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Master Thesis

Valuation of Nordic Nanovector ASA

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Summary

The purpose of this paper is to conduct a valuation of Nordic Nanovector ASA through the use of both traditional discounted cash flow models and real option analysis. We have therefore arrived at three different estimates for the company value. The calculated company values are NOK 6.133.507.000, NOK 3.260.601.301, and NOK 3.946.287.020 generated from the static discounted cash flow model, expected net present value model, and real options analysis respectively. Bearing in mind that Nano currently have 49 091 683 shares outstanding and presupposing the same order as above, we obtain a distribution of share prices equal to NOK 124.94, NOK 66.42, and NOK 80.39. All these are larger than the observed prevailing share price for the stock at Oslo stock exchange, amounting to NOK 50.95 for May 31, 2018.

The paper begins by briefly accounting for our choice of thesis topic and list of topic questions to be answered. Further information about the company and the biotech industry is then presented, in order to provide the reader with necessary insight and some context. Next we give an account of the financial theory underlying our reasoning and approach throughout the paper, before we proceed by conducting a strategical analysis for Nano's attributes. The strategical analysis is then complemented by an analysis of the historical statements, to create a solid foundation for the subsequent forecasting of the models important inputs.

Based on the forecasted cash flows and the calculated cost of capital in the previous step, we are then ready to perform the actual valuation. Two net present values have been calculated for the project. A static NPV estimate have been calculated by applying an unadjusted discounted cash flow model, and an expected NPV estimate have been calculated by probability adjusting the same DCF model. However, in order to value the inherent flexibility of the project, we must also apply a real options analysis. The real option analysis follows the process outlined by Mun (2006), and utilizes the Real Options Super Lattice Solver software to estimate the total company value of Nano, flexibility included.

The paper ends with a sensitivity analysis aimed at assessing the reasonability of the generated estimates, a discussion of the papers findings, and ultimately a conclusions addressing the topic questions

Preface

This report is the final part of our MSc in Business Major Finance at BI Norwegian Business School in Oslo.

In selecting the theme and topic question we have both emphasized our own experience and professional interest. We have both wanted to immerse ourselves and use our theoretical knowledge learned over the last five years at BI Norwegian Business School through a practical problem. In addition, we have been curious about linking business, strategic and financial theories. Therefore we decided to valuate a company.

We have both read that valuation using real option theory can provide other estimates compared to traditional long-term cash flow analyzes. A company were early pointed out as a natural choice. Nordic Nanovector ASA develops a drug that is in an exciting development phase in addition to be listed at Oslo Stock Exchange.

We would like to thank our supervisor, Geir Høidal Bjønnes, for availability through the writing process. We would also like to thank our family and class mates for encouragement and support throughout the course of the study.

Introduction

Background

Biotechnology companies have the potential to increase welfare levels globally by developing effective drugs. Although the opportunities are huge, the industry is entirely dependent on investors desire to finance these companies. Lack of information and uncertainty linked to the development of a product in the industry will help to reduce investments. The background for the choice of industry lies in highlighting and supplying the market precisely information about a company in the Norwegian biotechnology industry.

Over a decade of business, the industry has attracted large amounts of capital and through these years there is a positive trend. Both within product development and financially, the industry has delivered promising results in recent years. With increasing numbers of cancer cases from year to year, and a disease that affects people of all ages regardless of lifestyle and gender, there is an increasing demand for new biotechnological innovation.

Typical for the industry is that a product that reaches market launches generates large profits over the period until patent protection expires. It is also these breakthroughs that have increased the faith in research-based activities. A trend that has also has changed in recent years is the breakthrough made by smaller research-based companies. A consequence is that not only major pharmaceutical companies and their traditional technology that have launched products. A new era is on and several companies have already paved the way. The most important thing, however, is to help cure various cancerous diseases such as lymphoma. In a market that still lacks effective drugs, the opportunities are huge.

The purpose

The purpose of the report is to calculate a value of Nordic Nanovector ASA and based on the analysis provide a buy/sell recommendation. The recommendation must naturally be seen in comparison with the valuation at the Oslo Stock Exchange.

Topic questions

In accordance with the purpose of the valuation, we have a primary question and a secondary question.

Primary question:

What is the fundamental value of Nordic Nanovector ASA?

Secondary question:

Will the use of discounted cash flow method and real option methods result in different estimations for the fundamental value of the company?

In this report, the cash flow method and real option methods will be two different ways to find the company's fundamental value.

Stipulation of the report

The report is based solely on publicly available information. This means that we have not been in contact with any employees or others who may have more information about the company than the market is aware of. Our data collection and figures used in the report are based on the history up to the last quarterly report (Q1 May 30th 2018). Stock market announcements and other financial information after Q1 2018 have not been taken into account in the report [1].

About the industry, market participants and the company:

In this chapter we will start by providing a description of biotechnology as well as the biotechnology industry and their development. At the same time, we will look into the various particpants in the industry, and then we will present a presentation of Nordic Nanovector, which includes the story behind the company and their business (product).

About the company and the industry

Biotechnology in general

(Ministry of Health and Career, 2012) [2] defines biotechnology as "all technology using microorganisms, plant, animal and human cells". On the other hand, a general definition will depend on whether you want a wide or narrow definition. The following way defines OECD biotechnology [3]: "Use of science and technology on parts, products and models of these, so that living or non-living materials change to produce knowledge, goods and services." Some may think that this is a broad definition, so we think it may be appropriate to distinguish between modern and traditional biotechnology.

Older biological techniques such as bread baking for systematic breeding are examples of traditional biotechnology to improve or acquire products. This method of biotechnology rarely questions and is widely accepted in society. Modern biotechnology involves methods in which cells, biological tissues or genes [4] are manipulated to build up new tissues or alter the genetic structure

(inheritance) of an organism. The reason for using these methods is to create new features that are currently skeptical in, for example, manipulation of DNA (Government of Canada BioPortal, 2007). Genetic technology provides us with new opportunities in medicine and health, industry, food and agriculture, and not at least in marine resources [5].

Historical biotechnology

As mentioned in previous chapters, traditional biotechnology has been around for thousands of years to improve people's own lives. The first primitive vaccine is said to have already been used in China against copper (variola) 1000 years before the resurrection of Jesus Christ [6]. In addition, people have used plants for medical use for several centuries. Although modern medicine and vaccines were used from the late 1700s, the end of World War II marks the true start of modern biotechnology when the war had prevented many new discoveries. When the war ended in 1945, many scientific findings were reported [7] and paved the way for new discoveries for decades to come. Examples of this are the discovery of DNA in 1953 (Government of Canada BioPortal, 2007) and in 1972 when DNA molecules were constructed from genes from a virus and a bacterium by Paul Berg.

These discoveries paved the way for a number of medical advances as it enabled controlled gene manipulation and thus marked the start of gene technology. The evolution and progress made through the century has not only paved the way for improving health care, but also led to the development of fertilizer, a tool used today for increased food production. Modern biotechnology has also led to more controversial breakthroughs such as cloning and stem cell research. Due to the potential negative impacts of biotechnology on society, individuals and animals, Norway and most state governments have legislation regulating the use of biotechnology. These will be discussed in a separate chapter, as these regulations have a great impact on companies operating in the industry, and therefore also Nordic Nanovector.

The biotechnology sector in Norway and internationally

According to Menon [8], eleven companies in Norway currently have pharmaceutical production of medicines with a marketing authorization (active

substance or finished product). Among these companies, the Institute of Energy Technology (IFE), and other radioactive aids such as Nordic Nanovector and Bayer. Bayer, which purchased 92.17% of the Norwegian company Algeta in 2015, which in many cases can be said to be the major breakthrough in this industry in Norway [9]. These manufacturing companies have a total of around 2700 employees and export for almost NOK 15 billion. Looking at developments in Norway for decades in this industry, there are clear signs of strong growth. Total expenses (public and private) on health care of one person money from GDP at market prices were for Norway at 4.0% in 1970 while in 2014 it was 9.3% [9]. With a drug value of 1.624 million euros based on figures from 2015, Norway is a step behind other European countries such as the UK (22,375 million euros), Germany (30,038 million euros) and France (27,645 million euros) [8].

This illustrates that the biotechnology sector is an industry in growth, but it is also important to point out that profitability in the industry as a whole is very poor. 2008 was the first year that the biotechnology sector, overall, generated profits in the United States [10]. This is in line with the criticisms that Pisano (2006) argues against the industry when he claims that companies manage to raise capital, but that they still have the benefit of delivering results. United States is gigantic and a significantly more attractive market due to the way pharmaceuticals are financed, insurance companies pay what the drug costs, while in Europe and Norway there are various collaborations internally and between countries to reduce prices. You can see examples like Algeta's product Xofigo, where they will take around 20-30% higher price for the same medicine in the United States compared to Europe [10]. One of the reasons for these differences lies in the fact that, for example, there are many small savers and risk-free funds investing in the start-up phase. Big Pharma companies do not buy in until they are some stages into the process like Algeta (bought in phase II). More risky and biotech-specialized capital in the United States, which means that pricing of companies like this is comparatively low in Norway at early stages. The knowledge of Norwegian investor environments and investment companies is still low around biotechnology [11]

Regulation of the biotechnology sector

The regulation of the biotechnology sector has been stricter over the years due to a steady development. With several regulations, this helps to show the importance

of preserving the rights of individuals whether it is a human or animals. One of the concerns about rapid development in the sector are the ethical issues that emerge and which legislation must protect and preserve in the best possible way. There are currently two laws that mainly regulate biotechnology activity in Norway. These two laws are the Genetic Technology Act and the Biotechnology Act. The Gene Technology Act § 1 regulates the purpose of the Act, which "ensures that the production and use of genetically modified organisms and the production of cloned animals is conducted in an ethically and socially sound manner, in accordance with the principle of sustainable development and without health and environmental harm." The Biotechnology Act regulates mainly what goes on humans and therefore lies under the Ministry of Health and Care. According to the Biotechnology Act section 1-2, the Act regulates research on fertilized eggs and cloning, assisted fertilization, obstetric diagnosis, genetic studies of gene therapy and born [12]. This is done to ensure state control and governance in a field characterized by rapid development and many ethical and value issues [13]. The European Medicines Evaluation Agency (EMEA) enforces European regulation [14], while the Food and Drug Administration (FDA) enforces regulatory regulation in the United States. The FDA, among other things, stands for various fuses and approvals for faster treatment of developed products to launch a pharmaceutical product on the market, known as Fast Track. More information regarding Fast Track information will arrive later in the chapter.

The drug development process

The development of drugs follows several predefined stages before the product can be launched on the market. These stages may vary depending on the use of the product and the like, but we will provide an overview of general processes, as explained by Gambardella (1995) and Kellogg and Charnes (1999) . Seven phases consist of the development process. First, a potential new drug is identified during the discovery phase. After the new candidate has been discovered, it needs extensive tests. These tests can be divided into two; preclinical studies and clinical trials. Preclinical is performed in laboratory on animals to study biological activity of the component against the intended disease. These tests take about three and a half years. Clinical studies are divided into three phases; Phase I, Phase II and Phase III, each of which is performed on a larger test population given by the

previous phase was successful. Finally, the authorities will make their assessments and possibly approve before the drug can be launched.

Discovery

During this phase, a lot of resources are used by biologists and chemists to develop concepts for combining molecules (synthesization) for the formation of new molecular entities, NMEs. If you can see a potential in NME, you go into a new phase, if not, the process could be rejected in this stage.

Preclinical trials

Preclinical phase involves collecting data to ensure that the safety is good enough and provide indications of the efficacy of the drug. The individual NME is first tested in the laboratory, then on animals. Most drugs do not come through this stage due to little or no effect at all on animals, frequent and serious side effects or that sort. If the drug is approved in these tests, an application is submitted to the authorities for approval for further testing. Often, researchers need to explore more components in this phase before it is relevant, to deliver an Investigational New Drug Application (INDA) so that development can enter a clinical phase that starts testing the drug on humans (Pisano, 2006). In Norway, according to the Regulation on Clinical Trials of Medicinal Products, an approval of an application from the Ethics Committee (which is subject to the Ministry of Health and Care Services) is in addition to approval from the Norwegian Medicines Agency before starting with clinical trials on humans. Success in all three clinical phases is a requirement for the US Food and Drug Administration (FDA) to approve the drug. FDA approval is essential for many drugs, as the United States is a major potential market.

Clinical trials

Clinical trials generally consist of three phases (Pisano, 2006):

Clinical Phase I

Testing on a small number of volunteers to obtain information about possible toxicity and dose size. The purpose is to conduct a small-scale pilot test to rule out that the drug is dangerous when used on humans. The sample may consist of healthy persons or affected patients depending on the drug. If the tests indicate that the drug is safe, clinical phase II may start.

Clinical Phase II

The drug is administered to a larger number of subjects (50-500 patients) determined from the field of action of the drug. This is to confirm safety, dosage and efficiency. If you experience success at this stage, you have better assessed the effect of the drug, in addition to being able to express yourself better whether the drug is safe or not. The phase usually stretches over one or two years and may include multiple phases to measure different dosages and drug types against each other.

Clinical Phase III

In Phase III clinical trials, large-scale studies are conducted, which increase the likelihood that the results are statistically significant and effective, as well as likely to detect possible (rare) side effects. Phase III is designed to describe applications for the drug after launch.

Regulatory permission

Authority assessment. If you find the results of the clinical trials good enough, you submit an application called "New Drug Application" (NDA). In the United States, the application will go to the FDA, while in Norway and Europe it will go to the Norwegian Medicines Agency and the European Medicines Agency (EMEA), respectively. Here the agencies will evaluate the various clinical phases and either accept or decline the application. When this application is approved, you can start marketing the drug and sell it.

Clinical Phase I-II-III can be shortened through different permissions. These are fast track, breakthrough therapy, accelerated approval, FDA priority review, which makes the regulatory course easier for those who get this [17].

After approval

While the drug is on the market, we look for new use groups and / or uses for the drug. Examples here are the modified dosage or further development of the product for use in children for example.

The increasing global competition that exists and the subsequent specialization needs of biotechnology companies often makes it impossible for these companies to be involved in all research and development stages. (Krattiger, et al., 2007)

estimates that around 60-80% of all drugs on the market were marketed or developed through alliances with other participants. In this chapter we will look into the various players the biotechnology industry consists of and their functions. Decision makers, payers, competitors and suppliers will be introduced in a later chapter.

Private operators

Biotechnology in the financial market and investors

New biotech companies need capital, which applies to all sectors. The development process for a drug often takes many years (10-15 years), and in this period a company needs long-term investors who are risky. Most often, it takes several years before an investor can expect positive cash flows from a biotechnology company. In return, the big uncertainty gives big profits to investors who are long-term and diluting equity can make the financing expensive. Venture capital is a process the biotechnology industry has gained from other industries. This is because venture capital has funded the start-up of new companies. This type of capital must be understood in two ways: it is a management function in these new companies and it finances seed. With that, venture capitalists do not only provide capital, they will also carefully monitor developments in the individual investment object. This is done through participation in the board and participation directly in the operation of the company. The reason for active involvement is to counteract asymmetric information and poor communication that can make financing even more expensive as investors want more paid for uncertainty. Investors have less knowledge compared to the company's own entrepreneurs about core business and control functions become the way venture capitalists outweigh the lack of knowledge.

Companies in this industry usually choose to enter into alliances involving joint research, development and licensing of a drug. Patents, licenses and other technology may be purchased or sold by other biotechnology companies. During the development phase of the drug, a biotechnology company will often have to enter into alliances with major pharmaceutical companies such as Big Pharma and, as previously mentioned, the agreement with Algeta (Bayer) [18]. The biggest factor for a collaboration is primarily funding, for example, that a

company in this industry is through emissions to finance the entire process to the market [19]. (Krattinger, et al., 2007) mentions that Big Pharma can also offer commercialization capabilities and clinical testing, which may increase the chances of a biotechnology company having the license rights to the medicine, and thereby the right to sell the drug on the world market.

It is safer to take positions (later in the development process) when there is scientific evidence of the extent of patient population that is relevant to and that the drug works. Based on these factors, investors can make their decisions on whether a biotechnology company can go from research milestones to business milestones. When a drug becomes evident, the company still needs to go through some practical factors. These may include upgrading production facilities, obtaining marketing approval, and launching the device for distribution. A market introduction in the biotechnology sector may fail as in all other sectors. But if the management [20] is good, a medium drug can end up being a success in the market. If you have a first-rate drug in the hands of second-order management this may end up in failure. These are the moments most investors have better prerequisites for making decisions than considering the potential in early development phases.

The company: Nordic Nanovector ASA

In this chapter we will give an overview of the company. We will start with an introduction to the company's history and work from the beginning of the last quarterly report (Q1 2018). In order to appreciate Nordic Nanovector it is necessary to present the company's research product that becomes part of our valuation later in the report. Not only is this important for the valuation itself, but also how this helps create value for owners and future patients. Hence, we will present the company's prospects before we will describe the drug Nordic Nanovector is working to get on the market.

Background

Nordic Nanovector was established in 2009 in Oslo. When Dr. Roy H. Olsen decided to leave Algeta in 2006, this was to research a new type of cancer medicine. Dr. Roy H. Olsen also received Professor Dr Jostein Dahle and Øyvind S Bruland through the company Inven2 AS. Invent2 The TTO function took over

the function of Oslo University Hospital and Radium Hospital in the 2000s [21]. Among other things, there is a portfolio of Ultimovacs, Photocure, Vaccibody, PCI Biotech, Oncoimmunity, Oncoinvent, Zelluna Immunotherapy, Nextera and Biomolex. Dr Larsen and Professor Bruland had previously co-operated (Algeta ASA), which successfully developed and launched Xofigo® (radium-223 dichloride) with partner Bayer AG for the treatment of adults with symptomatic bone metastases and castration resistant prostate cancer.

Although Nordic Nanovector is still seen as a relatively young company, much of the research is derived from basic research from the 1980s when the monoclonal antibody called HH1 was developed and documented. When the three founders decided to research a new drug, the aim was to develop Betalutin® for the treatment of lymphoma. Betalutin®'s first patent application was filed in 2010 in Norway and was later approved in 2011. The company's development began to accelerate in the years 2012-2013. In the ongoing Phase I / II trial in 2012, the first patient was included. Nordic Nanovector began to attract more capital in 2013 as acceleration in development as two private placements in 2013 increased by NOK 110 million.

Private placements increased further in 2014 by NOK 300 million and in H2 2014 followed significant changes in management. The same year, the most important event in the company's history was performed by the first clinical data at the American Society for Haematology (ASH) conference. By 2015, both the EU and the US were given the authorities the Payalutin drug, and there were several patents approvals for key markets (eg, UK, Japan and the United States). In March 2015, the company went public on the Oslo Stock Exchange and raised a total of NOK575m (before costs). A new statement was announced at the end of 2016, with 4,374,244 new shares being corrected, which corresponds to 10% of the company's share capital [22]. Since its establishment, Nordic Nanovector has advanced Betalutin® into clinical trials for treating the main types of refractory / relapsed NHL.

Company's work

The number of people suffering from lymphoma-cancer in Norway is around 900 each year and around the world one million. As of today, patients are treated with radiation therapy, chemotherapy or immunotherapy. Previous treatments show

that a targeting antibody attacks the lymphoma cells. One of the founders of Nordic Nanovector, Professor Øyvind Bruland at the Department of Clinical Medicine at the University of Oslo and Department of Cancer Treatment at Radium Hospital, said this in 2011 about the weakness of the treatment at that time. "The weakness of regular radiation therapy is that we do not know where all the tumors are. In addition, much of the fresh tissue is damaged." Bruland further points out that 40 percent get back the disease with today's treatment.

This can explain the company's work and the possibilities surrounding this cancer treatment. Promoting cancer care and meeting as mentioned above the large number of people affected by this type of cancer is the driving force behind Nordic Nanovector. By delivering innovative treatments, the company wants to be a leader within targeted therapies (hematological cancer). Nordic Nanovector's focus area is Non-Hodgkin's lymphoma (NHL), which is a haematological disease that affects the body's lymphatic system. Betalutin®, the product that is the company's leading clinical stage candidate, is a targeted antibody intended to develop treatment with CD37-targeted radionuclide conjugates. By 2024, this market with specialization around lymphoma may be worth about $ 20 billion [23], where Nordic Nanovector has a patent to year 2031 [23].

Strategy and goals
Vision and mission [24]:

With innovative precision therapies, the vision for Nordic Nanovector is too much an advantage in treating cancer patients. Men's mission is to improve and extend the patient's life with home-based cancer by commercializing and developing innovative antibody radionuclide conjugates (ARC).

Strategic Expectations [25]:

1. Primary focus on the clinical development of Betalutin® to achieve first regulatory filing in 3rd line FL, and in parallel to run additional trials in 2nd line FL with a combination of Betalutin® and rituximab.
2. Establish a development and commercialization plan for Betalutin® with the intent to deliver a differentiated target product profile that meets the requirements

of both regulatory and reimbursement agencies, while achieving a strong and competitive market position.

3. Leverage the company's proprietary technology and expertise to target challenging haematological cancers where the unmet medical need is high, such as NHL, acute myeloid leukaemia, chronic lymphocytic leukaemia and other B-cell malignancies, through focused investments in discovery research and strategic collaborations.

Targeting initial efficacy and safety data for Paradigme in 1H 2020 (previously 2H 2019) and targeting first regulatory filing in 2020. The reason for delay is due to the fact that the recruitment of patients and health authorities in Norway's approval to start the study has taken longer than assumed. Exploring ways to bring Betalutin® to patients faster, e.g. via fast track, PRIME and breakthrough therapy designation (BTD). Financial resources are expected to be sufficient until data read-out from Paradigme. At the same time they emphasize that expectations for Paradigme will not be published until they are secure on their data (Q1 Report, 2018).

The company today (organization and ownership structure)

The headquarters and laboratories are located in Oslo, Norway. Nordic Nanovector's management team currently consists of 9 members. The new CEO, Eduardo Bravo, who took over for Luigi Costa (April 4, announced the company's withdrawal from his position) in July 2018. Eduardo Bravo the role of more than 25 years of experience in the biotechnology industry. He has worked in TiGenix as CEO and with his experience as CEO, he has helped lead and develop and, not least, succeeded in leading a company to market competition in Europe with TiGenix. Among the others in the management team, Dr Lisa Rojkjaer is the chief medical officer. She has over 15 years of experience in clinical development of biotechnology, where she has extensive experience in developing both biological and small molecules in hematology and immunology. Remaining in the management team and other employees consists of 30 people in total, and here it employs staff with logistics to marketing areas.

Since the stock exchange listing on Oslo Stock Exchange in March 2015, the company has experienced a consequent growth both economically and with rise of employees and thus needed an expansion of operations. In the management team,

many have been obtained after going public at the Oslo Stock Exchange and the common denominator for all of them is that they have solid and long experience from the industry. Another common feature of the management team is the ownership of shares themselves. Mr Bravo holds a share of stocks representing a market value equal to three times his income, while the other members of the management team expect to have a stockholding around one to two times the market value of their salary in the company (Annual Report, 2017).

Betalutin®

Nordic Nanovector currently consists of a pipeline portfolio of various products for different pharma technological developments. The therapeutic areas for Nordic Nanovector are Non-Hodgkin lymphoma, Leukaemia and Multiple myeloma. The product that we will primarily focus on in the thesis is Betalutin®. Nordic Nanovector's lead clinical-stage product is Betalutin®, the first in a new class of ARCs designed to complement current options and improve upon for the treatment of non-Hodgkin's Lymphoma (NHL). Betalutin® is currently being evaluated for the treatment of relapsed/refractory follicular lymphoma (FL) and relapsed/refractory diffuse large B-cell lymphoma (DLBCL). These three cancer-types will we describe more in the next subsection in this chapter.

Non-Hodgkin's Lymphoma (NHL)

Lymphomas are tumors of the lymphatic system, and arise from lymphocytes. About 10% of the lymphomas are Hodgkin's lymphoma (HL), the rest are non-Hodgkin's lymphomas (NHL) [26]. In general, Non-Hodgkin's Lymphoma (NHL) is the tenth most common type of cancer and the most common type of blood cancer. Based on the five most populated countries in the EU and with the United States, there are approximately 150,000 patients with active NHL treatment. Worldwide of all cancers, this means that this cancer form consists of 4.3 percent of all cancers and 3.2 percent of all cancer deaths Annual Report, 2017). Microscopy is the difference between H1 and NHL, through detection of characteristic HL tumor cells. Several factors may include the latest World Health Organization (WHO) lymphoma classification when classifying the different lymphomas. These are the microscopic, clinical, genetic and immunological properties of the tumor. The categorization as the main groups of the WHO classification is by type of cell from which the tumor occurs and those mentioned

in the classification are further subcategorized. It is not only a WHO classification in NHL, but it is also categorized by growth pattern.

In addition to the WHO classification, NHLs are also generally broad categorized according to their growth pattern. NHL consists of two subgroups, aggressive lymphoma versus indolent (slow growing). Indolent forms have a much less weaker prognosis than aggressive forms of NHL, as it is possible to cure an aggressive NHL. Indolent tumors grow slowly, as they are complicated to treat and are generally not possible to cure. Exceptions exist, where an early diagnosis of follicular lymphoma (common form of indolent lymphoma) and primary treatment provides a possible cure.

Follicular lymphoma (FL)

The most common type of indolent lymphoma is follicular lymphoma (FL). It accounts for 17-22 percent of all NHL cases. This type is an indolent mature B-cell lymphoma, and is the most common form of NHL in the United States and Western Europe after diffuse large B-cell lymphoma. With diagnosis, the median age has been 63 years. Survival of FL used to be around 10 years, but after intake of monoclonal antibody treatment (rituximab) it has increased to 14 years. At present, it is an incurable disease that is characterized by alternating periods of relapse and remission.

With a slow disease progression (lymphoma indolent) the clinical outcome was very heterogeneous. However, in 10-70% [26] cases, the disease progression is rapid and lymphoma is transformed into a more aggressive form, usually DLBCL, associated with a poor prognosis. FL usually develops asymptomatic and is therefore often diagnosed at a late stage (stage III) when the tumor has already spread, often in the spleen, bone marrow and lymph nodes, or liver. Despite large treatment processes of various forms, FL remains largely incurable.

Compared to today's available therapeutics, there is today a need for effective new treatments with a more favorable toxicity profile. This is especially true in elderly patients who have already failed many previous treatment lines.

Diffuse large B-cell lymphoma

An aggressive form of NHL is, among other things, diffuse large B-cell lymphoma (DLBCL) which is the most common NHL subtype and accounts for

37-43 percent of all NHL cases. This disease is seen as curable, patients with retracted DLBCL have a poor prognosis. Here is a median survival of less than 12 months for those who are not eligible for stem cell transplantation. This is for Nordic Nanovector's second focus area and therefore something we will not focus on in this report.

Composition of Betalutin®

Betalutin® consists of two parts that have been merged together to function as a single drug. The parts are the monoclonal antibody, which are the connection between antibody and lutetium and the radioactive material.

The antibody

An important factor of the substance is the antibody. It is crucial for the entire drug since it differs from today's market under radioimmune products. With a certain protein portion directed to CD37, expressed on the surface of the lymphocyte. HH1 is the antibody called and has no cell kill effect, but more crucial as a transport mechanism to get the material (radioactive) to the right place in the body. The CD37 epitope is needed to express the cells on their overfalls by binding to the cancer cells, which was tested and published in 2013 (Dahle et al., 2013). Here, various subcultures of NHL were tested through HH1 in 2017 lymphoma biopsies. The results based on these tests indicated that 216 of the 217 samples in about 50% of cases expressed CD37. Based on this publication, this may show that CD37 is a valid target for NHL indications in most cases.

The radioactive material

This material emits beta radiation, and the most common types of radiation are called beta, gamma and alpha. The penetration depth of radiation and the amount of energy emitted are the main difference between the different radiations. Atomic nuclei are stable when attractive and repulsive forces are balanced. The attractive forces as well as the positive landings of protons derived from the repulsive forces help to make the strong nuclear forces between protons and neutrons. Generally, instability increases when there is an increasing atomic size. Unstable core loses energy by emissions of particles or gamma rays, and is classified as gamma emitters, beta emitters and alpha emitters (Nature Review Clinical Oncology. Vol.8 2011).

Short description of competing products:

Ibrutinib and Idelalisib are the two competing products that we believe Betalutin® will be benchmarked against if it reaches the market. We will briefly review their effectiveness around the product and their side effects. To get a sense of the clinical effect Betalutin® must have to be competitive on the market. Although it is risky to compare different clinical trials with each other in general, that's all we have here as there have been so few head-to-head studies in this segment of the market.

Ibrutinib

Marketed by Pharmacyclics Inc. and Janssen Biotech, Ibrutinib is a PKI approved drug of chronic lymphocytic leukemia (CLL) and mantle cell lymphoma (MCL) [27]. Ibrutinib was recently approved for Waldenströms makroglobulinemia (WM), a rare form of NHL. With high response rate in relapses or refractory MCL, as well as significant effects in other recurrent or refractory B-cell malignancies. The drug's properties make it possible for a daily oral dose. The approved main indication is MCL, and the NHL type may be aggressive or indolent.

Idelalisib

Marketed by Gilead is Idelalisib is a drug that inhibits the PI3K 8 isoform. The drug is active in more than 90% of lymphatic cell lines and determinative for B-cell signals. Idelibialib, like Ibrutinib, is given daily orally to unacceptable toxicity or disease progression. Idelalisib was co-administered with a combination of ritximab to CLL patients who were not eligible for cytotoxic therapy (Cheah, Fowler, 2016). This study, for the rest, stopped in Phase III due to significant efficacy alone with Idelalisib. Similar to Betalutin®, Idelalisib has received FDA approval as a second reading for CLL based on its results.

Outlook:

Through this chapter we have provided a good description of Nordic Nanovector and the product Betalutin®. With fast track approval and Paradigme starting with the first patients, the future looks promising for the company. With the approval of the FDA in the United States, Nordic Nanovector has great opportunities to reach a global market if the company gets market approval. DNB (DNB Markets

Analysis May 30, 2018) estimates a global average price of USD 150,000 for Betalutin® with all indications. As Ludvik Sandnes, Chairman of the Board of Directors, points out, it is the United States representing the largest market, and of course, it is a priority to identify this market first for commercialization (Annual Report, 2017). As mentioned, a few competing comparable drugs that imply that it is critical for Nordic Nanovector to continue the development of the product in the future. Since this is a very low-fat market today, it's crucial to be out there, as it is nearby to believe that the first one will take a large market share in the lymphoma market. NHL is an indication of significant incomplete medical needs, which represents a growing market prospect worth 20 billion dollars by 2024 (Annual Report, 2017). Nordic Nanovector intends to retain marketing rights and actively participate in the commercialization of Betalutin® in core markets.

The downside risk (DNB Markets, 2018) is that there are more delays as mentioned earlier where it was postponed from H2 2019 to H1 2020. Not least, there are several other competing biotechnology companies that have focused more attention on NHL. At the same time, it is expected that the time for approval in the market will take longer than previously assumed. Future prospects for Nordic Nanovector nevertheless seem promising. For example, the company may be purchased by a Big Pharma company where both Roche and Bayer have been linked, but there is also a collaboration possible with other companies. Considering that you still do not know the outcome of both dosage and results from Paradigme study to Betalutin®. And since the phase II study has not yet been completed, there is still some uncertainty associated with the product. Mr Sandnes also points out that "It was particularly encouraging to learn that customers across all prioritized segments can clearly appreciate Betalutin®'s range of benefits and the value it can deliver to the NHL space."

Valuation theory and choice of method

Introduction

There is no such thing as an universal agreement on the notion of valuation, and it should therefore come as no surprise that numerous valuation frameworks have been produced over the long history of economics. We will therefore in this chapter make use of Damodaran's (2012) classification in order to present the

most important of these frameworks, and ultimately explain why we have chosen to use real options valuation for this thesis. In line with this classification, there exists a total of three umbrella terms, namely discounted cash flow valuation, relative or multiples valuation, and contingent claim or real options valuation. Each of these methodologies will be explored in greater depth below, however multiples only briefly, because we find it necessary to confine the scope of the thesis.

Valuation frameworks

The traditional discounted cash flow approach

Common to all discounted cash flow models is that they are all based on cash flows in and out of the company, and the value of the asset of interest is not what someone perceives it to be, but rather an objective number or intrinsic value that can be calculated. This value is found through plotting the cash flows that the asset is expected to generate, and discounting them back at a rate that reflects the riskiness of the cash flows, ultimately yielding us the net present value. However, the models are differentiated by how the cash flows are being discounted, and within this framework there are several valuation techniques (Damodaran 2006). Furthermore, this framework is also the foundation on which all other approaches are built. In order to correctly apply a multiples approach, we must be able to comprehend the fundamentals of the discounted cash flow valuation. For real option models, the first step is often to do a discounted cash flow valuation in order to obtain an estimate of the project without flexibility. Consequently, understanding the DCF approach allows us to analyse and use the other approaches (Damodaran 2012), and it is therefore of utmost importance to explore it in greater depth.

Discount rate adjustment models

This is the most popular and used method by far within this framework, where we discount expected cash flows at a risk-adjusted discount rate. I.e. we use higher discount rates to discount expected cash flows when the assets under scrutiny are deemed riskier, and vice versa for safer assets (Damodaran 2006). Moreover, this framework consists of two approaches that both should yield us the same result if conducted properly with consistent assumptions (Damodaran 2012). Firstly, we have the enterprise DCF valuation (from now on referred to as the EDCF), in

which we value the entire company as a whole, and thus have to subtract the value of debt and other non-operating assets in order to obtain the equity value.

Common equity = TEV0 - Value of debt - Value of non-operating assets
 Where:

$$TEV_0 = A_0 + \sum_{t=1}^{T} \frac{FCF_t}{(1 + r_{WACC})^t} + \frac{TV_T}{(1 + r_{WACC})^T}$$

Where:

TEV0 = Present value of the total enterprise value

A0 = Redundant assets

FCFt = Free cash flow in period t

TVT = Terminal value computed in period T

rwacc = The weighted average cost of capital

Secondly, we have the equity valuation model (from now on referred to as the CFE), which rather value directly only the equity portion of the company.

$$S_0 = AE_0 + \sum_{t=1}^{T} \frac{FCFE_t}{(1 + r_S)^t} + \frac{TVE_T}{(1 + r_S)^T}$$

Where:

S0 = Present value of the equity value

AE0 = Redundant assets to equity

FCFEt = Free cash flow to equity in period t

TVET = Terminal value of equity

rs = The cost of equity

As illustrated from the models above, we can see that the procedures for both methods follow the same logic and are almost identical. They are only differentiated by how the cash flows and discount rates are calculated. The EDCF model discounts the free cash flow available to all investors at the blended cost of capital, the WACC, while the CFE however, and discounts the free cash flow available to only equity holders at the cost of equity, which is often obtained through CAPM (Koller 2015). Other than that, both methods follow the same two step procedure of estimating two separate but yet additive valuations. In the first step all estimated cash flows for the foreseeable future are discounted back to the present value using appropriate rates, and added together to account for the

valuation of the explicit forecast period. In the second step a terminal value is calculated, which is a value that represents the company or asset value from the end of the explicit forecast period too the end of the company's life cycle. This second step and estimation of a terminal value rests on the assumption that the company has entered a steady state, thus growing at a constant rate, allowing us to apply Gordon's growth formula (Koller 2015).

$$TV_T = \frac{CF_{T+1}}{r - g}$$

Where:

CF$_{t+1}$ = The free cash flow we expect the firm to generate in the last period of our forecast

r = The risk-adjusted discount rate

g = The growth of the free cash flow

Koller (2015) recommends that the EDCF should be used in general. This is because the CFE valuation mix together operating performance and capital structure in the cash flows, increasing the likelihood of implementation errors. However, the CFE should be used for valuing financial institutions, due to the capital structure here being an inextricable part of the operations. Moreover, discounting all future cash flows at a constant WACC entails the implicit assumption that the company manages its capital structure to a target debt-to-value ratio. This may lead to biases and erroneous results for companies that have fluctuating levels of debt. Although the EDCF model may be adjusted to account for this problem, the process gets more complex (Koller, 2015), meaning that the CFE should be more favourable to use in such a scenario.

The adjusted present value model

An alternative to the models above is the adjusted present value model (hereafter APV). This model is equipped to deal with the fluctuating target debt-to-value ratio problem, through valuing the effects from debt financing on company value separately from the equity company value. Consequently the model consists of two steps. In the first step we value the company as if it were all-equity financed, by discounting the free cash flow by the unlevered cost of equity. In step two we estimate and add any value created by the company's use of debt, e.g. tax shields, subsidised loans etc (Koller, 2015).

APV = Unlevered company value + Present value of tax shields

$$APV_0 = A_0 + \sum_{t=1}^{T} \frac{FCF_t}{(1+r_U)^t} + \frac{TV_T}{(1+r_U)^T} + \sum_{t=1}^{\infty} \frac{E(\text{interest tax-shield})}{(1+r_?)^t}$$

Where:

r_U is the cost of equity for an unlevered firm

The last sum on the right hand side is the present value of the interest tax shield

$r_?$ is the companies appropriate cost of debt

The intuition behind the model is that we consider how the net effect of adding debt will alter the overall company value in either direction away from the base unlevered value scenario. I.e. the starting value represented by the all-equity financed firm, may increase or decrease dependent on whom of the benefits or costs associated with the debt will turn out to be greater (Damodaran, 2006).

Strengths and weaknesses of the DCF model
The main advantage of the model is that it relies solely on the flow of cash in and out of the company, rather than on accounting-based earnings (Koller, 2015), which entails that the model is not as vulnerable or prone to the applied accounting conventions (Mun, 2006). This methodical estimation of firm value based on future cash flows also leaves little room for prevailing market sentiments (Gupta, 2002). E.g. the model will generate the same results regardless of risk preferences of investors (Mun, 2006). However, a great weakness of this method is that it is built on the implicit assumption that the projects outcome is already known with certainty at the time of the valuation, and wont be affected by future decisions (Brandao 2005). I.e. the method considers investments decisions as an all or nothing investment, thereby ignoring the possibility and value of managerial flexibility (Mun, 2006). As a consequence, applying a DCF on a pharmaceutical company early in its life-cycle, runs the risk of significantly undervaluing the company, because most of the expected value is derived from their pipeline products who's value stems from flexibility, and is in the form of a growth option (Banerjee, 2003). Moreover, not accounting for the value of flexibility in investments may distort the investment portfolio of investors. Because of the DCF approach's inability to account for the value of flexibility, it naturally favours short term projects in relatively certain markets over long term projects in uncertain markets (Lint, 1998). Another disadvantage is that the model is very

sensitive to its underlying data, meaning that it requires a certain knowledge from the user. E.g. if the user is not capable to generate a reasonable discount rate, the model may generate unreasonable results.

Relative valuation

Damodaran (2006) explains the principle of relative valuation, also known as multiples, as the estimate of the value of an asset or company by looking at the pricing of a comparable asset relative to a common variable. E.g. if we know the that the enterprise-value-to-NOPLAT multiple (the common variable) for similar companies in the industry is 8 times, and that the NOPLAT (the comparable asset) for our company of interest is $120 million, we can easily find our company value through multiplying 8 by $120 million. This gives us an estimated enterprise value of $960 million for our company. I.e. we value an unknown by the notion that similar performing assets in the same marketplace should trade or sell for the same, and that by observing how these similar assets are priced in the market we should know the value of our asset (Koller, 2015).

An obvious advantage of this method is that it is pretty simple and quick to apply compared to the two other frameworks. An issue however, is that the method estimates values relative to other values, and not absolute values, which entails the risk of nonsensical results if the industry multiple in itself is skewed. E.g. if there is an industry bubble where companies are overvalued relative to their cash flows, then the estimated company value will also be overvalued and useless for long-term stakeholders (Koller, 2015). Another problem is that the method requires comparable companies, which often might be hard or not possible to find. E.g. a newly established pharmaceutical company that develops a new drug that the market have never seen, will be specialised in a very specific segment. This segment might be poorly researched and as a consequence have few to none competitors. Thus, the closest companies might be operating in a different segment, rendering a relative valuation rather inappropriate.

Real options valuation

Theory

A real option is defined by Kodukula and Papudesu (2006) as follows:

"A real option is a right — not an obligation — to take an action on an underlying non-financial, real asset. The action may involve, for example, abandoning, expanding, or contracting a project or even deferring the decision until a later time". Damodaran (2012) adds that: "an option is a claim that pays off only under certain contingencies". This means that this method interprets the whole project and its inherent flexibility as an option on the underlying cash flows generated, and that we value this option through the option framework.

The real options method is founded on the realisation that financial options and real investments share a great deal of common ground, allowing the method to utilise financial option theory. The most important similarity being that the payoffs from a real asset investment also stems from the value of an underlying. Furthermore, just like a financial option gives you the right, but not the obligation, to take an action with regard to the underlying, an initial investment in a real asset gives you discretionary rights as an owner. Given the progress of your project in which you invested, you can freely choose whether to continue, abandon, expand etc. Your ultimate decision is governed by the projects development and contingent value, giving the process an option like nature. Moreover, some real investments are continuously assessed, just as an American option, meaning that the option can be exercised at any given time before or at a predetermined expiration date. While other investments are only evaluated at predetermined dates in the future, like an European option, meaning that the option can only be exercised at the predetermined future date (Kodukula 2006). As a consequence to these close ties between financial options and real investments, we can portray these investments and projects as real options, and use the option theory's taxonomy. In which we can value the real option as a call option if the projects value exceeds the predetermined strike price, and on the other hand as a put option when the option gains value when the project value falls below the strike price (Damodaran, 2012).

However, there are a couple of differences between financial and real options that can make the option valuation process of a real asset more challenging. The first being that information needed to value and decide whether to exercise the option is generally more readily available for financial than real options. The second being that the option terms are often more clear cut for financial options, and

more ambiguous for real options. E.g. a holder of a given financial option on a company might have the right to buy some number of shares for a predetermined price up until a fixed date. On the other hand, it is a lot harder to determine what explicit right the real options gives you, and when it will expire (Copeland, 2004). In general, we can say that these differences stems from the way they are being traded and what claim they hold. The financial options gives you a right to buy an asset in a liquid market, while real options gives you a claim to a business opportunity that generally is not traded.

Value drivers

As is the case of a financial options, real options derives it value from a total of six parameters (Koller, 2015; Perlitz, 1999). These are the parameters that determine the flexibility of any option, and are therefore the inputs that must be retrieved. However, some of these inputs are not retrievable from the company's accounts, nor can we expect to acquire this classified information, meaning that we must estimate them ourself through best guesses.

The underlying asset: In real option theory, the underlying asset consists of the gross present value of the expected cash flows. Naturally, higher projected cash flows increases the flexibility value and consequently the value of the option, ceteris paribus. For NANO, the underlying will be the expected cash flows from the new medical treatment offered by the firm.

The exercise price: The exercise price for a real option is the present value of the investment cost. A higher cost for exercising the option reduce the option value, and vice versa for lower costs. The payoff of the option is defined as the difference between this strike price and the value of the underlying cash flows.

Time to expiration: This is the time left until the opportunity to invest disappears. The option value increases with time to maturity, because you have more time to explore and learn about the uncertainty, which subsequently gives you more pathways and greater flexibility.

Risk: This is the volatility of the present value of the cash flows, denoted by the standard deviation. More uncertainty increases the option value, because it

becomes more likely that the cash flows exceeds the strike price. It is however true that for symmetric volatility, which the probability for negative outcomes should increase as well. But because we are dealing with an option, we choose not to exercise when this is the case, rendering the negative effects inferior to the positive effects.

Dividend payments: Within the realm of real options, this parameter is referred to as cash flows lost to competitors, i.e. payments lost through waiting to invest. Losing more cash flow because we are choosing to deferring an investment naturally decreases the value of our option.

The risk-free interest rate: A higher interest rate increases the value of our option, because the time value of deferral increases. I.e. if you are to lend the money intended for investment, you can now earn a higher return than previously, effectively raising the value of deferral. However, higher interest rates might also reduce the present value of the underlying cash-flows.

Classification of real options

A pharmaceutical biotechnology company faces a lot of step-wise decisions as their project progresses on, rendering the nature of their flexibility as changing, complex and contingent on multiple real options, rather than a single one. This sequential progression also entails that the value of a real option may be dependent or affected in some way from the administration of the preceding one. It is therefore essential to know what type of options we are dealing with, and how they might influence our valuation, in order to get a precise company value. According to Koller (2015), we have the following classification of real options:

Option to defer investment

This is the option to defer an investment until the present value of the underlying rises above the development costs (Koller, 2015), or the uncertainty in the future cash flows has diminished as time progresses on. If or when the expected payoffs from the project is greater than the investment, the decision will be to make the investment at this very time, otherwise no investment will be made (Kodukula 2006). This is therefore financially equivalent to a call option.

Abandonment Option

The company has the choice to shelve their project if the present value falls below its liquidation value (Koller, 2015). This option has the characteristics of a put, because the contingent decision of exiting the project is exercised when the expected payoff falls below the salvage value (Kodukula, 2006). Generally, a firm has this option throughout the entire life-time of the project, meaning that this option drastically may effect the value of any other contingent decisions.

Compound Option

A compound option is the option of investing in stages dependent on performance, and it is therefore a series of options on options. Exercising a compound option generates another, effectively making the value of the options contingent on each other (Kodulula, 2006). We may therefore think of investing in a new drug as one large compound option, due to the step-wise development process.

Option to expand or contract

This is the option to rescale the magnitude of the project depending on its performance. If test results are superior to expectations the company can expand the scale of the project, and conversely, if the test results are poor, opt to reduce the scale (Trigeorgis, 1993). The strike prices are the investment cost for expansion and contracting respectively, and the option to expand would be exercised if the expected payoff exceeds the strike, and the option to contract would be exercised for lower expected cash flows than the strike. Thus, the option to expand has the characteristics of a call, while the option to contract has the characteristics of put (Kodakula, 2006).

Option to increase scope (growth option)

As the company gains knowledge and acquires a network through developing and launching a new drug, this paves way for potential new opportunities in the future. E.g. access to new markets, production of interrelated products etc. (Trigeorgis, 1993). These have the characteristics of call options, because they will be exercised if the expected cash flows generated exceeds the estimated investment costs.

Switching options

This is referred to as the ability to switch between alternative inputs and outputs (Trigeorgis, 1993), or the ability to turn the operation of a project on and off (Koller, 2015). An option of this type may for example be the right to switch between suppliers, dependent on their different quoted prices.

Real option valuation techniques

According to Kodakula (2006), we have a total of three commonly applied techniques used to obtain real option values: Partial differential equations, simulations, and lattices. The partial differential equation allows us to solve real options valuations by the use of formulas, given a certain set of input assumptions, of which the well renowned Black & Scholes equation is the most used:

$$C = S \cdot N(d_1) - e^{-r \cdot T} K \cdot N(d_2)$$

Where:

$$d_1 = \frac{\ln(S/K) + (r + 0.5\sigma^2) * T}{\sigma\sqrt{T}} \quad , \qquad d_2 = d_1 - \sigma\sqrt{T}$$

C = value of the call option, S = Current value of underlying asset, K = Cost of investment or strike price, r = risk-free interest rate, T = Time to expiration, σ = the annual volatility of future cash flows of the underlying asset.

In general, this method is relatively straight forward, and consists of identifying the input data listed above, which is the hard part, and then simply solving the equation, which is rather easy. However, the method's assumptions are first and foremost created to fit the field of financial options theory, with the unfortunate realization that many of the assumptions made simply do not carryover for real options. Most of the assumptions are violated when applied in the real world, thus inducing poor performance when applied in the context of real options valuation (Brach, 2003). Due to the questionable suitability of this method, we choose to not elaborate any further on this topic, as we feel that a utilization of this method requires expertise that reaches beyond the scope of this paper.

In technique number two, we simulate a whole host of scenarios with differing values the underlying might take during the option's lifetime, yielding us a distribution of future values. Given this probability distribution of the underlying, we can calculate the expected future value the underlying will take at the expiration date of the option. We are then able to use this value in our calculations of the real options value, by comparing each expected end value of the underlying too our strike price. E.g. for a call option, we would exercise the option if the end value of the underlying is higher than the strike, and the value of flexibility would be equal to the difference of the two measures. Vice versa, a higher strike price than the end asset value will lead us to not exercise the option, and the flexibility value will be zero. We then proceed by discounting back each of the attained flexibility values by the risk-free rate in order to get the present value of the generated numbers. Finally, the average of all these discounted simulated values is the flexibility value for the project, which are to be added to the estimated standard NPV value.

Binomial lattices involves picturing the underlying's development in tree like figures, where each node represents the underlying's value for a given point in time. The connecting lines between the nodes represents the time increments between the points in time, and it's over these periods the underlying's value changes. An important assumption of the model is that the underlying may take only two values over the time increments. I.e. for the next period, the value of the starting node goes either up or down only. The end nodes of the model depicts the range of asset values the underlying may take at the end of the option's life, which we can use in combination with the strike price to calculate the real option's possible exercise value.
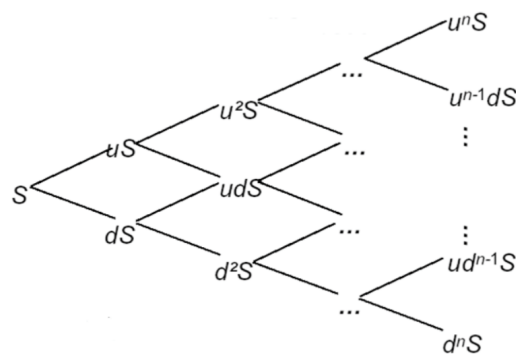
We can find the solution of this method in two ways, either through risk neutral pricing, or through the market-replicating portfolio approach. Both methods, when executed properly, will yield the same result (Mun, 2006). Regardless of the approach, we have to use backward induction when solving lattices. I.e. we start with the ending values, and work our way backwards in the tree all the way until we reach the starting date for our valuation. We would, however, recommend the use of the risk-neutral pricing technique, as the method of replicating portfolios is more difficult to understand and apply. Moreover, for real options, it's harder to find other assets in the market that can be obtained to replicate the projects payout profile (Mun, 2006). The risk neutral probability is found from the following formula:

$$p = \frac{(1+k)^T - d}{u - d}$$

$$u = e^{\sigma\sqrt{T}} \qquad\qquad d = \frac{1}{u}$$

Where:

The method finds the option value of the former node by multiplying the value of the up node with the risk-neutral probability of an upward movement, and multiplying the value of the down node with the risk-neutral probability of a downward movement. The resulting two values are then added together, and discounted at the risk-free rate. The method can be summarized as follows:

$$\text{Option} = \text{Max} \frac{(p * \text{Value}_u + (1-p) * \text{Value}_d)}{1 + r_f}$$

Mun (2006) further claim that the lattice method are easy to implement and can solve all types of options. This is in contrast to simulations and the Black & Scholes model, which are only able to solve relatively simple European options, and at best yield us approximate values of American and more exotic options. Another advantage is that lattices and the generated results are easily communicated to others, while the Black and Scholes model, however, is considered as a black box, meaning that the actual process is a bit of a mystery. Lattices do, however, require a great deal of computational power and complexity, because the precision of the models increase as a function of number of steps

added. Nevertheless, the lattice method should be preferable because most real options are generally not considered as being European, but rather American.

Choice of method and outlining the valuation process

According to Banerjee (2003), a company's value depends primarily on the value of its current operations and the value of future growth options, of which current operations accounts for the growth of current operations, and the future growth option denote the expected value from pipeline products and flexibility. Similar to most research driven companies, NANO's value is almost entirely captured by the expectation that their research will generate significant cash flows in the future, and that the company has great flexibility during the process. I.e. NANO's value is primarily in the form of a future growth option, and the value generated from current operations is rather insignificant as of now. Hence, applying a traditional DCF model, only capable of capturing the value of the current operations, will grossly underestimate the value of NANO and potentially yield a negative NPV. We therefore find it necessary to utilize the real option framework instead, because its fundamental premise is to overcome the underestimating of traditional models when payoffs are contingent on eventualities (Damodaran, 2012). It is, however, important to note that the real options framework is not created or thought of as a replacement, but rather as complementary to the traditional DCF model. This is illustrated by a DCF valuation often being the first step in a real options valuation, making up the base value to whom the value of flexibility is added. Consequently, we must carry out both methods in order to obtain a reasonable valuation.

According to Koller (2015) and Copeland (2002), a valuation of a company with inherent flexibility should follow a four-step process:

Estimate NPV without flexibility → Model uncertainty in event trees → Model flexibility in decision trees → Real options analysis/estimate contingent NPV
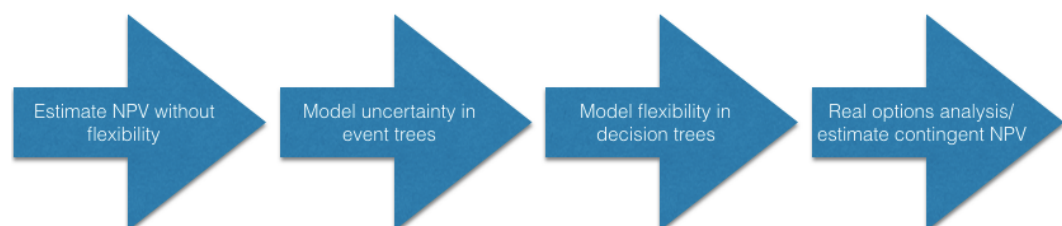
Step 1: Estimate NPV without flexibility:

The purpose of this step is to estimate the NPV of all the projects to be included in the analysis without flexibility. This is done through the use of the traditional DCF models discussed previously in the chapter. It is important to note that if we are to value multiple projects, then the valuations should be conducted separately.

Step 2: Model uncertainty in event trees:

In this step we map how the value of the project will evolve over time, by using unadjusted probabilities and an appropriate cost of capital. This is done to create an understanding of the underlying's development with respect to changing uncertainty. Still, the model does not include flexibility, meaning that the present value of the project, found from discounting the cash flows in the event tree, should equal the standard DCF value found in step 1.

Step 3: Model flexibility in decision trees:

The intention of step 3 is to turn the modelled event tree from step 2 into a decision tree, by identifying and incorporating the types of managerial flexibility that are available. This step therefore determines which of the project specific options we want to include in the real options analysis, and their pecking order. I.e. in the case of multiple possible options, we must prioritize between them. Now, analyzing the decision nodes gives us "updated" node-specific information of the underlying, combined with an overview of the available flexibility. Ultimately, this allows us create a road map of every possible action and outcome.

Step 4: Estimation of contingent value:

This is the final step in which we estimate the value of the project with flexibility. This is done by backward induction, i.e. working backwards in the decision tree, using either the replicating-portfolio method or risk-neutral pricing at each node.

Mun (2006) proposes an alternative process, which constitutes of eight steps. The process is actually quite resemblant of the four-step method outlined by Koller

(2015), but provides a more detailed walk through of a real option analysis. We have therefore opted for the latter methodology.
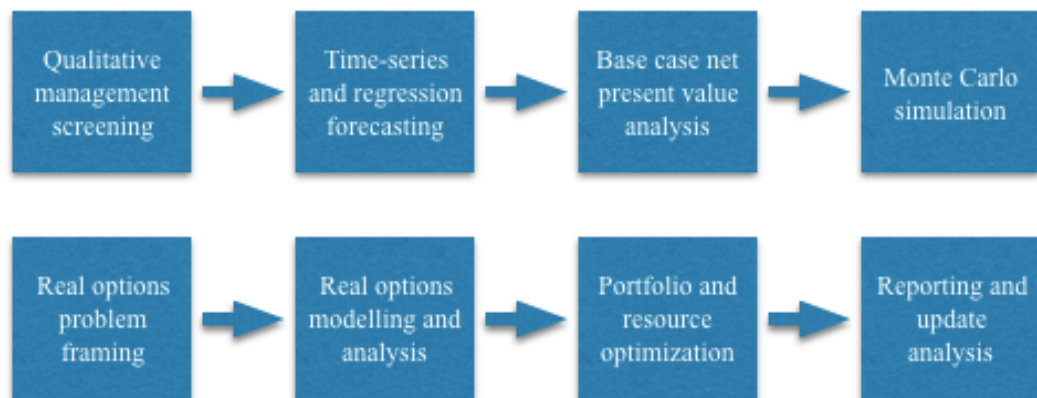
Step 1: Qualitative management screening

This step comprises of deciding which projects, assets, initiatives or strategies to pursue for further analysis. Betalutin® is really the only actual project Nano currently work on, so this step won't be necessary in our analysis.

Step 2: Time-series and regression forecasting

The goal of this step is to forecast the income statement and the future free cash flows. This will be done as a part of step 3 when we calculate the base case net present value, and step 2 and 3 of this process will thus be combined.

Step 3: Base case net present value analysis

Here we calculate the value of the company through the traditional dcf model. I.e. we utilizes the created forecast of free cash flows, and discount these at an appropriate rate. This step is identical to the procedure outlined in Koller (2015)'s first step.

Step 4: Monte Carlo simulation

The future cash flows of the company relies on numerous future factors that are highly uncertain. The static DCF in the previous step assumes a single determined value for each such factor, and produces therefore only a single-point estimate. As a consequence we cannot put too much confidence in the results. In order to obtain more accurate and realistic estimates of the NPV, we should run a Monte Carlo simulation on our static model. The Monte Carlo simulation allows the

creation of thousands on thousands of possible future scenarios, creating a more realistic and true NPV value.

Step 5: Real options framing

Based on the process so far, this step is concerned with disclosing what type of options the company potentially faces or may have at their disposal.

Step 6: Real options modelling and analysis

At this stage, the volatility of the base case value and the actual estimated value from the Monte Carlo simulation, is used alongside other variables as input data in our real options model. The real options analysis is then run in order to obtain the company's strategic option values.

Step 7: Portfolio and resource optimization

This step is optional, and is only possible for companies that have performed real option analysis on several projects. The idea is that we should review the real options analysis of each project as a combined portfolio, and make decisions from a portfolio maximizing perspective. I.e. the analysis may reveal correlations between the projects that may be used to enhance the overall value.

Step 8: Reporting and update analysis

It is also important to report the results of the analysis in a way that other relevant people can understand, and as time passes by, revisit and update the analysis when the uncertainties becomes certainties. However, we believe that this step reaches beyond our defined scope, and consequently disregard it for the remainder of the paper.

Strategic analysis

In a valuation, different scenarios with future cash flows will be prepared. For Nordic Nanovector in this process, a variety of input values will be determined, such as price, cost level and market penetration. To provide the most accurate estimation of these factors, it is necessary to map the company's strategic position. The strategic position seeks to identify the micro and macroeconomic factors that lay the foundation for the investigation later in the valuation. In this chapter,

relevant micro factors will first be analyzed using the SWOT framework. Thereafter, an analysis of the industry follows Porter's five powers (Porter, 1979). Finally, relevant macro-factors will be analyzed through a PESTEL analysis being presented.

SWOT framework

Nordic Nanovector's strategic position will be formed using the SWOT framework. This framework summarizes the company's internal business factors such as strengths and weaknesses. The company's external factors are presented as opportunities and threats (Kotler, 2008). The framework contributes to affecting Nordic Nanovector's value (Johnson, Whittington and Scholes, 2011). In an internal analysis, the goal is to identify the resources a company possesses, as well as to assess whether the company utilizes these resources in the best possible way. First of all, the resources influenced by a company have the strategic choices that the company takes. Thus, in many ways, resources can be seen as strategic capacity, where capacity affects individual resources but also an entire organization which can be crucial (Roos, Van Krogh, Roos, & Fernström, 2005). The SWOT framework is presented in key words and a brief summary follows in the end as the other analyzes go deeper into each area.

Strengths:

- The company's technology is patented and the company is predominant in this area until the patent has its expiration date.
- Good capital structure.
- "Management is competent and has experience from the industry, while large parts of the management team have been involved in processes previously with market launch.
- Fast track status at FDA.

Weaknesses.

- Continued great uncertainty as to whether the product reaches market launch.
- High labor costs
- Just picked up new CEO.

Possibilities:

- Great potential for Betalutin® as this market is not yet saturated.

- Can become a first-class player into the market, therefore creating benefits by adding to some extent its own price in the market.

- The users (patients) are makers and not the payers.

Threats:

- Competition from the above products that can determine whether Betalutin® is either on the market or not.

- More postponements and can thus lose the chance of being a leader in the NHL market.

- Technological development and research can provide new solutions.

Nordic Nanovector's strategic position at a micro level has been clarified in key terms at the SWOT framework. The framework presents essentially the possibilities that are found, with great potential if Betalutin® reveals good results in the next few years (phases). With skilled and experienced people in the staff, everything is in place to reach the goal of launching Betalutin®. While they have completed issues with the years, they have also accumulated enough capital to continue the development. Patents on the product do not expire until 2031, which can generate money in the billionaire class and large market share.

On the other hand, a postponement will increase the likelihood that other products will launch before Betalutin® and that a distribution of the market will destroy some of the potential currently in the international market. At the same time, it is important to note the importance of good management, where the new CEO is reliant on communicating well with investors and creating peace in their own rows. At the moment, the new CEO is seen as a weakness when a newcomer to the top in such a critical phase can create turmoil in the market. This can, however, change quickly and is also likely to happen, with his history and long experience in the industry. The most important thing is anyway, the sooner you reach the market, the greater the chances of earning money and bringing in market shares.

Porter's five powers

Profitability in an industry can be analyzed by a framework of five powers developed by the well-known American professor Michael E. Porter (1979). The five forces are bargain powers from buyers and suppliers, threats from substitutes and potential newcomers as well as rival competitors in the industry. An update of this framework was made in recent times (Porter, 2008) and this is the framework that will be the starting point for industry analysis. It is expedient to conduct an industry analysis in a valuation process as it can help understand drivers for profitability and how drivers can create value and influence the company. The internal analysis (SWOT) was presented in key terms, the structure around this framework will dig deeper into each area and therefore not a final summary.

Bargaining power of buyers

Due to the fact that the customers concern both private and public hospitals, while Nordic Nanovector has a special product, the negotiating power among buyers in this industry will be relatively high. This also applies to other public institutions such as Radium Hospital. Since it can quickly become few and large (quantum) buyers, buyers can utilize their negotiating power to achieve lower prices. This is a normal approach, among other things, from the authorities that use this power at significant price reductions. In the US, on the other hand, this is more difficult because there is no controlling agency for pricing in the industry. This gives lower negotiating power since there is no cost benefit relationship in the national unit. Another factor that can increase the negotiating power is the product's patent expiration. When this expires, one will be further exposed because competing manufacturers will have lower costs associated with the actual development of a product and thus push down the price in the market. Based on the above-mentioned points, the negotiating power of buyers is characterized as high in the industry.

Bargaining power of suppliers

Licenses, factories and researchers teams have looked at some of the largest suppliers in the industry, influencing production. A supplier of sales, market, financing and development, more specifically a partner can be considered as a supplier. The intellectual values associated with capital as well as high labor costs make the industry considered capital intensive. Given that the costs associated

with these points around suppliers do not apply to Nordic Nanovector, the supplier power is seen as low in the industry.

Threat of new substitutes

Porter (2008) describes a substitute as a similar or same function as the industry's product, but with a different process. The threats are therefore about scientific drugs that can solve a potential cancer mystery or that can improve a patient's life. Drugs that do not prolong the lifespan among patients are also seen as a substitute, as do alternative treatments. This helps to create limitations for market penetration and price levels. Substitutes are a threat to Nordic Nanovector to the highest degree. Based on performance and price, patients covered by government treatments include high performance demands. As no-one in the market has not yet found a real cure for NHL patients, threats are considered too be low. Should other competitors work in conjunction with different substitute products or treatments, however, the threat may increase significantly. A possible launch of such a product could lead to the hijacking of large market shares in a short period of time.

Threat of new entrants

It requires large investments to develop a new product and get it through the various clinical phases. An industry that is also so capital-intensive is the entry barriers high based on the complex market surrounding the NHL. Neither will it be a wise decision to start a similar drug after, for example, a product that has no patent, due to the distribution channels and already established facilities associated with production. The reason for this is also that established companies will have the advantage of delivering cheaper products. At the same time, a consequence as mentioned earlier in the chapter will be pressures on prices when a patent expires. It is thus seen as a low probability of threats from potential newcomers in the industry.

Rivalry among existing competitors

New products, quality improvements and price reductions are all reasons for rivalry (Porter, 2008). Competition among existing competitors is strong due to the continued growth of the industry. Researchers are always on the lookout for new methods and technologies. The growth in the number of NHL cases is increased in parallel with higher life expectancy and population growth in the

world. The industry is also exposed to cooperation agreements and acquisitions, which can create stronger powers among competitors both financially and technologically. As mentioned earlier, a major goal for Nordic Nanovector is to come first on the market. Either way, being the first to market can not only create major market shares. If competing products will reach market launch within a few years after Betalutin®, these can operate at lower prices and create strong rivalry even with two products on the market. Today there is a limited number of competitors in the market, where the market would call it an oligopolistic market. The number of competitors thus limits some industry's rivalry.

PESTEL analysis

A PESTEL analysis is a review of six different macro conditions that affect the company's macros, both in the short and long term. The purpose is to summarize which of these environmental factors are of the utmost importance to the company in the short and long term (Johnson, Whittington and Scholes, 2011).

Political factors

There are very strict regulations in the biotechnology industry. The company has good practices in complying with statutory procedures so that they are not particularly exposed. A possible amendment may lead to a significant increase in costs, but there is nothing short or long term that indicates this.

Economic factors

All activities related to production and distribution in the company are outsourced, so it is important that the company has strict requirements when it comes to quality, safety and how their activities affect human health, or it can adversely affect the company's value.

Social factors

In the short term, social factors do not have any impact on the company, but in the long run it will have an impact on the company's turnover. In 2-3 years from now on, for example, the world's population will increased even more, which will typically lead to even more cancer patients, so earnings potential will increase.

Technological factors

Technology is always a threat to product demand in the future. Better research and products can lead to lower demand for the products of Nordic Nanovector, reducing the company's value. But since the company has recently gained a fast track in the United States, they appear to have a head start on their competitors, so the outlook is very good. But by diversifying and having more research projects in progress, they can "secure" themselves against any other threats.

Environmental factors

Nordic Nanovector has the goal that their work should not cause any harm to the environment. The company is working systematically to reduce the environmental impact of their activities and they work hard to avoid polluting the environment, which is very important these days when environment is a key issue. If the company continues to operate in this way, there will be no short or long term problems related to the environment.

Legal factors

It is the authorities that decide if a company is granted approval to test a medicine on patients. In the United States, the FDA (Food and Drug Administration) has a system called "fast track", where the FDA facilitates the development of drugs to treat serious diseases, and drugs that can meet needs that are currently not covered by other drugs. This gives the company good opportunities to increase its value if they get "fast track" also in other countries. A drug candidate is through three phases of testing before a clear signal can be given in the market, but in some cases it is possible to get a preapproval already after the second phase, something a competitor of Nordic Nanovector, Bayer, got with his product Copanlisib [28]. Nordic Nanovector also has good opportunities for a large value increase.

Traditional valuation of NANO ASA

This chapter will revolve around the combined step 2/3 in Mun (2006)'s valuation process outlined above, and demonstrate how we find the company's base value

without flexibility. The structure of the chapter will follow the framework for a traditional discounted cash flow valuation described by Koller (2015):

Reorganizing the Financial Statements	Analyzing Historical Performance	Forecasting Performance	Estimating Continuing Value	Estimating the Cost of Capital	Calculating the Value	Analyzing the Results
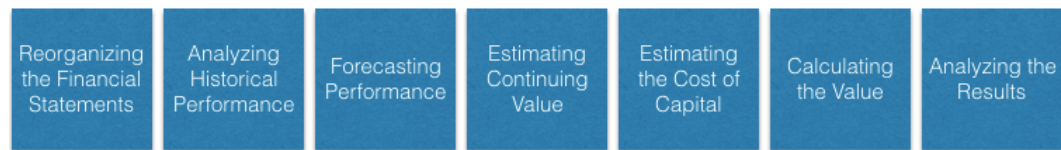
We do, however, find it pertinent to begin this chapter by presenting a brief overview of the accounting statements of Nano before we start the actual reorganization of the statements.

The accounting statements

The company has for its entire lifetime prepared its financial statements in accordance with International Financial Reporting Standards (ISRS) and interpretations issued by the International Accounting Standards Board (IASB), and disclosure requirements in accordance with the Norwegian Accounting Act [29]. It is further stated that these policies have been consistently applied over the whole period, implying that there should not be any irregularities in the reported data. Moreover, the functional currency of Nano ASA is NOK, and all amounts in the financial statements are stated in NOK. We will therefore continue in the same vain and report all values and value estimates in the forthcoming chapters in NOK.

The general purpose of using company's financial statements is to discover or disclose underlying economic conditions and interdependencies, which may be used to gain insight into value drivers and future performance. The importance of examining historical data does, however, vary between companies and industries, and depends largely on the consistency of the company performance. A company expected to either excel or plummet in the future will lack this consistency, which will result in modest relevance between the past and the future at best. Nano falls in the category of such a company, and as such historical data should provide limited guidelines for the long-term performance. This means that a rather short period for the historical analysis should suffice. We will, however, make use of all their available annual financial data, because we are of the opinion that some items carry future predictability nevertheless, e.g. the research and development costs.

Balance sheet

BALANCE SHEET (amounts in NOK 1000)	2017	2016	2015	2014	2013	2012	2011	2010	2009
Assets									
Non-current assets									
Property, plant and equipment	4 174	3 145	2 807	1 573	336	276	918	0	0
Shares in subsidiaries	137	137	137	137	0	0	0	0	0
Other non-current receivables	0	0	0	45	0	0	0	0	0
Total non-current assets	4 311	3 282	2 944	1 755	336	276	918	0	0
Current assets									
Receivables	18 165	22 421	13 666	6 841	6 118	4 029	3 605	1 560	1 294
Cash and cash equivalents	750 821	1 012 975	739 940	336 047	79 569	6 670	17 411	12 976	1 102
Total current assets	768 986	1 035 396	753 606	342 888	85 687	10 699	21 016	14 536	2 396
TOTAL ASSETS	773 297	1 038 678	756 550	344 643	86 023	10 975	21 934	14 536	2 396
Equity and liabilities									
Equity									
Share capital	9 809	9 795	8 904	5 310	2 215	1 277	318	212	102
Share premium	1 434 896	1 433 743	969 175	426 338	91 953	30 059	30 883	16 679	998
Other paid in capital	17 633	8 938	6 306	2 330	0	0	0	0	0
Accumulated losses	-779 680	-500 746	-274 244	-104 124	-39 813	-23 651	-10 714	-3 896	-2 305
Total equity	682 658	951 730	710 141	329 854	54 355	7 685	20 487	12 995	-1 205
Non-current liabilities									
Net employee defined benefit liabilities	0	0	0	0	0	0	0	0	0
Total non-current liabilities	0	0	0	0	0	0	0	0	0
Current liabilities									
Accounts payable	28 415	51 676	19 568	6 029	4 499	2 085	831	937	3 602
Current liabilities to group companies	6 810	3 773	4 412	588	576	536	288	0	0
Tax payable	11	0	0	0	0	0	0	0	0
Other curent liabilities	55 403	31 499	22 429	8 172	26 593	669	329	603	0
Total current liabilities	90 639	86 948	46 409	14 789	31 668	3 290	1 448	1 540	3 602
Total liabilities	90 639	86 948	46 409	14 789	31 668	3 290	1 448	1 540	3 602
Total equity and liabilites	773 297	1 038 678	756 550	344 643	86 023	10 975	21 935	14 535	2 397

Annual reported balance sheets of Nordic Nanovector ASA 2009-2017

The company balance sheet is divided in two, and constitutes of assets and equity/liabilities respectively. The most noticeable feature of the assets is that it is almost entirely made up by cash and cash equivalents, after private placements, the IPO, and stock emissions. A striking feature of the equity and liabilities compartment is that it constitutes of mainly equity. This is because Nano currently have no interest bearing debt, and is therefore solely financed by equity. The current liabilities are predominantly accounts payable and other operating accrued liabilities.

INCOME STATEMENT (amounts in NOK 1000)	2017	2016	2015	2014	2013	2012	2011	2010	2009
Revenues	302	314	437	439	306	148	63	0	0
Total revenues	302	314	437	439	306	148	63	0	0
Payroll and related expenses	43 122	37 956	29 036	13 690	4 991	3 919	3 182	32	0
Depreciation	1 483	1 160	994	345	237	779	566	0	0
Other operating expenses	257 566	168 778	151 055	54 159	12 354	8 801	3 385	1 764	2 308
Total operating expenses	302 171	207 894	181 085	68 194	17 582	13 499	7 133	1 796	2 308
Operating profit (loss)	-301 869	-207 580	-180 648	-67 755	-17 276	-13 351	-7 070	-1 796	-2 308
Finance income and finance expenses									
Finance income	22 957	10 124	12 202	4 996	1 257	439	268	205	2
Finance expenses	10	29 046	1 673	0	143	13	2	0	0
Net finance income (loss)	22 947	-18 922	10 529	4 996	1 114	426	266	205	2
Earnings before tax	-278 922	-226 502	-170 119	-62 759	-16 162	-12 925	-6 804	-1 591	-2 306
Taxes	11	0	0	0	0	0	0	0	0
Net income	-278 933	-226 502	-170 119	-62 759	-16 162	-12 925	-6 804	-1 591	-2 306

The income statement

The net income has been negative over the company's entire life-time, and exhibits a trend of ever decreasing figures. This is related to rather insignificant revenues and the increasing intensity of research and development as the company progresses through the development phases. More R&D naturally culminates in increased operating and payroll expenses. The revenues are expected to remain low until a potential market launch, and the expenses will only increase as the R&D and hiring of staff intensifies. We also observe that the company have significant financial income over the period, which are mainly interest income on their large bank deposits, and currency gain related to foreign exchange differences of currency bank accounts.

Reorganization of the financial statements

The creation of a robust valuation model demands both insights into the operating performance and a clear account of the financial performance of the company. The financial statements provided by the companies are created for this purpose. The accounting guidelines faced by companies for the recording of financial statements do, however, fail to differentiate between operating performance, non-operating performance, and capital structure, in their sheets. The resulting mixture of these metrics entails that key figures in an investor oriented analysis, like ROIC and FCF, cannot be directly computed from the reported statements. We must therefore first conduct a reorganization of the financial statements into new statements that separates operating items from non-operating items and the source of financing. This is done by going through the notes to individually separate the accounts that aggregate metrics (Koller, 2015).

More specifically, we need to reorganize the balance sheet to generate invested capital, and similarly reorganize the income statement to create NOPLAT. Finding these figures allows us to calculate both ROIC and the FCF by virtue of the following relationships (Koller, 2015):

$$\text{ROIC} = \frac{\text{NOPLAT}}{\text{InvestedCapital}}$$

$$FCF = NOPLAT - \text{Noncash Operating Expenses} - \text{Investment in Invested Capital}$$

Reorganizing the balance sheet

The classic balance sheet mixes together operating liabilities and sources of financing on the right hand side of the equation:

$$\text{Assets} = \text{Liabilities} + \text{Equity}$$

And we must therefore reorganize the balance sheet to clearly distinguish between the capital used for operations and the financing of these operations. This is done by first expanding the original balance sheet equation above, and making it more detailed. In general, we can separate the assets into operating- and non-operating assets, the liabilities into operating liabilities and debt & its equivalents, and the equity into equity & its equivalents, as illustrated below (Koller, 2015):

$$OA + NOA = OL + D + DE + E + EE$$

The second and final step is to rearrange the equation by switching over operating liabilities, yielding us total funds invested from both an operating and a financing perspective. We see now from the equation below, that from an investing perspective, total funds invested equals invested capital plus non-operating assets (Koller, 2015).

$$\underset{\substack{OA-OL \\ \text{Invested} \\ \text{Capital}}}{\boxed{}} + \underset{\substack{NOA \\ \text{Non} \\ \text{operating} \\ \text{Assets}}}{\boxed{}} = \underset{\substack{\text{Total} \\ \text{Funds} \\ \text{Invested}}}{\boxed{}} = \underset{\substack{D+DE \\ \text{Debt and} \\ \text{Its} \\ \text{Equivalents}}}{\boxed{}} + \underset{\substack{E+EE \\ \text{Equity and} \\ \text{Its} \\ \text{Equivalents}}}{\boxed{}}$$

Through careful scrutiny of the notes provided in the annual reports of NANO we have been able to separate the operating liabilities from the financial liabilities. It turns out that the company has not had, nor currently has any interest bearing debt, and that all the liabilities are classified as operating. We therefore switch the whole liabilities bulk over in the equation stated above, leaving equity and its equivalents as the sole source of the funds invested. Furthermore, we have chosen to follow Koller's (2015) definition of invested capital:

IC = Operating working capital + Net PP&E + Other operating assets

Where:

Operating wc = Operating current assets - Operating current liabilities

It is necessary to first calculate the operating working capital of Nano, which is done by subtracting operating current liabilities from operating current assets. Operating current assets comprise all current assets deemed necessary for the operation of the business (Koller 2015), and we have identified two such items, namely operating cash and accounts receivable. At this point, we find it necessary to provide an elaboration of operating cash. Nano have no explicit disclosure of their operating cash and its magnitude in their reports, implying that this figure must be estimated somehow. Koller (2015) suggests that 2% of the company's revenues should provide a good estimate of the company's operating cash. This approach do, however, require a positive stream of revenues in order to generate sensical numbers, which is not the case for Nano. Given the apparent absence of any empirical support on this matter we are left with our personal judgement. Given the negative stream of revenues, we have assumed that the operating losses must be covered by Nano's cash and cash equivalents. Consequently, we have chosen to set the size of operating cash equal to the operating losses for all the years in our analysis, and chosen to classify the remaining cash as excess cash. The operating current liabilities must then similarly include all the liabilities that are related to the current operations of Nano.

Deducting the identified operating liability items from the operating assets yields us the operating working capital, which we then are to add the net PP&E. This is because the net PP&E figure represents the investments in property, plant and equipment used in the operations. This line item may be read straight off the balance sheets in the annual reports. We have now arrived at the Nano's yearly invested capital, and all that is left for us to do is to add the value of the non-operating assts. Naturally, excess cash is a non-operating asset and need no further explanation. Moreover, in our view, other non-current assets should be classified as non-operating, because they are income that stems from other long-term business or investments. Thus, they are not directly tied to the operation of Nano. The same argument goes for the item "shares in subsidiaries", which we categorize as long-term investments not essential for operations. This items

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should therefore not be a part of invested capital, but rather be added to make up total funds invested.

Reorganized balance sheet of Nordic Nanovector ASA

Reorganizing the income statement

The reorganization of the income statement is done in order to calculate NOPLAT, which is defined by Koller (2015) as "the after-tax profit generated from core operations, excluding any income from non-operating assets or

BALANCE SHEET (amounts in NOK 1000)	2017	2016	2015	2014	2013	2012	2011	2010	2009
Total funds invested: uses									
Operating cash	301 869	207 580	180 648	67 755	17 276	13 351	7 070	1 796	2 308
Accounts receivable	18 165	22 421	13 666	6 841	6 118	4 029	3 605	1 560	1 294
Operating current assets	320 034	230 001	194 314	74 596	23 394	17 380	10 675	3 356	3 602
Accounts payable	28 415	51 676	19 568	6 029	4 499	2 085	831	937	3 602
Income tax payable	11	0	0	0	0	0	0	0	0
Current liabilities to group companies	6 810	3 773	4 412	588	576	536	288	0	0
Other current liabilities	55 403	31 499	22 429	8 172	26 593	669	329	603	0
Operating current liabilities	90 639	86 948	46 409	14 789	31 668	3 290	1 448	1 540	3 602
Operating working capital	229 395	143 053	147 905	59 807	-8 274	14 090	9 227	1 816	0
Net PP&E	4 174	3 145	2 807	1 573	336	276	918	0	0
Invested capital	233 569	146 198	150 712	61 380	-7 938	14 366	10 145	1 816	0
Excess cash	448 952	805 395	559 292	268 292	62 293	-6 681	10 341	11 180	-1 206
Other non-current receivables				45					
Shares in subsidiaries	137	137	137	137	0	0	0	0	0
Total funds invested	682 658	951 730	710 141	329 854	54 355	7 685	20 486	12 996	-1 206
Total funds invested: sources									
Share capital	9 809	9 795	8 904	5 310	2 215	1 277	318	212	102
Share premium	1 434 896	1 433 743	969 175	426 338	91 953	30 059	30 883	16 679	998
Other paid in capital	17 633	8 938	6 306	2 330	0	0	0	0	0
Accumulated losses	-779 680	-500 746	-274 244	-104 124	-39 813	-23 651	-10 714	-3 896	-2 305
Total funds invested	682 658	951 730	710 141	329 854	54 355	7 685	20 487	12 995	-1 205

financing expenses, such as interest. NOPLAT is the profit available to all investors". Moreover, the appropriate reorganization of the accounting income statement generating us NOPLAT should follow a three step process (Koller, 2015):

1. By not subtracting interest from operating profit, and thereby reclassifying interest as a financing item, NOPLAT is made independent of the company's capital structure.

2. Any non-operating income generated by assets left out from invested capital, should also be excluded from our calculations of the after-tax operating profit. Otherwise, we will end up with an inconsistent ROIC.

3. Keeping NOPLAT focused solely on operations requires that the effects of interest expense and non-operating income also be removed from taxes. This is done by adding back the tax shield from interest expense, and removing taxes paid on non-operating income, from the reported taxes.

In accordance with the first step, we have subtracted the increase in net finance income from the net income in order to reconcile the net income to NOPLAT. Alternatively we can subtract the costs, which are all operative, and the depreciation from the revenues, yielding us EBITA. We then subtract the tax from EBITA directly, and do not account for the finance income and expenses. This leaves us with NOPLAT, and a reorganized income statement. Due to lack of taxation we may observe that the company's EBITA equals the NOPLAT for all the years except 2017.

INCOME STATEMENT (amounts in NOK 1000)	2017	2016	2015	2014	2013	2012	2011	2010	2009
Revenues	302	314	437	439	306	148	63	0	0
Payroll and related expenses	43122	37956	29036	13690	4991	3919	3182	32	0
Other operating expenses	257566	168778	151055	54159	12354	8801	3385	1764	2308
Depreciation	1483	1160	994	345	237	779	566	0	0
EBITA	-301869	-207580	-180648	-67755	-17276	-13351	-7070	-1796	-2308
Tax	11	0	0	0	0	0	0	0	0
NOPLAT	-301880	-207580	-180648	-67755	-17276	-13351	-7070	-1796	-2308

Reorganized income statement

The cash flow statement

In contrast to the reported cash flows from operations in the accounting statement, free cash flow is independent of financing and non-operating items. This is adjusted for by recognizing that the FCF statement starts with NOPLAT rather than net income. As mentioned earlier, NOPLAT excludes non-operating income and interest expense, making the FCF's independent of these as well. We may therefore start directly from the NOPLAT in the reorganized income statement, and proceed by adding back depreciations, and subtract both the increase in working capital and increase in PP&E. The changes in both working capital and PP&E are calculated from the reorganized balance sheet, by comparing numbers at the end of the year with numbers at the beginning of the year. Doing this procedure enables us to calculate the free cash flows for each year.

INCOME STATEMENT (amounts in NOK 1000)	2017	2016	2015	2014	2013	2012	2011	2010	2009
Revenues	302	314	437	439	306	148	63	0	0
Payroll and related expenses	43122	37956	29036	13690	4991	3919	3182	32	0
Other operating expenses	257566	168778	151055	54159	12354	8801	3385	1764	2308
Depreciation	1483	1160	994	345	237	779	566	0	0
EBITA	-301869	-207580	-180648	-67755	-17276	-13351	-7070	-1796	-2308
Tax	11	0	0	0	0	0	0	0	0
NOPLAT	-301880	-207580	-180648	-67755	-17276	-13351	-7070	-1796	-2308
Depreciation	1483	1160	994	345	237	779	566	0	0
Change in working capital	-86342	4852	-88097	-68081	22364	-4863	-7411	-1816	0
Change in PP&E	-1029	-338	-1234	-1237	-60	642	-918	0	0
Free cashflow	-387768	-201906	-268985	-136728	5265	-16793	-14833	-3612	-2308

Calculation of free cash flow for Nordic Nanovector ASA

Analyzing performance

In order to forecast the future for a company it is important to also understand its past performance, because this allows us to base our forecasts on reasonable assumptions about the company's key value drivers. We should always begin our analysis by reviewing the return on invested capital (ROIC) and revenue growth, by examining trends in both the company's long-run performance, and performance relative to that of its peers (Koller 2015). While this may be true for most companies, we are of the opinion that analyzing historical ROIC and revenue growth for Nano, and any other biotechnology company in its early stages, will be a futile endeavour. Both past and current analysis of profitability will yield extremely poor results in a traditional view, and in noway provide any usable guidelines for the future. Almost all profitiabilty for the company is captured by future expectations, and the correlation between the present and the future will be close to zero. As a consequence, we will disregard a historical profitability analysis, and rather focus on examination of figures like liquidity and solidity. I.e. we believe it to be more prudent to review the company's risk profile, and chances of staying afloat and not go bankrupt before they reach the profitable future.

Liquidity

A liquidity analysis is a analysis of the company's ability to pay its dues, and includes the company's ability to pay its liabilities before or at the due date for payment (Kristoffersen 2014). Two important and used key figures are the current ratio and the quick ratio. The current ratio is a ratio of a company's current assets to the current liabilities, and the quick ratio is a ratio of a company's most liquid current assets to the current liabilities:

$$Current\ ratio\ =\ \frac{Current\ Assets}{Current\ Liabilities} \qquad Quick\ ratio\ =\ \frac{Current\ Assets\ -\ Inventory}{Current\ Liabilities}$$

We do have some rules of thumb according to Kristoffersen (2014), giving us an indication of the two ratios sizes. The current ratio should exceed 2, i.e. exhibit at least a 2:1 ratio. The quick ratio should, however, exceed 1, i.e. a 1:1 ratio. In the case of Nano, the two ratios will be equal. This is because Nano are yet to make a

market launch, and as a consequence has no inventory or other illiquid current assets.

	2009	2010	2011	2012	2013	2014	2015	2016	2017
Current Assets	2 396	14 536	21 016	10 699	85 687	342 888	753 606	1 035 396	768 986
Current Liabilities	3 602	1 540	1 448	3 290	31 668	14 789	46 409	86 948	90 639
Current/Quick ratio	0,67	9,44	14,51	3,25	2,71	23,19	16,24	11,91	8,48

With the exception of the startup year the liquidity has been above the rule of thumb ratio 2:1. As a matter of fact, the liquidity has been well above the minimum mark all years except 2012 and 2013, when the liquidity took a downturn compared to the rest of the period. Fluctuations like these are, however, to be expected in the research phase when the company has to make varying investments in equipment and generates other costs related to the drug development. The downturns in liquidity are therefore explained mostly by lower cash reserves following operational activities. In general, the cash and cash equivalents has increased dramatically over the period, largely offsetting increases in the current liabilities, generating an overall very solid liquidity figure. We can conclude from the analysis that there are no indication of Nano failing to pay their dues anytime soon, and that the liquidity risk is low.

Solidity

Solidity is a figure that paints a picture of a company's ability to sustain economic losses. The most important key figures of a solidity analysis are the equity ratio, debt ratio, and the interest coverage ratio (Kristoffersen 2014). The debt ratio exhibits how much of the total capital that is provided by debt, and the interest coverage ratio is a measure of the company's ability to pay their interest payments. Because Nano does not have any interest bearing debt, both the debt ratio and interest coverage ratio measures cannot be used. Our solidity analysis will therefore explicitly focus on the equity ratio.

The equity ratio shows the percentage of the company's capital that is financed with own recourses, and therefore tells us how much losses that can be sustained before the debt will be affected (Kristoffersen 2014). I.e. how much losses the company may take before they are declared bankrupt. In general we say that the higher the equity ratio, the stronger the solidity. The ratio is given by equity to the total capital:

$$Equity\ ratio\ =\ \frac{Equity}{Total\ capital}$$

	2009	2010	2011	2012	2013	2014	2015	2016	2017
Equity	-1 205	12 995	20 487	7 685	54 355	329 854	710 141	951 730	682 658
Total capital	2 397	14 535	21 935	10 975	86 023	344 643	756 550	1 038 678	773 297
Equity ratio	-50,27 %	89,40 %	93,40 %	70,02 %	63,19 %	95,71 %	93,87 %	91,63 %	88,28 %

Historical solidity of Nordic Nanovector ASA

As illustrated in the table, the equity ratio and solidity of Nano have been very high over the entire life span of the company. However, just as in the liquidity analysis, we observe that the solidity took a downturn in the years of 2012 and 2013. The downturn of 2012 is mainly driven by an increase in the accumulated losses lowering the equity value, and a simultaneous increase in current liabilities. Likewise the downturn in 2013 is driven by a significant spike in current liabilities. This tells us that the equity ratio is mainly affected by the yearly negative operating results, which are to be expected in a research phase. Keeping in mind that the company has been granted a fast track, it is also likely that the R&D costs will be somewhat lower than what they would be otherwise, which should strengthen the solidity for the forthcoming years. As a result, we may conclude that the solidity overall have been very good, and that the company are capable of sustaining sustainable losses.

Comparison with peer companies

As mentioned in the introductory paragraph of this chapter, we should also complement and enhance our risk analysis by comparing Nano's historical trend with that of its peers. We have therefore calculated the same key figures for ten of the total twenty biotech companies Nano has listed in their annual reports as peers. The numbers for the peer companies have been extracted from their annual

reports, and third party providers of financial information, like the The Wall Street Journal.

	Current ratio/Quick ratio			Equity ratio		
	2017	2016	2015	2017	2016	2015
4 D Pharma	11,60	15,19	20,91	89,77 %	92,84 %	95,18 %
arGen-X	14,13	2,40	5,08	93,00 %	59,92 %	81,11 %
Bavarian Nordic	11,23	3,04	2,38	79,50 %	71,44 %	67,49 %
BerGenBio	11,29	8,19	6,80	91,16 %	87,82 %	78,58 %
Celyad	4,58	7,57	95,23	39,81 %	53,49 %	59,45 %
Hansa Medical	14,32	9,99	14,25	92,69 %	91,32 %	94,39 %
Innate Pharma	1,86	3,01	4,19	33,71 %	30,60 %	23,55 %
Molecular Partners	10,08	11,52	8,20	80,82 %	73,76 %	69,19 %
Nordic Nanovector	**8,48**	**11,91**	**16,24**	**88,28 %**	**91,63 %**	**93,87 %**
Targovax	13,37	8,03	10,27	96,96 %	95,73 %	96,22 %
Zealand Pharma	9,28	4,26	8,69	71,68 %	40,05 %	39,65 %
Average	10,02	7,74	17,48	77,94 %	71,69 %	72,61 %
Average w/o Celyad			9,70			

Comparison of key figures with peer companies

From the analysis we see that the industry in general exhibits an overall great ability to both meet their payment requirements and ability to sustain losses. Moreover, Nano consistently places very high on this ranking for both key figures, except for the 2017 current ratio. This is further illustrated by Nano placing well above the industry average for all metrics and years, except current ratio 2017. It should be noted that we consider the 2015 current ratio for Celyad to be anomalous and most likely a one-time event. As a consequence, we believe the inclusion of this figure will artificially inflate the 2015 average current ratio, and we find it reasonable to exclude the figure from this year's calculation. Despite ranking somewhat below the industry average in 2017 liquidity wise, Nano still exhibits an excellent current ratio, well above the rule of thumb 2 to 1 ratio. We thus find that in general, Nano performs exceptionally well in the two metrics, and that the risk of imminent future financial distress is very low. This is mostly due to their large reserves of cash, which we believe will last until market launch in 2021.

Forecasting of income statement

The traditional valuation process is done by starting from both the strategic analysis and the actual accounting analysis. These two analyzes will build the foundation for displaying the budgeted cash surplus for a given period. Strategic accounting analysis that is used is both investor and creditor-oriented. The analysis helps to describe underlying financial conditions recorded, reported and measured in accordance with International Financial Reporting Standards (IFRS). Nordic Nanovector is listed on Oslo Stock Exchange and is thus dependent on complying with international standards. We have chosen to do strategic accounting analysis to gain insight into the historical figures that are represented in the Nordic Nanovector reports for the years 2009 to 2017, hence from the company's start-up to the last quarterly report (Q1 Report, 2018). The preparation of future accounts is calculated to be 7 to 15 years according to (Dahl, G. A., Hansen, T., Hoff, R. and Kinserdal, A. 1997). Based on the company's patent for the Betalutin® product by 2031, we have considered that the appropriate budgeting period will be from the start-up year 2009 to 2031.

Certain assumptions have been necessary to account for when preparing the income statement. Nordic Nanovector is currently not in a position where they generate profits and, in the event of any approved Betalutin® in the market, the company expects major changes in the future. Thus, our own prerequisites will be explained continuously. Due to an unpredictable future for the company, our own assumptions are based on assumptions with help from other sources such as DNB Markets analysis 2018, the annual reports of the company and our own work through this task. The budgeting of cash surpluses together with the future accounts will, through a framework, present the preparation in the most transparent manner.

The framework

As explained in the previous section, the chosen budget period is chosen for 14 years and will show which figures are budgeted. With the chosen budget period, this framework is intended to provide an overview of both the profit and loss balance that has been rebuilt through the future accounts.

Nordic Nanovector's main product is Betalutin® and, as mentioned in previous chapters, it is this product that we have prepared a project account around and which we have calculated the value of.

Income statement

Due to the fact that Betalutin® and Nordic Nanovector are undergoing deficits and the company's product has not yet been launched on the market, we do not think it is appropriate to present any estimates based on growth. We therefore found it more appropriate to do this manually during the given 14-year future budget period. Therefore, we have budgeted the various items in the profit and loss account by looking at the possible selling price to budget revenue. However, costs such as payroll and other operating costs that we consider to be more stable have been done using growth calculations. In recent years, the tax rate has changed since the first fiscal year for the company, but we have calculated a tax rate of 24%.

Penman (2013) believes it is necessary to classify profit or loss items in operation or finance to reveal underlying sources of profitability, so that results can be compared with the corresponding capital source. The result posts must therefore also be classified as abnormal or normal, where only normal records are presumed to last over time (Penman, 2013). Normal items are therefore the starting point for the future accounts in this chapter, and the future accounts are the basis for the fundamental valuation in later chapters.

The balance

Since the company has limited operating assets and no fixed assets, we have not found it appropriate to budget the balance sheet. Instead, we have chosen to base short-term debt and current assets at a percentage increase. The fundamental valuation is based on a percentage increase, also for depreciation, due to the assumption of minor changes regarding the company's assets over the fiscal period.

Currency calculation

The annual accounts of the company are disclosed in NOK, and we have therefore chosen to use this currency in the calculations of the future budget. Although the annual accounts are in NOK, the actual product Betalutin® is denominated in

dollars. As mentioned earlier in the presentation of Nordic Nanovector, the US market is the major potential market, primarily for the industry, and for this purpose we have used a conversion here to NOK also for future sales revenue from Betalutin®. The calculation of the dollar exchange rate is done at an average dollar rate through annual average rates.

Budgeting of results

Own sections with each of the items in the result will be presented and explained on the basis of their own prerequisites. Explanations and reasons for the size of different items and growth calculations are presented.

Budgeting of operating revenues for Betalutin®

This item is the most unpredictable item in budgeting the result. The reason for this is more, as both Betalutin® is still present on the market and what revenues the company will be able to earn on the product in the international market. As the company and the market currently do not have a similar product for potential buyers, it is clear what market share such a product could achieve. Our assessments of the market share of Betalutin® are based on the source usage of the average market share of a product that is in a low-price industry [30]. Because we do not know about Betalutin® will be out there and thus hijack the entire market or fight against already established companies. This has also been mentioned under the chapter strategic Analysis. With this in the background, we estimated a market share of 20% in 2021, before it will increase significantly over the years until a flat development will balance the market share of 20% from 2026.

DNB Markets estimates a global average price of USD 150,000 for Betalutin® with all indications per person. Since it is this Nordic Nanovector also uses as the estimate, we believe this is the most accurate we can estimate as revenue per person of the number of patients. This is also based on inflation growth of 2% per year, as this is the expected inflation rate of the Norwegian Central Bank [31], the European Central Bank [32] and the US Central Bank (FED) [33]. In terms of market launch for Betalutin®, we have based this on the company's own stock exchange announcements about the development process. The original target was 2H 2019, but is currently added to 1H 2020, and this is what we have also

budgeted for in the future accounts. The first full year of income, however, we do not think will happen until 2022, subject to further postponements.

Regarding the number of patients we have included as potential buyers of Betalutin®, we have used the same assumption as DNB Markets (30 May 2018). Growth per year is set at 1.5% increase in lymphoma patients per year. This trend has been kept constant throughout the entire future accounts. However, all figures under this item have been prepared on the basis of the best discretion and the information available. This means that there will therefore be uncertainty associated with this item.

Budgeting of operating expenses

The respective costs under budgeting are carried out through different individual considerations since the items presented below are important to show based on the annual reports. The different cost items we will present first are budgeting of labor costs, then other operating costs before we will look into R&D costs related to the various phases the company is going through before any possible launch. In the end, depreciation will be presented.

Budgeting of labor costs

The wage costs of the company have been made using a growth scale while we have taken our own account of expansion, as previous reports have shown that new phases have demanded more resources. When both Phase II and III still are not over, we have taken special consideration for this. From the years 2015 to 2017, which has really shown a real development in both the company and the product, we believe these years are the strongest for carrying out an average growth rate of both the number of employees and the increase in wages per employee.

As already mentioned in the performance of the company in the previous chapter, Nordic Nanovector has employed highly competent employees in the last 3 years, who have both entered the research department and also in the management team. From 2015 to 2016, wages per employee increased by 11%, while from 2016 to 2017 they increased by 5%. With these figures in the previous year, we have determined an average growth rate in wages per employee to be around 8%. The

reasons for this are supported by the fact that it will most likely not occur for excessive replacements in the future and that an established staff has been established for further efforts. Furthermore, we have not facilitated a significant increase in the number of employees from 2017 to 2018, as history shows that the number of employees from 2015 to 2017 does not show a larger increase than 2 new employees per year during this period. The reason for a larger increase in 2018 is, as mentioned earlier, that Phase II enters a decisive phase. As for Phase III, we have budgeted that this phase will not be as long as they have already got a fast track in the United States.

As shown in the table below, estimated labor costs are rising throughout the entire future budget. From the first budgeting year in 2018 to the last year with patent for the company in 2031, the cost item will increase significantly, it will be 2.7 times higher. It can be argued that this wage development seems to be a bit too extreme, but compared to this item with potential revenue, it is not such a big increase anyway. Estimated payroll costs are presented in this way in the income statement.

Budgeting of other operating expenses

Other operating expenses are a large item with a lot of different accounts, ranging from renting of premises, travel expenses, courses and conference expenses, as well as IT expenses. When estimating this item, we do not consider it necessary to calculate a growth rate as all accounts under this item are included in operation. On the other hand, we have chosen to estimate a different percentage increase over the budget period. With the same reason as the increase in labor costs, we have chosen to increase other operating costs considerably in 2018, as this is seen as crucial for the Phase II study for Betalutin®. A doubling has been estimated in 2018 compared to 2017. In the years after, from 2019 to estimated market launch in 2021, we have posted a growth rate per year to 10%. The reason for this is based on the fact that this item will also increase with the other cost items. From the launch year, a reduction in other operating expenses of 50% is expected. This percentage may seem high, considering that it has been budgeted a relatively steady increase in previous years. Either way, with fewer commitments to development, we believe this is a real estimate of the item. See table for development of other operating expenses.

Budgeting of R&D costs

The total R&D costs accrue as the years pass and are expensed accordingly. This complies with what the annual reports to the company inform. This is in accordance with section § 5-6 of the Norwegian Accounting Act that its own research and development expenses may be accountants [34]. Based on this disclosure of the legislation, it is assumed that this assumption applies to the entire budgeting period. It also means that all R&D costs will not be capitalized and therefore will not affect the item for depreciation. This will be explored more in the next chapter.

The total R&D costs for the years 2013 to 2017 are taken from the annual reports of the company. Based on these figures, we have found the ratio between R&D and total costs. Furthermore, we have assumed that this ratio applies to all the other years we do not have accounting figures. Due to little information about the phases and the current costs in this item, the R&D costs have been estimated based on our own assumptions. This means what costs are divided into the different phases. With the help of DNB Markets (Q1 Report, 2018), the division of the various costs in the various phases has become more transparent. As the table below shows, the discovery phase has been established in 2009, while the pre-clinical phase in the years 2010 to 2012. Since the company has not budgeted for a normal phase in the study however instead chosen to go for a Phase I / II study, a natural cost management done here by combining the different phases costs. The Phase I / II study started in 2012 and has been estimated in our future budget to end in 2019. With a short Phase III period, as previously explained with the fixed track estimated in the budget, the rest of the R&D costs will be part of the market approval.

A review of the different sections of phases over these years gives the cost of R&D as these costs from 2009 to 2017 have had a formidable development and a development that is also expected to increase over the years into market launch.

Marketing expenses

In the same table as R&D, an estimate of marketing costs has also been budgeted. These costs will not accrue until 2021 as this is the goal of getting Betalutin® on

the market. From 2021 to 2022, the year we believe the product is fully on its way into the market and an increase in marketing costs is estimated at 177%, while in 2022 these costs will increase by another 130%. In the years 2023 to 2025, marketing costs are expected to rise before a falling growth rate of 0.2 percentage points will be established in the years to 2031. The reason for such high costs arises from an international market where not only the US is a great opportunity for launch. At the same time, we do not know if there is no one or more competitors in the same market. The assumptions set aside are also here in consultation with what DNB Markets (Q1 Report, 2018) induces in its analysis.

Budgeting of depreciation

Operations and current assets are relatively high, which indicates that they own some. Based on this and with the annual reports as support, we have not made major changes around this item due to the company seeing large investments. We have found it appropriate to base the budgeting on the depreciation that has been made in the annual reports, while underlying factors such as inflation have counted. An increase of 50% in 2018 and a further 25% increase is based on assumptions that after this time inflation-rate growth of 2% will be a realistic development. Assuming that the company does not change its strategies around this item.

Budgeted operating profit before taxes

Operating profit has been summarized through budgeted operating income and operating expenses. For Betalutin®, budgeted operating earnings are the same as the whole of the company as we have focused on the product with the greatest chance of launch and the product that is the first priority for the company. At the same time, this is also the basis of the annual reports. The company has budgeted with deficits in 2018, an extension of what previous operating results have been presented through the various annual reports to the company. The deficit will increase in the years to 2021, as this corresponds to the trend of the company when Betalutin® is on the market.

The company is budgeted for a profit in 2022, when Betalutin® is launched on the international market. An expected increase in profits is seen as natural in the years

after market launch. The tax cost is calculated in the following chapter, as this can be distributed to the owners and is of greater interest to potential investors.

Budgeted tax expense and NOPLAT

The tax expense has been in the years prior to the budgeting period, nominal 27% in 2009 to 2015, 25% in 2016 and 24% in 2017 until today's year. Therefore, the tax expense is 24%, as we think this is the most recent updated rate and the amount we have to deal with in the budgeting period, even with some uncertainty that this will change in the years to come. The operating tax has not been calculated in the previous year, due to the fact that the company has not generated money. One of the uncertainties surrounding tax is the deferred tax. It appears in the annual report that the deferred tax asset is not taken into account in the balance sheet and therefore not included in our budget period. Since the deferred tax asset is not used now and historically, it is based on the fact that the company has so far only a deficit. As they have not included this item earlier, we assume that this trend will continue in the future.

Investments and Property, Plant, and Equipment (PP&E)

Assuming that the company has completed most of its investments, as mentioned in the sub-chapter on depreciation. Based on this we have chosen to put the depreciation above the same as the investments. Therefore, expects only maintenance investments in the years to come.

The PP&E budget line is based on long-term resources and can thus be seen in conjunction with the investment item. The reason for the expense account for this item is the same as the investments related to the depreciation item. The assumptions underlying this choice are explained in the same way as most investments are already completed.

Change in working capital

In the pharmaceutical industry, according to (Damodaran, 2013), the working capital in relation to sales revenue is empirically at 8.77%, and thus this is what we assumes for the budgeting.

Free Cash Flow

This method takes into account operating profit after tax, together with changes in working capital, PP&E and investments. The method is thus to determine the value of the company by calculating the present value (NPV) of future free cash flows through budgeting and discounted with the total return requirement (WACC). The table below is a result of the assumptions that have been explained in the previous sub-chapters.

Summary of the budgeting process

The fundamental appreciation that has been prepared through this chapter is the figures that underlie the completed process. At the same time, this forms the basis for the real-stock analysis, which will be presented later. As mentioned in the beginning of the chapter, all basis has been prepared through the help of the annual accounts and DNB Markets (report 2018), while our own assumptions are prepared by best judgment. The industry is based on some uncertainty, and the estimates are also linked to the same uncertainty of nature equality. The fact that the budget period is quite long, since the patent will not be lost until 2031, this makes for a long budget period together with many uncertain moments that have been prepared in the best possible way.

INCOME STATEMENT (amounts in NOK 1000)	2018	2019	2020	2021	2022	2023	2024
Phase	Phase 1/2	Phase 1/2	Phase 3/Approval	Market	Market	Market	Market
Estimated market	37 147	37 704	38 270	38 844	39 426	40 018	40 618
Market share				1,0 %	7,5 %	11,5 %	14,9 %
Price per treatment				1 033 612	1 054 284	1 075 370	1 096 877
Revenues	254	213	179	401 494	3 117 503	4 948 911	6 638 414
Payroll and related expenses	15 728	17 835	20 179	22 784	25 677	28 886	32 445
Payroll expense R&D	68 082	77 205	87 352	98 629	111 150	125 044	140 450
Other operating expenses	130 216	143 238	157 562	78 781	82 720	86 856	91 199
R&D expenses	384 916	423 407	465 748	232 874	244 518	256 743	269 581
Marketing costs			15 200	42 200	97 300	160 900	247 600
				177,6 %	130,6 %	65,4 %	53,9 %
EBITDA	- 598 688	- 661 473	- 745 862	- 73 773	2 556 138	4 290 481	5 857 139
Depreciation	2 225	2 781	3 476	3 545	3 616	3 689	3 762
EBITA	- 600 913	- 664 253	- 749 338	- 77 319	2 552 522	4 286 793	5 853 377
Corporate tax rate	24 %	24 %	24 %	24 %	24 %	24 %	24 %
Tax	-	-	-	-	612 605	1 028 830	1 404 811
NOPLAT	- 600 913	- 664 253	- 749 338	- 77 319	1 939 917	3 257 963	4 448 567
Depreciation	2 225	2 781	3 476	3 545	3 616	3 689	3 762
Change in working capital	- 94 976	- 104 474	428 650	- 436 511	-2 954 203	-1 992 023	-1 837 672
			195	436 705	3 390 908	5 382 931	7 220 603
Free cashflow	- 695 889	- 768 727	- 320 688	- 513 829	-1 014 286	1 265 940	2 610 895
NPV of free cash flows	- 589 736	- 552 088	- 195 180	- 265 028	- 443 354	468 944	819 625
Discount factor	18 %	18 %	18 %	18 %	18 %	18 %	18 %
NPV	6 133 507						
Share price	124,94						

INCOME STATEMENT (amounts in NOK 1000)	2025	2026	2027	2028	2029	2030	2031
Phase	Market	Market	Market	Market	Market	Market	Market
Estimated market	41 227	41 846	42 474	43 111	43 757	44 414	45 080
Market share	17,4 %	20,0 %	20,0 %	20,0 %	20,0 %	20,0 %	20,0 %
Price per treatment	1 118 815	1 141 191	1 164 015	1 187 295	1 211 041	1 235 262	1 259 967
Revenues	8 025 896	9 550 816	9 887 960	10 237 004	10 598 371	10 972 493	11 359 822
Payroll and related expenses	36 388	40 755	45 587	50 932	56 840	63 368	70 576
Payroll expense R&D	157 520	176 422	197 341	220 477	246 052	274 309	305 511
Other operating expenses	95 759	100 547	105 574	110 853	116 395	122 215	128 326
R&D expenses	283 060	297 213	312 073	327 677	344 061	361 264	379 327
Marketing costs	295 700	315 800	336 600	358 100	380 302	403 120	426 501
	19,4 %	6,8 %	6,6 %	6,4 %	6,2 %	6 %	6 %
EBITDA	7 157 469	8 620 079	8 890 784	9 168 966	9 454 720	9 748 217	10 049 581
Depreciation	3 838	3 914	3 993	4 072	4 154	4 237	4 322
EBITA	7 153 632	8 616 165	8 886 792	9 164 893	9 450 566	9 743 980	10 045 259
Corporate tax rate	24 %	24 %	24 %	24 %	24 %	24 %	24 %
Tax	1 716 872	2 067 880	2 132 830	2 199 574	2 268 136	2 338 555	2 410 862
NOPLAT	5 436 760	6 548 285	6 753 962	6 965 319	7 182 430	7 405 425	7 634 397
Depreciation	3 838	3 914	3 993	4 072	4 154	4 237	4 322
Change in working capital	-1 509 164	- 1 658 656	- 366 711	- 379 656	- 393 058	- 406 933	- 421 298
	8 729 767	10 388 422	10 755 134	11 134 790	11 527 848	11 934 781	12 356 079
Free cashflow	3 927 596	4 889 630	6 387 250	6 585 663	6 789 372	6 998 492	7 213 099
NPV of free cash flows	1 044 890	1 102 397	1 220 377	1 066 344	931 634	813 839	710 843
Discount factor	18 %	18 %	18 %	18 %	18 %	18 %	18 %
NPV							

The cost of capital

In order to acquire necessary capital for a project, the firm must promise the capital providers a certain minimum return on their lent capital. This minimum return must equal their opportunity cost of the capital, i.e. the rate of return that the best alternative investment with equal risk characteristics would be expected to yield. We can therefore say that the cost of capital is an estimate of the return the investors requires to be adequately compensated for time spent and risk taken. The risk being the foregoing of other potentially lucrative returns, and the time accounting for all the time that the capital is potentially misplaced. Because the cost of capital is an expense for the firm, and it is expected that this cost is to be covered by the firms future cash flow, we must discount the cash flows by the estimated cost of capital. Furthermore, because we are discounting the total cash flows generated, the appropriate discount rate should be the total cost of capital, namely the WACC. The WACC represents the returns that all investors in a company expect to earn for investing their funds (Koller 2015), and it is given by the following formula:

$$r_{WACC} = \frac{B}{B+S} r_B(1 - T_C) + \frac{S}{B+S} r_S$$

Where:

B = The company's interest bearing debt

S = The company's equity

B+S = The company's total capital

r_B = The company's cost of debt

r_S = The company's cost of equity

T_C = The company's marginal tax rate

However, as mentioned before, Nano does not currently have any interest bearing debt, making the whole first term zero. The resulting equation is then WACC = r_S, and we obtain that the appropriate cost of capital for Nano is equal to the cost of equity. This makes intuitive sense because zero interest bearing debt implies that all the capital is provided by equity holders, which means that the company only needs to compensate for their opportunity cost. The most well renowned method for estimating the cost of equity is the capital asset pricing model (CAPM), and we will therefore make use of this model in our estimation of the cost of capital.

The CAPM

The CAPM is built on the assumption that all security prices already reflect public information about a firm's prospects (Bodie 2014). This implies that investors only get compensated for the time value of money and taking on additional risk (Bogdan 2010). The time value of the money is represented in the form of a risk-free rate over a specified period of time. The risk component constitutes of both a systematic risk measure, called beta, and the market risk premium. The systematic risk component tells us how risky the returns of the company are in contrast to the overall market return. E.g. a beta that exceeds one, i.e. greater than the market risk, tells us that investing in this company is riskier than the overall market, and for that we should receive a greater compensation. The market risk premium is the required compensation by investors for taking on systematic risk, i.e. risk that affects all firms and for that reason cannot be diversified away (Bodie 2014). If there were not any extra return to be expected from investments in assets affected by systematic risk, then all investors would invest in systematic risk-free assets. Hence, we define the market risk premium as the extra return from investing in systematic risky assets over investing in systematic risk-free assets. The CAPM is therefore defined as follows (Bodie 2015):

$$E(R_M) = r_f + \beta_i(E(R_M) - r_f)$$

As explained, the model constitutes of a total of three factors, factors that we must either acquire or estimate. The following sections will therefore be dedicated to the calculation of these figures.

The risk-free rate

Koller (2015) proposes the use of the current yield on long-term government bonds as a means to estimate the risk-free rate, and claims that the most theoretically sound approach is to discount each year's cash flow with a cost of equity based on that particular year's appropriate risk-free rate. I.e. discount the 1 year cash flow by the cost of equity based on the 1 year risk-free rate, and proceed in a similar manner for the remaining years. A drawback with this method is that it is rather cumbersome, and most practitioners choose instead to use a single yield to maturity that best matches the cash flow stream. In the case of Nano, where the stream of cash flow is expected to start in 3 years' time, and continue for another 11 years, the ideal yield to use will be that of a 14 year government bond. The problem of using bonds with long maturities is that they are quite illiquid, and hence might not give a correct representation of the risk-free rate. Koller (2015) therefore recommends the use of 10-year government bonds as a proxy for the risk-free rate, and urges the use of government bonds denominated in the same currency as the company's cash-flows. The average 10-year return on Norwegian bonds in 2017 was 1,64 %, and we will use this as our risk-free rate.

Market risk premium

The market risk premium is not observable, and must therefore be estimated. The calculation of market risk premium can be done in two ways. The first one uses historical data of market returns to estimate the historical market risk premium. This method is based on the assumption that underlying factors won't deviate much from their historical values, which seems like a far-fetched scenario, given that risk aversion continuously changes in response to information streams. The second method is to reverse engineer the cost of equity from a large sample of companies we have valued using the discounted cash flow methodology. This method estimates the cost of equity implied by the relationship between current share prices and aggregate fundamental performance (Koller 2015). This method is however, quite cumbersome and time consuming, due to a requirement of a large sample. We have therefore chosen to disregard both of these methods, and

opted to rely on expert opinions instead. PWC has an ongoing cooperation with "Norske Finansanalytikeres Forening" (NFF), in which they conduct a research on the market risk premium in the Norwegian market. The purpose of the research is to gain insight into important Norwegian professional's opinions and estimations of key figures like the markets risk premium, the risk-free rate, long-term inflation etc. According to their research, the market risk premium has been stable over the last five years, and surmounted to 5%. We will therefore use 5% as our market risk premium in our calculation of the cost of equity.

Beta

The beta is a measure that compares the volatility of an asset relative to the volatility of the broader market, and is derived mathematically by dividing the covariance between the stocks's and market's return on the variance of the markets return (Bodie 2014):

$$\beta_M = \frac{Cov(R_i, R_M)}{\sigma_M^2}$$

An explanation of this expression is that the ratio measures the contribution of a stock i to the variance of the market as a fraction of the total variance of the market (Bodie 2014). As we can see, the magnitude of the covariance determines the size of the beta and thus the associated risk. Generally, a lower covariance lowers the systematic risk and the beta value, with the exception when the covariance is zero and the beta is zero. A beta of zero implies that there is no correlation, and consequently no compensation. A beta of one implies that the asset co-varies perfectly with the market, and a beta above one is considered aggressive, because we assumes more risk than the market.

In the CAPM, both the risk-free rate and the market risk premium are common to all companies, and it is only the beta value that varies across companies (Koller 2015). We must therefore estimate an unique beta for Nano. For publicly traded companies like Nano we may calculate the beta using historical data and a single-index model regression. In this regression, we regress the historical return of the Nano stock against that of an market index, which is believed to incapsulate the general market movements over time. The returns are estimated by calculating the

natural logarithm of the historical price movements, and the beta will thus be represented by the slope of the resulting regression line.

$$R_{Nano} = \alpha_{Nano} + \beta_{Nano}R_M + \varepsilon$$

Where:

α = The intercept of the regression
β = The covariation of the returns of Nano and a chosen market index
ε = The error term of the regression

There are a couple of underlying conditions that must be met in order to make sure that the model yields reliable results. Firstly, the input data of the model should include at least 60 data points, and comprise of monthly returns rather than more frequent return periods like weeks or days. Otherwise we run the risk of systematical biases in our results. Secondly, the company stock returns should be regressed against a value-weighted and well-diversified market portfolio. Because in the CAPM, the market portfolio equals the portfolio of all assets (Koller 2015). The requirement of 60 monthly data points entails that we need 5-years of historical data. However, Nano went public on Oslo stock exchange in late March 2015, meaning that there is not a sufficient amount of monthly data points to make the regression work properly. Thus, we are of the opinion that using daily historical data will yield better estimates. Moreover, we have chosen the OSEBX index as the proxy of the market index in our regression model. This is because the OSEBX index comprises of a representative selection of all shares listed on Oslo stock exchange, and is the most used performance indicator for the overall Norwegian stock market. Regressing Nano's daily returns against the OSEBX returns for a period of a year and a half, yielded the following results:

Regression Statistics								
Multiple R	0,16829623							
R Square	0,02832362							
Adjusted R S	0,02544884							
Standard Err	0,03823189							
Observations	340							
	Coefficients	standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	-0,0014254	0,00208555	-0,6834785	0,49477277	-0,0055277	0,00267686	-0,0055277	0,00267686
X Variable 1	0,89956288	0,28658907	3,13885972	0,00184544	0,33584009	1,46328567	0,33584009	1,46328567

The estimated beta is equal to approximately 0.90, implying that a 1% increase in the OSEBX index returns leads to an average increase of 0,9% for the Nano stock. The p-value of the regression is 0.0018, which tells us that the results are statistically significant. The interpretation of the p-value is that it should be below the critical value of 0.05 in order for the coefficient to be significantly different from zero. The R-square is approximately 0.03, indicating that the change in returns for the OSEBX explains merely 3% of the change in returns for the Nano stock. The explanation for this weak linkage is that a company's beta at any point in time may be heavily influenced by non-repeatable events, and such events may thus have influenced the beta more than the market (Koller 2015). In line with this thinking, it is very likely that Nano's stock price continuously adjusts to the frequent leakage and presentation of new information from the ongoing studies, rather than the overall market changes. A more appropriate method for estimating the beta is to use an industry peer median (Koller 2015). This is done by repeating the procedure above for all companies in the peer set, thus estimating the beta for each company. We must then convert the obtained betas into unlevered betas. When this is done and we have generated a sample of unlevered betas, we can use the median of the sample as a representative beta for Nano. The conversion from levered to unlevered beta is given by the formula:

$$\beta_u = \frac{\beta_e}{1 + \frac{D}{E}}$$

Where:

D/E = A companies debt-to-equity ratio

β_e = The levered beta

However, due to this method being extremely cumbersome and time consuming, we have chosen to rely on levered beta values from Reuters. We have next calculated the debt-to-equity ratio for each of the companies in the extracted peer group. We have chosen to use the same peer group as in our key figure analysis for consistency purposes. The D/E ratios are 5-year averages because the levered betas from Reuters are calculated on the basis of 5 years of historical data. The unlevered betas are assumed to equal the levered betas for the companies with no interest bearing debt. Moreover, some entry points are left blank due to removal

of large outliers or missing data for the particular year. Taking all these conditions into account yielded us a median peer beta of 0,70.

	Peer beta							
	Levered Beta		D/E				Average D/E	Unlevered beta
		2017	2016	2015	2014	2013		
4 D Pharma	0,71	0,11	0,08	0,05	0,06		0,08	0,66
arGen-X	0,58		No interest bearing debt					0,58
Bavarian Nordic	1,60	0,26	0,40	0,48	0,51	0,49	0,43	1,12
Celyad	1,91	1,51	0,87	0,68	3,37		1,61	0,73
Hansa Medical	2,17	0,08	0,10	0,06	0,09	0,11	0,09	2,00
Innate Pharma	1,39	1,97	2,27	3,25	0,22	0,39	1,62	0,53
Molecular Partners	0,61		No interest bearing debt					0,61
Nordic Nanovector	1,18		No interest bearing debt					1,18
Targovax	1,12	0,27	0,31	0,29	0,11		0,24	0,90
Zealand Pharma	1,02	0,40	1,50	1,52	1,36	0,10	0,97	0,52
Peer median	1,15							0,70

According to Koller (2015), it is quite common to apply a smoothening of the obtained beta value as well, due to the observed mean-reverting process of the betas. We assume that this has not been done by Reuters during their calculation of the levered betas, and will therefore make such an adjustment towards the market beta. The Bloomberg adjusted beta is given by (Koller 2015):

$$\text{Adjusted Beta} = 0,33 + 0,67 * \text{Raw Beta}$$

Consequently, our resulting beta is equal to approximately 0.80, which fits well with research conducted on the topic. Koller (2015) estimates the unlevered beta for the pharmaceutical industry to fall within a range of 0.80-1.0. This is the final beta value which we will base our cost of equity calculation on.

Calculation of the Cost of equity
The cost of equity is calculated to surmount to 5,64% based on the estimated input data above.

rf	1,64 %
(rm-rf)	5,00 %
Beta	0,80
CAPM	5,64 %

There is, however, great uncertainty attached to the estimated cost of capital as the data in our input list is largely influenced by discretion. Furthermore, we find the cost of capital to be relatively low considering the company's sensitivity to phase success and market psychology. The problem is that CAPM considers factors like

these as diversifiable and they are hence not rewarded in the model. We are thus of the opinion that the CAPM probably does not account for all the underlying risk factors and subsequently does not generate high enough compensation.

A survey conducted in 2010 by Ralph Villiger and Nielsen supports our suspicion. The survey disclosed that experts within the field of biotech valuation used average discount rates of 19,5%, 26,7% and 40,1% for biotech companies situated in late-stage, mid-stage, and early stage respectively [35] We believe that Nano currently is in the middle of the mid-stage and the end-stage, and thus the cost of capital should be 23,1%, which is the average of the two. Harrington (2012) on the other hand argues that the average CAPM calculated cost of equity for R&D intensive companies, for the period 2001-2008, is approximately 13%. Consequently, we choose to take the average of the recommended cost of capital and the estimated cost of equity. This procedure yields us a discount rate of 18,05%, and we will therefore use 18% for the forthcoming valuation.

Valuation of Nano

We have now reached the fifth step of the valuation process outlined by Koller (2015), and we will now conduct the actual valuation by putting all the estimated parameters in the preceding steps to use. We will in this chapter value Nano with the traditional discounted cash flow method, and arrive at our base case value for the forthcoming real options analysis.

Static NPV calculation

The valuation will utilize the equity valuation model in order to find the present value of the future cash flows. This is because the equity valuation model and the enterprise model will be equivalent for this case, due to the lack of interest bearing debt. The fact that the company is solely financed by equity implies that the only claim holders in fact are the equity holders. Thus, this implies that the appropriate cost of capital is represented by the cost of equity, and that all cash flows in fact goes to equity. Plotting the generated input list from preceding chapters into the model allows us to calculate the present value of the free cash flows and the terminal value.

$$S_0 = AE_0 + \sum_{t=1}^{T} \frac{FCFE_t}{(1+r_S)^t} + \frac{TVE_T}{(1+r_S)^T}$$

Where:

S_0 = Present value of the equity value

AE_0 = Redundant assets to equity

$FCFE_t$ = Free cash flow to equity in period t

TVE_T = Terminal value of equity

r_S = The cost of equity

However, we assume that the terminal value for the cash flows generated by the Betalutin® and thus the company as a whole will be zero. This is because we believe that the market will be flooded by generic drugs produced at lower costs, enabling the companies producing these treatments to offer lower prices, resulting in loss of sales volume and enforcement of price cuts for Nano. Losing all the margin will ultimately force Nano out of the market. As a consequence, the model will essentially only consist of the middle term, which is the sum of all the discounted free cash flows. We finally obtain the value per share by dividing the estimated equity value from the model by the total shares outstanding, which currently is 49 091 683 [36]. The static model yielded a NPV of NOK 6.133.507.000, which is equivalent to a stock price of NOK 124,94.

Expected NPV calculation

Nano's value is highly reliant upon the level of success experienced in the project developing the Betalutin® treatment. There are a whole host of factors that may result in a failed clinical trial, effectively plummeting the company's value. Moreover, even if we presuppose that the treatment completes the clinical trials and is put on the market, the value is still extremely sensitive to factors like potential market share, treatment prices, size of the total market etc. A static NPV value, representing a single point estimate in the future, for Nano may therefore not spur much confidence in its results. A more appropriate method would be to adjust for the future uncertainty by creating future scenarios accounting for different project outcomes. We have therefore opted for the utilization of the expected NPV method as well, which calculates the NPV for multiple scenarios and probability-weighs them, in order to acquire the most probable future NPV.

This is the fourth step in the real option analysis outlined by Mun (2006), and involves the use of Monte Carlo simulation. In order to probability weigh the different scenarios, we must naturally include some sort of probabilities. We find the use of phase success probabilities to be the most appropriate, and choose to rely on the probabilities calculated by Kellogg (2000):

	Probability of succss		Multiplied probability	
		Phase 2	Phase 3/Approval	Market launch
Phase 2	0,50	0,50		
Phase 3/Approval	0,80	0,40	0,80	
Market launch	1,00	0,40	0,80	1,00

We have chosen to only include probabilities from phase II and onwards because Nano currently is situated in the phase II of their clinical trials. In addition, the original phase III -and approval probability in the work of Kellogg & Charnes have been merged by averaging the two respective probabilities. This is due to the granted fast track of Betalutin, and thus the expectation that Nano will conduct the phase III research and FDA filling simultaneously. The probability of success column exhibits the conditional success probability for each respective phase. The multiplied probability column shows us the probability for success in the current and subsequent phases, given differing starting points. E.g. the phase II multiplied probability column assumes that the company currently finds itself in phase II, implying that all previous stages are finished and exhibits probabilities equal to 1. The column is thus calculated by multiplying the current with the preceding probability of success. E.g. the probability of successfully completing the phase III/approval given that the company currently is in phase II, is found by 0.50*0.80, which yields us the probability of 0,40. The complete model taking into account the appropriate probabilities may be seen in the appendix.

Input of the Monte Carlo simulation

A Monte Carlo simulation runs a given number of simulations, in which each represents a future scenario or path the underlying variables and the resulting NPV may take. The purpose is to increase the precision of the calculated estimate, and the more simulations conducted the higher probability of an accurate result. The first step of a Monte Carlo simulation is therefore to decide how many

simulations to include. Mun (2006) states that the number usually varies between 1.000 and 100.000 simulations, and we thus choose 100.000 in order to maximize the accuracy of our ENPV estimate. The second step is to clarify which variables in the model that will be allowed to vary in the different scenarios, and which to be kept fixed. We have chosen to define the market share, price per treatment, all the costs, and the cost of capital as independent variables, and decided to keep the rest as fixed. This is based on which of the value estimates in our model we believe to be the most uncertain. Naturally, the NPV variable is our dependent variable, and will vary in line with our independent variables. A third requirement is to choose a probability distribution for the independent variables. We have chosen to apply a triangular distribution with an upper and lower limit set to +/- 50% of the estimated values. This is done in order to capture as much uncertainty as possible regarding our forecasted revenues and costs. The included probabilities for success have been given a Bernoulli distribution instead. The Bernoulli distribution is a discrete probability distribution, and will randomly pick out whether the cash flows will occur or not.

Running the Monte Carlo simulation described above on the "probability adjusted" equity model yields an average company value of NOK 3.260.601.301, and thus a share price equal to NOK 66,42. The value spread of the simulation was rather large, with a maximum simulated value equal to NOK 19.595.488.554, and a minimum value of NOK -3.046.464.334. This illustrates the large uncertainty related to the value of Nano, and the danger of utilizing a static DCF model not accounting for the projects accompanying risk. I.e. not adjusting for the probability of success in the different phases. This point is further exaggerated by the observation that the share price of NOK 66,42 calculated by the ENPV is significantly lower than the share price of NOK 124,94 calculated by the static NPV.

Real option analysis

This chapter will revolve around the fifth and sixth step of Mun's (2006) real options framework, namely the real options problem framing and the real options modelling and analysis. We must thus first disclose and outline the associated real options for Nano, before we move on to the actual analysis and valuation of the

identified options. The two final steps of the model will, however, not be accounted for in this paper as explained in chapter 3.4.

Real options problem framing

The nature of Nano's project and research allows for several sequential decisions regarding whether to expand the project or not, i.e. whether to continue or abandon. These decisions are dependent on the progress made up till that point and the corresponding estimated value of the project. The decisions can only be made based on the research results, and may thus only be made when phases and studies are completed. As a consequence, we may therefore think of such a decision as an European call option on the subsequent phase, and all the decisions as multiple European Calls. A sequence of European Call options, in which the value of an option is dependent on the exercise of the previous option, are called a sequential compound option. Nano is currently situated in the phase I/II studies, and have therefore already exercised two options. The first option of conducting pre-clinical studies, and the second option of entering simultaneous phase I and II studies. Due to the assumption that Nano will execute a rather brief phase III parallel to the FDA filling, we choose to treat these two processes as a single option, equal to the combined phase I and II option. This entails that only two options remain for Nano, the phase III/ approval option and the market launch option.

	Description	Alternative	Maturity
Option 1	Enter pre-clinical studies	Abandon	Early 2010
Option 2	Enter phase 1&2 studies	Abandon	Early 2014
Option 3	Enter phase 3 studies & apply for FDA filling	Abandon	Early 2020
Option 4	Market launch	Abandon	Early 2021

There may be several other potential growth options related to Nano's development of Betalutin®. E.g. an option to expand the patent period for another five years, or leverage their research and technology into new products and markets. We have, however, chosen to focus on the valuation of the sequential compound option, because the inclusion of other growth options would require more uncertain assumptions in the model, resulting in decreased confidence in the estimated values.

Real Option Analysis

The inputs and framework of the real option analysis must first be specified, followed by the actual analysis implementation. Finally, the values of the options and the result of the analysis are presented. We have chosen to use a tool for implementing the real option analysis. The tool is made by Jonathan Mun and is called "Real option super lattice solver"(ROSLS). The reason for choosing this tool is because we believe it provides greater precision as we do not have to perform complex mathematical calculations as well as it is time-efficient. While the tool calculates the estimates for us, it still necessary that the input entered is good (garbage in is also garbage out). Hence, the calculations are not completely protected from the risk of errors, but we believe the use of (ROSLS) reduces the risk considerably.

Definition of inputs

Before calculating the analysis program (ROSLS) and option values, a definition of different inputs is a necessity. Risk-free interest, underlying, implementation costs, volatility, dividend yield, maturity (time to maturity) and step (number of steps) that the binomial tree will consist of are all input values that must be entered into (ROSLS).

Risk-free rate, time to maturity, dividend yield and number of steps in the binomial tree

Input for risk-free interest rate is set at 1.7% before tax. The calculation of risk-free interest rates was derived from a previous chapter on return requirements and consequently a further justification of the input will not be discussed. We have estimated a possible launch of Betalutin® in 1H 2020 as mentioned earlier, and therefore the time to maturity is set at 11 years. In this model, each year is based on 10 steps, with a total number of steps of 110. Dividend yield is set at 0, while it is assumed that no dividend will be paid.

Value of Underlying and Implementation Costs

By estimating the expected cash flows (probability adjusted) from current value to market launch, according to (Mun, 2006), the value of underlying is found. Furthermore, (Mun, 2006) recommends performing a Monte Carlo simulation assuming that the probability adjustment is Bernoulli-distributed. This is the same as the Monte Carlo simulation in chapter 8, but there are some small adjustments

in the model as compared to the calculation of ENPV. The reason for this choice is that the implementation costs will not be discounted. Hence, a new simulation of Monte Carlo has been completed where cash flows have not been discounted until launch of Betalutin®.

The costs (incurred) related to the implementation of the product are, according to Mun, the implementation costs of the company. All costs incurred until launch are assumed to be implementation costs as it is nearby to believe that the costs would never be incurred if there was no implementation of the product. Mun points out that the costs are included in the estimated value and therefore not discounted. We also assume that all costs associated with a phase will be binding for the entire phase, hence no assumptions to end in the middle of a phase. This scenario applies to the company when exercising an option to commence a new phase. In order to get a consistent model in line with ENPV, this is likely to be adjusted on an equal footing. The value of the underlying in the real option analysis and implementation costs are used as Mean Bernoulli.

Volatility

The product expected cash flow is determined according to Mun using the natural logarithm. This is supposed to be the best estimate. A natural logarithmic approach to the non-discounted values is seen as another alternative according to Mun. However, using both of these methods expects all cash flows to be positive during the period, which is not the case for Nordic Nanovector. Hence, we have found volatility using closing prices from the first trading day of the company to the last trading day (Q1 2018) of the stock market. The reason for this is that the company has little available information around the area. In the real option analysis, this assumption is seen as an uncertainty in the calculation. However, we consider out of availability that the estimate is the best we can prepare at the moment. The annual average volatility (based on 252 days) is calculated for the Nordic Nanovector to be 68.5%. See appendix for detailed calculation.

Result of the real options analysis

Now that we have established an input list, we are able to run the ROSLS. We obtain a valuation of the pre-clinical option equal to NOK 3.426.072.530. This option is already exercised by the company, implying that the current value is

zero, and thus won't affect the overall project valuation. The same goes for our second option, valued to NOK 3.446.057.440. Due to Nano currently being situated in the parallel phase I/II study, the associated investments are assumed to already have been executed. The value of our third and final strategic option is NOK 3.946.287.020, and this value stems from the possibility to wait with the phase III/ FDA filling until the phase I/II studies are completed. This allows the company to put a halt to their operations if the future outlook takes a turn for the worse after the phase II studies are completed. The total loss will then accumulate to the cost of the executed investments related to the pre-clinical and phase I/II study, rather than the overall total project investment. This is of course valuable, and is ignored in a discounted cash flow analysis. Moreover, an exercise of this option implies that the company seeks approval for the product, and will enter the market with total certainty as long as the filling gets approved. This option does therefore incorporate any flexibility value of a delayed market launch decision as well. As a conclusion, the real option valuation model yields us a company value of Nano equal to NOK 3.946.287.020, and a share price of approximately NOK 80,39. The output of the real option valuation can be found in the appendix.

Sensitivity analysis

The calculations of company values in the static DCF framework rests on numerous assumptions regarding the value of input variables, and there has been applied great amounts of discretion. It is therefore great uncertainty associated with the chosen input values and the resulting value estimate. We will therefore run a Monte Carlo simulation on the model, making the same assumptions as in the calculation of ENPV, with the exception of the probabilities. The probabilities have naturally been removed to account for the static nature of the model. We will then based on the simulation results perform a sensitivity analysis concerned with disclosing the uncertainty in the individual input variables. Finally, we will use the insights from the sensitivity analysis to make sequential individual adjustments to a few chosen variables, in order to measure the subsequent effect on the value estimate. The output from the Monte Carlo simulation may be seen in the appendix, and the result from the sensitivity analysis is shown in the figure below.
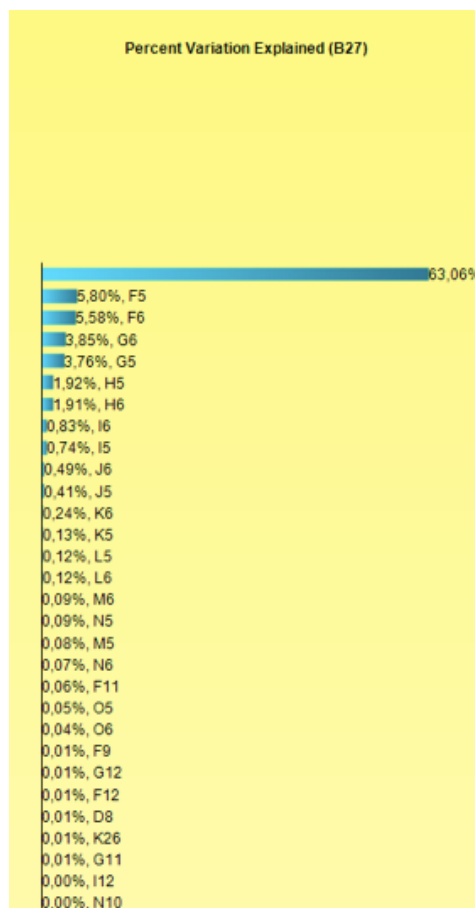
Exhibit 6: Results from sensitivity analysis on the static NPV model.

As can be seen from the exhibit, there are only a few variables that account for most of the variation in the NPV estimate, and the most uncertain variable is the cost of equity, accounting for a staggering 63,06% of the variability. The rest of the essential variability is mainly due to the uncertainty regarding the future market shares (line item 5) and the treatment prices (line item 6).

Nano's revenues is expected to arrive in the future, and large parts of it is expected in rather distant years. This entails that the chosen cost of equity used to discount the free cash flows will affect the result significantly. If we combine this insight with the great uncertainty attached to the actual true value, we recognize that most of the estimation error in our results most likely is linked with the applied cost of equity. We have as a result chosen to apply a change of +/- 10% in the cost of equity, in order to get a feel for the impact the chosen rate will have on our valuation estimates. Reducing the cost of equity to 8% increases the NPV of the company by 65,49%, and increasing the cost of equity to 28% reduces the

NPV by 67,19%. This illustrates the major impact the choice of cost of equity inflicts on the estimations of company value.

Larger market shares or higher prices in the future are equivalent with higher revenue streams, which naturally implies that the company value is also significantly dependent on the projection of the future market share and price per treatment. However, the price per treatment and market share is causally linked through their effect on the revenues. I.e. the revenues are calculated by multiplying estimated market with the market share and with the price per treatment, which induces the realization that a percentage change of one of the two variables should yield an equal change in NPV. This is because the variability of the two variables gets aggregated in the revenue estimate. We therefore observe that a change of +/- 10% for the market share while keeping the price per treatment fixed, and vice versa, results in an NPV change of +/- 27,66%. The remaining input variables show insignificant variability in regard to the overall resulting NPV. We thus conclude that the cost of equity, market share, and price per treatment are the main culprits behind the uncertainty of our static NPV estimate.

Discussion

The purpose of this paper is to conduct a valuation of Nordic Nanovector ASA through the use of both traditional discounted cash flow models and real option analysis. The statc discounted cash flow analysis values the company to NOK 6.133.507.000, which is equivalent to a stock price of NOK 124,94. A static DCF value represent only a single point estimate in the future, and is as a consequence highly sensitive to its underlying assumptions. A more realistic approach to estimating an uncertain future value is to create many probability weighted scenarios, and use the average value as the expected NPV. This method is called ENPV analysis, and values the company to NOK 3.260.601.301, with a corresponding share price of NOK 66,42. The ENPV value is therefore considered as the most reliable by a vast margin. Early stage biotech companies like Nordic Nanovector do, however, generally experience lots of flexibility in their projects and product development, a feature that traditional DCF models fails to account for. The real options valuation yields a company value of NOK 3.946.287.020, and a share price of approximately NOK 80,39, a valuation that is slightly higher

than that of the ENPV. This result is in line with popular theory on the topic, stating that real options analysis are supposed to generate higher estimates than common NPV approaches, because they take the inherent flexibility into account by assigning it an appropriate value. The calculated option value is then to be added on top of the values generated from the traditional net present value calculations. Hence, despite of the fact that the ENPV outperforms the static NPV, it still falls short in comparison with the real options framework when the subject of the valuation exhibits significant flexibility. Since the project currently is situated in the phase I/II part of their studies, we still find it to be significant amounts of flexibility left. We thus conclude that the share price of NOK 80,39, generated by our real options analysis, is the most accurate in theory. Moreover, because there are significant uncertainty in relation to all our estimates, irrespective of the applied valuation method, we fail to find any other differentiating reasons other than the theoretical one. In light of this, the share price of NOK 80,39 is set as the final value. Comparing this too the prevailing stock price of Nordic Nanovector ASA at May 31, 2018 of NOK 50,95, signals a distinct buy recommendation for the company stock.

Conclusion

We have now conducted a full valuation of Nordic Nanovector ASA and discussed several aspects regarding the estimated value, and consequently established a solid foundation for answering the respective topic questions presented in chapter 1. The topic questions asks:

1. What is the fundamental value of Nordic Nanovector ASA?
2. Will the use of discounted cash flow methods and the real option method result in different estimations for the fundamental value of the company?

This papers estimated company value equals NOK 3.946.287.020 with a corresponding share price of NOK 80,39. This is approximately 57,8% higher than the observed market valuation, and thus implies a significant upside potential for the stock. We therefore provide a buy recommendation for the company stock, and urges current stockholders to remain patient and keep it as part of their portfolio.

In our opinion, the static NPV method demands to much stability and unrealistic assumptions in order to work, and as a consequence significantly overvalued the company stock with a stock price of NOK 124,94. The ENPV method, averaging thousands of future scenarios, yielded the much more precise and reliable estimate of NOK 66,42. This is because the model incapsulates much more of the uncertainty. The model, however, still failed to account for the large value of the remaining flexibility currently in Nano's possession. The real options method, which used the ENPV as its base case value, yielded the share price of NOK 80,39. This is the most reliable and appropriate share price because the value of flexibility is accounted for, by adding it on top of the ENPV estimate.

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Appendix

Appendix 1 - Payroll estimation

The next years earnings per employee is therefore assumed to increase by 8%.

Multiplying the forecasted earnings per employee with the expected number of employees yields the total future payroll expenses.

Payroll expenses: 000'	2015	2016	2017
Payroll	29036	37956	43122
Total employees	22	26	28
Earnings per employee	1320	1460	1540
Growth % EPE	1	11 %	5 %
Average growth of EPE		8 %	

Appendix 2 – Estimation of R&D expenses

Uses the reported R&D costs in the annual company reports of 2013–17, to find the average R/D to payroll ratio and R&D to other costs ratio. The ratios are then applied for the future periods to estimate all the respective costs.

	2013	2014	2015	2016	2017
Total R&D	17 700	42 500	129 500	150 600	220 300
Payroll expenses	4991	13690	29036	37956	43122
R&D payroll expenses	4900	11400	26500	22400	32100
Other payroll	91	2290	2536	15556	11022
Ratio R/D to payroll	0,98	0,83	0,91	0,59	0,74
Average			0,81		
Tot. other operating exp	12 933	54 159	151 055	168 778	257 566
R&D expense	12 800	31 100	103 000	128 200	188 200
Other operating expenses	133	23 059	48 055	40 578	69 366
Ratio R&D to other	0,99	0,57	0,68	0,76	0,73
Average			0,75		

Appendix 3 – Costs allocated over the phases

| | Phase 1 and 2 | | | | | | | Phase 3 &Approval |
	2013	2014	2015	2016	2017	2018	2019	2020
R&D			560 600			953 610		553 100
Operational			212 686			307 017		177 741
Marketingand sales costs			0			0		15200
Total cost of phases:			773 286			1 260 628		746 041
Probablity			100 %			70 %		53 %
Probability adjusted cost			773 286			882 439		395 402
Tot prob adj phase costs			1 655 725					395 402

| | Market | | | | | | | | | | |
2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
					5361295,0					
					1593464,0					
					3064124,0					
					10018883,0					
					100 %					
					10018883,0					
					10018883,0					

Appendix 4 – ENPV Monte Carlo simulation

Number of Trials	100000
Mean	3260601,301
Median	2874229,882
Standard Deviation	2461150,953
Variance	6,06E+12
Coefficient of Variation	0,7548
Maximum	19595488,55
Minimum	-3046464,335
Range	22641952,89
Skewness	0,9895
Kurtosis	1,583
25% Percentile	1516327,072
75% Percentile	4580220,012
Percentage Error Precision at 95% Confidence	0,46785

UNDERLYING

C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
										36274709,51
									29209814,66	
								23520885,04		23520885,04
							18939936,44		18939936,44	
						15251177,48		15251177,48		15251177,48
					12280844,52		12280844,52		12280844,52	
				9889016,26		9889016,26		9889016,26		9889016,26
			7963022,61		7963022,61		7963022,61		7963022,61	
		6412137,21		6412137,21		6412137,21		6412137,21		6412137,21
	5163303,63		5163303,63		5163303,63		5163303,63		5163303,63	
4157694,00		4157694,00		4157694,00		4157694,00		4157694,00		4157694,00
	3347937,80		3347937,80		3347937,80		3347937,80		3347937,80	
		2695890,44		2695890,44		2695890,44		2695890,44		2695890,44
			2170836,41		2170836,41		2170836,41		2170836,41	
				1748042,37		1748042,37		1748042,37		1748042,37
					1407592,07		1407592,07		1407592,07	
						1133448,18		1133448,18		1133448,18
							912696,80		912696,80	
								734939,16		734939,16
									591801,75	
										476541,91

PRECLIN

C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
										34851704,69
									27847009,17	
								22222133,10		22203108,77
							17708489,26		17689564,72	
						14089595,74		14070978,29		14052076,85
					11190936,38		11172821,58		11154397,75	
				8871803,05		8854367,77		8836608,11		8818517,99
			7018732,59		7002129,39		6985196,05		6967924,75	
		5540226,51		5524579,46		5508605,57		5492295,81		5475640,90
	4362502,15		4347904,21		4332990,90		4317752,48		4302178,82	
3426072,53		3412584,76		3398799,87		3384708,01		3370298,84		3355561,50
	2670644,43		2658023,09		2645118,63		2631921,11		2618419,95	
		2071977,31		2060268,75		2048295,69		2036048,52		2023516,83
			1598984,51		1588218,00		1577209,54		1565950,30	
				1226587,07		1216774,24		1206745,03		1196491,86
					934556,93		925691,79		916637,77	
						706586,04		698645,72		690544,63
							529537,00		522483,17	
								392839,30		386620,32
									288002,12	
										208220,50

PHASE1

C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
										34872082,92
									27867352,78	
								22242442,16		22223487,00
							17728763,82		17709908,34	
						14109835,85		14091287,35		14072455,08
					11211142,05		11193096,13		11174741,36	
				8891973,99		8874607,76		8856917,15		8838896,22
			7038867,62		7022334,31		7005470,37		6988268,33	
		5560322,22		5544747,40		5528844,30		5512604,45		5496019,06
	4382550,53		4368029,92		4353190,98		4338024,69		4322521,70	
3446057,44		3432656,44		3418953,30		3404938,96		3390603,97		3375938,45
	2690639,24		2678112,65		2665296,24		2652180,88		2638757,00	
		2091971,09		2080368,20		2068492,09		2056333,85		2043884,15
			1618961,77		1608315,69		1597416,59		1586256,07	
				1246526,16		1236853,35		1226950,54		1216810,09
					954427,96		945728,37		936823,77	
						726348,31		718606,08		710684,89
							549136,03		542320,69	
								412203,37		406271,56
									307038,79	
										226813,33

PHASE3

										35966999,68
									28908359,52	
								23226490,23		23223613,93
							18653419,68		18650406,55	
						14973349,98		14970218,91		14967084,53
					12012491,54		12009265,68		12006028,45	
				9630877,59		9627583,61		9624270,24		9620938,86
			7715773,90		7712441,04		7709081,15		7705695,25	
		6176372,92		6173031,97		6169657,01		6166248,66		6162807,69
	4939522,42		4936204,64		4932846,75		4929449,01		4926011,76	
3946287,02		3943023,06		3939713,97		3936359,66		3932960,09		3929515,26
	3145999,36		3142769,32		3139489,92		3136160,76		3132781,48	
		2503742,89		2500567,53		2497339,27		2494057,41		2490721,30
			1988745,98		1985645,91		1982490,19		1979277,88	
				1576213,23		1573208,43		1570146,14		1567025,17
					1246161,39		1243270,75		1240321,71	
						982482,38		979723,22		976905,70
							772189,22		769576,84	
								604809,14		602356,48
									471895,36	
										366634,17

Appendix 7 –Sensitivity analysis

Statistics	Result
Number of Trials	100000
Mean	12,598,788,0913
Median	-544,235,5836
Standard Deviation	20,619,208,6812
Variance	4,251518E+014
Coefficient of Variation	1,6366
Maximum	80,200,750,5179
Minimum	-700,235,7660
Range	80,900,986,2838
Skewness	1,0293
Kurtosis	-0,7212
25% Percentile	-582,812,3402
75% Percentile	35,275,699,8357
Percentage Error Precision at 95% Confidence	1,0144%

Variable	Estimated NPV	New NPV +10%	% change in NPV	New NPV -10%	% change in NPV
Cost of equity	6 133 507	2012540	-67,19 %	17771493	65,49 %
Market share	6 133 507	7830002	27,66 %	4437013	-27,66 %
Price per treatment	6 133 507	7830002	27,66 %	4437013	-27,66 %