and clinical tests to demonstrate their viability and safety. Rather, collective drug applications must show that the item is a bioequivalent, in that it acts in ways similar to the original medication.

**Understanding the pharmaceutical industry, as described above, may contribute to a better understanding of other technology domains. One example is smart mobility.**

***8.4 Ride-Sharing Platforms and Pharmaceutical Companies***

There has recently been a lot of talk about the long-anticipated initial public offering of ride-sharing companies, Uber and Lyft in the United States. The analysts have warned against excessive investor excitement, emphasizing that the companies have not only yet to turn a profit, but also continue to post huge losses. Several believe that investing in such a company, particularly Uber, can be justified if one looks at it as the “Amazon of transportation,” hoping for future development of other businesses, such as micro-mobility, including e-scooters and e-bikes, food delivery, and so on, which are already lucrative for the company. Others say that shareholder pressure could lead to these companies taking higher shares from both their drivers and the riders.

It is also possible to look at these ride-sharing companies as if they were R&D-intensive companies: that is, companies without a product ready for market. This has become a well-known operating model, mainly in early-stage technology companies and most especially in life sciences.

**Table 8.1**: **Ride-Sharing Sales**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| In $ millions | Uber | | | Lyft | | |
| Year | 2016 | 2017 | 2018 | 2016 | 2017 | 2018 |
| Gross Bookings | 19,236 | 34,409 | 49,799 | 1,905 | 4,587 | 8,054 |
| Annual Revenue | 3,845 | 7,932 | 11,270 | 343 | 1,060 | 2,157 |
| Operating Loss | (3,023) | (4,080) | (3,033) | (693) | (708) | (978) |
| Net Loss | (370) | (4,033) | (2,204)\* | (683) | (688) | (911) |
| \*Excludes Uber’s sale of its Russian and SE Asia businesses to Yandex and Grab respectively | | | | | | |

Ride-sharing businesses spend billions on branding and marketing to attract a loyal customer base, to attract R&D partnerships with original equipment manufacturers (OEMs), and to invest directly in their R&D. These measures are well justified, as they bring the era of autonomous vehicles closer to reality. Today, businesses need to pay drivers a 75% fee, so that their income is derived from only 25% of gross bookings. However, with autonomous and electrified fleets, the booking fee could be eliminated, and companies could earn closer to 100% of the gross bookings.

Life science companies, especially pharmaceutical and biotech companies, burn millions of dollars from day one as they seek to prove the effectiveness and safety of their treatments. Early-stage life science companies have a respectively higher burn rate, as regulations prevent them from earning any income in the short-term in the absence of FDA approval. In the case of larger pharmaceutical companies, the losses they suffer during the many years of drug development may be partially offset by their ability to continue selling already approved medications and devices. Like these large pharmaceutical companies that are able to offset R&D losses with current earnings on profitable products, ride-sharing companies can enjoy short-term revenues based on their current business model, with long-term profitability reliant upon self-directed and electrified fleets. With eventual vehicle autonomy, these companies could earn 100% rather than 25% on gross bookings, as previously noted, covering not only driver and corporate costs, but fuel, maintenance, vehicles, accessories, and so on.

In terms of capital expenditure (capex), if the companies elect to purchase their fleets, the vehicles can appear as fixed possessions on their balance sheet, thus boosting non-current assets. Current assets, consisting mainly of levels of cash on hand, would thus remain strong. On the operating expense (OPEX) side of the equation, drivers have reported the most expensive operating expense to be fuel. Therefore, assuming that the electricity infrastructure can continue to provide electricity at a stable cost, the company can enjoy significant savings in the future once autonomous electric cars are introduced.

*8.4.1 How the Ride-Sharing Investment Opportunity Compares with the Life*

*Sciences*

The hype accompanying the stock market listings of ride-sharing companies led to inflated initial public offering prices that have fallen considerably for both Uber and Lyft. Historical data shows a similar tendency in life sciences companies. Both industries are heavily regulated for efficacy and safety in the case of pharmaceuticals, and for safety and low accident rates in the case of ride-sharing companies. In both cases, regulation is stringent because of the life and death consequences involved. This regulatory environment influences investor behaviour concerning the risk profile of both industries. There is also a striking similarity in milestone analysis. During the FDA approval procedure, life science companies face milestones around their clinical trial phases of. Decisions of the FDA regarding approvals at each of the clinical milestones can strongly influence the choices of investors in life science companies.

The SAE, the global leader in technical learning for the mobility industry, has set five levels of vehicle autonomy: driver support, incomplete automation, provisional automation, high automation and complete automation. Automobile manufacturers work hard to meet these five levels. However, it does not appear that milestone-based trade occur in high volume in the ride-sharing space. For example, Lyft stock was not affected by an important announcement made in 2019 by Waymo that was rolling out level-4 autonomous robo-taxis on the Lyft app. Had such an event occurred in the pharmaceutical industry, the share price would have skyrocketed.

With pharmaceutical companies, the success rates of getting final approval from the FDA are both low and unpredictable, due not only to the actual scientific studies, but also to external factors such as competition, funding constraints, and regulatory shocks. Pharmaceutical companies are also vulnerable to FDA post-approval conditions, such as the reimbursement policies of insurance corporations. With autonomous vehicle milestones even less clear-cut than those of pharmaceutical companies, the relationship of ride-sharing companies with the market is even more uncertain.

An important caveat should be born in mind. The ultimate outcome of the FDA process, and its equivalents in other jurisdictions, is the granting of an economic monopoly in the initial years after regulatory approval to successful pharmaceutical and biotech companies. While this monopoly usually ends upon expiration of the original patent, it can be extended under certain circumstances, such as that of orphan drugs treating rare conditions. In contrast, in the cast of ride-sharing and mobility, there is a highly objective race between a few to the finish line. With nearly every main automotive manufacturer in the running, the autonomous automobile market looks set to be as oligopolistic as it is today with human-driven cars. Another important caveat is that no ride-sharing company has been listed for more than a single economic year. They are still in their very early days, and increases in demand for ride-sharing stocks following effective milestone-based progress in autonomous vehicle testing might be soon reflected in the markets.

***8.5 Lessons for Valuations of Disruptive Technologies***

**When evaluating emerging technology in new industries, experts can most certainly suffer from information and precedent insufficiency. There is certainly a benefit in looking at the elements of value and the timing of the actualization of incomes and conceiving of new models grounded on similar diverse industries. The lead-time of new products in cybersecurity or enterprise software is long in contrast with manufacturing, but short in comparison to life sciences. When faced with the unique challenge of valuing independent vehicle companies, one might naturally expect answers to be found in industries with operational and product-based comparisons, like manufacturing or software, as these are components which, together, become part of the new product innovation.**

**However, as noted above, sometimes the valuation precedents or insights to help one build a new model are hidden. Experts tackling new technologies, companies, and industries can, therefore, benefit from having more comprehensive knowledge of many different industries and the financial valuation approaches in each. While no analyst can be a specialist in every sector, incorporating the foundations of large, well-researched and precedent wealthy sectors can increase the chances of finding helpful building blocks for conducting a corporate assessment of a scarce information candidate.**

**Chapter 9: Life Sciences: Disrupting Biologic Drugs Manufacturing**

***9.1 Biologic Drugs Overview***

Biopharmaceuticals today can be broadly categorized in two distinct classes based on their production technology: small-molecule, simple-structure chemical drugs, and the large-molecule, complex-structure biologic drugs, or biologics. Unlike chemical drugs, which are synthesized through chemical reactions between organic and inorganic compounds, biologic drugs are composed of proteins, nucleic acids or living cells and tissues in a living system that are isolated from natural sources and produced, using mostly recombinant DNA technology, for numerous products for diagnosing, preventing, treating, and curing a growing variety of diseases.[[34]](#footnote-34) Biologics have literally revolutionized the treatment of numerous diseases in fields such as oncology, autoimmune diseases and rare conditions which previously had no available treatments.[[35]](#footnote-35)

The biologics market is experiencing rapid growth. Over 90 products were approved by the FDA during 2010–2019, compared with ~20 products during 1990–1999.[[36]](#footnote-36) Biologics today account for nearly a third of all new active substances approved annually,[[37]](#footnote-37) and about 40% of the biopharmaceutical R&D pipeline.[[38]](#footnote-38) The biologics market is currently estimated at approximately $50 billion and projected to maintain growth at a CAGR of 10.5%–11% over the next five years.[[39]](#footnote-39) From a regional perspective, the Asia-Pacific (APAC) region is expected to see the biggest and fastest growth, at a compound annual growth (CAGR) of 13.0%, followed by Europe and North America with a CAGR of 11.8% and 11.6%, respectively.[[40]](#footnote-40)

This surge is partly explained by the biologics’ significantly higher price tag and profit margins compared to small-molecule drugs.[[41]](#footnote-41) Indeed, biologics are expensive. In the United States, the average price for a biologic drug ranges between $10,000 to $50,000 per annum, with extremely expensive biologics exceeding $500,000 annually.[[42]](#footnote-42) Biologics’ expensive price tag constitutes a significant barrier to their accessibility by patients who need them.

***9.2 Biosimilars’ Competition***

When market exclusivity of an innovative chemical drug expires, follow-on products with an identical active ingredient are generally easily produced, as the chemical structure of small-molecule drugs is typically well-defined and their composition easily analyzed. Their regulatory approval requires proof of *therapeutic equivalence*: that is, proof that equivalent clinical outcomes are expected to be produced to those of the reference product, and that they are also expected to exhibit the same safety profile of the reference product.[[43]](#footnote-43) These follow-on products are typically known as generics.

Because of the differences between chemical drugs and biologics in terms of their molecular complexity, manufacturing process, sensitivity, and their effect on the body, it is not possible to produce a generic product, nor a complete analytical analysis of one.[[44]](#footnote-44) For these reasons, stringent drug regulatory affairs (DRAs) professionals today require follow-on products to demonstrate *high similarity* to the original product as well as *no clinically meaningful differences*. These new products are commonly known as biosimilars.[[45]](#footnote-45)

The unique market conditions of biosimilars – high savings potential to payers and higher profit margins for manufacturers – contribute *inter alia* to the market’s strong and sustaining growth. The biosimilars market is currently estimated at $4–$6 billion and is projected to increase ten-fold, and grow at a staggering CAGR of 25%–30% in the next five years,[[46]](#footnote-46) with 54 biosimilars already approved for marketing in the EU and 25 biosimilars (for nine reference products) approved in the United States.[[47]](#footnote-47) Indeed, a recent Frost & Sullivan report estimates that by 2025, innovative biologic drugs, with a shared market size of $70 billion–$80 billion, will lose their market exclusivity by 2023, with the APAC region accounting for over 20%. The figure below provides a snapshot of the geographic segmentation of the biologics market by sales, based on a similar estimate by IQVIA.

Source: IQVIA, Leveraging biosimilars for better access and lower cost, March 2018, p. 3, <https://www.eahp.eu/sites/default/files/p._troein.pdf>.

*Fig. 9.1: Global Biologics and Biosimilar Markets by Sales, 2017*

However, as will be discussed below, the research, development and mass-scale production of biosimilars is significantly costlier than that of generics. Thus, while market entry of biosimilars does drive prices down, their price tags remain very high for both patients and payers***.***

***9.3 Biobetters***

An additional unique characteristic of the biologics market is the recent practice of building on and improving the properties of an innovative biological entity in order to gain superiority over the original, whether in improved safety or clinical efficacy, lower dosing or reduced risk of immunogenicity. These improved products are generally referred to as biobetters.[[48]](#footnote-48)

Biobetters are a potential game changer in the biologics market. A biobetter product that proves superior to the original biologic could considerably diminish the value proposition of biosimilars, thus preventing competition. Furthermore, a biobetter is deemed as an entirely new entity and, unlike a biosimilar, may be eligible for a patent protection and/or regulatory data protection (12 years in the United States and up to 11 years in the EU).[[49]](#footnote-49) While the R&D costs are high, the risk is lower, and the prospects for regulatory approval and ROI are significantly higher.

*9.3.1Main Challenge of Biologics: High Costs of Production = High Price, Less*

*Affordability*

The main driver of the expensive price tag of biologics and biosimilars is their production process and its constraints. Producing biologics requires significant capital investment in state-of-the-art facilities, bioreactors and clean rooms, expensive growth media, high levels of maintenance, costly purification procedures, and a skilled workforce.

The biopharmaceutical industry’s method of choice for producing a biologic drug is the use of microbial or mammalian cell-based expression systems (mostly *E.Coli* or CHO cells), where a genetically-engineered gene is inserted into living cells that produce the required protein, which is then harvested and purified.[[50]](#footnote-50) Developing production capabilities requires investments of $200–$500 million and several years in building facilities. The production process is time-consuming and susceptible to contamination by mammalian pathogens, and the cost per goods is estimated at $200 per gram.[[51]](#footnote-51) It is also estimated that this method could not sustain a dramatic increase in demand, expected to be driven mainly by monoclonal antibodies (mAbs) of which over 1,700 candidates are in the R&D pipeline for a variety of indications.[[52]](#footnote-52)

A recent study reveals that in 2018, the net spending on biologics in the United States amounted to $125.5 billion D (~36% of the total net spending on prescription drugs), yet the share of specialty drugs (which include biologics) of the total prescription volume was only 2.2%.[[53]](#footnote-53) These findings were also echoed by the former FDA’s Commissioner Scott Gottlieb in his remarks on the FDA’s Biosimilar Action Plan:

While less than 2 percent of Americans use biologics, they represent 40 percent of total spending on prescription drugs. So, enabling a path to competition for biologics from biosimilars is a key to reducing costs and to facilitating more innovation.[[54]](#footnote-54)

***9.4 Enter Biopharming***

The production constraints of the traditional method of microbial or mammalian cell-based expression systems and their impact on the finished product’s price drove a renewed interest in an alternative platform of using plant cells as bioreactors. Plant molecular farming, aptly named biopharming, is becoming a viable new solution, with several vaccines and mAbs (monoclonal antibodies) and diagnostic proteins already in commercial production, and numerous follow-on products for blockbuster biologics. now approaching commercial launch.

*9.4.1 Biopharming offers several advantages over its microbial/mammalian cells*

*Counterpart*

* faster production at lower costs - as much as 10% of facility cost and 50% of production cost compared to CHO expression;[[55]](#footnote-55)
* no risk of mammalian pathogen contamination;
* easier cultivation and high yield biomass;
* access to available genetic tools for trait manipulation;
* status as a non-food status, thus minimizing the possibility of contaminating the food supply with industrial products (i.e., lower regulatory burden);
* correspondence with new plant breeding techniques (CRISPR/Cas9), resulting in a significantly lower risk of batch-to-batch variability (a crucial regulatory hurdle).

These advantages can be juxtaposed with the current size of the biosimilars market ($4–$6 billion) and its projected ten-fold increase by 2025, as well as the market potential of successful biobetters, based on long market exclusivity periods. As a result, a considerably lucrative market potential can be assumed for plant-based biologics, especially when accounting for the savings potential, the range of new indications tested, and recent regulatory developments in this field.

***Within this context, the plant-based biologics sector is expected to be the next major commercial development in the field of biotechnology, with a disruptive impact on the global biopharmaceutical market, and, most importantly, on patients.***

## Chapter 10. An Overview of the Cybersecurity and the Renewable Energy Sectors

***10.1 Cybersecurity Background***

Cybersecurity is a vast domain. We will focus on the industry’s main functions to help provide a basic understanding of the way in which cybersecurity operates throughout the system, as everyone uses cybersecurity with their phones or computers. Developments in communication and associated technologies have undergone meaningful changes in recent years. The multitude of connected devices, connectivity protocols and applications enable exceptional access to and sharing of data and information. As the dependence of consumers and enterprises on networks for countless needs and demands grows, so does their vulnerability to cyberattacks. Attacks can cost millions of dollars, affect competitiveness and damage the reputation of companies. The high complexity of systems and networks enhance weaknesses, making the task of securing them even more challenging.

Network security employs software and hardware technologies to maintain integrity, confidentiality and availability of networks and data. Adequate network security can deter unauthorized access and stop a variety of threats from entering the system using protocols and controls implemented across many layers within the network and at its perimeters. Network security uses a number of methods, such as the active and passive deployment of software that can track and stop invasive and harmful activities and preventive deployment to identify potential threats and security glitches, and notifying users so that they are aware of these potential threats and of subsequent security protocols. Network security experts are capable of a complete assessment of the network architecture and the security of the internet and intranet connections of any user.

Cybersecurity experts can deliver a customized security solution with different components, such as firewalls, that best suits a particular user’s systems. Additionally, monitoring and end-to-end visibility enable improved network security management. After a thorough vulnerability assessment, network security is installed along with threat intelligence, endpoint security, application security, and other cybersecurity facilities. The primary areas where network security is most in demand are detailed in the graphic below:

*Fig. 10.1: Applying the Network and Information Security Directive*

Since the enactment of the Network and Information Security Directive and the General Data Protection Regulation in the European Union in 2018, operators must ensure that their network and information systems meet exacting requirements and high standards of cybersecurity. Multiple incidents and vulnerabilities targeting communication service providers reported in the last few years necessitate proactive reply plans and tools to deal with legal, operational, technical, reputational and supervisory risks. Communication service providers, with their core structures and the large volumes of personal data they hold on subscribers, have become prime targets for hostile attacks on their systems. One solution for meeting these threats enables communication service suppliers to both protect the network infrastructure and offer value-added security as a feature. The following represents areas where network security may be provided as a service to subscribers:

**Table 10.1: Network Security Market**

|  |
| --- |
| Network Security Market |
| Network-Based: Data Path |
| * This refers to security that is located in the network itself and not on individual devices. (Users do not need to download anything and are automatically protected, with no battery cost to devices.) |
| Network: Based: DNS Path |
| * This refers to security that prevents users from entering known malicious websites. |
| Network-Based: Home Router |
| * This refers to security that is located in home routers. |
| Endpoint-Based: Applications |
| * This refers to ssecurity that is downloaded onto individual devices. |

***10.1 Trends Impacting the Network Security Market***

The zero-trust tactic in cybersecurity has moved beyond being a buzzword. With the growing culture of BYOD (bring your own device), cloud computing, and remote workers, zero-trust tactics may soon become a mandatory as a network security approach. The scope and rate of insider threats are growing at alarming rates, and the solutions for mitigating them must expand accordingly. The zero-trust tactic mandates visibility and mapping of secure entries to data and resources based on user and location, with the aim of reducing the pathways for attackers and malware to enter the system. The zero-trust approach also requires the examination and logging of all traffic, the implementation of security rules based on business policies, and the use of multiple authentication methods to counter attacks.

Enterprise mobility has increased as employers adapt to the emergence of the BYOD trend and strive to meet employees’ preferences for smartphones, tablets, and portable computers at work. This trend affects the hardware that needs protection. As a result, network security frameworks and solutions must adjust and change to meet BYOD-enabled workplaces, becoming more flexible so that they can adapt to different operating systems, hardware and software.

The advanced technologies in network security, such as AI and ML-enabled network security systems, enhance prevailing defence capabilities and over time, learn to identify unusual patterns and hostile activities. These methods help to detect and stop known threats. The real value however, emerges when encrypted web traffic can be monitored for unseen variations of known risks or associated new threats or new malware threats. Automatic alerts to security teams concerning unusual patterns increase the effectiveness of the system by dealing with skills and resource gaps.

***10.2 Factors Driving the Adoption of Network Security***

The exponential rise in connected devices and, consequently, the increase in data and information that networks have access to, mandate the adoption of comprehensive security measures.

**Table 10.2: Four Major Drivers Affecting the Adoption of Network Security Measures**

|  |  |
| --- | --- |
|  | |
| Digital Transformation in Telecommunication and Other Industries | In addition to the increasing number of mobile and connected devices, the implementation of other technologies, such as Cloud, AI and Machine Learning (ML) is also creating a digital transformation in industries. Their use increases the complexity of the network, adding numerous endpoints and hybrid cloud structures. Consequently, single-layered security architectures have become unsuccessful, leading to the adoption of multi-layered and all-inclusive network security measures. |
| Privacy Concerns | As more customers and the devices become part of the network, data and information flow have improved considerably. This makes it imperative that network security is further improved to meet the pressures of maintaining data security and privacy. |
| Regulatory Changes | The evolution in communication, admission to data, and information in the network has made regulators take notice of the risks of breaches. This has led to the application of stricter norms and guidelines to which companies must adhere in order to ensure that they adopt best performance measures in securing the data of the customers. |
| Constantly Evolving Security Hacks | Potential hackers are aware of the increase in surface area in which they have opportunities to attack network security. Technologies such as AI and ML are being used by hackers to constantly develop and introduce new threats. New users, using a multitude of channels such as emails, apps, etc., are unaware of the need to implement adequate security methods, and become easy targets. |
| Additional Layer of Security | While end users comprehend the importance of implementing security features, they are limited by their lack of knowledge and failure to employ best practices. |

***10.3 Factors Constraining Adoption of Network Security***

The lack of standardization and resulting fragmentation in the network security sector creates confusion among users. As they seek integrated yields and services, network providers also need to find partners in the ecosystem with similar aims and approaches with respect to their security approaches.

**Table 10.3: Major Constraints Affecting the Adoption of Network Security**

|  |  |
| --- | --- |
|  | |
| Lack of Unified Network Security | Fragmentation in the market confuses users. As a result, the network security measures they do use are inadequate. The lack of inclusive solutions that can meet a variety of needs creates significant gaps that can be damaging to networks. The solutions must be able to scale up and meet the ever-growing and evolving needs of networks. |
| Security Budgets | Applying network solutions requires constant updates and changes. This requires a significant investment from a business, which may not always be possible. However, by adopting advanced network security solutions, organizations may have less pressure to hire IT experts, thus reducing costs. |
| Lack of Standardization | Dissimilar systems and protocols cannot support the integration of different providers and APIs to create a complete system. Users may not be able to make configuration changes, thus leaving susceptible areas in the network. Devices may use completely different systems, making visibility and organization difficult. |
| Lack of Trained Professionals | The security sector requires a high level of ability. Those working in the field must be able to react and change quickly in order to stay ahead of hackers. They must also be able to design technology and systems that can successfully overcome the continuous development of threats. |
|  |  |

***10.4 Challenges and Insights***

There are numerous and dissimilar approaches to security. As networks become more sophisticated and diversified, a host of different actors, both within and outside the industry, come together to help a network function. The importance of network security can have various levels of significance in different industries. In addition, not all outside actors can invest equally. As a result of these factors, some weak spots in network security could remain vulnerable, and breaches could go unnoticed. Even when applying network security, it is essential to monitor networks, since breaches can go hidden for several months.

Many efforts have been made to track across multiple layers in order to enable comprehensive monitoring and control. However, a single, comprehensive ecosystem has not emerged. Over the last few years, network security has moved beyond providing partial solutions to creating end-to-end solutions. As internet service providers (ISPs) offer improved security as a value-added service to customers, the solution provided becomes critical in ensuring protection not just for end users but for ISPs themselves. Multiple innovative companies, including large firms, startups and technology enablers have begun working together to improve and create effective solutions. Platforms that can integrate different components from different earners are increasingly becoming the preferred go-to solutions.

***10.5 Use Cases***

With regard to end-to-end network traffic, network security has moved beyond perimeter security to include communication in the cloud, and network infrastructures from remote sites to software, such as ML service applications. In terms of working across encrypted or decrypted solutions, the network security can detect suspicious traffic without the need to decrypt each time, even though most data is encrypted. Secure access using network security solutions ensure that access is granted only to reliable users, such as end user devices, APIs (Application Program Interface), IoT (Internet of Things), micro-services, and containers. Using network security solutions also prevents gaps in visibility. Better visibility leaders to enhanced threat detection, ensures highly secure access, and allows for software-defined segmentation.

***10.6 Future Trends in Network Traffic***

There has been a rise in the use of mobile devices to launch attacks on mobile phones and associated strategies to breach network security, as these devices tend to be more vulnerable. With end users using the same devices for business and personal use, endpoint security becomes critical. According to RSA's 2019 Current State of Cybercrime Whitepaper, 70% of fraudulent transactions in 2018 originated from a mobile channel.[[56]](#footnote-56) The next generation of 5G advances will also means growth in the attack surface area for ISPs. The complex and faster networks can expect more malware, security breaches and DDoS (denial of service) attacks.

The automation of security structures creates an added layer of security that is not reliant on human intervention to secure networks. This is important, as there are simply not enough skilled professionals in the industry able to enhance security capabilities and utilization. Automation can help fill the resulting gaps. In addition, most end users lack the requisite proficiency to secure their networks, and rely on third-party providers, which further adds to the popularity of automation. The growing trend applying AI and ML to devise solutions can also contribute to the beneficial growth of automated security solutions. The benefits of these technologies include enabling better response rates, pre-empting threat discovery, and supplying insights on effective mechanisms to reduce threats.

Those working in network security are increasingly looking at ensuring integrated solutions for comprehensive solutions. Haphazard or disjointed expansion of digital systems can leave systems vulnerable to attacks. Regulations such as the GDPR can encourage the work of reducing breaches and curbing malpractices, and thus enable the security sector to focus on defence and protection. Since hackers can utilize several entry points, such as emails and public clouds, among others, to enter the system, the need for end-to-end systems to prevent threats to networks with recognized standards will continue to grow. These new integrated systems should also feed into all network security controls, including physical, virtual, and cloud-based. They should be able to report to a more conventional control panel for other activities, such as configuration, policy, and changes in the organization.

***10.7 The Renewable Energy Sector Background***

The renewable energy sector uses non-perishable sources such as the sun, wind or water to generate power, and has received considerable support, including subsidies and incentives, from governments around the world. This support has become even more pronounced since the Kyoto protocol in 2008, which stipulated that world governments must reduce their greenhouse gas emissions by decreasing their reliance on oil and coal to produce power and by finding alternative sources.

The renewable energy sector is a rapidly developing and dynamic one, and includes several areas of alternative energy sources. The most developed renewable energy sources today are solar and wind energy. Companies working with energy storage and waste are also included in the renewable energy sector.

Renewable energy projects are more similar in nature to real estate ventures than to early-stage technology companies, such as life sciences or cyber. However, because of the complexity of the pricing of projects in this field, equivalents must be considered in the context of early stage firms.

As a rule, any renewable energy project is subject to state or regulatory policies. First, a company is given the right to participate in a tender for a project. The government agency awards the tender to a company on the basis of a number of considerations, and the winning company pledges to comply with a specific tariff. Once a company has won a tender, it needs to raise capital to finance the construction of the project and then to begin operating it in practice. Either of these stages can be done with a partner or alone, depending on the business model the company chooses.

Under this government-regulated process, a renewable energy firm must meet specified milestones, much like a life science company does. In addition, renewable energy firms need to recognize and factor in uncertainties and probabilities, as do any early-stage companies. Renewable energy firms also face a dynamic market which must be taken into account, due to the changing potential between different markets, different business models and different projects in terms of size, scope and partnership structure. As a result, renewable energy companies are valuated much like other early-stage companies.

It is always important in making valuations to consider market constraints. Investors should reduce the level of optimism when assessing market size and growth. When estimating the size of the market, the investor is relying on history, i.e., the size the market had before applying looking to the future. However, we must always remember the anchoring effect, which can explain judgment heuristics such as hindsight bias, preference reversals, and probability weighting. The latter is important for market estimation and the probability of things to occur.

The following section includes case studies of actual companies that combine financial and behavioural analysis in arriving at valuations.

***PART V: ACTUAL VALUATIONS***

**Chapter 11: Company A: Pharmaceutical/New Compounds**

***11.1 Background***

The valuation begins by examining the current status of the company’s product development.

We first present a valuation of a pharmaceutical company that is now in the clinical stage of development for a pain relief drug. What distinguishes this company’s product and what makes it a “dream company” is that its research t has enabled it to identify a unique component found in natural bee venom that it has reason to believe can lead to a unique and marketable product. Starting with just an idea that bee venom could provide a solution for pain, the company began researching the venom itself, finding that it has over 1000 components. After fully studying and analyzing all these components, the company has developed its own molecular chain of amino acids based on what it discovered about bee venom. After considerable research and experimentation, the company has reason to believe that the molecules or peptides it has produced have unique pain relief, anti-viral and anti-inflammatory properties that could provide breakthrough treatments for a number of skin conditions. These conditions will be identified as conditions I–IX.

Having completed its Phase I clinical trials to determine its product’s safety for Condition II, the company is now recruiting volunteers suffering from the condition for Phase 2 testing of the efficacy and optimal dosages. The company has also tested its product’s efficacy in treating Condition I, and has completed Phase 2 testing for this application of its new molecule and is planning to seek FDA approval to conduct Phase 2b clinical trials for using its molecule to treat this condition. The Phase 2b clinical testing involves further research into the drug’s efficacy and optimum dosage for different patients. Additional conditions that the company believes its discovery may be able to treat are Conditions III, IV VI and VII and VIII and it is still conducting pre-clinical trial research on these applications.

Given this background, a good financial valuation will then chart where the company stands in terms of its R&D and clinical testing of the company’s potential product applications. Such a chart could resemble the following:

**Table 11.1: Company A’s R&D and Clinical Testing Status**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Product Application** | **R&D Phase** | **Phase One**  **Testing** | **Phase Two Testing** | **Phase Three Testing** |
| **Condition/Product I** | Completed | Completed | Phase 2a: Completed  Phase 2b: Planned |  |
| **Condition/Product II** | Completed | Completed | Phase 2a: Planned |  |
| **Condition/Product III** | Completed | Completed |  |  |
| **Condition/Product IV** | Completed |  |  |  |
| **Condition/Product V** | Completed |  |  |  |
| **Condition/Product VI** | Completed |  |  |  |
| **Condition/Product VII** | Completed |  |  |  |
| **Condition/Product VIII** | Planned |  |  |  |
| **Condition/Product IX** | Planned |  |  |  |

In making the valuation, the professional must examine the sector or market for the product. With this company’s proposed treatment for Product I having advanced the furthest among its products under development at this point in time, the analysis will focus on this market sector. In this case, the potential global market for treatment for this condition in general was valued at $2,300 million in 2018. While there are several varieties of this condition included in this market, there is only one that is relevant to Company A’s product is caused by the HSV-1 virus. Figures from the World Health Organization indicate that over 3.7 billion people under the age of 50 suffer from this virus. Consequently, the market for a Product I-treatment, which addresses the results of this virus, can be expected to produce a 4.6% compound annual growth rate during the forecast period under study in this case (2017–2027).

Today, the drug acyclovir, a [nucleic acid analogue](https://en.wikipedia.org/wiki/Nucleic_acid_analogue) made from [guanosine](https://en.wikipedia.org/wiki/Guanosine) that decreases the production of the virus's [DNA](https://en.wikipedia.org/wiki/DNA), discovered in the mid-1970s, is the dominant treatment for Condition I. Acyclovir‘s 2016 revenue market share was 28.6%, which could be expected to grow at a 5.1% CAGR during the forecast period. Company A’s venom-derived treatment can be distinguished from other treatments as it has an exclusive combination of anti-viral and analgesic activity. This unique combination provides it with an advantage over other treatments currently on the market.

Another product of Company A at a relatively advanced clinical stage in its treatment of Condition II, a common and persistent, skin disease that afflicting a large percentage people throughout the world. With a global value of $7,224 in 2017, the global market revenue for Condition II is expected to expand at a 12.8% CAGR over the forecast period, reaching $23,992 million in 2027. The current treatments for the condition are based mainly on corticosteroids, calcineurin inhibitors, immune-suppressants, biologic therapy, PDE-4 inhibitors, antibiotics, anti-histamines and emollients. Most of these treatments include steroids that may cause side effects. The clear advantage of Company A’s unique venom-derived product is that it relieves pain quickly and doesn’t cause side effects.

In making the valuation for Company A, only anticipated values for Conditions I and II solutions being developed need to be considered, as they are at an advanced stage of development, with more likelihood of getting to market in a reasonable time. The potential of the technological platform and other equity valuation elements are considered for the valuation. The valuation then includes:

* Background about the product
* An in-depth, detailed examination of the nature of these two products,
* The company’s pre-clinical research
* The clinical testing
* The technology involved
* A market overview
* Key market drivers and restraints
* The competitive environment in the sector
* Valuation methodology
* The potential market.

The valuation will then continue by making a clinical review of the product and the related science, as well as what is known as a pipeline review of the progress and status of the Company’s product.

***11.2 Clinical Overview***

## One of the most common human pathogens is the virus causing Condition I, knows as Herpes simplex-1 (HSV-1). Between 50 to 90% of people worldwide are affected by it. [[57]](#footnote-57) While herpes of the mouth (herpes labialis) and eyes caused by HSV-1 are the most common forms the virus takes, there has been an increase in HSV-1 genital infections. An infection from HSV-1 usually presents with watery blisters on various parts of the body, especially in areas around the face, or genitals, which can be very painful.[[58]](#footnote-58) The infection can never be completely eradicated, remaining in nerve cells during even when it is latent and causing the watery blisters when it is active. While there are drugs to treat HSV-1 infections when it erupts, patients can develop resistance to them, which means there are fewer treatment options for such patients suffering from this life-long conditions. Consequently, there is a meaningful market for additional treatments for herpes infections that are more effective and less likely to result in resistance, or at least to be longer-lasting.

## Among the many new products Company A is developing from the unique molecules it has produced, is a synthetic tetra peptide which has already been extensively tested for use in treating Condition I (Phase 2a clinical trials completed) and Condition II (Phase 1 clinical trials completed). With respect to Condition I, Company A’s product is unique in that its effects include pain relief and anti-viral and anti-inflammatory activity, which distinguishes it from and gives it a significant advantage over today’s commonly-used generic drugs, such as Zovirax®, that are based on the generic anti-viral medication acyclovir.

## 11.2.1 Pre-Clinical Studies

## Studies to determine potential harm: The Company has performed all the required regulatory tests to determine if any harm results from topical administration of its product. These included:

## a genotoxicity study battery (in vitro)

## a skin irritation study (in vivo

* a skin sensitization study (in vivo)
* intra-vaginal toxicology (in vivo).

## These tests confirmed that Company A’s product is safe and does not lead to any structural chromosome aberrations or mutagenic activity. In addition, evaluation of the permeation behavior of the product on the skin indicated a very low absorption profile (< 1%).

## The Company carried out several pre-clinical in vivo and in vitro animal studies to determine its product’s efficacy as an antiviral agent and as a painkiller.

## One of the in vitro experiments for efficacy was on Vero cells, in which herpes tend to flourish. As can be seen below, when the Company’s peptide was used, the level of infection was reduced. The addition of the Company’s product also resulted in a reduction in the size of the plaques, which clearly indicates the peptide’s activity.

## The efficacy of the product for pain relief and anti-viral potential were tested by the Company in different models: animal pain models, inhibition of HSV-1 replication, inhibiting HSV-1 replication and spread, inhibition of HSV1 replication and spreading, peptide sequence specific (changing the peptide’s amino acid order to demonstrate a direct potency) and anti-inflammatory activity in different assessment models (in vivo, in vitro).

## 11.2.2 Clinical Trials

## The product’s Phase 1 clinical trial was designed to determine the safety, tolerability and pharmacokinetics (PK) data for doses of 0.1% and 1.0% of its product in cream form, administered topically to healthy volunteers for up to five consecutive treatment days.

## The primary goals of this study were:

## Safety evaluation: To determine the safety of the Company’s product in terms of

## the skin irritation score and the type and severity of any reported adverse effects.

## Tolerability evaluation: To demonstrate how the Company’s product was tolerated based on the treated volunteers’ treatment compliance.

## The clinical study results indicated topical administration of the Company’s product in cream form was well tolerated, appears to be safe for use and had an effective pharmacokinetic profile. Furthermore, these results could possibly be applicable to other conditions suitable for treatment by topical application, such as Conditions II and IV and other skin traumas, such as burns.

## 

## In the Company’s Phase 2 clinical trial: The company carried out a non-inferiority study to demonstrate that its product was not inferior to available treatments. The company carried out prospective, randomized, double-blind, parallel group, acyclovir-controlled (acyclovir currently being the most popular standard treatment) clinical study in 210 recurrent Condition I patients to assess safeness, tolerability and preliminary therapeutic efficacy of 1.0% of the product in ointment form for the treatment of Condition I symptoms after five consecutive treatment days with five times daily topical administration. To date, the results have shown that the product is not inferior. The Company is now seeking FDA approval to carry out more extensive Phase 2 testing.

The following section of the valuation examines other potential uses for the Company’s products.

## 11.3 Pipeline Analysis

## 11.3.1 The Company’s Technology Platform

1. The Company plans to test its first product based on its unique molecule aimed at treating Condition I. It is also planning to carry out further testing on Product II, which, due to its chemical properties that promote healing and provide pain relief, could also be used to treat other conditions, such as first degree burns and pruritis, or itching.
2. Whereas the composition of acyclovir cream, today’s leading treatment for Condition I is not suitable for the treatment of ocular herpes, the Company’s molecule is both soluble and anti-viral and could be suitable for treating HSV-1-based infections in the eyes. Therefore, it may be able to provide a solution for treating this condition. The product may also be further developed and tested for the possibility of use in treating dry eye syndrome.
3. Pre-clinical testing has been carried out on the Company’s molecule to determine its suitability for anti-aging properties, and was, indeed, found to inhibit cell death. Consequently, the Company’s molecule has the potential to be developed as an anti-aging treatment.

The following Market Overview analyzes potential target applications and possible markets for the Company’s product innovation.

*11.3.2* *Possible Markets for the Company’s Product Innovation*

### *Condition I*

### Many of the applications for the Company’s products are suitable for treating conditions caused by herpes simplex viruses. These viruses are ubiquitous pathogens with the ability to adapt to their host and the potential to cause a wide variety of diseases and conditions. As mentioned above, HSV-1 is usually associated with the recurrence of small, painful, fluid-filled blisters usually around the face or genitals.[[59]](#footnote-59)

### While HSV-1 is mostly asymptomatic when latent, it is known that it is transmitted orally, causing infection in or around the mouth, a condition which Product I addresses. HSV-2 is almost always transmitted sexually, causing genital or anal area infection (Condition VI). HSV-1 can also be transmitted to the genital area through oral-genital contact, causing Condition VI. Both types of infections cannot be “cured” and are lifelong, although they can have long periods when they are not active in the body.[[60]](#footnote-60)

### The World Health Organization estimates that an HSV-1 infection afflicts 67% of the world population.

### Every year, around 776,000 people in the United States develop new herpes infections, and every sixth person aged 14 to 49 years suffers from Condition VI (2016).

### *Condition VI (HSV-2)*

### HSV-2 infections are widespread all over the world, and are almost exclusively sexually transmitted. While HSV-2 is the main cause of Condition VI, HSV-1 can also cause that particular infection in certain circumstances, as discussed above. As with HSV-1, infections from HSV-2 are incurable and lifelong. Most infected people with Condition VI are unaware that they have the infection, as such infections often have no or mild symptoms, or undetected mild symptoms. The symptoms, when they do appear, are characterized ulcers, and symptoms of new genital herpes infections can include fever, body aches, and swollen lymph nodes. HIV viruses are also affected by HSV-2, with an HSV-2 infection greatly increasing the risking of acquiring a new HIV infection, and those with both HIV and HSV-2 are more likely to spread HIV to others. For those suffering from HIV, HSV-2 is among their most common infections, occurring in 60–90% of HIV-infected persons.

### At least 45 million people in the United States suffer from Condition VI.[[61]](#footnote-61)

### The global treatment market for Condition VI is projected to register a 4.4% CAGR in value terms during the forecast period,[[62]](#footnote-62) with the market anticipated to be valued at $2.4 billion by 2027.

### *Condition II*

### Condition II is a chronic skin disease that is caused by a combination of an immune system dysfunction and problems with the skin barrier, usually of an allergic nature. Often characterized by dry, itchy skin, Condition II includes a number of medical conditions that cause red, inflamed and itchy skin. Condition II is chronic, often remaining latent with periodic flare-ups. Those suffering from it may also suffer from asthma or hay fever.

### There are a number of treatments currently used for Condition II, depending on how severely the disease or condition presents. Treatments for mild cases of Condition II include emollients and mild potency topical corticosteroids. Moderate cases of Condition II can be treated with emollients, moderate potency topical corticosteroids, PDE4 inhibitors (PDE-4 is an enzyme that helps regulate inflammation in the body), topical calcineurin inhibitors, (calineurin activates the immune system’s T-cells) antihistamines and bandages. When Condition II cases are severe, it can be treated by the same drugs used for it in its moderate state, as well as by biological therapy, immune-suppressants, phototherapy and systemic therapy.

### Global market revenues for Condition II treatment are expected to expand at a 12.8% CAGR of over the forecast period.[[63]](#footnote-63)

### In 2016, the treatment market for Condition II in North America, the most lucrative market in this sector, followed by Western Europe, accounted for a 30% share of the global market.

### Between 2015 through 2025, the prevalence of Condition II in Canada, the United Kingdom, the United States, and France are expected to increase by 0.49%, 0.54%, 0.44% and 0.17% respectively. Respective decreases of 0.97%, 0.17%, 0.32% and 0.46% are expected to be seen in Japan, Germany, Spain and Italy.

### The United States has the highest rate of prevalence of Condition II;[[64]](#footnote-64) 18 million adults and 9.6 million children under 18 suffer from the condition. Among children, 3.2 million have moderate to severe cases of Condition II.[[65]](#footnote-65)

### *Condition III*

### Condition III is a common skin condition that speeds up the life cycle of skin cells, so that cells to rapidly build up on the skin surface. These excess skin cells cause scales and red patches that are itchy and even sometimes painful.[[66]](#footnote-66)

### According to scientists, there are a number of factors that can cause and promote the development of Condition III:

### Genetic reasons: At least 10% of people inherit one or more of the genes that could eventually lead to Condition III. In order to develop Condition III, a person must have both the genes that cause the condition as well as exposure to specific external factors known as “triggers.”

### Stress can cause Condition III to flare for the first time or aggravate existing cases of Condition III. The impact of Condition III may be reduced, or even its recurrence prevented through relaxation and stress reduction.

### Injury or trauma to areas of the skin can lead to the appearance of Condition III in those areas.

### Medications: Certain medications may trigger the onset of Condition III Medications associated with the condition include high blood pressure medications, such as Lithium and Inderal, the heart medication Quinidine, the non-steroidal anti-inflammatory drug Indomethacin, and more.

### Condition III may be triggered or affected by any infection that has an impact on the immune system.

### 

### According to the World Health Organization, at least 100 million individuals throughout the world are affected by Condition III. Other sources indicate that about 125 million people have some form of Condition III. Therefore, the average number of people affected by the disease amounts to 110 million people.[[67]](#footnote-67)

### There are over 140,000 new cases of Condition III annually in the United States, and a total of 7.5 million Americans are affected by the disease.

### 

### Anyone can develop Condition III, regardless of age. But Condition III is most likely to first appear between the ages of 15 and 35, with males and females developing it at about the same rate.

### *Condition IV*

Condition IV, a skin disease characterized by severe rashes on the skin, is caused by the virus varicella zoster, also known to cause chickenpox.

In the United States, nearly one third of the population will develop Condition IV during their lifetimes. There is also a risk of developing persistent post-therapeutic neuralgic pain in the area where the rash appeared after infection with the virus. This risk increases sharply with age. In the United States, Condition IV occurs in nearly one million individuals annually, accompanied by a significant morbidity rate.[[68]](#footnote-68)

Primary infection with the Condition IV leads to varicella. Even after the illness passes, the virus remains dormant in the spinal nerves. Condition IV can reappear later in life after a latency period, causing a painful, maculopapular rash.[[69]](#footnote-69)

People with Condition IV most commonly suffer from a localized rash in one or two adjacent dermatomes, which are areas of the skin that are mainly supplied by conducting nerve fibers from the single dorsal root in a spinal nerve. The rash most commonly appears on the trunk of the body along a spinal nerve.[[70]](#footnote-70) People with active Condition IV lesions can spread the infection to others who have neither had the disease nor received a vaccine, and thereby infect these individuals with varicella.

A person’s risk for developing Condition IV rises dramatically after the age of 50. Factors that compromise the immune system, such as HIV, AIDS, cancer, chemotherapy or radiation treatment can increase the risk of developing the condition. Taking certain drugs, such as steroids or medications given after an organ transplant, also increase the risk of contracting Condition IV.[[71]](#footnote-71)

*Condition VII*

The [herpes simplex virus (HSV)](https://www.healthline.com/health/herpes-simplex) can also cause Condition VII. The most common type of Condition VII affects the cornea, the clear front portion of the eye. When Condition VII presents in a mild form, it can causes pain, inflammation, redness and tearing of the cornea surface. When Condition VII results in an infection of the stroma, or deeper middle layers of the cornea, it can cause severe damage, even resulting in vision loss and blindness.

Each year, about 50,000 new and recurring cases of Condition VII are diagnosed in the United States, and the condition presents slightly more frequently in men than in women.[[72]](#footnote-72) While Condition VII infections can remain dormant, the recurrence rate after an initial episode is approximately 27% after one year, 50% after five years, and 63% after 20 years. The optimal treatment for the active virus involves topical or oral antivirals. However, steroids are counter-indicated unless the condition appears in the stroma, in which case prophylactic treatment with steroids together with oral (never topical) antivirals is indicated.

In contrast to existing treatments, the Company’s product can provide immediate improvement and pain relief. Acyclovir, used to treat similar infections, is forbidden for use in the eyes. However, the Company’s product is soluble and can be used as eye drops for the treatment of Condition IV for which there is currently no effective treatment.

The following section in the valuation presents the key factors in the market that could positively or adversely affect the performance of Company’s products and their specific applications in the relevant sectors.

## 

## . Key Positive and Inhibiting Factors in the Market

## The Herpes Simplex Virus and Condition VI: Positive Factors:

* Population growth
* Potential increase in number of patients (rise in elderly population)
* Increasing prevalence of viral diseases in the population (increasing disease burden of herpes)
* Growing awareness by both patients and physicians, particularly in developing countries

* New product launches, development of new antiviral medications and technological advancements in the development of antiviral treatments
* A growing focus on evidence-based medicine
* With the virus developing resistance to the existing anti-viral medications, there is a need for innovative therapies for the treatment of the conditions the herpes simplex virus causes.

The Herpes Simplex Virus and Condition VI Inhibiting Factors:

* Poor access to diagnostic services in remote areas
* Pricing pressures, leading to a preference for generics
* High costs of antiviral drugs and stringent regulatory approval processes
* Narrow scope for market growth because of many generic products and little to no innovation in the pipeline products.

Condition II Positive Factors:

* Growing prevalence of food allergies which exacerbate Condition II[[73]](#footnote-73) (approximately one-third of all children with Condition II suffer from both a food allergy and severe cases of Condition II)
* Increasing focus on developing systematic therapies
* Increasing use of medications in developing countries
* Several products in advanced stages of clinical development
* An evolving reimbursement environment for new treatments for Condition II, involving high government funding and numerous pharmaceutical company initiatives to support research in the field.
* Increased awareness and advances in treatments.

Condition II Inhibiting Factors:

* Variations in treatment costs limit patient access
* Lack of awareness
* The use of low efficiency drugs
* Adverse effects of some of the drugs in use[[74]](#footnote-74)
* Insufficient progress in approving new drugs and challenges in performing clinical trials.

## 

The following section of the valuation analyzing the competition in the sector in which the Company operates for each of its relevant applications.

## 11.4. The Competitive Environment in the Sector

## Herpes Simplex Virus

### Currently, there is an abundance of aleady-approved anti-viral therapies in the herpes simplex market. These drugs include: Zovirax® (acyclovir sodium), Sitavig® (acyclovir), Denavir® (penciclovir), and several others, such as Valtrex® (valaciclovir), Famvir® (famciclovir), and more[[75]](#footnote-75) Some new therapies that are expected to soon become prominent in the herpes market are Pritelivir (AIC316) and SQX770, being developed bySquarex LLC.[[76]](#footnote-76) Pritelivir[[77]](#footnote-77) now under development, derives from a novel chemical class and offers a new approach to the virus by inhibiting the viral helicase-primase enzyme complex. It appears to have a long plasma half-life, which helps make it a potentially strong inhibitor of HSV replication. Pritelivir is effective against Conditions I and VI and appears to be effective in treating cases in which the virus has become resistant to drugs already on the market.

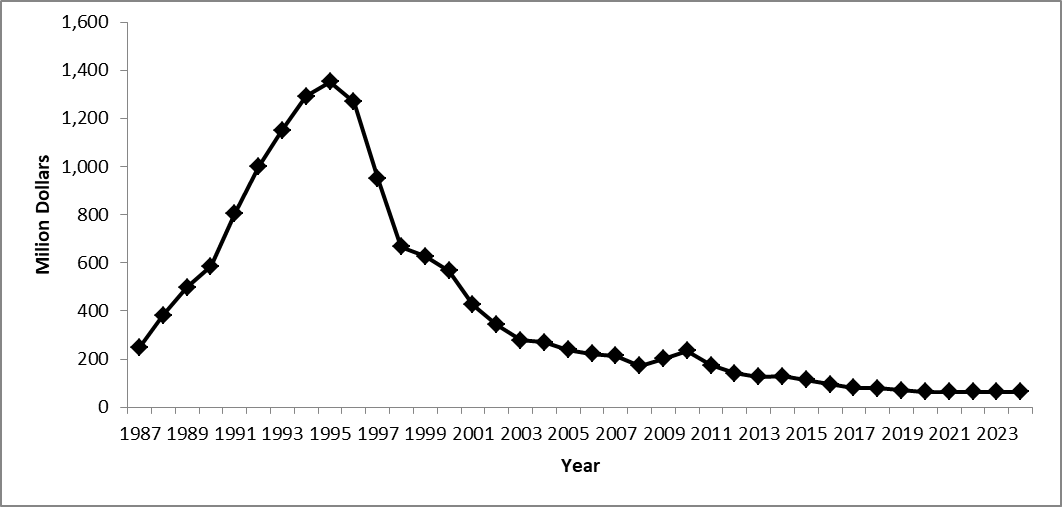
The primary companies in the herpes market are Pfizer, GlaxoSmithKline (GSK), Abbott and Novartis (partially generic), and generic companies such as: Valeant Pharmaceuticals (Bausch Health), Sun Pharmaceutical Industries, Teva, Dr. Reddy’s and Mylan.

## The next part of the valuation continues by analyzing competing drugs already on the market or in advanced stages of development for this particular application of the Company’s product.

## Conditions I and VI: Competing Drugs

## Acyclovir (Zovirax) (Company A’s major competition)

### The anti-viral drug acyclovir (Zovirax®), a synthetic nucleoside analogue, is the major drug being used today to treat infections in humans caused by the human herpes simplex virus. The kinases of the herpes virus (a kinasis is an enzyme that catalyzes processes in the body that transfer phosphate groups from high-energy, phosphate-discharging molecules to specific substrates) facilitate acyclovir’s modification into an active form that inhibits the production of one of the virus’s proteins that is essential for replicating the virus.



Patent expiry

### Zovirax World Wide Sales 1987-202315

### *Fig. 11.1. Competitor’s Sales*

### Zovirax® was originally launched in 1981 as an antiviral treatment for cold sores by GlaxoSmithKline. From 1987, when its sales amounted to $200 million worldwide, they increased to $1.3 billion by 1995, falling precipitously as the expiration of its patent approached in 1997, when generic drugs entered the market.[[78]](#footnote-78)

**Acyclovir resistance:** Acyclovir is commonly used for pain reduction and acceleration of the healing process of the sores caused by the herpes simplex virus. Anti-viral resistance, is a major challenge to acyclovir’s effectiveness. Key factors in developing the resistance to acyclovir include prolonged exposure to antiviral drugs and immunosuppression-induced ongoing viral replication.[[79]](#footnote-79) When HSV becomes resistant to acyclovir, infected people can suffer from painful and unsightly lesions on the skin lesions or enlarged skin masses near or close to the genitals.[[80]](#footnote-80) Those suffering from HIV or with compromised immune systems are more likely to experience such symptoms, and it may be more difficult to treat them, and they are more likely to suffer from recurrences even following treatment.

The valuation can include a table showing the nature and status of the major competitors to the Company’s products, like the one shown below.

The table below contains key competing drugs to Company A’s product currently in advanced clinical stages.

**Table 11.2: Potential Direct Competitors for Company A’s Products**

|  |  |  |
| --- | --- | --- |
| **Drug (Company)** | **Phase** | **Description** |
| **X**  **Company Alpha** | 3 | X is being developed as a topical gel to treat Condition VI by intravaginal application. |
| **Y**  **Company Beta** | 3 | Y is being developed to treat a number of conditions, including herpes simplex infections 1 & 2 and Condition IV. It is based on a naturally-occurring poison excreted by a reptile. |
| **Z**  **Company Delta** | 2 | Z is being developed as a topical get to prevent reoccurrences Conditions I and VI. |
| **XX**  **Company Gamma** | 2 | XX is an orally-active antiviral compound, under development to suppress and prevent Condition VI. |
| **YY Vaccine**  **Company Epsilon** | 2 | YY Vaccine is being developed to treat herpes simplex 2. However, there are reports that the vaccine has not met is primary endpoint in clinical trials. |

## Condition II:

## Today, the most common chronic inflammatory skin disease afflicting people is Condition II. It can significantly undermine one’s quality of life, and, because it is never eradicated from the body, it has a lifetime prevalence of up to 20% and its significant impact on quality of life can often require long-term systemic treatment.

## The ten leading treatments currently being used to treat Condition are: Dupixent®, Eucrisa®, Bepanthen®, Temovate® and Betamethasone Butyrate Propionate®. It is expected that ANB020 Etokimab, Lebrikizumab, Olumiant and PF-04965842 will soon be on the market.

## The two-part figure below indicates the potential global sales of all these treatments together.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
| Dupixent (SNY) | 247 | 741 | 1,381 | 2,040 | 2,744 | 3,270 | 3,805 | 4,319 |
| Eucrisa (PFE) | 67 | 168 | 315 | 473 | 608 | 729 | 816 | 893 |
| Bepanthen (BAY) | 428 | 478 | 494 | 516 | 535 | 554 | 573 | 594 |
| ANB020 (ANAPTY) |  | | | | 44 | 125 | 235 | 382 |
| Lebrikizumab (DRMRA) |  | | | | 8 | 23 | 56 | 103 |
| Temovate (GSK) | 97 | 102 | 101 | 101 | 101 | 101 | 101 | 101 |
| Olumiant (LLY) |  | | | 34 | 45 | 73 | 82 | 92 |
| PF-04965842 (PFE) |  | | | | 6 | 25 | 48 | 75 |
| Betamethasone Butyrate Propionate (Torii Pharmaceutical) | 57 | 57 | 57 | 57 | 57 | 58 | 58 | 58 |
| Clobetasol Propionate (AKRN) | 60 | 51 | 50 | 49 | 47 | 46 | 46 | 45 |
| Other | 219 | 213 | 182 | 169 | 170 | 173 | 199 | 226 |

*Fig. 11.2:Worldwide Sales for the Top 10 Condition II Drugs*

## The following are descriptions of some of the most dominant and unique competitors in the market for the Company’s Condition II treatments.

## Dupixent®[[81]](#footnote-81) is the first biologic approved for those adult patients suffering from moderate to severe Condition II who cannot use topical therapies or for whom topical therapies do not help. Dupixent® currently has the highest market share of the Condition II treatment market, and its sales may reach $4.3 billion in 2024.

## Eucrisa®[[82]](#footnote-82) is the first topical prescription treatment for Condition II approved by the FDA in over ten years. It is a steroid-free ointment for those suffering from mild-to-moderate Condition II. Because its active ingredientacts deep within skin cells, targeting the phosphodiesterase 4 enzyme, Eucrisa® can be effective above and below the skin.

## Bepanthen® [[83]](#footnote-83) uses dexpanthenol (Vitamin B5) to help aid the natural recovery of the skin.

## Temovate®[[84]](#footnote-84) is a corticosteroid for treating a number of skin conditions. It reduces many of the swelling, itching and redness symptoms that occur in skin conditions such as Conditions II and III, dermatitis, etc.

## Etokimab,[[85]](#footnote-85) is an antibody that inhibits IL-33 activity. IL-33 increases inflammation and numerous studies have found that it plays a role in atopic diseases, including Condition IIs, food allergies and asthma.

## Lebrikizumab[[86]](#footnote-86) is a new monoclonal antibody designed specifically to block the action of interleukin-13, or IL-13, that plays a central role in Condition II.

## The market leader is Sanofi’s Dupixent®, which enjoyed a 21% market share in 2017. This is expected to increase to 70% in 2020. It has an expected CAGR of 51% for the period of 2017–2024. Following Dupixent® is Pfizer’s Eucrisa®, that is expected to reach a 15% market share by 2020.

## 

## Dupixent® is administrated by injection and is used to treat adult patients with moderate to severe Condition II symptoms who are unresponsive to topical prescription therapy. Although it has the highest anticipated market share, its disadvantage is the undesirable side effects associated with it, such as injection site reactions, pink eye (conjunctivitis), and more.

## Eurcrisa® is a prescription ointment used topically for treating mild-to-moderate Condition II. It does have some unpleasant side effects, such as allergic reactions at or near the application site, hives, itching, swelling, and redness.

## It should be born in mind that Condition II affects millions of people worldwide, with a strong negative impact on overall life quality. Despite recent promising advances, it is still difficult to treat and additional treatments are essential. The Company’s product differs from others on the market in that it offers immediate pain-relief effect, which crucial for atopic dermatitis patients. The Company’s product also provides anti-inflammatory treatment. Not only is the Company’s product safe for use, but it has no side effects. These unique qualities provide the product with an advantage over current available treatments.

The following section of the valuation presents the methodology and factors used in making the Company’s valuation. The following are the elements examined to reach a value determination:

*Recent Relevant Deals*

*Success Rates*

*Main Valuation Parameters for Conditions I and II*

### *Technological Platform Valuation*

*Equity Value*

## Valuation Scenarios

*Capitalization Rate*

# 11.5 Valuation Methodology

As discussed in Chapter 8, valuating R&D companies is challenging due to their limited cash flow, if any, and because in most cases there is a long time before they will reach the market. Methods usually employed for company valuations are not useful when valuing R&D companies. The business’s current status cannot be analyzed by its balance sheet or even revenues, and, usually, the company is unlike other companies, as it is unique technologically and financially.

The discounted cash flow (DCF) method is the most common one used in making financial valuations. However, in order to use this method to value an R&D company, several modifications must be made. In general, as described in earlier chapters, there are three primary approaches possible using the DCF method when valuing young companies:

1. **Real Options:** The real options valuation method can be used with early-stage companies like life-sciences or cyber security, when the assessment can be viewed as make-or-break or in other words like a binary decision. The valuation is based on initial phases where in most cases even the market the company would like to penetrate to is still vague.
2. **Pipeline Assessment**: Combined projects value to which are added unallocated costs and an assessment of its future technology. Then valuation also assesses the ability of the company to create new projects (pre-clinical or clinical projects) and, along with their technological potential.
3. **DCF:** The DCF method can be applied to firms that already have a positive cash from products they are producing.

Our Company’s valuation was conducted using two separate methods, as the Company currently has both a stream of revenue as well as clinical and commercial potential. We then summarize the valuation as a “sum of parts.”

For current sales, we use the DCF valuation in the basic method we describe above.

For our Company’s two currently viable applications for Conditions I and II, we use the “pipeline assessment”, as the company develops several products and it has technological potential. The valuation is calculated as the Company holds few existing projects (as an holding company) based on Risk-adjusted Net Present Value (rNPV), and taking into consideration several possible scenarios. These included primarily analyzing the Company’s income, according to scientific and technological assessments, drawing on a number of sources and estimates regarding market scope; determining the potential projected market success; and assessing the regulatory risk.

Revenues are based on the following data

* Product or product line market potential.
* Company’s market share or its ability of market penetration.
* Peak Sales: Company or its products’ projected peak sales
* Treatment Costs: Estimated patient cost per year.
* Success Rate: Clinical trials’ success and of progressing to the next phase in the examined sector.

The Following Presents the Actual Financial and Valuation of the Company and the Methods Used.

# 

# 11.6 Financial Analysis & Valuation

## Even when making a financial valuation, we strongly take into consideration the competitors and similar transactions, as we are aware that we may have over-confidence in our “bottom-up” financial analysis.

We proceed by evaluating the Company based on its two leading clinical applications for Conditions I and II along with its pre-clinical scientific platform, as shown below:

**Table 11.3: Company A’s Clinical Applications**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Molecule | Indication Valuation Method & Approach | Clinical Stage | Comments | Go To Market |
| P-3 | Condition I | Phase 2b In the US. Pre IND- Q1-2019 | Innovative treatment for anti-viral infection | 2023 |
| Condition II | Towards Phase 2a- March 2019 | The toxicity and safety studies done for Condition I can be used to shorten the developmental time. | 2024 |
| Condition IV | Completed Phase 1 studies |  |  |
| Condition VI | Pre-clinical |  | ~10-11 years |
| Both P3 and P4 | Condition VII | Pre-clinical | Today’s leading alternatives either cannot come in direct contact with eyes or are not good enough. | Three years from beginning of development |
| P-4 | Condition III | Pre-Clinical |  |  |

*11.6.1 Recent Relevant Transactions*

Condition I:

## In June 2010, GlaxoSmithKline and Medivir entered into an agreement to commercialize Xerclear® (acyclovir and hydrocortisone). According to the agreement, GSK can commercialize and distribute Xerclear® in various European countries.[[87]](#footnote-87)

## In 2012, Renaissance Pharma entered agreed with Deerfield Management Co. to purchase the rights to manufacturer and commercialize Denavir® (1% penciclovir cream).[[88]](#footnote-88)

## In May 2016, Mylan NV acquired the dermatology drug business of an Illinois pharmaceutical company. According to Mylan NV estimates, Denavir® (Penciclovir), used to treat cold sore, generated sales of about $50 million.[[89]](#footnote-89)

## Condition II:

## In July 2016, Leo Pharma in-licensed worldwide rights from AstraZeneca to develop and market the Phase 3 drug Tralokinumab, for dermatological uses. LEO Pharma paid $115 million upfront and agreed to pay $1.0 billion for commercially- milestones and mid-teen percentage royalties on product sales.[[90]](#footnote-90)

## In July 2018, Dermavant Sciences signed an agreement with GlaxoSmithKline to obtain rights for a Phase 3 development drug and for its commercial supply. Upon completion of the transaction, Dermavant Sciences (a subsidiary of Roivant Sciences) acquired worldwide rights, with the exception of China, as well as preclinical topical back-up programs and responsibility for all development milestones owed to third parties. Dermavant Sciences will pay $184 million upfront and a potential future milestone payment of $122 million.[[91]](#footnote-91)

## In August 2017, Dermira in-licensed exclusive worldwide rights from Roche for a Phase 2 Condition II drug, paying $80 million upfront and agreeing to $55 million in additional payments in 2018, plus additional payments upon reaching certain milestones. Dermira agreed to pay $40 million upon initiation of the first Phase 3 clinical study, and up to $210 million if and when certain milestones are met in certain regions, and up to $1.025 billion based on reaching certain net sales thresholds for indications other than interstitial lung disease. Dermira will pay royalty payments ranging from high single-digits to high teens percentages of net sales conditional upon regulatory approval.[[92]](#footnote-92)

## In April 2012, Vanda Pharmaceuticals in-licensed exclusive worldwide rights from Eli Lilly for a Phase 3 drug, paying a $1 million initial license fee and agreeing to cover all future development costs. Vanda also agreed to make a $4 million payment for pre-FDA approval milestones and up to $95 million for future milestones, along with tiered low double-digit royalties.[[93]](#footnote-93)

## Based on the above agreements, it can be estimated that a deal structure for Condition II would amount to $100 million during Phase 3, with 8% royalties. A deal structure for Condition I can be estimated to amount to $20 million, with 15% royalties.

*11.6.2 Success Rates*

**Success rates provide vital tools for dealing with our optimism, as they provide us with outside data upon which we can rely, such as general data based on previous clinical trials. This outside data, which we as analysts did not collect, must be referred to and incorporated in our analysis, thus imposing cognitive limits on our analysis**.

The Company engages in the dermatologic therapeutics ecosystem by advancing its candidate drugs through the clinical phases. Success rate data for all applications, including dermatological ones for transitioning from Phase 2 to Phase 3I is 31%, and for transitioning from Phase 3 to FDA milestones, is 58%. To date, there has been an 86.9% success rate of obtaining final regulatory approval. Based on our analysis, we estimate similar success rates. However, we assume higher success rates for the herpes trials between Phase 2 and 3, due to higher certainty.

As presented below, the rNPV valuation includes success rates for each indication:

|  |  |  |
| --- | --- | --- |
|  | **Probability of Phase 2 success** | **Probability of Phase 3 success** |
| Hematology | 57% | 75% |
| Metaboloc | 45% | 71% |
| Ophthalmology | 45% | 58% |
| Infectious disease | 43% | 73% |
| Endocrine | 40% | 65% |
| Other | 40% | 70% |
| Gastroenterology | 36% | 61% |
| Urology | 33% | 71% |
| Allergy | 33% | 71% |
| Autoimmune | 32% | 62% |
| All Indications | 31% | 58% |
| Neurology | 30% | 57% |
| Respiratory | 29% | 71% |
| Oncology | 25% | 40% |
| Cardiovascular | 24% | 55% |
| Psychiatry | 24% | 56% |

Source: Biomedtracker (2018)

*Fig. 11.3: Clinical Development Success Rates (SR)*

Based on capital asset pricing model (CAPM model), we calculate our discount rate at 18.3%.

**Table 11.4: Main Valuation Parameters for Conditions I and II**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Indications | Current  Stage | SR  Phase 2 | SR  Phase 3 | Regulatory Approval SR | Launch | Patent until |
| Condition I | Phase 2 | 50% | 58% | 86.9% | 2023 | 2036 |
| Condition II | Phase 2 | 31% | 58% | 86.9% | 2024 | 2036 |

Based on the aforementioned parameters, we evaluate the following:

**Table 11.5: Company A Pipeline Analysis**

|  |  |
| --- | --- |
| Pipeline Analysis | rNPV |
| Condition I | 22,582 |
| Condition II | 110,368 |
| Total rNPV Pipeline | **132,950** |

### 

### *11.6.3 Technological Platform Valuation Background*

The Company's broad business and technological base supports its product pipeline The Company’s evualated “technological base” is a “residual value” valuation of the company. The way the residual value is calculated is based on feed rate method, communal in life sciences. It is used here as traditional terminal value is usually used by non-life-science companies. Reasons for this choice are as follows:

* In non-life-scince firms terminal value echoes a steady state in growth rate (g) as it is based on historical data. However, in life science companies or in general in early stage firms, terminal value is derived from future, under developmnt projects.
* Usually, the terminal value for a given company constitutes more than 50% of its worth. However, most of an early stage company’s value is attributed to revenues generated during a number of years after the drug or product is launched (approximately six to ten years), after which there is a certain decline, whether due to patent expiration or emerging new and competing products.
* “Technological base” in life science firm is the know ho, the technology platform in which the company will produce in the future new projects on an annually base. Several factors, as describe below such as clinical and regulatory development and a different capitalization rate than that applied for the forecast years, contribute to the estimation of the capitalization value of such future projects.[[94]](#footnote-94)

Our valuation includes future potential of early clinical stage drug candidates for other dermatologic indications. We view the Company’s technological platform as the basis for enabling its management to engage in additional worthwhile technology purchases, and incorporate them into the company's product pipeline in advanced clinical phases.

*11.6.4. Technology Platform Valuation Factors*

* A new project is assumed every five years, with $68.5 million value (based on average projects value in the company’s pipeline).
* Unallocated costs are mainly General and Administrative and operating costs, with a same portion of the value of the project. While the structure of the Company is a lean one, we nevertheless estimate a 5% increase in its future costs, as the company will also need to finance its IPO.
* We estimate unexpected costs at an additional five% of the average value.
* Corporate Tax: The United States federal corporate income tax rate was cut to 21% on January 1st, 2018.
* Because of increased uncertainty other than the one used in the pipeline valuation capitalization rate is different.

**In behavioral terms, the analyst takes extra precautions here, estimating a higher capitalization rate for future technology in order to counteract our innate optimism which could lead to an over-valuation.**

* Assuming that the technology platform produces projects for n years, we value n at 18 years, based on the average patent period and then subtract all projects generated n years after from technological platform value.

Technology value is calculated as follows:

**Table 11.6: Primary Valuation Parameters of Company A’s Technology**

|  |  |  |  |
| --- | --- | --- | --- |
| Average # of New Projects Annually |  |  | 0.20 |
| t Value of Project ($K) |  |  | **66,475** |
| Unallocated Costs ($K) |  |  | -2,296 |
| Unexpected Costs ($K) |  |  | -3,324 |
| Tax |  |  | 21% |
| Capitalization |  |  | 20.3% |
| Terminal Technology Value ($K) | |  | 47,271 |
| Technology Value - 2018-2036 ($K) | |  | 1,687 |
| Technology Value ($K) |  |  | **45,584** |

### 

### *11.6.5 Equity Value*

Let’s assume Company A has loans of approximately $80,000. The company also has a tax loss carry-forward of $4.2 million as of Dec. 31,2019. Because we assume that the Company will use this asset as well as future tax assets, we do not take these assets into account.

**The Table below shows the equity valuation:**

**Table 11.7: Company A Expanded Pipeline Analysis**

|  |  |  |
| --- | --- | --- |
| Pipeline Analysis | | rNPV ($K) |
| Condition I |  | 22,582 |
| Condition II |  | 110,368 |
| Total rNPV Pipeline |  | **132,950** |
|  |  |  |
| Unallocated Expenses |  | -4,592 |
| Technology Value |  | **45,584** |
| Enterprise Value |  | **173,942** |
| Non-operational assets and liabilities |  | -83 |
| Company A Equity |  | 140 |
| Equity Value |  | **174,000** |

## 11.6.6 Sensitivity analysis

## In the Table below is the Company’s equity value in relation to the capitalization rate.

**Table 11.8: Company A Sensitivity Analysis**

|  |  |
| --- | --- |
| Sensitivity Analysis - Cap. Rate vs. Equity Value | |
| Cap. Rate | Equity value |
| 16.3% | 179,141 |
| 17.3% | **175,604** |
| 18.3% | **173,999** |
| 19.3% | **172,492** |
| 20.3% | 169,745 |

## In view of all aforementioned findings and assessments, we value the Company's equity value between $172.5 million to $175.6 million and, on average, at $174 million.

## 11.6.7 Valuation scenarios as of Dec. 31, 2018

## Based on our DCF valuation and scenarios, we can evaluate future developments at several clinical stages. In the event that the company achieves positive clinical results, equity value will be affected. We assumed that positive clinical results in the Phase 2 Condition I trial would increase the Company value to $220.0 million, while achieving positive clinical results only in the Condition II’s Phase 2 trial would bring the company to a value of $417.1 million.

## See our detailed forecasts in the table below:

**Table 11.9: Company A Forecasts**

|  |  |
| --- | --- |
| Scenarios | Equity Value |
| Current Status | 174,000 |
| Product I end of P2 | 220,027 |
| Product I at end of P3 | 330,361 |

|  |  |
| --- | --- |
| Scenarios | Equity Value |
| Current Status | 174,000 |
| Product II end of P2 | 417,127 |

*11.6.8 Capitalization rate*

The capitalization rate is calculated using the CAPM and is calculated on a long term Treasury bond as suggested by New York University Professor Aswath Damodaran’s ([www.damodaran.com](http://www.who.int)). As of Jan. 2018, the Israeli market, in which the Company operates, had an estimated risk of 5.89%

Using a sample of 185 companies representing the U.S. pharmaceuticals sector, regression beta of the three-year market is 1.09. The Company has no loans or any other rate-carrying liabilities, which are considered non-operational liabilities. In order to reach the relative CAPM, we used an unleveraged beta, resulting in an implied CAPM is 9.7%.

Because the Company is a small-cap company, size premiums and marketability need to be considered. Duff and Phelps research indicates that an 8.6% premium should be added for small-cap companies in the 10th decimal to the CAPM. Therefore, the Company’s CAPM is 18.3%.

**In making these calculations, we also exercise more caution in order to avoid innate excess optimism. The size premium is that of early-stage company limited liquidity.**

**Table 11.10: Company A CAPM Model**

|  |  |  |  |
| --- | --- | --- | --- |
| CAPM Model |  | Value | Source |
| Long-term T-bond | R(f) | 3.29% | U.S. Treasury |
| Risk Premium | R(m)-R(f) | 5.89% | Damodaran’s sample (12/31/18) |
| Unleveraged beta | Β | 1.09 | Sample of 185 Drugs (Pharmaceuticals) firms  (Jan. 2018) |
| Cost of Capital | Ke | 9.7% |  |
| Size Premium | P | 8.6% | Duff and Phelps 2017 |
| CAPM | CAPM | 18.3% |  |

**Chapter 12: Company B: Pharmaceutical/Biologics**

In this valuation, the Company was seeking a valuation in order to present itself as an investment opportunity. The valuation began by examining the general market environment for biologic drugs. It then explained the technological background about biologic drugs, with a focus on those derived from agricultural products. The valuation then proceeded to examine the Company itself in moredetail.

The following valuation represents a different method of analyzing a company’s value, and responds to a different set of needs of the Company.

***12.1 Company Overview***

A life-sciences company, Company B, has approached its operational stage. Its innovative, patent-protected platform technology dramatically simplifies and reduces the production costs of biologic drugs by 90%. Company B’s platform, a stable protein expression system using transgenic leaves, from the nightshade family offers significant advantages over traditional production platforms for biologic drugs in terms of costs, simplicity and efficiency. In fact, its unique platform can make a substantial impact on the affordability of biologic drugs worldwide.

Company B has developed a proprietary purification process based on the patented chimeric protein CBD-Protein A, and has established CRISPR-silenced nightshade lines with a “humanized” glycosylation pattern for the expression of adalimumab, a medication used to treat rheumatoid arthritis, ulcerative colitis, and numerous other conditions. Company B will secure its intellectual property with patents focusing on its CBD – NCC – HF purification technology, and CRISPR-based immunogenic sugar silenced plants.

Let’s assume Company B has signed a manufacturing and distribution agreement with a strategic partner in Russia in order to launch the product in Russia and EAEU/CIS member states by 2025. This partner invested in establishing a pilot-scale production facility and biomass supply chain. Company B has also established a cultivation greenhouse and plantation. The entire infrastructure is close to being operational and is capable of processing 200 kg of leaves per batch, with a 200% expansion capacity.

This valuation continues by studying the company’s technology and core advantages, as well as its proof-of-concept.

**Company B’s Technology and Core Advantages**

Company B uses the cells of leaves of the nightshade family as the platform for the production of biobetters and biosimilars.

Company B’s platform utilizes the leaves from the nightshade family as this type of leaf has several advantages over other plant varieties:

* It grows quickly in an open field (three months in one cycle), producing a large biomass with a relatively small environmental footprint, while reducing CO2 emissions and producing oxygen;
* The molecular biology and genetics of the leaves are well-established within the scientific and agricultural body of knowledge;
* The costs of the upstream (protein production) process are reduced by at least 90%, and also help eliminate the considerable additional costs of establishment, maintenance and operation of clean rooms, as Company B’s production process is performed mostly in an unclassified environment up to the very final stages of production.

An additional core advantage of Company B’s platform is the use of a stable expression technology, as opposed to the transient expression technology, which is common among major biopharming companies. In the transient expression technology, the plant is inoculated with recombinant protein expressing bacteria on a constant basis by means of vacuum infiltration. This process requires the expensive establishment, maintenance and operation of bioreactors, sophisticated vacuum infiltration systems, clean rooms, etc. which result in very high production costs (between $200,000–$400,000, by various estimates).

Company B’s stable expression system reduces the costs of production dramatically by 90%, to as little as $20–$40 per gram. Additionally, the scalability is limited only by the number of hectares being used and the three-month growing cycle, and the costs of establishing a new production facility are a fraction of the costs of upgrading an existing production facility using microbial or mammalian cell lines.

Production costs decrease dramatically as the rate of plant yield (the weight of antibody produced per biomass) increases, suggesting that Company B’s platform could potentially produce biological APIs at a cost of $20–$30 per gram, compared to the costlier traditional microbial/mammalian cell expression systems, as well as the plant-based transient infiltration systems of protein expression, in both of which the costs range from $200–$400 per gram.

Based on its innovative technology, Company B aims to reduce the production price of biologic drugs by at least 90% and sequentially lower their costs to patients and payers worldwide, while maintaining current profit margins.

***12.2 Adalimumab: Company B’s Proof of Concept: Market Analysis***

Adalimumab (brand name: Humira, manufactured by AbbVie) is a recombinant, fully human IgG1 monoclonal antibody from the Tumour Necrosis Factor-alpha (TNF-α) inhibitor family. This biologic drug was first approved in 2002 by the FDA to treat rheumatoid arthritis. It was later approved for additional applications, such as plaque psoriasis, psoriatic arthritis, and more.[[95]](#footnote-95)

In 2018, Humira generated $19.9 billion in global sales, an increase of 8.2% over 2017, with the United States accounting for about 69% of the market.[[96]](#footnote-96) As is evident in the Figure below, it is expected that in the coming years, the market will experience fierce biosimilar competition from major biopharmaceutical multinationals, which is expected to result in some price reduction.

Source: EvaluatePharma

*Fig. 12.1: Adalimumab Biosimilars Competition, Sales Data and Forecast through 2024*

However, to date, Humira and its biosimilars are all produced in a mammalian cell expression system. This means that despite biosimilar competition, the price for adalimumab will remain high, mostly due to its production costs, which range between $200–$400 per gram.[[97]](#footnote-97) As a result, patients’ access to adalimumab will remain limited. Other blockbuster biologics facing patent expiration in the near future are facing similar challenges.

The following section of the valuation analyzes the Company’s competitive environment.

***12.3 Competitive Landscape***

There are several biopharming companies operating around the world today, ranging from seed and early-stage companies to larger, private and public companies. However, to date, no company is commercially producing biobetters or biosimilars using plant cell expression systems. The table below provides a comparative analysis of key competitors in the field of biologic drugs biopharming in comparison with Company B’s technological platform.

**Table 12.1: Key Competitors of Company B: A Comparative Analysis**

|  |  |  |  |
| --- | --- | --- | --- |
| Company Name | Expression Technology | Product and Stage of Development | Additional Data |
| Company B | Stable, Nightshade Family | * Adalimumab biosimilar in pre-clinical tests |  |
| Planet Biotechnology  (Est. 1998, U.S.) | Stable, Tobacco | * CaroRX (Anti-tooth decay mAb): discontinued | * Keeps several proteins (non-pharmaceutical) for research purposes |
| Mapp Biopharmaceutical Inc. (including its commercial arm LeafBio Inc.)  (Est. 2003, U.S.) | Transient, Tobacco | * ZMapp: Vaccine for Ebola, at clinical trial stage stage * MB66: HIV and STI prevention film, at clinical trials stage | * Partnered (BARDA) to expedite manufacturing of ZMapp (produced by KBP) |
| IBio Inc.  (Est. 2008, U.S.) | Transient,  Tobacco | * IBIO-100: Treatment of systemic scleroderma and pulmonary fibrosis, received FDA orphan drug designation, currently at pre-clinical stage, market valued at USD10 billion | * Provides Contract Development and Manufacturing Organization (CDMO) services |
| PlantForm  (Est. 2008, Canada) | Transient,  Tobacco and rapeseed | * ranibizumab (Lucentis) biosimilar for age-related macular degeneration * Innovative mAb for the treatment of HIV and Ebola, at clinical trial stage * Trastuzumab biobetter, for a novel indication (nerve regeneration after acute trauma, pre-clinical stage | * Received funding from the Government of Canada and the Bill & Melinda Gates Foundation * In 2014 PlantForm formed a joint venture called PlantPraxis with PharmaPraxis of Brazil, focused on developing biosimilars for the Brazilian market. The production remains to date at a pilot stage with no success. |
| Medicago  (Est. 1999, Canada and U.S., acquired by Mitsubishi Tanabe, Japan) | Transient Tobacco | * One novel vaccine in regulatory appraisal stage, two novel vaccines candidates in clinical trial stage, and one vaccine candidate in pre-clinical stage * two antibodies candidates in research stage | * Health Canada recently accepted for scientific review Medicago’s plant-based Quadrivalent Virus-Like Particle (QVLP) influenza recombinant vaccine |
| Icon Genetics  [Est. 2000, Germany, acquired by Denka, Japan (formerly owned by Bayer and Nomad Biosciences)] | Transient, Tobacco | * One vaccine for personalized non-Hodgkin’s lymphoma treatment currently in clinical trial stage (sponsored by Bayer Innovation) * Main focus is vaccines and diagnostic reagents | * Icon Genetics’ magnICON® platform holds over 400 granted patents, used by Kentucky BioProcessing in the production of ZMapp vaccine. |
| Kentucky BioProcessing, Inc. (KBP)  (Est. 2006, U.S.) | Transient, Tobacco  (Icon Genetics’ magniCON platform) | * Three novel drug candidates in early research stage:  1. A gel-based microbicide for prevention of HIV transmission; 2. An immunotherapeutic to treat colon cancer; 3. An HPV vaccine | * Provides Contract Development and Manufacturing Organization (CDMO) services * However, KBP’s operation capacity is three million protein-producing tobacco plants in a production cycle, the equivalent of only 1.6 km2 (or 0.65 mile2) of open field plantation. |
| Ventria Bioscience  (and InVItria, its commercial division, Est. 1993, U.S.) | Stable and Transient, Rice | * VEN120: Drug candidate for treating inflammatory bowel disease (IBD), currently in clinical trial stage * VEN BETA: Drug candidate for treating diarrheal disease caused by Enterotoxigenic Escherichia coli, in preclinical stage | * InVitria developed and commercialized eight recombinant proteins and cell culture media supplements, including rhAlbumin and rhTransferrin * Received funding from the Bill & Melinda Gates Foundation and collaborates with Johns Hopkins School of Medicine and other universities. |
| Protalix Biotherapeutics Inc.  (Est. 1993, Israel) | Transient, Carrot | * Elelyso: First and only FDA-approved plant-cell derived drug, for Gaucher Disease (sold by Pfizer) * Two novel drug candidates for Fabry disease and Cystic Fibrosis and one novel drug candidate as orally-delivered protein, for IBD – in clinical trial stage | * Provides Contract Development and Manufacturing Organization (CDMO) services. |
| Greenovation Biotech GmbH  (Est. 1999, Germany) | Transient, Moss | * MOSS-aGal (agalsidase): Drug candidate for Fabry disease, in early clinical trial stage * MOSS-FH: Drug candidate for C3 glomerulopathy (C3G), in preclinical stage * MOSS-GAA: Drug candidate for Pompe disease, in early preclinical stage | * Provides Contract Development and Manufacturing Organization (CDMO) services. |

Sources: Company websites

The above Table reveals the following advantages of Company B over its competitors:

* Company B uses a stable protein expression technology, which is considerably less costly in terms of facilitation, maintenance and operation and is considerably more efficient and less limited in scalability vis-à-vis transient expression systems, which most competitors use;
* Company B operates an open-field plantation which is both sustainable and significantly less costly to scale up in comparison to biopharming in a greenhouse or Vertical Farming Unit (VFUs) facilities;
* Company B’s production process is performed mostly in an unclassified environment up to the very final stages of production, which substantially reduces production costs in comparison to the competitors’ production process in greenhouses or VFUs, both of which require clean rooms, media and additional supporting systems at substantial costs.

To recap, Company B uses a transgenic leaf of the nightshade family, which reaches cultivation level in just three months at a large biomass and with nearly unlimited scalability, in an open-field environment which is inexpensive and efficient, and in a stable protein expression system whose establishment, maintenance and operation are relatively inexpensive compared to other protein expression methods.

**The valuation now proceeds with a financial analysis and valuation of the company, bearing in mind the behavioral guidelines discussed above.**

***12.4 Company Financial Analysis & Valuation***

*12.4.1Valuation Method & Approach*

Company B’s business operation model is a “classic” one in the biopharmaceutical field. Company B will produce the active pharmaceutical ingredient (API) using its proprietary platform and will distribute it to strategic partners around the world for local manufacturing of the finished form, packaging, labeling and local circulation, based on a structured deal of upfront, royalties and milestones payments. As Company B has opted to first enter the Russian market, the time-to-market is estimated at five to seven years, and at least 15 years of sales are projected.

A 360-degree evaluation is performed from three different perspectives:

1. **Bottom-up:** Evaluating Company B’s operations in the Russian market with adalimumab as a Proof-of-Concept (PoC) for its technology and business potential;
2. **Top-down:** Analyzing Company B’s potential market share based on its time-to-market and other parameters;
3. **Similar agreements:** Creating a benchmark for recent similar agreements.

The bottom-up analysis focuses on the signing of the manufacturing and distribution agreement with Company B’s Russian partner. As detailed above, Company B’s partner invested $1.65 million in building a pilot production facility in Israel and initiating a production line for adalimumab. It also has future plans for conducting clinical trials in Russia, as well as locally manufacturing the finished form and engaging in commercial distribution by 2025. As already mentioned, this business strategy is unique, and, should it succeed, it can portend wider applications and relatively shorter times-to-market. Thus, we can model Company B’s business strategy in Russia with adalimumab with a high degree of confidence.

Based on the following parameters, the evaluation included:

1. Company B’s adalimumab operations in Russia;
2. A technology assessment.

*12.4.2 Company B’s Adalimumab Operations in Russia*

The Russian market for Humira was estimated at around four billion rubles (~$65 million in 2018, representing an increase of 25% from 3.2 billion rubles (~$52 million in 2017. Nonetheless, this represents only 0.33% of the global market.[[98]](#footnote-98) In 2019, Humira entered the public reimbursement list for a limited number of patients, at a public tender of 14 million rubles (~$220,000) won by R-pharm, for local packaging and distribution only.[[99]](#footnote-99)Humira’s current prices in Russia range between 35,000 to 70,000 rubles (~$550 to $1,200) for both the 40 mg, 0.4 ml s and the 0.8 ml syringe.[[100]](#footnote-100)

However, during 2018, the Russian biopharmaceutical company Biocad developed an adalimumab biosimilar called Dalibra, which very recently entered the Russian market.[[101]](#footnote-101)Biocad has committed to selling Dalibra at a 30% discount, yet is selling it in the public sector at considerably larger discounts compared to Humira.[[102]](#footnote-102)Furthermore, as Dalibra is manufactured locally, Biocad is potentially eligible for a preferential treatment in public procurement, which covers the Ministry of Health’s reimbursement plans as well as regional pilots, a treatment which also allows it to place a higher price tag on Dalibra.[[103]](#footnote-103) Finally, Biocad is partly owned by Pharmstandard, Russia’s largest pharmaceutical manufacturer.[[104]](#footnote-104)

In 2017, the Common Pharmaceutical Market of the Eurasian Economic Union (EAEU), which includes Armenia, Belarus, Kazakhstan, Kirghizstan and Russia, entered the market, enabling the circulation of a drug approved under the unified regulatory approval process among all member states.[[105]](#footnote-105) Additionally, under EAEU Resolution No. 1289 and further amendments, a three-tier preference procurement system was established, dictating that public tenders must be granted exclusively to local/EAEU manufacturers that apply, with the exception of patented drugs, along with a 15% price preference for locally-produced products.[[106]](#footnote-106)

**Thus, we assume that the CAGR of Company B’s adalimumab product will be in the range of 20–25% and the market share of peak sales to be 20%, based on market potential and the competitive landscape.**

*12.4.3 Manufacturing Costs*

We assume a conservative forecast of 10% of future revenues of Company B’s adalimumab in Russia to be funneled by the firm for manufacturing costs, with the remaining funds to be paid to Company B’s strategic investor.

*12.4.4 Capitalization Rate*

Our discount rate was calculated at 18.3%, based on our Capital Asset Pricing Model (CAPM) model (see a detailed calculation below).

*12.4.5 Success Rates*

The biosimilar industry presents several obstacles. There is have a clinical trial success rate of 95% for small molecule generics, but a lower success rate of 50–75. while with biosimilars.We assume a 75% chance of reaching the final clinical trial phase and a success rate of 86.9% for obtaining the Russian Ministry of Health (Minzdrav) approval by mid- tolate- 2024.[[107]](#footnote-107)

**Based on these parameters, we evaluate Company B operations, including its partnership and royalties with respect to adalimumab at a total value of $17.9 million**.

***12.5 Technology Assessment***

The Company's broad business and technological base supports Company B's technology evaluation, which is an assessment of the Company’s residual value. A feed rate methodology is used. Our valuation includes future potential of early clinical stage drug candidates for other mAbs such as adalimumab, and those in additional operations in several territories.

*12.5.1 Technology Platform Valuation Factors****:***

* It is assumed that the company will generate one new project every two years. As a result of adalimumab’s success, scaling up will be rapid, valued at $17.9 million, equal to the current program’s value.
* Unallocated costs are primarily General and Administrative and sales costs. Company B has a lean structure. However, we assumed 10% in its future costs.
* We estimated unexpected costs to be an additional 10% of the average value.
* Corporate Tax: we assumed a statutory tax of 23%.
* To reflect increased uncertainty, the capitalization rate is higher by 5% than pipeline valuation capitalization rate.

In this case and base on patent period, it is assumed that *n* valued at 19, the average period of patent. The following reflects the value of the technology:

**Table 12.2: Valuation Factors of Company B’s Technological Platform**

|  |  |
| --- | --- |
| Average # of New Projects per Year | 0.50 |
| Value of Project ($K) | **$17,924** |
| Unallocated Costs ($K) | $-1,792 |
| Unexpected Costs ($K) | $-1,792 |
| Tax | 23% |
| Capitalization | 23.3% |
| Terminal Technology Value ($K) | **$23,652** |
| Technology Value - 2020-2039 ($K) | **$439** |
| Technology Value ($K) | **$23,213** |

The valuation continues by examining additional elements of the Company’s value, including its equity value and a sensitivity analysis.

*Equity Value*

Unallocated costs and non-operational assets and liabilities: The company has no loans or non-operational assets. Cash will allow the company to continue its operations, thus we do not consider it.

**The equity valuation factors are presented below:**

**Table 12.3: Company B Valuation Elements**

|  |  |
| --- | --- |
| Pipeline Analysis | rNPV ($K) |
| Adalimumab (Russian market only) | $ 17,924 |
| Unallocated Costs | $ -1,526 |
| Terminal Technology Value | $ 23,213 |
| Enterprise Value | $ 39,611 |
| Non-operating assets/liabilities | 0 |
| Equity Value | $ 39,611 |

*12.5.2. Sensitivity Analysis*

Company B’s equity value in relation to the capitalization rate can be seen in the Table below. We set a range of 1% change from our CAPM model (see Appendix 2).

**Table 12.4: Company B Sensitivity Analysis**

|  |  |
| --- | --- |
| Sensitivity Analysis – Equity Value vs. Cap. Rate | |
| Equity value | Cap. Rate |
| $ 41,439 | 16.3% |
| $ 40,473 | **17.3%** |
| $ 39,611 | **18.3%** |
| $ 38,807 | **19.3%** |
| $ 37,355 | 20.3% |

***In view of all aforementioned findings and assessments, we value the Company's equity value, using rNPV method between $38.8 million to $40.5 million and an average at $39.6 million***

The valuation also performed a CAPM analysis for valuing Company B.

***12.6 Capital Asset Pricing Model (CAPM) for Company B***

The capitalization rate is calculated using the CAPM including a long-term Treasury bond, as suggested by New York University Professor Aswath Damodaran’s ([www.damodaran.com](http://www.who.int)). As of Jan. 2018, the Israeli market, in which the Company operates, had an estimated risk of 5.89%

Using a sample of 459 U.S. biotechnology firms, regression beta of the three-year market is 1.29. The Company has no loans or any other rate-carrying liabilities, which are considered non-operational liabilities. In order to reach the relative CAPM, we used an unleveraged beta, resulting in an implied CAPM is 9.7%.

Because the Company is a small-cap company, marketability and size premiums need to be considered. Duff and Phelps research indicates that an 8.64% premium should be added to the CAPM for small cap companies in the 10th decimal. Therefore, the Company’s CAPM is 18.34%.

The CAPM model (ke):***ke = rf + β(rm-rf) + P.***

Company’s CAPM is set to be 18.34%.

**Table 12.5: Company B’s CAPM Model**

|  |  |  |  |
| --- | --- | --- | --- |
| Model |  | Value | Source |
| Long-term T-bond | R(f) | 2.10% | U.S. Treasury |
| Risk premium | R(m)- R(f) | 5.89% | Based on Damodaran’s sample (1/19) |
| Unleveraged beta | Β | 1.29 | Sample of Biotechnology firms |
| Cost of Capital | Ke | 9.7% |  |
| Size Premium |  | 8.64% | Duff and Phelps data, 10dz. |
| CAPM |  | **18.34%** |  |

The valuation also included a Top-Down Analysis of the Company, which examines the larger environment.

*12.6.1 Top-Down Analysis*

Company B’s platform has the potential to significantly reduce the costs of producing biologic drugs. The general benchmark for Company B’s evaluation is calculated based on several assumptions concerning its portfolio and business strategy. First, Humira’s current sales in the Russian market, including nearby, are $65 million at the minimum level. We assume current CAGRs (20%+) to continue, resulting in top-line sales of $198 million in 2025, and a manufacturing and distribution agreement with 6% royalties with no upfront or milestones payments. Thus, we reach $12 million for the first year of sales, assuming launch at the beginning of 2025 and 10 years minimum sales time, with a discount rate of 18.3% based on our CAPM model, presented in Appendix 2.

We implied a 75% success rate of reaching the market, as discussed above and reached a valuation of $40 million ($53 million at a discounted value of 75%).

This top-down analysis can be performed as a minimum benchmark, as we did not take into consideration additional years of sales nor technological expansion, such as developing additional products or launching in additional markets. Nevertheless, it should be noted that obtaining Russian marketing aprroval entails wider applications, such as expedited regulatory approval and market entry for Company B’s adalimumab in additional developing markets, such as India and APAC, Latin American, African and Gulf countries.

The valuation also includes a Similar Agreements Analysis for assessing the Company’s value.

*12.6.2 Similar Agreements’ Analysis*

We analyzed Company B’s competitors’ capital rounds and recent mergers and acquisitions.

The table below details the results with regard to the firms that are viewed as competitors to Company B in terms of technology and field of operations:

**Table 12.6: Company B’s Competitors’ Capital Rounds and Recent M&As**

|  |  |
| --- | --- |
| Company Nname | Capital Rounds and M&As |
| Medicago | * Raised $25M (Round A+) on September 2011 and $10M, (Round A on 2010)[[108]](#footnote-108) * On July 2013, Medicago was sold to Mitsubishi Tanabe Pharma (no available data).[[109]](#footnote-109) |
| Mapp Biopharmaceutical | * Develops pharmaceuticals for the prevention and treatment of infectious diseases * Recently received a $16.5M grant from the U.S. Department of Health & Human Services (HHS) |
| KBP Biosciences | * Raised (Round A), $76 million on January 2018 from several VCs |
| PlantForm corporation | * In 2013, the firm received a $2 million equity investment from the U.K.-based Atlantic Assets Trust and $0.5 million in equity investment from a rights offering; * In February, 2015, the company announced a $20 million round of funding to advance its biosimilar Herceptin® (trastuzumab) drug candidate in clinical trials and to begin preclinical development and testing of two additional biosimilar candidates. |
| Ventria Bioscience | * Raised $3.4 million 2010 VC; $4.2million grant from the Bill & Melinda Gates Foundation in 2017 |
| Greenovation Biotech GmbH | * Raised 5.4 million euros in 2006 |
| Planet Biotechnology | * Raised $25 million in non-dilutive funds since 1998.[[110]](#footnote-110) |

**Based on Round A statistics and recent agreements made within this sector, we assume round A for Company B to be in the value range of $47 million–$60 million.**

*12.6.3 Valuation Summary*

We evaluated the Company using the rNPV methodology, a common method to evaluate early-stage life science firms. Using this methodology, Company B’s operations in the Russian market, with adalimumab as a proof-of-concept for its technology and business potential are valued in the **range of $39 million to $41 million, and, on average, at $40 million as the current minimum value.**

We also calculate Company B’s value using two benchmarks: 1) Top-down analysis 2) Recent Agreements

1. **Top-down:** Analyzing Company B’s potential market share based on its time-to-market and other parameters, we assume a minimum value of $40 million**.**
2. **Recent Agreements:** Creating a benchmark for recent similar deals, **we assume a value range of $47 million–$60 million.**

**Based on the aforementioned data and analysis, Company B’s value ranges between $40 million–$60 million.**

**Chapter 13: Company C: Cybersecurity**

**The following valuation provides another real-case example with specific methodology for a cybersecurity company.**

***13.1 Overview***

Company C, listed on the NASDAQ, is a B2B2C software company with over 20 years of experience that focuses on two solutions:

1. Network security solutions
2. Network intelligence solutions

These solutions enable entities such as communication service providers (CSPs) to secure their networks and optimize the digital experience of their customers. Company C’s motto is “Look. Take Charge. Defend.” This motto precisely defines the company’s value proposition. The company allows its customers to see their network, to control it in order to obtain the optimal personal experience for end users on all connected devices, and to defend and secure all of these devices against threats. It does this while providing network insights that save its customers significant capital while creating new revenue streams for them. **In essence, Company C empowers its customers to get more out of their networks.**

The valuation examines how Company C is positioned in its sector’s ecosystem.

*Fig. 13.1: Company C’s Position in Sector Ecosystem*

Since its establishment, Company C has acquired six companies including X CO, Y CO, CO S.A., EX LTD, and Z CO. Company C has amassed an extensive experience and know-how from its human capital, and through its acquisition strategy and experience designing and implementing use cases for large customers.

The company’s HQ is located in Israel, where the principal administrative and research and development activities take place. Additional offices for either sales or research and development are located in the United States, Spain, France, Italy, Singapore, South Africa, Columbia, and India.

Company C had more than 500 employees. About 40% of its employees engage in R&D, 50% in sales, marketing, and support (Company C puts a high emphasis on being customer-centric and providing its customers with the support they need), and 10% in management and administration. Company C has introduced a new management team that is highly experienced and focused on implementing Company goals.

The value proposition of Company C lays where their solution fits within the larger picture of the sector in which it operates. Below is a use-case meant to demonstrate this. The following diagram represents a cellular network:

Cellular Antenna Backhaul Core Network Internet



Company C

*Fig. 13.2: Company C’s Position in User Network*

The valuation now examines Company C’s technological solutions, customers and products.

When you want to watch a YouTube video on your mobile device through your cellular provider, your phone makes a request to the nearest cellular antenna. The antenna then sends this request through either physical cables or wireless methods termed backhaul. The backhaul carries your request to the core network, which can be likened to a highway intersection where data is directed to where it needs to go in the internet to retrieve the YouTube video you want. On the way back from the internet, the video is sent back through to the core network to the backhaul to the cellular antenna and to your phone. The YouTube video, sent across the network, is sent in small data chunks termed packets because our current networks are not designed to send data in one large chunk. Because of this, Network Intelligence Solutions such as Company C’s are also termed Deep Packet Inspection or DPI solutions. The core network, where all of the data packets are directed, is where the Company C network intelligence and network security software sit with a very low signature that does not affect the flow of data. It is at this critical point that Company C’s solution sees, controls, and secures the data packets flowing in the network.

Company C’s Customer Base

# 

# *13.2 Customers*

Company C’s combined customer base has over one billion end users. Below find just some of Company C’s customers and two case studies clearly demonstrating how

customers implemented Company C’s solutions.

|  |  |
| --- | --- |
| **1B** | **Users** |
| **13** | **Tier 1 Operators** |
| **150+** | **Mobile Deployments** |
| **350+** | **Fixed Deployments** |
| **1,000+** | **Enterprises** |

*Fig. 13.3: Consumers of Company C Solutions*

Company C provides different services to 13 tier 1 operators. Company C also provides network intelligence and security solutions to enterprises. Customer breakdown is about 80% CSPs and 20% enterprises.

Company C’s Products

# *13.3 Company’s Products*

Company C’s products fall under two categories.

1. **Security Solutions:** These secure our connected devices against threats.
2. **Network Intelligence Solutions:** These allow for the optimization of the communication networks that deliver content to our connected devices.

Regardless of the specific product, Company C has three concepts that characterize each of its products.

* First, they easily integrate with existing customer infrastructure.
* Second, they provide well-communicated feedback about what is happening on customer networks.
* Third, they maximize revenue-generating opportunities for customers.

Their solutions achieve the following for network operators:

* Provide a clear understanding of what is happening in their network through granular analytics.
* Assure optimal network performance, utilization, and customer QoE via traffic control and shaping.
* Drive increased revenue and customer satisfaction through network-based security services.
* Comply with government regulations for safe internet activity.
* Protect local, national and enterprise networks against threats such as volumetric DDoS attacks.
* Reduce OPEX and CAPEX via methods such as forecasting, closed loop automation, and fully NFV compliant deployments.

Company C’s products are network agnostic and can be incorporated into any type of network that supports connected devices, including mobile, fixed, satellite, and cloud networks. The Company’s solution transforms simple broadband pipes into smart and sophisticated ones, allowing for value-added internet services to be rapidly deployed for wireless broadband, Communication Service Providers (CSPs) of mobile broadband, and digital line carriers clients. The Company’s solution is network-based (it is located on the network and not on devices), so it is accessible to any device, does not require end user software or installation, and does not affect performance or battery life.

Company C’s solutions can be incorporated via hardware supplied by Company C or via their customer’s existing hardware. Their solution is also fully NFV compliant. This means that it can integrate into any network regardless of how it is structured.

The two main platforms by which the Company offer their services are **Company C Safe** and **Company C Alert**.

**Company C Safe** enables CSPs to offer security services to mobile, residential, and business markets that protect end user and IoT devices. It also protects the CSP networks and telco infrastructures themselves from threats such as DDoS attacks. The Company C Safe platform includes five separate solutions which offer security for any application: Endpoint, Home, Network, IoT, and DDoS.

**Company C Alert** gives CSPs and enterprises the ability to see, control, and optimize network traffic to ensure delivery of services at a high QoE, while reducing both operational and capital expenditures.

## This part of the valuation continues by analyzing competing companies operating in various spaces in the sector, including their services and methods.

# *13.4 Competitive Analysis*

## 13.4.1 Competitive Analysis: Network Security

Security Method Mapped by User Acceptance and Future Relevance

User Acceptance

Future Proof

Network Based

**Data Path** Security

**Endpoint** Based Security

Network Based

**DNS Path** Security

Network Based

**Home Router** Security

Company C focuses on these and also provides DNS path and End-point security.

*Fig. 13.4: Company C’s Position in User Network*

Competition within the Network Security domain can be divided into four major categories:

1) Network-based Data Path: This refers to security located in the network itself and not on personal devices and which inspects data going through the network;

2) Network-based DNS path: This refers to security that keeps users away from known malicious website domains;

3) Network-based home router: This is security that is present on home routers;

4) Endpoint: This refers to security that is downloaded onto our devices themselves.

For our analysis, we mapped these categories on two axes:

1) User Acceptance

2) Future Proof.

Endpoint security is a highly predictor, but it is not practical, as end users do not tend to download it onto their mobile devices (the penetration rate is about 2%), let alone update it.

The Domain Naming System or DNS is a methodology by which a domain name is translated into an IP address where our webpage data is located. This system is put in place simply because we are people, and it is easier for us to use words and not numbers to name our websites. For example, when we type in “YouTube.com” in our web browser, the DNS is what translates this into a numbered IP address that retrieves the correct data from YouTube. DNS-based security inspects domain name and provide a feedback.

*13.4.2 Network-Based Data Path*

•Perceived Strengths: greatest functionality, future proof, high penetration

•Perceived Weaknesses: long integration, cost of solution scales with traffic increase

•Players: Company C / Fortinet / Checkpoint / Palo Alto / Secucloud.

The areas where Company C is very strong compared to its competitors are in

* engagement with the end customer;
* scalability;
* unification.

These areas were developed through extensive work with Tier 1 providers and respond to a real need of CSPs.

1. Many of Company C’s competitors are B2B players. Company C is a B2B2C Player and thus provide engagement tools that CSPs can use to engage end users. These include campaign management tools that gradually onboard end users through try and buy security campaigns as well as provide them with reports showing the efficacy of protection. Such campaigns significantly increase penetration and can target millions of users at a time.
2. Company C is strong in the area of scalability, with solutions designed to scale to millions of subscribers, an area that is difficult for many competitors
3. Company C’s solution is a unified solution. This means that not only can they protect our phones, but they can protect our routers, and all other connected devices inside and outside the home. Therefore, if a parent sets parental controls on their child’s devices, these controls are effective when the child is using the home WiFi network or when they are using the mobile network outside of the home.

*13.4.3 Network-Based DNS Path*

Perceived strengths: simplicity for fixed networks; “good enough”

Perceived weaknesses:

* easy bypass by users and Google
* not future proof to DoH
* cannot solve most phishing attacks
* no virus protection
* no IoT protection.

Players: Akamai/Infoblox/Cyan

**While Company C does not rely on DNS Path Security, it does provide it.**

*13.4.4 Network-Based Home Router*

•Perceived strength: IoT visibility and protection and per device protection

•Perceived weakness: slow adoption due to CPE legacy variety;

•Players: Company C / McAfee / Cujo / SAM / Trend-Micro / F-secure

The areas where Company C is very strong compared to its competitors are

* Security can run on legacy routers because it has a low signature and

high performance.

* Company C knows to check for viruses (as opposed to only malware).
* They provide high resolution analytics to both end-users and CSPs to

show them what is happening in the home network.

Company C’s solution is a unified solution. This means that not only can they protect routers, but they can protect our phones, and all other connected devices inside and outside of the home. Therefore, if a parent sets parental controls on their child’s devices, these controls are effective when the child is using the home WiFi network or when they are using the mobile network outside of the home.

*13.4.5 Endpoint-Based Applications*

• Perceived strength: complete functionality; protects anywhere

• Perceived weakness: low penetration (the fact that actively downloading

this solution is necessary causes a major drop in adoption rates)

• Players: McAfee / Bitdefender / Kaspersky / Symantec / F-Secure

**Company C works with McAfee and BitDefender to provide end-point security.**

*13.4.5 Competitors*

**Fortinet:** Fortinet’s Network Security Solution is an important component of the Fortinet Security Fabric and can provide visibility and automated threat protection across the entire attack surface using a single operating system to deliver security. Its AI-driven solutions help reduce complexity and provide comprehensive threat protection in a cost-effective way. Network operators benefit from intelligent intent-based segmentation, adaptive access control, and on-site / multi-cloud threat protection.

**Palo Alto Networks:** Thisis amultinational cybersecurity company offering a platform with advanced firewalls along with cloud-based security products to extend the capacity of those firewalls to cover other aspects of security. With 60,000 customers in ~150 countries, its products are used by many of the Fortune 100 companies

One of its flagship products, an open and integrated AI-based continuous security platform, AI helps it to constantly evolve to stop sophisticated threats. As part of its growth plans to meet customers’ changing requirements, the company recently announced its intent to acquire Zingbox. Zingbox offers a cloud-based service and advanced AI and ML technology to identify threats from devices and is likely to enable Palo Alto Networks to enhance IoT security through its Next-Generation Firewall and Cortex™ platforms.

**McAfee:** McAfee, one of the well-known cybersecurity companies, has a long history of providing cybersecurity software, having been acquired by Intel in 2011 as part of its security division. The company has a large corporate and government client base across the globe using products such as McAfee Global Threat Intelligence to help thwart hackers.

McAfee has a research lab to incorporate technological advances into its solutions. The company also partners with network providers to provide consumers with better security. For example, McAfee’s Safe Family enables parents to monitor and control children’s online activities.

**F-secure:** This company offers security solutions for enterprises and homes. Its global intelligence network, software and AI-based solutions focus on prevention, detection and response as a service. F-secure has identified managed endpoint security as a strong growth area, and its solutions include digital Safety solutions for consumers to protect information, identities, devices, smart homes and families. All its products are designed to be delivered from the cloud.

The company relies on a partner ecosystem to expand its reach in the market. With a focus on helping customers develop a comprehensive approach to cybersecurity, the company recently launched the Global Partner Program to connect B2B IT resellers with F-Secure, enabling them to offer cybersecurity expertise and services to customers using a tiered structure depending on IT reseller capabilities. F-Secure partners with over 200 communication service providers globally, and recently joined the Broadband Forum to help with development of industry standards for the connected home and secure home broadband experience. The company recently acquired MWR InfoSecurity to strengthen its cyber consulting and managed security services, such as phishing protection and cyber-attack detection.

**Akamai:** Akamai uses amulti-layered approach to network security and enables customers to supplement perimeter defense with cloud security. After acquiring Nominum, a DNS-based security solutions provider, in 2017, Akamai was able to offer this solution to enterprises. Akamai Intelligent PlatformTM offers a portfolio of cloud security solutions that stops attacks at the edges of the Internet. Some of its solutions include Enterprise Application Access to secure access, centralize access control and reduce breaches; Enterprise Threat Protector that proactively protects against malware at the DNS layer; Prolexic Solutions that mitigates DDoS attacks; and the Web Application Firewall to detect potential attacks in HTTP and SSL traffic upstream.

**Infoblox:** A provider of Secure Cloud-Managed Network Services and offers network security as part of its solutions. As part of its Next Level Security approach, the company enables clarity and a consolidated single view for the core network. This helps to identify attack points and unmanaged and vulnerable devices. It also enhances automatic detection and DNS attacks. The third-party integration has further enabled an ecosystem that is able to improve infrastructure security and threat intelligence. Detailed reports and insights enhance security teams’ capabilities to plan, execute and respond to security issues.

Infoblox recently launched a security platform, BloxOne™ Threat Defense, a hybrid security that can leverage DNS as the first line of defense in detecting and blocking sophisticated cyber threats. As part of its efforts to create an ecosystem to offer comprehensive solutions to customers, Infoblox focuses on a partner sales strategy. It expanded its partner alliance ecosystem by adding 100 new partners in 2018 and continued to focus on further expansion in 2019.

**Kaspersky**: Kaspersky has a comprehensive suite of security solutions and a long history of providing security solutions to consumers and enterprises. A global cybersecurity provider, its capacity to offer security solutions extends across small and large corporates, infrastructure and consumers. It has over 400 million users and 270,000 corporate clients. Some of its security products for consumers include anti-virus, Internet security, Security Cloud, etc., while products for enterprises include Endpoint Security, Hybrid Cloud, and IoT and embedded, among others.

The company is committed to continuous innovation, a fact corroborated by Kaspersky Enterprise Blockchain Security that helps in assessing applications working on a blockchain infrastructure and conducting an audit of smart contract code. Over the years, the company has been working closely with organizations such as Interpol to identify cyber threats.

**Symantec:** Symantec has a long history of providing security solutions and has a presence in over 35 countries. It enjoyed more than $5 billion in revenue for the fiscal year 2018, and it has accumulated more than 2,000 global patents over the years. The company offers solutions to enterprises and individuals with integrated solutions to help them stay secure global attacks.

Symantec recently announced a new cloud access security solution as part of its ICD Platform for enterprises that can secure cloud and internet access and use. This integrated cloud-delivered solution helps companies lower operational costs and complexity, as well as risk. Numerous companies have joined Symantec in its efforts to further reduce cost and complexity in order to ensure cyber security and improve response times.

The Following Market Overview Analyzes Potential Applications and Markets for the Company’s

Services

# *13.5 Market Overview*

## 13.5.1 Network Intelligence - Deep Packet Inspection (DPI)

Conventional packet filtering is a basic, unsophisticated approach that reads only the header information of each packet, making little or no evaluation of the data inside. The low processing power of firewalls makes them incapable of handling large volumes of packets. An alternative is deep packet inspection (DPI), which enables network providers to inspect the data being shared in detail at the inspection point.

DPI helps maintain the integrity and security of networks by managing and controlling customer usage, speed and type of content. The information collected can also be used for internet data mining, eavesdropping, internet censorship, preventing denial-of-service (DoS) attacks, other sophisticated intrusions, and identifying worms that may fit within a single packet.



Source: Frost & Sullivan, Reports Intellect

*Fig. 13.5: DPI Advantages*

|  |  |
| --- | --- |
| Market Segmentation of DPI | |
| Application-based | * Data loss/leak prevention and management * Network performance management |
| Product-based | * Standalone DPI * Integrated DPI |
| End user based | * Internet service providers (ISPs) * Enterprises. |

Source: Frost & Sullivan

*Fig. 13.6: DPI Market Segmentation*

The capabilities of DPI can be utilized by different user groups for various purposes, based on the intended outcome. The high adoption of internet and connected devices that link to enterprise systems require a more comprehensive security tool to protect against unauthorized access. Using firewalls alone may not be the most sophisticated and effective technique, but using DPI can enable IT administrators and security officials to set and enforce policies across all layers to ward off threats. For example, DPI can facilitate data leak prevention (DLP) by guiding a user with information on obtaining clearance to send a confidential file via email.

It is anticipated that the DPI market will grow from about $7 billion in 2016 to $17 billion in 2021, at a CAGR of around 20%.

**Regional Trends**



Source: Frost & Sullivan

*Fig. 13.7: DPI Regional Trends*

Across the rest of the world, in regions such as Latin America and Africa, the market is much smaller, since the availability and use of advanced technology is limited. However in potential markets, such as Argentina and Brazil, higher awareness can be expected to drive demand.

This section of the valuation examines the competitive value of Company C’s Solutions.

## 13.5.2 Network Intelligence - Deep Packet Inspection (DPI)

DPI is simply a term to describe the inspection of the packets of data that flow through a network. When these packets are identified by type, CSPs can know exactly what is happening in their networks and act upon the information. For example, if a parent does not want their child to have access to certain content, a DPI solution identifies that this content is going through the network and then blocks it from entering the child’s device. In order for network operators to make the best decisions about traffic management, accurate data traffic classification is essential for achieving visibility on networks. But this is very difficult to achieve when data is encrypted. The best DPI solution is one that is able to identify the largest amount of types of data at the highest resolution while bypassing encryption of data packets. For example, a basic DPI solution would be able to identify that a packet of data is simply Facebook content, whereas a sophisticated DPI solution would be able to identify exactly what type of Facebook content is going through the network (a message, a video message, etc.), set very specific controls over which type of data is allowed to go through, and learn what is being done to try and bypass the controls it put in place. Lessons that the DPI learns from one device can be shared through the network and applied to all devices. These features of an advanced DPI are what allow deep insights for CSPs and high QoE for users and they require very extensive know-how and experience. Company C has all of the features of a sophisticated DPI.

The DPI market can be roughly segmented into three types of players:

1) **Pure players**, which include only Company C and Sandvine;

2) **DPI library providers** which include players such as Qosmos; and

3) **Network Equipment Providers (NEPs) with a DPI feature** such as Huawei, Cisco, or Nokia.

**Pure players** offer comprehensive DPI solutions that not only understand what data is flowing through the network but also allow control of data flow for automated congestion mitigation, policy enforcement such as parental controls, or 5g slicing (allotting only parts of a network to deliver 5g capabilities to avoid burdening the whole network).

**DPI library providers** offer a solution that needs to be integrated with another solution that uses the DPI network visibility component, adding a control component to it so that the insights gathered from the network can be acted upon.

**NEPs with a DPI feature** also provide a comprehensive solution but, because DPI is not their main offering, the resolution of visibility into what is happening in a network along with the ability to control the network are not close to the level of pure players. However, these solutions may be less costly, especially if a CSP has purchased infrastructure from the NEP.

Company C’s DPI fits all the criteria of a sophisticated and advanced DPI:

1. It offers multi-dimensional **Network Awareness** (visibility of what types of data is flowing through a network) at one of the highest levels in the industry.
2. Company C uses MLandAI to ensure QoE by prioritizing data that is most crucial to satisfy customers in order to limit customer churn.
3. The level of customization of policies that can be enforced on Company C’s network creates flexibility that is one of the best in the industry.
4. Company C’s DPI, by nature, is designed to meet the specific needs of CSPs. This is due to the Company’s extensive work with CSP throughout the years.
5. The solution is designed as a service gateway**,** which means that other critical services, including firewalls, analytics tools, and caching can seamlessly be added to it.
6. Company Cs solution enables CSPs to comply with local regulations.

All of these advanced DPI capabilities of Company C allow CSPs to:

* Save access bandwidth costs.
* Defer capacity expansion.
* Cut OPEX through automation.
* Reduce revenue leakage.
* Prioritize network traffic.
* Create subscriber profiles based on usage patterns.

*13.5.3 DPI Competitors*

**Sandvine:** Sandvine and Procera merged in 2017 to create a strong competitor in the DPI market.

**Qosmos:**  Qosmos has launched new functionalities, enhanced its products and garnered new business in the last 18 months. Among them are:

* Qosmos signed an agreement worth $2.8 million for embedded DPI technology for a U.S.-based market leader in cloud technology and SD-WAN solutions for enterprises.
* ENEA’s Qosmos ixEngine that delivers real-time traffic visibility to networking and security products by identifying protocols and applications in network packets was further enhanced to include LAN Device Identification, First-Packet Classification, a Traffic Detection Module and categorization of unclassified traffic. The granular traffic visibility helps to optimize traffic, manage data flows, improve service quality and identify security breaches.
* In 2018, Qosmos Probe 2.0, configured as a Deep Packet Inspection (DPI) sensor, was launched. It is designed to strengthen cyber threat hunting capabilities at Security Operations Centers (SOCs).

**Arbor Networks (Netscout):** Arbor Networks is the security division of Netscout, offering DDoS protection and network visibility solutions for visibility and traffic intelligence. The company’s DPI solution can analyze service performance issues, evaluate service degradations, enhance user experience by reducing the impact of mean-time-to-repair (MTTR) issues, integrate DPI capability into a single management platform to increase efficiency and reduce operational costs and complexity.

The company recently launched Arbor Threat Analytics (ATA), a network-based threat detection and analytics platform to provide full visibility into multi-cloud environments and enable faster threat detection. This enables the company to offer comprehensive threat intelligence by integrating the new solution with its proprietary ATLAS Intelligence Feed that uses ML.

The following part of the valuation examines trends in the DPI sector that may encourage or inhibit growth.

***13.6 Trends Impacting the DPI Market***

1. **Growing demand for bandwidth-intensive applications:** Global Internet and mobile Internet trends indicate an increase in usage of applications that require high bandwidth, such as video streaming services. According to Sandvine’s 2019 Global Internet Phenomena report, internet traffic is dominated by video streaming, which contributes more than 60% of total downstream traffic volume. To deploy network analytics and optimizing strategies, providers will require network and customer insights derived from DPI technology.
2. **Increasing use of tiered service plans:** Operators tailor offerings based on customer usage to have an impact on average revenue per user (ARPU) for operators. DPI can meet these specific demands by providing specific insights.
3. **Increasing use of connected devices:** The ongoing increase in the Internet of Things (IoT) and Machine to Machine (M2M) strategies across verticals means that certain services such as telematics and remote patient monitoring will demand better quality of services (QoS). Users will include DPI as an integral part of the IoT and M2M strategies and providers must offer solutions that are capable of identifying and categorizing traffic generated by connected devices.

*13.6.1 Factors Driving Adoption of DPI*

The ability of DPI to manage network traffic efficiently is aiding its popularity and its impact on various parameters is driving adoption across user groups.

|  |  |
| --- | --- |
| Major Drivers Impacting Adoption of DPI | |
| Increasing mobile device penetration | Rising use of mobile devices will also drive demand for mobile broadband data. This will intensify the competition among network providers who will look at an option to enhance performance. |
| Access to data trends | Access to data trends such as statistical information about usage patterns by different user groups helps to understand user behavior based on their connections. The insights reveal trends that can, in turn, enhance network planning. |
| Need for cybersecurity | The threat of spam, worms, and viruses is constantly rising. The ‘Internet Security Threat Report’ published by Symantec (U.S.) in 2019, mentions that malware diagnosed in 2018 rose by tens of percent in some sectors. |
| Enhancing customer experience and engagement | Quality of experience (QoE) is a key metric driving DPI adoption. It helps to increase efficiency across subscriber management, bandwidth management for P2P applications, and security requirements for enterprise customers. Ensuring QoE decreases customer churn. |
| Innovation possibilities | Documentation and understanding of trends enable innovation at the edge. One such example is online messaging, which replaced expensive international phone calls. |

Source: Frost & Sullivan

*Fig. 13.8: Major Drivers Impacting Adoption of DPI*

*13.6.3 Factors Constraining Adoption of DPI*

The depth of information gained via DPI raises concerns about misuse of insights to influence customer choices and experience, limit options, and, at its worst, impinge upon the privacy of users.

|  |  |
| --- | --- |
|  | |
| Net neutrality laws | Inspection of the content layers is considered against the principles of open access of the Internet and something that undermines infrastructure of the internet. |
| Privacy concerns | The content of packets reveals user insights like never before, going into minute details of behavior and enabling inferences about personal interests and purchasing habits. Analysis can be intrusive and be used unfairly by ISPs. |
| Unethical use of information | DPI appliances can be used to interfere with web-based technologies (such as VoIP) and enable prioritization to benefit commercial agreements.  Serious violations may include the introduction of forged packets into the data stream. |
| Ambiguous regulations | Laws to govern the privacy of data accessed by DPI are ambiguous at best. For example, in the United States, the secondary use of DPI data is not restricted by law. Users have little control over how the data is used or stored. Companies have been known to utilize the data to conduct experiments on creating strong marketing campaigns. |

Source: Frost & Sullivan

*Fig. 13.9: Major Constraints Impacting Adoption of DPI*

*13.6.4 Challenges/Insights*

**Calls to curb DPI:** DPI is considered an effective tool for ensuring high-quality service and rational allocation of limited bandwidth. However, academics, public service organizations and privacy advocates are increasingly calling for anti-DPI regulations. Net neutrality is expected to be significantly affected as current regulations for monitoring how data is used by different user groups are fairly insubstantial.

**Driving Economies of Scale:** Due to the growing complexity of network and shrinking operating budgets, operators struggle to meet the QoS and QoE requirements. DPI enables better performance by leveraging automation, analytics and optimizing deployment. Providers have been able to guide their customers to new revenue streams, faster time to market, scaling up and enhancement of end-user experience by optimizing resources.

***13.7 Use Cases***

Among the use cases where DPI is specifically used:

* Service/ content based charging
* Policy enforcement, such as parental controls
* Quality of Experience (QoE) Assurance
* Quality of Service (QoS) Assurance
* Network congestion mitigation
* 5g slicing
* Network managers can ease the flow of network traffic, enabling high priority messages or mission-critical messages to pass through before others.
* Customization of data usage by mobile service operators and prevention of illegal downloading of content

***13.8 Future Trends***

**Real-time insights:** From communication to video streaming to gaming, the demand for better QoE is only bound to increase. Going beyond customization and value addition, use cases such as telematics and gaming require real-time analytics and insights. DPI-enabling with analytics and machine learning will impact the level of value addition that operators can provide to end customers.

**Cybersecurity demand set to grow:** The growing sophistication of cyberattacks demand multi-level security. DPI offers an effective tool to companies to tackle cybercrimes and protect networks and devices from malicious attacks.

The following represents the valuation based on the foregoing together with:  
A Financial Analysis

Company Valuation

Equity

Sensitivity Analysis

# *13.9 Financial Valuation and Projections*

## 13.9.1 Financial Analysis

Company C generates revenues from two sources:

(1) Network Intelligence Solutions sales which show network operators what is happening on their networks at the highest resolution; and

(2) Sales of Network Security solutions, such as security as a value added service that telecom service providers can offer to subscribers in order to protect them from cyber threats.

Company C revenues are mainly based on services and products. However, an investor can view that Company as two separate lines of business operating in two different, however integrated domains: Network Intelligence (DPI) and Network Security. The seven-year forecast predicts two revenues streams: one for Network Intelligence (DPI) and one for Network Security with different CAGRs based on the potential of Company C as described below in these two markets.

* DPI revenues: It assumes that some growth in 2020–2021 and a steady growth from 2022 are assumed in the forecast. Based on our understanding, the entire market will enter into a relatively static state in the coming years, as the DPI market potential, according to our analysis and Company C’s management view, has already experienced somewhat of a peak. We assume a 5% CAGR in our future forecast.
* Security revenues: We consider this market to be its early life cycle, with higher CAGRs and with a great potential for growth. We analyze the company’s maximum annual revenues from its clients and assume $27 million by the end of 2019 and then an annual two-digit growth rate as can be seen in the table below.

Gross profit was an average of 68% in 2016–2018, with some growth in 2018. We assume mild growth mainly due to clients’ movement to cloud-based services in the coming years.

Operating expenses:

* Selling and marketing: These will continue to be in the range of 40% to 43% of revenues in linear correlation with revenues in order to support growth.
* Research and development: As Company C needs to support its efforts in the security domain, R&D costs will remain high at a 10–12% annual growth rate.
* Operating profit: We assume a break-even point in late 2021/early 2022.
* General and administration: We assume a constant and high growth rate of 5% annually.

Below is our forecast for 2019–2024:

**Table 13.1: Company C Five-Year Forecast**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| $, 000 |  | 2016 A | 2017 A | 2018 A | 2019 E | 2020 E | 2021 E | 2022 E | 2023 E | 2024 E |
| DPI |  |  | 57,900 | 71,337 | 82,087 | 94,400 | 103,840 | 109,032 | 114,483 | 120,207 |
| *Annual growth* |  |  |  | *23%* | *15.1%* | *15.0%* | *10.0%* | *5.0%* | *5.0%* | *5.0%* |
| Network based security |  |  | 24,129 | 24,500 | 26,950 | 30,993 | 54,461 | 94,522 | 144,792 | 202,633 |
| *YoY growth* |  |  |  | *2%* | *10.0%* | *15.0%* | *75.7%* | *73.6%* | *53.2%* | *39.9%* |
| Total revenues |  | **90,533** | **82,029** | **95,837** | **109,037** | **125,392** | **158,301** | **203,553** | **259,275** | **322,840** |
| *YoY growth* |  |  |  |  | *13.8%* | *15.0%* | *26.2%* | *28.6%* | *27.4%* | *24.5%* |
|  |  |  |  |  |  |  |  |  |  |  |
| Revenues cost |  | 26,251 | 26,288 | 28,086 | 31,188 | 36,121 | 44,809 | 57,618 | 73,391 | 91,384 |
| Gross profit |  | **64,282** | **55,741** | **67,751** | **77,849** | **89,271** | **113,492** | **145,935** | **185,884** | **231,456** |
| *% of revenues* |  | *71.0%* | *68.0%* | *70.7%* | *70.7%* | *71.2%* | *71.7%* | *71.7%* | *71.7%* | *71.7%* |
|  |  |  |  |  |  |  |  |  |  |  |
| Operating expenses: |  |  |  |  |  |  |  |  |  |  |
| Selling and marketing expenses |  | 32,289 | 34,740 | 38,959 | 44,803 | 51,523 | 63,320 | 79,386 | 101,117 | 125,908 |
| *% of revenues* | *15%* | *36%* | *42%* | *41%* | *41%* | *41%* | *40%* | *39%* | *39%* | *39%* |
| Research and development expenses |  | 22,629 | 20,889 | 24,415 | 28,077 | 32,289 | 37,132 | 42,702 | 49,107 | 56,473 |
| *% of revenues* | *15%* | *25%* | *25%* | *25%* | *26%* | *26%* | *23%* | *21%* | *19%* | *17%* |
| General and administrative expenses |  | 9,002 | 8,735 | 9,187 | 9,830 | 10,518 | 11,044 | 11,597 | 12,176 | 12,785 |
| *% of revenues* |  | *10%* | *11%* | *10%* | *9%* | *8%* | *7%* | *6%* | *5%* | *4%* |
| Total operating expenses |  | 63,921 | 64,364 | 72,561 | 82,710 | 94,330 | 111,497 | 133,684 | 162,401 | 195,166 |
| *% of revenues* |  | *71%* | *78%* | *76%* | *76%* | *75%* | *70%* | *66%* | *63%* | *60%* |
| Operating (loss) profit |  | **361** | **-8,623** | **-4,810** | **-4,862** | **-5,059** | **1,995** | **12,251** | **23,483** | **36,290** |

Other parameters:

* Tax: We assume, based on our tax model, that the company will use its carry forward tax.
* Working capital: We assume a constant pace based on actual data (2016–2018).
* CapEx: We assume CapEx will be similar to depreciation in our model.
* Capitalization rate: Based on our CAPM model (see Appendix II) we assume a CAPM of 17.8%.

*13.9.2 Equity Value*

In June 30, 2019, Company C had non-operational assets (cash) of approximately $101 million. The company had $0.5 million in loans as of June 30, 2019.

**Based on the above factors, we assume Company C’s value at $411.8 million**

**Chapter 14: Company D: Renewable Energy**

This example provides another insight into making a valuation of an innovative company.

***14.1 Sector Overview***

Globally, the renewable energy sector is growing in most countries as a result of government decisions and pressure from organizations to reduce dependence on polluting fuels and to reduce greenhouse gas emissions, which are reflected in government actions to meet renewable energy targets to which they are committed under to the 2015 Paris Accords.

The implementation of government decisions translates into policies, regulations and licensing processes of companies that build renewable energy, in particular, electricity generating facilities that are supposed to provide electricity over many years in a reliable, safe and economical manner.

Company D is well respected in its industry, both locally and globally. Their reputation extends across the renewable energy value and supply chains, as well as within their specific business ecosystem. This is demonstrated by the list of Company D’s institutional investors, financing partners and equipment suppliers.

The Company has successful experience across stages of renewable energy projects, including initiation, development, financing, construction, management, operation, ownership and sale of assets.

# *14.2 Company Overview*

Company D operates in the renewable energy industry in Israel and abroad.[[111]](#footnote-111) The Company is active in the development and initiation of utility scale renewable energy projects.

The company is in the midst of a significant growth trend, expecting to multiply its installed capacity by a factor of 3.5 over the next two years from 100 MW in Dec 2017 (~156 MW, including assets that were sold) to over 365 MW at the end of 2019.

The Company’s structure reflects the multiple projects, initiatives and partnerships in which it is involved, from inception and development to operations and ownership. Typically, for each project, the Company creates a Special Purpose Company (SPC) that is the owner of the project and has one or more shareholders: the Company and its partner/s where applicable. Each SPC represents a single project or a cluster of projects of a similar nature.

The following examines the market environment in which the Company is operating.

# *14.3 Global Power & Renewable Market Overview*

Global power investment in 2019 is forecast to increase by 3.3%, reaching $443.5 billion.

Renewable energy is gradually becoming a key source of energy, attracting a significant portion of all investments in new energy generation capacity. T, wind and solar energy projects dominate the European market, and are forecasted to account for 65% to 70% of total investment through 2020. Solar Photovoltaic (PV) energy is expected to record the fastest growth, of 11.5%) and will account for $141.5 billion of total investment. These levels of investment in solar energy will exceed wind power by $44.1 billion, and secondary energy storage will become an increasingly important factor in future solar power growth.

The contrast between regions for renewable investment is significant. In Europe, over 70% of power generation investment in 2016 were in renewable technologies, whereas in Russia and the CIS, only 7.7% of investment was in renewables.

Key driving forces of renewable energy investments in many regions are:

* Decrease in capital costs for renewable technologies
* Improved technology providing better energy output
* Global and local policies, particularly incentive-based programs following the COP21 Agreement, which came into force Nov. 4, 2016
* Concerns regarding future carbon liabilities
* Growing political power: for example, renewable energy is now a significant employment sector in the United States, with influential Congressional supporters.

The energy landscape will be increasingly driven by the 3Ds of energy: decentralization, de-carbonization, and digitalization. These concerns are central to the thinking of decision makers when making energy investment choices.

The total installed capacity of global wind, solar and biomass energy is expected to grow by 550 GW (gigawatt, or 1000 megawatts) between 2016 and 2020, increasing their share from 15.1% to 20.7%.

*14.3.1 Key Regional Market Highlights*

According to forecasts, solar energy will account for 37.5% of global power investment by 2020, ahead of wind, in second place with 21.0%. Clearly, the rise of renewables continues.

North America: Solar PV is forecast to account for 49.3% of the investment between 2017 and 2020, ahead of wind with 20.4%. Renewables will continue to challenge fossil fuels in a number of key state markets within the United States.

Europe: Wind and solar dominate the European market, accounting for 65–70% of total investment each year through 2020.

China: Solar PV and wind are clearly ahead of coal power in terms of investment. By 2020, solar and wind investment will account for 63.9% of the total, with coal down to 11.6%.

APAC: Solar is forecast to account for 40.1% of regional investment by 2020, well ahead of hydropower, in second place with 17.6%. Coal investment is likely to drop to just 10% of the total.

India: Solar investment is expected to have doubled between 2016 and 2017. By 2020, it will account for 52% of the total investment.

Africa: In this diverse investment landscape, strong growth is anticipated in decentralized, small-scale solar PV, balanced with a small number of large coal, hydro, and gas plants in key country markets. Coal investment is gradually declining as development bank funding for new projects is limited.

Latin America: Solar and wind investment will gradually increase and account for 48.3% of the total by 2020. Fossil fuels and nuclear will see minimal investment, and hydropower will account for the remaining 30%.

*14.3.2 Global Solar Market Overview*

Global solar power investment is projected to increase from $130 billion in 2016 to $185 billion in 2021. Solar power is forecast to account for 37.5% of global power investment by 2020. The average installed capacity during 2015 to 2020 is expected to be 64 GW. Generation costs of PV electricity are already competitive with fossil fuels and other renewables, and with energy storage, will become more efficient not only economically, but also operationally.

*14.3.3 Global Wind Market Overview*

Wind capacity is forecast to increase by 48% to 725 GW by 2020, with annual investment in the range of $95-$100 billion, attracting 21.0% of global power investment during this period. Near double-digit growth is expected in most regions, even in the mature European market that is forecast to record a CAGR of 7.9%. China will almost double its cumulative installed wind capacity to reach 263 GW in 2020.

In order to expand adoption and increase economic viability, turbine manufactures are consistently investing in increasing power generation capacity and efficiency. Specific focus is on developing downwind turbines.

The following section of the valuation examines the Company’s activities and projects.

# 

# *14.4 Company Activities*

Company D initiates, develops, constructs, manages, operates and owns renewable energy projects.

In Israel, the company is deeply involved at all stages of project development from their initial stages through completion, while in overseas markets, it prefers to partner with local entities which are already in the process of obtaining permits and investments for these projects.

The company’s project pipeline, across all these stages, totals more than 1,500 MW.

Company D’s current pipeline and projects include, according to stage:

* Grid connected: This refers to a facility that is fully active and selling electricity to a grid.
* Under construction: These are projects that are under construction and will gradually or fully become grid-connected within a short period.
* Ready for construction: These are projects that have received a conditional license (where applicable), a statutory plan and/or approved urban building plan, and for which there is a valid tariff arrangement to which the projects are entitled or are included in the balance of vacant quotas (at least in the project's capacity). These projects are likely to be accepted and the company estimates that the financial closing will be completed within the next 12 months, but there is still no certainty that they will materialize.
* Advanced development: This includes projects that have obtained conditional approval, approval of the Ministry of Defense and decision on deposit, but there is still no certainty of their full realization.
* In development: This refers to projects that are in various stages of evaluation, planning, or regulatory processes, for re-designating agricultural or uncultivated land in order to revive a regulatory permit to build and operate an electricity generation facility; uncertain if materialized or when.

The following reviews the elements of the Company’s potential value to third parties.

The value proposition to investors, partners and suppliers includes:

* Experience in evaluating projects and uncovering upside opportunities.
* Focus on markets that are mature or maturing in terms of renewable energy policy and regulation, and such markets where renewable energy sources provide competitive electricity prices without the need for subsidies.
* Identifying opportunities to optimize projects’ capacity or timetables immediately and/or in the long term.
* High likelihood of securing financing due to corporate reputation and industry relations.
* Leveraging experience to generate margins from optimization, development and construction.

## 

The valuation continues by examining the competitive environment in which the Company is operating.

### *14.5 Competitive Landscape*

The opportunities in the Israeli renewable energy market supported the rapid development of many companies, some specialized and some as an add-on activity. These companies competed for the limited quota available for developing, contracting, building and operating renewable power generation facilities.

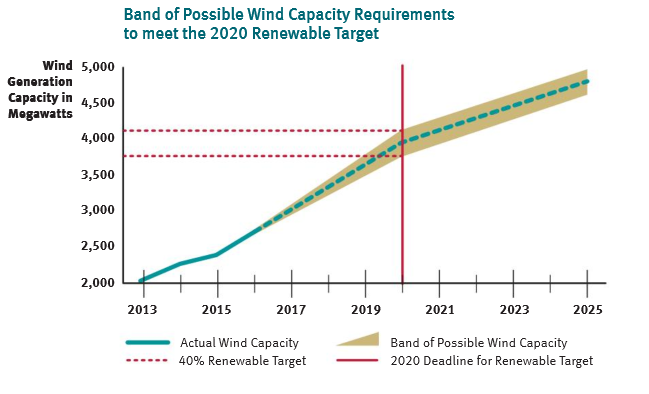
In addition to local companies, multinational companies have become actively involved in the development and operations of facilities, highlighting the local market’s potential.

Interestingly, the relatively new renewable energy sector shares similarities with the established real estate sector in terms of how it is structured and operated.

Of the one hundred or so companies active in the Israeli renewable energy market, some are focused on one stage of the project process (development, establishing/construction, and operations), and some operate in more than one renewable energy sector. Only a few, typically large companies, such as Energix, Shikun Ubinui and EDF, operate across all project stages like Company D does. In the wind power sector, Company D is the most prominent developer with the most advanced and sizeable project pipeline.

## 14.5.1 Ireland Activities: Renewable Energy Market Overview

Wind energy is a growing sector in Ireland, with 240 wind farms at a total installed capacity of over 2,800MW, supplying more than 20% of Ireland’s electricity demand.



Source: EirGrid Group (a state-owned company)

*Fig. 14.1: 10 Ireland Wind Capacity Projections*

The valuation now looks at the Company’s Key Projects and Activities

### *14.5.2 Ireland: Key Projects*

### *Tully Project*

Company D has one wind energy project in Ireland with an installed capacity of 13.6 MW.**No index entries found.**

On December 17, 2019 the company reported that all of the approvals required for the full commercial operation of the project had been obtained.

According to the production capacity and wind measurements made at the site, the company estimates that the project will yield revenue of €2.6 million per year from the sale of electricity during the regulated period (15 years).

After this period, electricity sales will be made under market conditions.

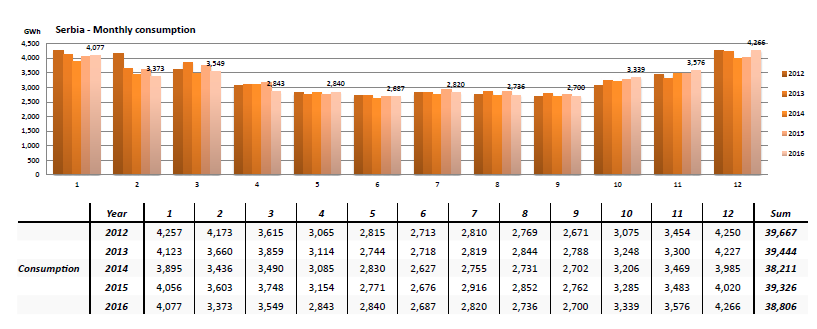
|  |  |
| --- | --- |
|  |  |

### *Competition*

The market is highly fragmented and involves small-scale local developers and operators, to large-scale projects owned by international companies. Competition is evolving mainly due to the Company locating and purchasing projects in pre-grid connected stages, or to the sale of portfolios of revenue-yielding assets.

## 14.5.3 Serbia Activities: Renewable Energy Market Overview

Serbia is a former Yugoslav state in Southeastern Europe without a maritime border. The nation has a total installed capacity of 8.3 GW, almost unchanged since 1991. Its population totals approximately seven 7 million, which consumed 39.2 TWh (terawatt-hour) of energy in 2015. The illustration below details the monthly consumption between 2012 and 2016.



Source: Balkan Energy Country Report – Serbia

*Fig. 14.2: Serbia Electricity Consumption*

Serbia is the eighth largest producer of lignite (brown coal), which supplies 70% of the country's energy production, but under the Energy Community Treaty, the country is committed to reducing this, so that coal will represent 27% of the renewable share in gross final consumption of energy by 2020. In the spring of 2017, Serbia’s Minister of Energy confirmed the country’s commitment to meet said targets.

The country suffers from old and outdated infrastructure and new renewable capacity is planned to not only add capacity but also to replace older larger hydropower plants that were built in 1950s and 1960s.

On June 13, 2016, the Serbian government adopted a set of regulations often referred to as the PPA Package, and the electricity market became almost completely liberalized by the introduction of the electricity market/power exchange in February 2016.

A feasibility survey concluded that there is potential for more than 1,300 MW of wind energy across the country. However, the current quota includes 500 MW which is fully utilized, and there are some twenty additional projects in various stages of development.

### *The Black Project*

The project has a total installed capacity of 104.5 MW.

The farm is included in the 500MW quota and is among the first large-scale wind projects expected to reach commercial operation in Serbia. The wind farm is located in the northern town of Kovacica, 50 kilometers northeast of the capital Belgrade.

The total investment of €189 million will be divided between equity and debt. On September 24, 2017 the company announced the financial closure with a syndicate led by an Austrian bank (ERSTE). It also announced that the German export insurance agency (Euler Hermes) would provide credit insurance of €83 million. The lenders will provide €142 million (about 75% of installation costs).

## 14.5.3 Croatia Activities: Renewable Energy Market Overview

As an EU member, Croatia has already met the 20% renewable energy source target set for 2020. In fact, Croatia is currently generating around 30% renewable energy, which is enough to meet the 2030 targets.

Since 2015, Croatia’s economy has grown (2017 GDP growth was estimated at 2.8%,) driven mainly by internal demand. This growth improves the government’s ability to further promote investment in renewables. Furthermore, the demand to increase capacity is also required, as it is estimated that growth in wealth per capita and increased ownership of domestic appliances will drive energy demand growth by an average of 1% annually to 2035.

Wind is a growing sector in the Croatian renewable energy market and of the total of ~ 600 MW green energy capacity installed over the last decade, wind projects constitute almost 80%, with 20 active wind energy plants/farms.

### *The Lukovac Project*

Investment in the project will total $66 million, of which 75% is debt financed.

On September 3, 2017, the company announced that the construction of the turbines was completed and that it had entered a process of inspections and tests for receiving formal approval. Expected annual revenues from the project are approximately NIS 53 million.

## Hungary Activities

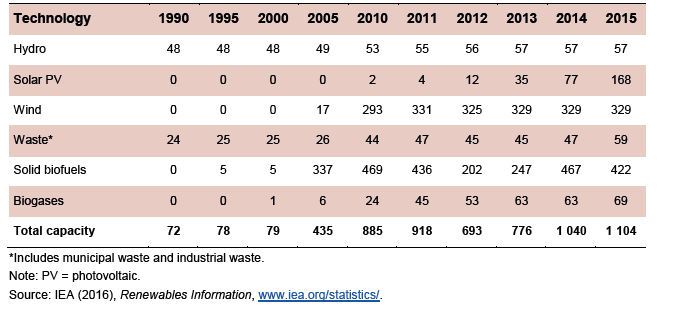
### *14.5.4 Hungary: Renewable Energy Market Overview*

Hungary is also a landlocked central European country, with a population of about 9.8 million. Its electricity consumption in 2015 was 37 TW (terawatt), of which 36% was imported, due to a small installed capacity of just 8.6 GW. Primarily relying on nuclear power, Hungary’s 2020 renewable energy targets include a goal of 10.9% of electricity demand to be supplied by renewable energy, the lowest among the EU members. In 2015, 7.3% of electricity production was generated from renewables, unchanged from 2014.[[112]](#footnote-112)

A new system for renewable-based electricity generation, METÁR, was introduced in 2017, replacing the KAT system. In general, Hungary did not promote growth with renewables until 2017. However, the Hungarian government has recently adopted favorable regulations towards solar PV. Examples include a series of recent regulations aiming at limiting the installation of new wind turbines and a high environmental tax on solar panels (by international comparison). As a result, this segment was forecast to grow rapidly and is expected to exceed one GW by 2019.

The National Energy Strategy 2030 plan calls for a Nuclear-Coal-Green energy combination and it seems that the green component is being promoted mainly to reduce the EU’s objections to the controversial nuclear element.

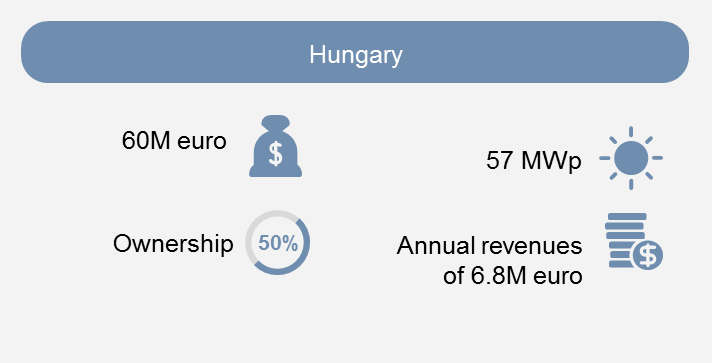
Approximately two GW of PV projects were approved under the old Feed-In Tariff plan (closed in mid-2016), which could materialize if grid-connection is achieved by the end of 2019, or 2020 resulting in a 10% deduction in the Feed in Tariff period. However, much of this capacity, possibly 50% or more, comprises small-scale projects which may not be economically viable.

**Renewable Electricity Generating Capacity, 1990-2015 (MW)**

### *Fig. 14.3: Hungary Renewable Electricity Capacity*

### *Key Projects*

On October 29, 2017 the company and Movilim partners announced it had signed an agreement to buy and hold 100% ownership in three projects, totaling 57 MWp (Mega-Watt peak), in Western Hungary. The owners, experienced developers, managed to receive the permits required to qualify for the quota, and Company D believes that the projects can be connected to the grid by 2019.



*Fig. 14.4: Company D’s Hungary Projections*

The report concludes with the actual financial analysis and valuation.

# 

# *14.6 Financial Valuation & Projections*

*14.6.1 Revenues*

Company D’s revenues at the end of September 2017 totaled NIS 25.1 million, similar to the respective period in 2016. Gross profits as of the end of September, 2017, were NIS 9.7 million, higher by NIS 1.6 million over the same period of the preceding year, due to one-time expenses. General and administrative expenses were NIS 9.0 million at the end of September, 2017 compared to NIS 8.1 million in the previous period, and selling and marketing (mainly business development fees) were NIS 3.3 million at the end of September, 2017, compared to NIS 2.8 million the previous year, with the increase due to the company’s growth operations.

The company has 86.1 MWp installed capacity of PV projects plus grid-connected wind projects in Ireland, with 13.6 MW installed:

**Table 14.1:** **Company D’s Israeli and Irish Holdings**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Country | Project name | Type | MW | Holdings % |
| Israel | Kramim | PV | 5.0 | 100.0% |
| Israel | Idan | PV | 3.0 | 100.0% |
| Israel | Miftahim | PV | 10.0 | 51.0% |
| Israel | Talmi Bilu | PV | 10.0 | 100.0% |
| Israel | Halutizot | PV | 55.0 | 79.5% |
| Israel | Golan, Nehamia, Barbur | PV | 2.6 | 51% to 100% |
| Israel | Zayit | PV | 0.5 | 100.0% |
| Ireland | Tully | Wind | 13.6 | 50.1% |
| Total |  |  | **99.7** |  |

*14.6.2 Balance Sheet*

Company D’s equity as of September 30, 2019 was NIS 458.0 million, 23% of its balance. In 2018 the Company D had NIS 306.4 million. In its financial report, the company had NIS 128.5 million in cash as of September 30, 2019 and loans totaling NIS 186.5 million.

As of September 30, 2019, revenues for the preceding 12 months from electricity sales for grid connected projects totaled NIS 142 million (a company’s share is NIS 112 million); while the company’s revenues were NIS 158 million in 2018, including an operation that had been sold in Italy, NIS 126 million in 2017 and NIS 103 million in 2016. Enterprise Value was NIS 124 million and its Funds from Operations (FFO) were NIS 72 million.

*14.6.3 Valuation*

### Forecast: Revenues

To date, Company D has disclosed information about 20 specific projects (we refer to three of the projects as a single project due to the financial and legal structure) totaling approximately 800 MW. These projects are in various stages of development or operations, in five countries and in one of two areas of renewable energy, either solar PV or wind. Below is the full scope of Company D’s identified and disclosed projects based on information received from the company and based on our analysis for the relevant operating years:

**Table 14.2: Full Scope of Company D Projects**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Project name | Type | Status/Commencement of Operations | Holdings | MW |
| 1 | PV | Grid connected | 100% | 8.0 |
| 2 | PV | Grid connected | 100%-51% | 20.0 |
| 3 | PV | Grid-connected | 79.5% | 55.0 |
| 4 | PV | Grid-connected | 51%-100% | 2.6 |
| 5 | PV | Grid-connected | 100% | 0.5 |
| 6 | Wind | Grid-connected | 50.1% | 13.6 |
| 7 | Wind | Mid-2018 | 50.1% | 49.0 |
| 8 | Wind | Mid-2019 | 50.1% | 105.0 |
| 9 | PV | 2019 | 77.0% | 53.0 |
| 10 | PV | Mid-2019 | 50.1% | 57.0 |
| 11 | Wind | 2021 | 36.5% | 109.0 |
| 12 | Wind | Mid-2021 | 60% | 168.0 |
| 13 | Wind | Mid-2021 | 50% | 32.0 |
| 14 | Wind | 2022 | 60% | 36.0 |
| 15 | Wind | Mid-2021 | 85% | 20.0 |
| 16 | Wind | 2023 | 60% | 50.0 |
| 17 | PV | End of 2019 - 2020 | 100% | 18.0 |

*14.6.4 Main valuation parameters:*

* As a base-line, we calculate the revenues generated by each project based on:
  + Its electricity production capacity
  + The number of operating years
  + Electricity contract price per MW
  + Hours of electricity production based on similar projects and information we received from the company’s management
* We then calculate revenue per project for Company D, based on the percentage of holdings by the company in the project.
* For the forecast period, we:
  + Employ PV degradation of the solar panel in an annual decrease of 0.5%.
  + Add extended operating years (over the contract period) assuming much lower electricity prices.
* We then add operating expenses based on the company’s financial reports and our estimations.
* We allocate financing expenses for each project based on percentage of holdings.
* We also add tax rates for every project based on its legal structure.
* We implement different success rates for the projects based on stages of operation and financial closing.
* We add Company D’s WACC of 6.72% (see below).

The table below details our main variables for each individual project:

**Table 14.3: Company D’s Project Variables**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Project Name | Degradation | Gross profit | Financing – Total Loan (NIS M) | Years to end |
| 1 | 0.5% | 81% | 87 | 18 |
| 2 | 0.5% | 81% | 18 |
| 3 | 0.5% | 90% | 229+86 (mezzanine loan) | 19 |
| 4 | 0.5% | 80% | 19 |
| 5 | 0.5% | 88% | 377 | 18 |
| 6 | 0.5% | 70% | 15 | 18 |
| 7 | 0.5% | 70% | 2 | 18 |
| 8 | 0.0% | 85% | 520 | 18 |
| 9 | 0.0% | 81% | 76 | 15 |
| 10 | 0.0% | 83% | 197 | 13 |
| 11 | 0.0% | 88% | 574 | 12 |
| 12 | 0.5% | 80% | 160 | 18 |
| 13 | 0.0% | 85% | 600 | 18 |
| 14 | 0.0% | 85% | 208 | 18 |
| 15 | 0.0% | 85% | 200 | 18 |
| 16 | 0.0% | 85% | 92 | 18 |
| 17 | 0.0% | 85% | 208 | 18 |

*14.6.5 Pipeline Value*

**Revenue**

We assume revenues from PV and wind will dramatically increase over the coming years, as the company will engage in more large wind projects, especially in Israel. For example, it is forecast that Company D’s revenues in 2020 will be NIS 142.8M (representing 100% holdings) whereas all revenues are PV project-based revenues. However, it is assumed that by 2020, total revenues will amount to NIS 366.3 million, with PV and wind revenues almost equal, as shown below. On the right of the chart, we show the estimated increase in wind revenues during the forecast period, while PV revenues are remaining in a steady state.

**Table 14.4: Company D’s Pipeline Values**

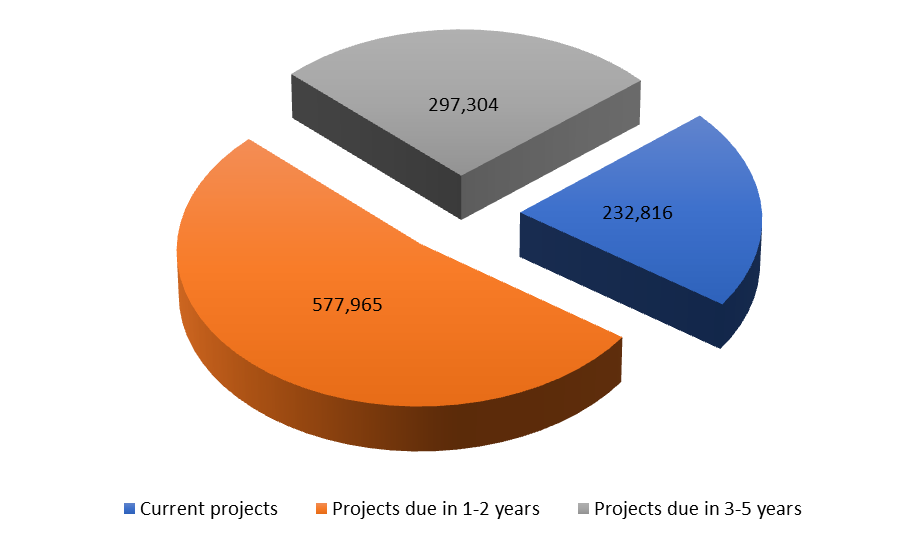
|  |  |  |
| --- | --- | --- |
| Project name | Holdings | NPV (NIS, 000) |
| 1 | 100% | 33,643 |
| 2 | 100%-51% | 39,775 |
| 3 | 79.5% | 133,513 |
| 4 | 100%-51% | 5,275 |
| 5 | 100% | 3,891 |
| 6 | 50.1% | 17,273 |
| 7 | 50.1% | 126,160 |
| 8 | 50.1% | 247,489 |
| 9 | 77.0% | 28,290 |
| 10 | 50.1% | 26,275 |
| 11 | 36.5% | 138,141 |
| 36.5% | 13,523 |
| 12 | 60% | 202,411 |
| 13 | 50% | 18,492 |
| 14 | 60% | 22,575 |
| 15 | 85% | 19,878 |
| 16 | 60% | 41,647 |
| 17 | 100% | 7,456 |
| Total pipeline |  | 1,125,708 |

Pipeline valuation is based on different stages of the projects. For example, the Emek Harocot project will have a grid connection in 2023 and it is dependent on several milestones until the permanent permit is granted. Thus, we evaluate Company D’s pipeline based on the different stages for each project and based on the forecast grid connection year.

We forecast that the current grid connected projects are valued at NIS 232.8 million, projects that are due in one to two years are valued NIS 578.0 million and projects due in three to five years are valued at NIS 297.3 million as we show below:

**Table 14.5: Company D Project Breakdown**

|  |  |
| --- | --- |
| **Current Projects** | **297,304** |
| **Projects Due in 1-2 years** | **232,816** |
| **Projects Due in 3-5 years** | **577,965** |

****

*Fig. 14.5: Company D Project Breakdown*

*14.6.6 Equity Value*

We evaluate Company D’s equity value based on 20 projects within the pipeline the company has identified and disclosed and that we have analyzed. We have added management fees which the company is entitled to receive to the value of the projects. Furthermore, the company is also entitled to development fees in any project that completes the financial closing.

In addition, the company announced a new 105 MW project in central Europe on January 21, 2018. At this time, it is still premature to evaluate the project, as it is in very early stages. Therefore, thus we do not include this project in our pipeline valuation. We will update our valuation upon closing.

On the expenses side, Company D has General and Administrative (G&A) expenses as well as selling and marketing expenses (mainly due to business development costs for future projects). We consider the baseline G&A expenses as reported in the company financial reports with a 2% annual increase, as the company will need to support its progress.

The company’s cash was NIS 128.5 million on September 30, 2017 with unallocated loans and bonds (i.e., not related to a specific project) of NIS 186.5 million. We added these as non-operational assets/liabilities.

Below is our equity value breakdown:

**Table 14.6: Company D Equity Breakdown**

|  |  |
| --- | --- |
| Total Pipeline | 1,125,708 |
| Income from management fees | 39,203 |
| Unallocated expenses | (32,539) |
|  |  |
| EV | **1,132,372** |
|  |  |
| Non-operating assets/liabilities |  |
| Cash | 128,534 |
| Loans | (186,543) |
| Total non-operating | **(58,009)** |
|  |  |
| Equity Value | **1,074,363** |

**Based on the above parameters, company’s D equity value is evaluated at NIS 1.1 billion. This valuation encompasses identified projects 800 MW.**

### *14.6.7 Sensitivity Analysis*

We set a 0.5% change range from WACC model (see below). Company D had 494.7M shares as of 2019.

**Table 14.7: Company D Sensitivity Analysis**

|  |  |
| --- | --- |
| Cap. Rate | Price target (NIS) |
| 7.22% | **2.17** |
| 6.72% | **2.30** |
| 6.22% | **2.45** |

### Valuation by Multiples

We also viewed the EV/EBITDA multiples as known in the Green and the Renewable Energy industry and as calculated by Professor Demodaran of New York University (NYU).[[113]](#footnote-113) Based on 25 companies in the Green & the Renewable Energy sector, the EV/EBITDA multiple for 2017 was 11–12. Company D’s forecast EV/EBITDA for 2017 was in this range as well.

**Chapter 15. Conclusion**

*“Hope in reality is the worst of all evils because it prolongs the torments of man.”*

Friedrich Nietzsche

Decision making involves psychology in many aspects. It has an increasingly important role in economic forecasting, adding elements to the normative and traditional approach, based on the standard economic and financial assumptions of rationality. Several academic papers and books have investigated, among other issues, how beliefs and expectations influence our decision-making process. Special challenges are involved when referring to the valuation of early-stage firms.

As part of the process of assessing companies, and certainly the early-stage firms, future cash flow must be forecast. In contrast to mature companies, there is a component of greater uncertainty for younger ones, as the market can change by the time the company's product reaches it, thus altering the product’s potential and value. That is, the uncertainty components of early-stage companies are significantly higher than those of mature companies. The field of behavioral finance teaches us that people tend to be optimistic when assessing risks and giving weight (anchoring) to the data they know or believe they should rely upon. This tendency can distort value for those companies and prevent growth.

While this book essentially falls within the genre of financial literature, it draws on interdisciplinary insights in a discussion of the issues encountered when evaluating early-stage ventures. Of particular importance is the analysis of psychological insights into investor/entrepreneur behavior at different intervals throughout the valuation process.

Therefore, this book not only seeks to provide new tools in the usual financing world for early-stage companies, but it also strives to connect the behavioral area with an emphasis on understanding the cognitive failures that may stand in the way of investors evaluating those early-stage companies. Finally, the book aims to combine the behavioral and financial aspects of valuations with examples of the various technology areas: drug development, cybersecurity and renewable energy.

In that sense, the book explores and merges two disciplines: traditional corporate finance and behavioral finance, creating a focus on early-stage firms' valuation based on a behavioral understanding of investors as well as on financial factors.

On the financial side, the book explores standard methods for assessing companies, such as the discounted cash flow method and the multiplier method, but draws attention to adapting these methods to early-stage companies. As an example, the book discusses the method of multiples, using parameters that are not usually acceptable among mature companies, such as multiples based on research and development expenses or the number of employees as an indication of company value.

The book deepens and presents actual examples of valuations of drug development companies, cybersecurity and renewable energy. The discussion on valuation for the early-stage companies offers ways in which drug development risks (the probability of a clinical or regulatory phase transition), as well as the development and establishment of a renewable energy project (such as the prospect of financial closure or regulatory approval), can be incorporated into the valuation.

Also, the book introduces a method that combines cash flow discounting with multiples in which investors can capitalize on the multiplier of mature companies and thereby reach expected value.

All these issues are examined in depth, with the aim of providing investors and the companies themselves with more up-to-date tools for assessing the value of intellectual property and equity.

On the behavioral side, people, including investors, are prone to optimism, overestimation and disregard of risk. The book extensively discusses investor behavior, especially concerning valuing early-stage companies. In doing so, it tries to combine an understanding of the underlying cognitive failures of investors, discussing them, and offering ways on how to make more informed valuations.

I hope investors, as well as companies, will find this book useful in the new world of companies and distributive technologies.

## Appendix I: Capitalization Rate for Renewable Energy Firm

The capitalization rate is calculated using the CAPM, based on a long-term 30-year Treasury bond with a market risk premium. As of Jan. 2016, the Israeli market, in which the Company operates, had an estimated risk of 6.69%

Using a sample of 25 companies representing the U.S. renewable energy sector, regression beta of the three-year market is 0.47. The debt-to-equity ratio is 1.74 and debt beta is equal to 0, i.e., Beta is 1.29:

|  |  |  |
| --- | --- | --- |
| βe: |  |  |
| Unlevered beta | Βa | 0.47 |
| D/E - average for a sample of 25 firms | D/E | 1.74 |
|  | Βd | 0.00 |
| βe=βa +D/E\* (βa -βd) | **Βe** | **1.29** |

CAPM model (ke) is as follows:

*ke = rf + β(rm-rf) + P*

CAPM is estimated to be 11.4%. We also add a specific risk premium to the company, as a major part of its projects are outside of Israel where they face different regulatory risks.

The company’s financial structure, based on the WACC model, is as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| WACC | Parameter | Data | Source |
| Long-term (20 years) T-bond | R(f) | 2.80% | Rf - Israel |
| Market risk premium | R(m)- R(f) | 6.69% | based on Damodaran (1/1/19) - Israel |
|  |  |  |  |
| Beta | Βe | 1.29 | Beta sample - Renewable energy (Damodaran, 2019) |
|  |  |  |  |
| Cost of Capital | Ke | 11.4% |  |
| Debt, rate | Rd | 4.2% | Company`s financial long term average loans |
| Debt (%) | D/(D+E) | 75.4% | 2019 financial data |
| Equity (%) | E/(D+E) | 24.6% | 2019 financial data |
| Tax | T | 23.0% |  |
| Specific risk premium | | 1.5% |  |
| WACC= Rd(1-t)\*(D/D+E)+Ke(E/D+E)+risk premium | | **6.72%** |  |

## 

## Appendix II: Capitalization Rate for Software Firms

The capitalization rate is calculated using the CAPM as suggested by New York University Professor Aswath Damodaran’s ([www.damodaran.com](http://www.who.int)). As of Jan. 2018, the Israeli market, in which the Company operates, had an estimated risk of 5.69%. Using a sample of 44 companies representing the U.S. software firms sector, regression beta of the three-year market is 1.25. The Company has no loans or any other rate-carrying liabilities, which are considered non-operational liabilities. In order to reach the relative CAPM, we used an unleveraged beta, resulting in an implied CAPM is 7.6%.

Because the Company is a small-cap company, marketability and size premiums need to be considered. Duff and Phelps research indicates that an 10.24% premium should be added to the CAPM for small cap companies in the 10th decimal. Therefore, the Company’s CAPM is 17.8%.

|  |  |  |
| --- | --- | --- |
| CAPM Model |  | Value |
| Long-term T-bond | R(f) | 0.46% |
| Risk premium | R(m)- R(f) | 5.69% |
| Beta unleveraged | Β | 1.25 |
| Cost of Capital | Ke | 7.6% |
| Size Premium |  | 10.24% |
| CAPM | CAPM | **17.8%** |

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