Valuation of Danisco
A Discounted Cash Flow + Real Option Premium Approach

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Executive Summary

The thesis has a dualistic purpose. 1) It attempts to estimate the fair value of Danisco using the extended net present value, proposed by Stewart (1984). 2) It argues that the ENPV is a more refined valuation model for practitioners, highlighting that incorporating a real option perspective enables a more informed investment decision. An extensive academic body of research exist on real options, but it was identified that a limiting factor for its use, is the lack of practical examples. Subsequently the thesis has both a theoretical and practical scope; but with an emphasis on practicality, as the theoretical discussion revolves around solving the practical issues related to the construction of the ENPV model.

Part I contains a complementary theoretical discussion, outlining the benefits of the – considered best-practice valuation model – the discounted cash flow, and highlighted its embedded static nature and that in situations of stable competitive dynamics the model was favored compared to a real option model, due to its reliance on historic financial data. However in situations of uncertainty, defined as the continuous emergence of new information and the existence of managerial flexibility, ROA was superior. Subsequently, applying a complementary valuation model would yield a more accurate estimate for the value of Danisco. The process of identifying real options became incremental and based on a theoretical review and the case study analysis (Part II) a three-dimensional identification model was developed, proposing to utilize the criteria of high uncertainty and high managerial flexibility as defined above, but included low correlation among option as an important factor. Using this model, the 2nd generation bio-fuel research project with Dupont (DDCE), was identified as a sequential compound option, wherein abandonment and expansion options were present and of significant relevance for Danisco’s future.

Part III comprises of the practical valuation of Danisco, where it is divided into applying DCF on its current operations and applying ROA on DDCE. This equaled a fair value of dkk 526 per share, wherein current operations accounted for dkk 512 per share and DDCE’s real option premium accounted for dkk 14 per share. Based on the estimated fair value of Danisco the recommendation to investors is “BUY”, as the share price as of 22 September 2010 was dkk 500 per share.

The conclusion of the thesis is that the ENPV model is a more refined valuation model, enabling investors to distinguish between relevant real options and their counter parts, thereby overcoming the theoretical black hole that infinite real options exist within a firm setting. Two processes were identified as incremental in the efficient application of ENPV, firstly; the identification of real options and secondly; We developed a six step real option valuation model. Based on this, it can be concluded that it is a meaningful approach for practitioners to apply real options. If not contributing actual value, incorporating a real option perspective enables the identification of strategic value. In our case we can reject that DDCE is Danisco’s answer to securing the future growth. The application of the real options approach is computationally heavier than traditional models. The validity is difficult to maintain, when estimating the novel variables in ROA. Despite these complications, we found the level of information retrieved from the real options analysis is valuable.
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Introduction

1. Problem Identification
Asymmetric information often exists between management and potential investors in a firm. Any investment decision is characterized by uncertainty and this holds true on the stock market. A method of partially overcoming the knowledge-gap is by performing a fundamental firm valuation. However, implementing this is something the financial literature has always struggled with. To address the issue of intrinsic value – associated risk, time and value of money, was incorporated into the capital based cash flow valuation models (Fisher, 1930) and (Williams, 1938). Empirical research highlight that these models are considered standard practice, largely because of the inherent logical linkage between strategy and financial statements, which enables one to develop a forecasted budget.
Myers (1984), Trigeorgis (1996) and Copeland & Tufano (2004) describe the embedded short-comings in this traditional valuation method. This body of research brings forth a new investment paradigm called real options, which attempts to value management’s investment flexibility as an additional source of value. They criticize the traditional valuation methodology emphasizing, that there is an embedded flaw in this model, as investments are seen as irreversible, and it therefore operates with a static notion of decisions over time. Real options attempt to incorporate management’s strategic choice to alter investments given changes in the external and internal environment.

Stewart (1984) described the relationship between the two valuation methodologies; Extended net present value = Static Net Present Value + Real Option Premium (hereafter ENPV).

Real option approaches were initially thought of as an internal capital budgeting valuation tool and not directly applicable on firm level. Managerial flexibility might be a source of additional value and this should in theory be reflected in the stock price. Subsequently a paradox exists, as cash flow based valuation models are considered standard, but does not incorporate the choice to change our investment decision associated with a given project. As an investor, it therefore becomes a dilemma of whether the fundamental value derived from a cash flow based model is appropriate or additional value should be added due to potential real options within the firm. The fact that investments have valuable strategic options embedded in them has great allure, however there is a danger that this argument will be used to justify poor investments. Subsequently this thesis seeks to investigate whether the real option model can reduce the information barrier for investors and thus validate its mainstream use.
Practically the thesis seeks to investigate the applicability of the EPNV model using a case study in Danisco and herein perform a fundamental valuation enabling a discussion of whether the model facilitates a more accurate value of the stock price.

1.1 Problem Statement

The thesis has an exploratory focus and seeks to construct a more refined valuation model by practically implementing the ENPV model on Danisco A/S, as proposed by Stewart (1984). Our approach is innovative, as we see the firm composed of areas most appropriately valued using standard DCF, and other areas, which fulfils real options criteria are subsequently best captured using a real option valuation model.

The thesis builds on a hypothesis that understanding how to incorporate managerial flexibility from an outside investor perspective, enables a more informed and efficient investment decision on the stock market. These aspirations have yielded the following problem statement:

*What is the fair value of Danisco using the extended net present value approach? How can ENPV enable a more informed investment decision?*

1.1.1 Research Questions

To focus and narrow the investigation fostering the necessary insight, the following research questions have been included, and each addresses a fundamental issue enabling the authors to answer the problem statement:

- What are the central limitations in the Discounted Cash Flow and can the Real Option valuation methodology improve these?, and under what circumstances can these supplement each other?
- What characterizes Danisco competitive sphere? Given this, how does a forecast of industry profitability look?
- What characterizes Danisco’s financial profitability? And how is the relative performance with a peer group of competitors?
- What divisions are suited for applying either DCF contra ROA valuation model to achieve an accurate market value of Danisco? And how could one identify relevant real options in Danisco?
- What is the fair value of Danisco, using a DCF valuation model?
- What is the fair value of the identified real options in Danisco?
• Does the increased level of information achieved through ROA, validate that investors include a real option premium when valuing stocks?
• Based on the case in Danisco, can the ENPV generally be used by investors to value stocks? And what investment characteristics and criteria should investors look for?

1.2 Relevance
The thesis builds on three identified limitations within the academic literature on business valuation; initially, the authors identify a gap between best practice valuation methodology, acknowledged as discounted cash flow and the recently developed theory of real options, which ascribe “hidden” value to choice, flexibility and uncertainty. The gap consists of, how an investor can quantify this added real option premium?
Secondly, although a significant body of research exists on real options, the majority has been theoretical presentations without applicable examples or case studies. By neglecting practicality, real options will never be an integral part of valuation and will remain a theoretical idea. This thesis will address this issue, of limited empirical research on real options. A comprehensive application of real option framework on Danisco, will provide insight into what the real option value drivers are, and a model to quantify this will be made. A typical application problem has been the advanced mathematics and unrealistic assumptions, which has refrained and discouraged many to try incorporating real options into their valuation. Based on this, the case study will test the limits and relevance of the real option framework.
Thirdly, the final step, for integrating real option into best-practice, and thus develop a more refined valuation model, is to understand what investors should consider when applying real options. Developing a more standardized approach to assessing real options, should enable easier access and enhance the applicability for quantifying the otherwise “hidden” real option premium.

1.2.1 Target Audience
The thesis attempts to utilize the vast body of research on real options as a supporting framework to the regular discounted cash flow valuation method. Adopting an empirically driven approach, the intent is to facilitate insight and practical knowledge on creating a more refined valuation model. The target audience of this thesis is therefore outside investors, faced with the task of performing practical business valuations.
1.3 Methodology

This section will elaborate on research methodology chosen for the thesis; thereby illustrating the framework established to answer the problem statement.

1.3.1 Structure

The structure of the thesis is constructed around 4 parts as illustrated in Figure 1 below.

Part I, develops and establishes the theoretical foundation through a comparable discussion based on the premise, that the discounted cash flow and real options approaches are inherently different, but can complement each other, facilitating a more precise valuation model for investors. Clarifying the conceptual and methodological framework embedded in the two models, will provide insight into the reasons behind why ENPV is a useful valuation model, and highlight its limitations. Not so much in technical terms, but more with regard to the reasoning behind it. It is the authors’ belief that such an analysis also helps to raise the confidence in the models.

Part II, Herein a strategic and financial analysis provides necessary insight, enabling the establishment of required valuation inputs and assumptions.

Part III, practical application of DCF and ROA on Danisco. Building on the deduced valuation model from Part I and the in depth understanding of Danisco provided via the fundamental analysis in Part II. This part’s central focus is the different models’ estimation and calculation techniques, as well as the results obtained. The identification of real options furthermore rests on a thorough understanding of Danisco.

Part III, the findings from Part I to Part III will be discussed using a dialectic approach integrating and discussing the theoretical and practical findings. Practicality, validity and implementation process of the ENPV will be discussed and will reflect on whether it enables a more informed investment decision.
1.3.2 Research Approach

The following is a clarification of our research approach, data collection and choice of theories laid out in order to improve the arguments and choices that are made throughout the thesis. Such a clarification will also assist the reader in understanding the arguments, interpretations and theoretical choices throughout the thesis.

The thesis utilizes a deductive causality based analytical framework, wherein it is assumed, that through the valuation models, it is possible to measure, depict and predict necessary and sufficient conditions for any phenomenon by creating a general model for valuations. The choice of a positivistic analytical paradigm enables the authors to adopt a causal logic approach to actors, markets and organizations thereby assuming rational and utility maximizing behaviour. As the valuation theory builds on this positivistic paradigm there is a coherent relationship between the problem statement and the choice of theory. However this aim is not without problems, as through this ontology a stylized version of Danisco will be portrayed and within this view there is a tendency to ignore variables that corrupt the generality of our conclusions. As the only constant on the market is change, any conclusions are contextual, and the valuation model needs to be reassessed as the internal and external competitive environment change (Fuglsang and Olsen, 2003).
These considerations do not invalidate the conclusions, but it is important to clarify the embedded positivistic axiom of universality in the chosen analytical framework (Ibid). The relationship between theory and practice should in financial theory be value-free (objective), however reality limits this as all valuation models are constructed based on an analyst’s opinion. As a consequence all conclusions should reflect and be validated by comprehensive empirical investigations.

This valuation positivism means that that the particular valuation is considered unbiased and most authentically reflects the prevailing market price of Danisco. However considering insight from behavioural finance the restriction of rational actors is not upheld as bounded rationality is introduced (Simon, 1987). Subsequently stock prices are influenced by market inefficiencies such as, cognitive biases in decision making resulting in over- or under-reaction to firm specific information (Shleifer, 1999).

The overall analytical framework is constructed using a deductive reasoning as the understanding of Danisco is shaped by the choice of theory, given as DCF and ROA. It is through the logic of these valuation methodologies Danisco is investigated. Deductive arguments are generally evaluated in terms of their validity and soundness, which reflects the aim of this thesis. The thesis attempts to test and validate the set forth premise of ENPV as a superior valuation methodology, investigated through an empirical application.

1.3.3 Case Study

The case study generates in-depth knowledge and a sharpened understanding of a single event; contrary to only examining a limited number of variables through quantitative data research or qualitative interviews. The advantage of large quantitative analysis is breadth, whereas their problem is one of depth. For the case study, the situation is the reverse (Yin, 2009).

Given that business valuation is a comprehensive process, and the limited available practical applications of calculating real option premiums, this thesis decided on a single holistic case study. Within the framework presented by Flyvbjerg (2006) the choice of Danisco falls under the category a “critical case study“, as it intends to achieve information that permits logical deductions of the sort, if the valuation model is applicable and valid for this case then it is possible to generalize it on others.

Because the thesis uses a “real life” case study and not a theoretical one, the complex nature of the firm and its environment will influence our valuation models and thus decrease the generality of the conclusions. Ideally our conclusions, can contribute to frame similar problems in other cases, but we should be aware that the essence may be lost when one tries to sum up contextual and complex issues. However any good valuation rests on the analyst’s subjectivity regarding certain variables, if the
argumentation is sound and well documented, incorporating changes in the model should not affect the validity and generality of the conclusions. Despite a lower generality compared to a theoretical case, the advantage of a practical case is the insight into the actual implementation process’ challenges and possibilities. The case study is ultimately intended to stretch and test the applicability of our more refined valuation model.

1.3.3.1 Choice of Danisco
Danisco has largely been labelled a “dog” among investors and the share price has steadily decreased since 2005 reaching its bottom the 9 of March, 2009 at 150 Dkk. Hereafter, driven by the divestment of its large sugar division, internal organizational restructuring and a general rise in the economy, suddenly the share price rose 233 percent reaching 500 Dkk, the 22th of September, 2010. Comparably, the OMX index has increased 95 percent over the same one year period, highlighting the firm specificity behind the rise in share price.

Danisco was initially chosen as it fulfilled our initial requirements of: 10 years of available data, lack of performance on the stock market and few large identifiable real options. The case study has a descriptive nature aimed a deducing and proving the validity of our valuation model. Our investigation of Danisco began in January, 2010 and we have been interested spectators watching this dramatic increase in share price from the sideline. Over the course of the this period the choice of Danisco was strengthened as seemingly, the market swiftly reacted, after management adjusted the budget upwards in early March, 2010. As in financial theory, the share price seems to be driven by prospected earnings. Another significant action that influenced investors was the fact that management decided to disclose more information on its product divisions, hereby facilitating more insight (Børsen, 28.05.2009). This strengthened our conviction that Danisco was an interesting case, wherein it was possible to test the application of ENPV.

1.3.4 Data Collection
The scope of the thesis is to replicate the reality of an investor, where the main data source is publicly available information; subsequently we have refrained from performing primary empirical data. A vast body of secondary qualitative research has been used to obtain hard to identify information especially related to the technological possibilities of Danisco. Considering and investigating independent experts’ opinion enables us to reflect on and assess what seems to be the critical issues. Primary empirical data
could have provided additional insight into the capital budgeting decisions faced by managers and enabled a more accurate framing of the real option calculation.

1.3.4.1 Theoretical literature
The choice of this theory is based on a comprehensive scientific research of available material creating a general consensus on what is considered “best practice”.

Real option theory can be split in two categories, with a strategic and mathematical focus. Within the strategic category “classic” articles from Myers (1984) and Copeland & Antikarov (2003) have inspired the problem statement, and the latter as to how real options can be identified. The mathematical literature refers to the calculation-process where our primary inspiration has been Mun (2005). To ensure practicality and usability, this thesis seeks to minimize the complicated mathematics often found in other real option analysis.

Our case Danisco, is characterized as a biotechnology firm and within this sector, a vast body of research on real options exists. Authors such as Kellogg & Charnes (2000), Gustafsson (2000) and Ollila (2000) emphasize the accurate nature of the binomial lattice in valuing real options. Penham (2007) and Brealey, Myers & Allan (2008) has been the guideline when performing the discounted cash flow valuation. The DCF model is fairly standardized and the choice of reference does not have a major effect. While inherently having a different focus, both valuation methodologies subscribe to a logic positivistic ontology. The majority of real option literature uses the model on a project level, but all agree that a firm in theory must be an infinite number of real options. Myers’ (1984) ENPV formula can however be viewed from a firm perspective as any firm overall can be characterized as one large project. This choice presents a unique way to view a firm, as suddenly its discounted cash flow and real options can complement each other, as each model has certain strengths and weaknesses. This will be elaborated on in chapter 3.

1.3.4.2 Validity Criteria
The generality and applicability of the constructed model is discussed and evaluated against four criteria for valuation models, inspired by Plenborg’s (2000), which consists of fundamental and the cosmetic requirements.
The fundamental requirements consist of: object of analysis, modelling and assumptions. These address the realism of the models’ assumptions and whether they give a precise (unbiased) result, whereas the cosmetic requirements focus on user-friendliness and intuition of the results. The fundamental requirements dominate the cosmetic ones, as deviations from the former can lead to irrational investment behaviour. However, the importance of cosmetic requirements should not be underestimated, as it is of great importance for investors, to be able to understand the model and a central requirement, if real option valuation is to become an important part of the standard valuation tool kit.

Flexibility has been included, as the thesis seeks to investigate the applicability of real options. Subsequently the models’ ability to incorporate changes over the course of an investment, defined as events, will be discussed. Events are the sequential stages in the development process when management has the ability to decide on the future of an investment.

These criteria will be used to assess the quality of both the DCF and ROA in chapter 3 and later on ENPV in chapter 9, wherein we discuss our results.

1.3.5 Delimitation

To ensure the practicality, it has been necessary to narrow the focus of the thesis. The scope is fairly broad as two full valuation models are applied on an actual case study, with all its complexities. Especially given the complicated nature of the real options model, it is necessary to limit the amount of topics, which are treated thoroughly in the thesis.

1.3.5.1 Traditional Valuation Models

The thesis builds on a premise that Stewarts (1984) formula for extended net present value, accurately captures firm value. Herein is an assumption that, net present value + option premium, can be separated and valued individually.
We chose discounted cash flow as the basic valuation method, as this was highlighted among practitioners as the standard valuation model (PwC - Valuation Methodology Survey, 2009). Subsequently other useful models such as multiples based on industry peers and economic value added have been disregarded. Incorporating these models could further validate our found firm-value. The thesis assumes that the reader is familiar with the DCF, whereof chapter 3 will only highlight the relevant aspects and deviations of the model compared to real options. A thorough presentation can be found in appendix C.

1.3.5.2 Real Option Theory
The options research-field has produced a tremendous amount of literature since the breakthrough of Black, Scholes (1973) and Merton (1973). We have chosen to focus on the binomial lattice model, as this model is considered by practical real options literature, best suited for valuing real investments. Furthermore, compared to Monte Carlo simulation and Black & Scholes, it can incorporate management’s strategic choices. The choice of this model supports the general consensus among practitioners that the next step for incorporating real options into mainstream valuation is to focus more on its practical applications (Mun, 2005).

1.3.5.3 Danisco A/S
The authors have not included cash flow from Biosoprene, a research and development project in collaboration with Goodyear on developing a renewable alternative to rubber, in making tires. Commercial availability of the product is expected in 2013, with 50 million invested over a 3 year period and a best case market potential of 1 billion Dkk (Danisco Presentation - June 12th, 2009). A potential real option is present as management’s ongoing decisions can make or break this venture. The choice of not including this, is made on page restrictions, and it has been necessary to focus only on substantial real options and not include ones deemed small.

1.3.5.4 Practical Focus
The focus of the thesis is on the practical application of ENPV more than the mathematical or technical issues of the real option model. These issues are therefore only discussed when the authors deem that it adds value to the understanding of the application of the model. This is based on an idea that the introduction of complex mathematics would have changed the character of the thesis, giving less space
to the issues, which are crucial for investors, and made it less approachable from the viewpoint of non-financial or non-technical decision makers.

1.3.5.5 Timeframe

Business valuation is an “a-work-in-progress” process and the estimated value changes as new information - strategic and financial emerges. Therefore it has been necessary to define a timeframe to avoid having continuously having to refine estimates and the underlying argumentation. Danisco released first quarter financial figures on the 21st of September and these have been included in the valuation model. Thus 22nd of September, 2010 has been selected as the cut-off date, and data prior to this has been included resulting in the found share price for Danisco.
2. Presentation of Danisco

Danisco\(^1\) is a Danish based enzymes\(^2\) and food ingredients developer. After recognizing the growth potential in enzyme production, Danisco began divesting production divisions, Alcohol in 1999 and Sugar\(^3\) in 2009. Furthermore the disappointing Flavour division\(^4\) was divested in 2007. This was intensified as the new CEO Tom Knutzen, since his appointment in 2006, changed the structure and course of Danisco.

The declared financial goal is to achieve an EBIT margin of 13.5 percent in 2012. This is to be accomplished by increasing the profitability focusing on reducing debt gearing to 1.5 – 2.5 times EBITDA and achieving a RNOA\(^5\) larger than 11 percent (Annual Report, 2010). To meet these financial goals a number of strategic initiatives have been employed. These are:

- Become first choice
- Expanding production facilities to meet demand
- Best supply chain
- Yearly organic growth of 5-7 percent
- Consolidating share in international markets through acquisitions and organic growth

The strategic motivation relates to the hypothesis of value creation by focusing on core business versus non-core business (Williamson, 1981). Furthermore the strategic initiatives can be derived from financial aspirations of increasing profitability after turbulent years of restructuring and global recession. Substantial amounts of debt have been paid off, which pressured the limited available cash flow. The earlier increase of debt was a result of an aggressive acquisitive strategy aiming to create powerful and

\(\text{Footnotes:}\)

\(^1\) Founded in 1989 through a merger of De Danske Sukkerfabrikker og De Danske Spritfabrikker and focused on the production of food ingredients, sugar, frozen vegetables, alcohol and packaging. A change in management, in 1997, lead to a change in strategy with an enhanced focus on food ingredients. Danisco A/S bought in 1999 the Finish ingredients firm Cultor and sold off the production of Alcohol.

\(^2\) Enzymes are often divided in to three main groups of use; Food, Feed, and Industrial enzymes. Within the uses can be mentioned: food and beverage production and processing such as sugar and starch processing, dairy products, beer production, wine processing, juice processing, baking industry, and bio-fuel production.

\(^3\) The previous successful sugar production division was sold off in 2009 for approximately DKK 5.6 billion plus DKK 600 million for EU sugar quotes. The divestment was part of creating a more focused ingredients strategy (Børsen, 14. July 2008).

\(^4\) Danisco sold of the flavour division in 2007 for DKK 3.4 billion. Flavours had a market share of 2-3 percent and was not considered cost effective and in line with Danisco future strategic direction (Danisco Press Release, 3. May, 2007)

\(^5\) Return on Net Operating Assets (RNOA) measures the ability to generate profit from assets. Firm’s such as Danisco such in theory have a fairly high ratio as it is knowledge intensive, meaning less reliance on physical assets. Danisco had a very low ratio of 4 percent in 2010.
innovative ingredient and enzyme divisions. Moreover these strategic initiatives have transformed Danisco from a low-cost producer on a highly competitive market with homogenous products (sugar and alcohol) towards becoming a more differentiated developer and producer on markets with fewer competitors (Porter, 1980). This has put increased emphasis on research and development. Historically Danisco’s core competence has been driven by low-cost production via economies of scale. However with a new competitive reality, management had to engineer an organization that utilized the historic competence of optimization with an increased focus on innovation as many markets still have unmet needs. The purchase of Genencor\(^6\) signals an attempt to integrate its technology and knowledge base to commercialize bio-based solutions within high-growth markets (McGahan, 1999). As these markets are characterized by uncertainty, Danisco has diversified risk by entering into a number of partnerships, including the joint venture with DuPont to commercialize second-generation bio-ethanol (Hereafter DDCE) (Annual Report, 2009).

Overall food ingredients contributed approximately 77 percent of total revenue. Within industrial enzymes, feed ingredients and bio-ethanol accounted for 19 and 15 percent. Furthermore within industrial enzymes, food enzymes stood for 29 percent of Genencor’s total revenue. This emphasizes the importance of these markets and especially the food ingredients market. Other markets include detergents and textiles, which constituted 7.4 percent of total revenue and showed a modest growth of 3 and 4 percent respectively (Annual Report, 2010). Market analysts consider these markets as being in the mature phase of the life cycle (Frost & Sullivan, 2008).

Danisco has sales distribution divisions across North America, Europe and Asia Pacific. The geographical strategy has two pillars; one focused on consolidation and cost reduction on the production side. The other seeks to expand ingredients global reach by establishing alliances and partnerships with other major suppliers (Business Insight, 2010). Danisco has 40 manufacturing sites in food ingredients and 9 manufacturing sites in enzymes. This strategy is to be driven by distribution complexities and not aimed at developing new products.

The financial year 2009/10 has been a turning point for Danisco. The firm continues to take important steps towards meeting the strategic and financial ambitions. Net income saw a significant increase to Dkk 481 million. In order to legitimize the shift in strategic focus, margins should on the long-term improve beyond 2005-2008 level. Becoming a more focused firm within enzymes and ingredients changes the benchmark (Grant, 2008). Previously Danisco had part production - part biotechnology. Now

\(^{6}\) Danisco acquired the American industrial enzymes developer Genencor in 2005 for approximately DKK 5.700 billion. Genencor products are used in animal nutrition, detergents, bio-ethanol, textile treatment, carbohydrate processing and food and beverages.
the firm is largely a biotechnology firm and within this industry, financial margins are expected to be significantly higher. A more thorough investigation will be performed in the financial analysis below (Ref. Section 5).

2.1 Product Portfolio

Danisco consists of the chemicals division, food ingredients and the biotechnology division Genencor. The ingredient portfolio is comprised of ‘enablers’ and ‘bio-actives’ (Sweeteners and Cultures), which also reflects the overall organizational structure. Two separate divisions are responsible for logistics\(^7\) and sales\(^8\), highlighting that Danisco is a hierarchical organization.

Enabling ingredients such as emulsifiers, hydrocolloids and functional systems provide technological benefits, in terms of more efficient nutrition, whilst bio-actives or health-orientated ingredients such as pro-biotics and specialty carbohydrates, provide physiological effects, facilitating better health. The Enablers and Sweeteners divisions are market leaders within their segment, whilst Cultures is the second largest producer of cultures and media for the dairy-, meat- and health industry. (Annual Report 2009) & (Business Insight 2010).

Genencor delivers bio-based industrial enzyme solutions. Major application areas include industries as diverse as feed ingredients, detergents, bio-ethanol, textile treatment, carbohydrate processing and food and beverages. (Annual Report, 2009).

Danisco only launched one ingredient in 2009, however approximately 5000 customizations were made divided into Sweeteners, Enablers and Cultures. Industrial enzymes (Genencor products) is characterized by sizeable development costs and few product launches (approximately 4 in 2009). Both within ingredients and Industrial enzymes patent protection is an essential competitive barrier. The industry is characterized by few product innovations but many smaller adaptations.

For elaborations on Danisco, see Appendix A herein are presentations of the Markets, Basic Economics and Corporate Governance.

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\(^7\) Logistics food ingredients (LOGFI) is responsible within ingredients, while Genencor has its own subsidiary
\(^8\) Sales & application food ingredients (SAFI) and within Genencor Sales Industry Enzyme
Part I – Theoretical Framework

3. Valuation Theory
This chapter has three purposes: Initially, it will present the limitations of traditional valuation models, thereby facilitating the existence and emergence of real options. This facilitates the second purpose, which is to improve our understanding of how the real options model can be used on Danisco. The third purpose is conclusively to try to deduce, when a complementary model is more accurate than using a standard DCF model. Both models will be evaluated against the valuation model criteria set forth above to highlight their inherent strengths and limitations (Ref Section 1.3.4.2).

Damodaran (2002) describes how most valuations done in the “real world”, are cash flow based valuations and states: “it is the foundation on which all other valuations approaches are built”. Numerous empirical studies support this claim and the DCF is considered best practice among investors (PwC - Valuation Methodology Survey, 2009) and (Demirakos, Strong & Walker, 2004). The DCF model is still the most widely used approach, but economists agree, that it does not have the ability to capture the value of flexibility. The approach of Extended Net Present Value = DCF value + Real option Premium (Myers, 1984) and (Mondher, 2002) is a compelling approach if this could be implemented instead of either choosing one or the other method. Analysing Danisco using this approach, could facilitate new insight into the value of pipeline projects, and the value of decision-making.

3.1 Limitations of Discounted Cash Flow Approach
The rationale behind DCF is to incorporate risk, time value of money and timeframe on expected future cash flows to find the intrinsic Net Present Value. This makes intuitively good sense, and is among other reasons, why the model is so attractive for many to work with. Basically the DCF utilizes the firm’s financial statements and together with the environmental competitive dynamics to develop a forecasted budget. Herein the free cash flow⁹ is calculated and discounted with the risk adjusted rate¹⁰ after accounting for the level of debt versus equity (Penham, 2007).

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⁹ Penham (2007) defines the free cash flow to the firm (equity and debt holders) as: Operating Income + Depreciation and Amortization – Changes in Net Operating Assets (change in Capital Expenditures and Working Capital).

¹⁰ Brealey, Myers & Allen (2008) and Penham (2007) state that the capital asset pricing model (CAPM) is preferred when estimating investors cost of capital.
It is assumed that the reader is familiar with the general methodology of the DCF, if not, a thorough presentation of the inherent assumptions and application can be found in Appendix C. The thesis deems that because the model is standard practice, the important aspect of performing a DCF valuation lies in the estimation process, which will be dealt with when applying the model in chapter 7.

The classical criticism of the DCF is, even though it is simple in thought; there is a tremendous sensitivity to the choice of cost of capital and achieving a valid estimation of the central variables is complex. The terminal value is seen as being arbitrary as the future is difficultly predicted. The static notion that historical data is seen as representative for assessing the future is furthermore questioned (Mun, 2005) and (Copeland, Koller & Murrin, 2000). An assumption often criticised is the fact that retained earnings is seen as being reinvested without generating shareholder value (Brealey, Myers & Allan, 2008). This is assumptions is often seen broken in real life further emphasizing the frail ground on which the model lies.

### 3.1.1 Flexibility

It is important to note that the DCF does not consider the value of active management. This implies that all future investment decisions related are taken in present time, and subsequently management is seen as being unable to alter its decisions throughout the course of the project’s life, which could have limited potential losses or increased cash flow based on changes in the environment. The DCF model is therefore recommended for situations where such decisions cannot significantly impact the value of an investment. Generally the value of real options must be low in the following situations:

- Firms where irreversible investment are small (e.g. low capital investment)
- Firm’s with diversified products, where decisions about expansions and development of single products seems to have a smaller impact
- Firms with stable markets, were large upside and downside potential is limited

### 3.1.2 User Friendly

While seemingly very intuitive, a large number of uncertain variables need to be addressed and consequently the result of the DCF can be debated. The linearity between reformulating budgets and forecasting based on strategic and financial analysis is easily communicated and understood. However the gain from easy communication might be offset by a loss of information, as only a single cash flow is
utilized for each time period. Furthermore the forecast does not explicitly visualize the uncertainty of the cash flows (Amram and Kulatilaka 1999). Coupled with its limitations regarding incorporating management’s strategic flexibility the model is most suitable for firms with stable cash flows. The comprehension of DCF being perceived as having a high usability is likely based on its long historic use.

3.1.3 Evaluation of Discounted Cash Flow Model
This section utilizes findings from above and the more in depth analysis from appendix C to evaluate on the advantages and limitations of using the DCF.

<table>
<thead>
<tr>
<th>Fundamentals</th>
<th>User Friendly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object of Analysis</td>
<td>Modeling</td>
</tr>
<tr>
<td>Firm or Project</td>
<td>Linear cash flow</td>
</tr>
<tr>
<td></td>
<td>Time consuming, but</td>
</tr>
<tr>
<td></td>
<td>fairly easy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assumptions</th>
<th>Flexibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal Period</td>
<td>Risk</td>
</tr>
<tr>
<td>Somewhat arbitrary</td>
<td>Beta</td>
</tr>
<tr>
<td></td>
<td>Probability of</td>
</tr>
<tr>
<td></td>
<td>project success</td>
</tr>
<tr>
<td></td>
<td>Incorporate Decisions</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

The DCF is recommended in stable situations with fairly predictable cash flow and when managerial decisions are of lesser importance. The model’s reliance on WACC and herein CAPM, makes the results debatable, as the estimation of investors’ risk premium on equity and debt is difficult to estimate. Furthermore, the terminal period equation is a simplification of reality and is very difficult to assess. The validity of the DCF results lies in the investor’s ability to understand the competitive dynamics of Danisco both currently and future, which enables a more precise estimate of the required variables. The Sensitivity analysis is a method wherein the investor can close financial and strategic doors and present the limitations of the constructed model. Lastly, it is necessary to incorporate real option model to capture flexibility as the model has a linear approach to investments.

3.2 The Real Options Approach
This section will give a thorough presentation of the real option valuation model. The presentation is divided in two. Firstly, the general theoretical thought is discussed focusing on its appropriateness for
Danisco. This includes investigating the different types of options and the identification of these. Secondly, the application of real options will be discussed and presented.

3.2.1 Definition

Building on Black, Scholes and Merton (1973) innovative research on financial options theory, Myers (1974) coined the term “real option” as the opportunity, but not the obligation to purchase a real asset. The basic concept is that the model facilitates substantial upside potential while limiting downside loss, as with a financial option were an unexercised option’s loss is zero. This is achieved by incorporating the possibility of actively altering decisions related to the given project. Subsequently researchers have debated whether real options are able to bridge the gap between finance and strategy, and thereby facilitate a more informed investment decision (Andersen, 2006) and (Myers, 1984).

The analogy from financial to real options translates into the fundamental variables. The logic is that by investing a small amount today, e.g. in R&D, Danisco effectively purchases an option to continue development, defined as a call option with unlimited payoff. If conditions turn out to be worse than anticipated, Danisco can choose to walk away, only losing the upfront investment of development, defined as a put option with a payoff equal to the potential salvage value. In many case – but not all – this adds considerable value, but the question still remains. Can financial option pricing techniques be justifiably used on real assets, due to the differences? Figure 4, below sets up the deviations between financial and real options and describes how a change in one variable affects the value.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Financial Options</th>
<th>Real Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value of Underlying Asset</td>
<td>Stock Price</td>
<td>Present value of project</td>
</tr>
<tr>
<td>Option Value</td>
<td>Fixed on financial market</td>
<td>Initial project investment</td>
</tr>
<tr>
<td>Exercise Price</td>
<td>Fixed value in option contract</td>
<td>Investment Cost of project</td>
</tr>
<tr>
<td>Time to Maturity</td>
<td>Fixed contract</td>
<td>Hard to define, based on project life</td>
</tr>
<tr>
<td>Volatility</td>
<td>Volatility of stock price</td>
<td>Volatility of project</td>
</tr>
<tr>
<td>Increase in time</td>
<td>Value increases</td>
<td>In theory value increases, external factors might offset this</td>
</tr>
<tr>
<td>Increase in volatility</td>
<td>Value increases</td>
<td>Value increases</td>
</tr>
<tr>
<td>Owner’s control</td>
<td>None</td>
<td>Management can influence option value</td>
</tr>
</tbody>
</table>

Figure 4 - Difference between Real and Financial Options
It becomes evident that real option variables are substantially more difficult to estimate compared with financial options. The estimation of these required inputs will be elaborated on below and in chapter 8, when the practical real option application is completed.

The initial differences between ROA and DCF revolve around a conception of valuing uncertain opportunities as oppose to predictable cash flows (Trigeorgis, 1996). It involves fewer variables than the DCF, and in some way could be seen as more simple in spite of the mathematics involved. Below the fundamental value driver is presented and discussed, namely uncertainty (Trigeorgis & Mason, 1987).

### 3.2.2 Uncertainty creates Opportunities

Risk can be defined as “*something one bears, and is the outcome of uncertainty*” (Mun. 2005). The uncertainty can be described as the way the external environment evolves in a random way in time. The uncertainty of the future cash flows is the main value driver of a simple option. The higher the uncertainty/volatility of the cash flows, the higher the value of the option. Uncertainty is only implemented in the DCF in the discount rate, as a measure of risk. A riskier business will give a higher discount rate, and thereby a lower value of the firm, all other things equal. The ROA will give a higher value for a more risky business or project, as the possibility of higher earnings are incorporated. As explained in the DCF section, the risk of the DCF is meticulously identified and a number is put on it, as the future cash flows are more uncertain. Uncertainty is encompassed in the ROA through the volatility of the underlying asset. This could be the entire company, a project or e.g. a possible takeover of another company. As the volatility is one of the main drivers of the value of an option, the choice of volatility will impact the option value severely. In financial options one would most often choose the historical volatility. For an investor with only publicly available information at hand to make investment decisions, it will be hard, if not impossible, to estimate the volatility of an entire company, a new division or project.

The ROA has the advantage of being able to incorporate the different choices that will inevitably have to be made in the strategic future of the company. The model is stochastic, which means that the estimation in general will be harder to do, compared to the DCF. On the other hand, this complexity will force the management’s thinking, which will give the management opportunity to extract information that could be valuable in both strategic and operational aspects.
3.2.3 Types of Real Options

As described real options adds value through managerial flexibility, which the DCF neglected. The flexibility constitutes itself through a range of different managerial actions, such as *waiting, delaying, expanding or abandoning* an investment (Trigeorgis, 1996), (Copeland & Antikarov, 2003) and (Mun, 2005). The offsetting nature of an abandonment option and a expand option makes it important to understand types of option interdependencies, which are compound, mutually exclusive and independent (Lander and Pinches, 1998). Many more sophisticated options than the ones stated above can be fabricated to fit each individual situation, but to stay true to the original theoretical foundation we have refrained from including these.

In order to perform an accurate real option valuation of Danisco it therefore becomes important to distinguish and discuss the options that are present and relevant to include. Scientific research highlight that industrial focus is highly determinant and distinctive for the available and valuable present real options. Generally, Copeland & Antikarov (2003) distinguish between real options being present in either manufacturing or R&D. Research conducted by Gustafsson (2000) and Ollila (2000) highlight that within biotechnology firms particularly, the most valuable options lie in R&D. Especially interesting is Ollila’s study, as it highlights two types of options as being significant in biotechnology R&D projects; the option to abandon and the growth options. Most R&D projects pass through sequential phases wherein management assess the project, and choose to continue, abandon or scale the investment. This means that choices are path-dependent and therefore such projects can be considered as compounded options. Mun (2005) highlights that in order to capture the complexity of management’s choices and the external market dynamics it can be necessary to model more than one option together.

Danisco cannot directly be characterized as a biotechnology firm and the presence of other types of options has to be considered. Therefore a more elaborate presentation of the different types of options is necessary.

3.2.3.1 Option to Delay

External factors can and will affect the company over time in a way, which can make it more favourable to wait with an investment instead of investing immediately. Most often, the value to delay will increase, when the volatility increases, because the chance of a positive market situation will be larger. When the company operates in a market nearing perfect competition, the value of the delay will move towards zero, as the possible profit also nears zero (Mun, 2005).
3.2.3.2 Option to Abandon
The abandonment option is the choice of reducing or divesting an investment. When an investment is already made, and does not show the potential or earn what was expected, the choice of closing the project completely or reducing the capacity or other future investment is at hand, and can be valuable as future costs can be reduced, management has a put option (right to sell at present value). The theory is of course easy to understand, but the choice of minimizing an investment or closing it completely will of course delude the value of the call option, the possibility that this project can later add value. So these are two opposite options where a choice to reduce or close an investment, will eradicate the option of waiting or delaying and expanding or increasing later on.

3.2.3.3 Option to Choose
Refer to the choice of expanding, decreasing, contract or shut down. Expansion of production facilities is relevant if new market opportunities arise or if new technology turns out to perform better than expected. The option to expand or increase, can be seen as a call option as it most likely will add value. Decreasing or shutting down production is relevant in opposite situations. These puts gives management an opportunity to sell at salvage value. Option to contract is a way to reduce the risk of an investment by entering into a partnership. A growth option is when a small portion is invested, providing additional information, where after management chooses to expand or abandon the project.

3.2.3.4 Compound Options
The value of the compound option is dependent on a number of prior options being exercised. Internally this could be a product passing through a R&D phase, where management decides to continue or abandon the investment, a so called staged compound option. Externally, in a shared compound option a firm is dependent on the choices of a competitor. This could relate to achieving first-to-market advantages thereby minimizing the value of the firms soon to be launched product (Copeland & Antikarov, 2003).

3.2.4 Identification of Real Options
Real option scholars have investigated the biotechnology industry immensely and it has been found that following a real option perspective has a positive impact on both R&D, performance and financial performance (Garud & Kumaraswamy, 1998). Within the real option logic, basically a firm consists of a
bundle of real options, but as identified, many are correlated and offset each other. For management and investors the key objective is to recognize options posing the largest opportunities. Internally in an organization, it is of significant importance to identify and evaluate the right options, as these are the ones that might shape the firm’s future. Weighing opportunity against uncertainty is a difficult task. Dixit and Pindyck (1994) distinguish between technical and input cost uncertainty. Input cost uncertainty is related to exogenous factors that cannot be affected by investment decisions, but can give the company a reason to delay investments, as only time can tell what will happen to e.g. prices. Technical uncertainty is the probabilities and cost of accomplishing technical success and this is only reduced via investments. This type of uncertainty puts pressure on a firm to invest immediately, as a delay can lock out late entrants (Cottrell and Sick, 2006). Moving early can be necessary, but can also lead to difficulties as one is not fully prepared for the problems that may arise when accessing a new field. This timing dilemma is one of the biggest reasons for a firm to take a real options approach, when conveying which investments to make. Dixit and Pindyck, operate with a third form of uncertainty, lying between the two prior forms. This form of uncertainty is defined as largely external, but not “technical” in nature, but can be affected by the firms decisions. In this way the firm can act as an agent in shaping contingencies in its favour. This could be through first mover advantages such as setting the technological standard on a market.

**Figure 5 – Option Flexibility Value**

<table>
<thead>
<tr>
<th>Uncertainty</th>
<th>Moderate flexibility value</th>
<th>High flexibility value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low room for managerial flexibility</td>
<td>High</td>
<td>Moderate flexibility value</td>
</tr>
<tr>
<td>High room for managerial flexibility</td>
<td>Low</td>
<td></td>
</tr>
</tbody>
</table>

Source: (Copeland and Keenan, 1998)

It is important to recognize that real options are not only a large opportunity surrounded with high uncertainty, but manifests itself through the ability to change strategic actions. Copeland and Keenan (1998) present uncertainty as the likelihood of receiving new information, facilitating a better informed
decision. Managerial flexibility is the ability to react to this acquired information. Differentiating between valuable and invaluable options becomes a choice of the underlying assets potential, uncertain product/market conditions and management’s ability to react as time goes. The more specific the option is, the less difficult it is to estimate the relevant variables and this makes the ROA less suited for valuing entire companies for an outside investor. Damodaran (2008) describes how to prevent real options from falling into its usual black hole of not being used in practice; we need to be more rigorous in our measurement of finding valuable options. He proposes justifying the identification of value real options based on a more qualitative approach, as opposed to Copeland and Keenan’s where volatility is of significant importance. He continues that real options cannot be easily valued, since the inputs are difficult to obtain and often noisy, meaning that they can easily be manipulated to back up whatever conclusions. Damodaran concludes that looking at whether the option equals obtaining a competitive advantage is incremental in the importance of the identified real option.

Gamba (2002) presents how options often are intertwined in a firm’s web, making it difficult to assess the correlation among different factors. Therefore in order to perform an accurate valuation of real options, it is important to consider their independence, described as correlation. All options fall under two correlation categories: Independent options or Mutually exclusive options. Independent options can be exercised without it affecting other options in the portfolio. Subsequently the value of independent options can be added in a portfolio. The option of launching a product in a new geographic market is an example of an independent option, as this is largely unaffected by the rest of the firms actions. Mutually exclusive options are when one option removes the possibility of exercising one or more options. The option to grow and abandon a pipeline product is mutually exclusive. Furthermore within a firm setting, many actions will have a major effect on other parts rendering it difficult for the analyst to assess these impacts in terms of value. A compound option is also mutually exclusive as the latter options are dependent on management to exercise a previous option.

As highlighted above the theoretical literature on identifying options emphasizes different aspects of the process. Copeland & Keenan focus on what determines real options and their existence, whereas Gamba highlight the difficulties associated with actually calculating the value due to the correlation among options, rendering them mutually exclusive. As a consequence it was deemed necessary to add an additional dimension to Copeland & Keenan’s model that grasps both of these aspects. Firstly the investor identifies relevant and valuable real options (high flexibility + high uncertainty). Secondly, the investor has to assess the interdependence between the options and the firm and if this is found to be
low (blue area), the binomial lattice is an appropriate method for finding the value. If correlation is high (green area), it will be highly difficult to separate the option rendering the total value incalculable.

![Figure 6 – Identification of Real Options and their calculability](image)

The figure emphasizes that only options, which can actually be modelled based on a measurable uncertainty, and which management would actually exercise, should be included. If there are many different types of options present it is often necessary to determine the most important ones, as including too many options is likely to increase complexity and make it incalculable.

### 3.2.5 Modelling Real Options

#### 3.2.5.1 Real Option Models

The real options literature distinguishes between three different model categories. The three different categories are “Analytical approaches, herein Black & Scholes”, “Monte Carlo Simulation” and “Binomial lattice models” (Geske and Shastri, 1985). The applicability and relevance of the choice of model
depends on the investor abilities, level of information and overall intent. As both Monte Carlo and Black 
& Scholes, are continuous models, they do not have the ability to incorporate managerial choices. 
Furthermore, other lattice models exist, hereunder trinomial-, Quadranomial-models. The binomial 
model is however the most used and acceptable model, both within lattice models, but also generally in 
real options valuation. This is largely due to its intuition and ease of use. Furthermore the added 
precision of constructing a multi lattice models can be questioned (Lander & Pinches, 1998). Conclusively 
the Binomial Lattice approach is recommended due to the practical focus of the thesis (Copeland & 
Antikarov, 2003) and (Mun, 2005). See Appendix B for elaboration of deselected models.

3.2.5.2 The Binomial Lattice
The binomial tree model is mathematically the simplest one and the concept is close to the cash flow 
based models like the DCF, in the sense that it is based on projecting cash flows (Cox, Ross and 
Rubinstein, 1979). The method is called dynamic programming, referring to the sequential steps in which 
management can decide to abandon or continue an investment. Thus the tree does not consist of a 
single option, but several options. Such a multistage option was defined above as a compound option. 
This model is said to be a direct method as the underlying asset is often a tangible and explicit asset. The 
theory is to set future pathways of the given asset and to use a recursive folding back method to 
discount these to a net present value using the appropriate required rate of return (Hull 2008). 
The binomial models are intuitively easy as every pathway can be seen, and time is discrete, but they can 
be modelled to be very large and thus become incalculable. As the binomial model can be calculated as 
an American option it is suited for calculating real options, as these often of this sort, meaning one can 
stop at each node where management has a strategic choice.

3.2.5.3 Appropriate For Danisco
Theorists have diverging opinions on the appropriate model within biotechnology. This thesis supports 
biotechnology options. Their motivation behind using this model lies in its ability to take into account 
growth options as described above. Another conclusion is that the method is especially suitable at the 
early phases of a development process, when average assumptions can be used. As projects move into 
later phases, the use of averages do not work so well and more specific assumptions about time to 
launch, market size and the probability of success will reflect the value of the company more accurately.
It is important to understand that the real options method in this thesis should not attempt to implement strategic choices, but “just” evaluate and systematize the ones faced by Danisco. We are not to make the decisions, and change the strategy, but only try to capture the value of apparent opportunities in form of real options that are currently available, whether this being a abandon, delay or growth options.

Based on the intuitive appeal of the binomial model and its status in the practical literature, we too recommend it for real option valuations on Danisco. Below follows a presentation of the practical application of the binomial model, but firstly it is relevant to clarify the underlying assumptions.

3.2.5.4 Underlying Assumptions

The binomial model rests on a number of important assumptions enabling us to capture such complex situations, but they can also limit the practicality of the model. It is therefore important to understand these in order to assess the validity of our created model.

A significant assumption, which has a major influence on the chosen model, is the no arbitrage assumption, meaning that similar assets should trade at the same price on all markets. This assumption can be used to value options in the binomial model using two different approaches: the replicating portfolio or the risk-neutral approach. The limitation of the first is that for options with multiple periods, it is necessary to rebalance the portfolio in every time step, and it thus becomes computationally heavy (Copeland and Antikarov, 2003)

The risk-neutral approach to option pricing is preferred in most of the practical ROA literature; because the option parameters calculated using this approach remain constant through the life of the option. Because the portfolio is risk-free, it is possible to discount the expected future cash flow by the risk-free rate and subtract the underlying value of the asset to find the present value of the option. The two approaches have the same option value, and based on the fact that the risk-neutral approach is simpler it is preferred.

Other underlying assumptions include that $\sigma$ and the $R_f$ is known and constant throughout the life of the option. Other important assumptions of the model include: no transaction costs, unlimited riskless lending and borrowing, no taxes and no margin requirements. Lastly it is assumed that the underlying asset follows a Geometric Brownian Motion (Cox, Ross and Rubinstein, 1979). This assumption, together with a constant $\sigma$ is necessary for the probability of up and down movements to remain constant throughout the model (Brandão et. al. 2005). A derived consequence from these assumptions is that
information is perceived as arriving continuously in a smooth manner and thus the underlying asset does not make any large jumps. It is questionable whether management acquire additional information this way and it becomes clear that the assumptions have been violated. However it holds true for all valuation models that all assumptions will never be fulfilled when faced with real assets.

### 3.2.5.5 Binomial Tree 1. Underlying Assets

The value of a real option using the binomial model requires at least two binomial trees, one for the underlying assets and one for the valuation of the real option.

In order to calculate option value, firstly an asset tree is constructed using the risk-neutral probability of either a up (u) or down (d) movement for the underlying asset. Each new “branch” in the tree, represents a step in time (Δt). Each time step is discrete, and could represent anything from months to years, depending on the underlying asset. 

The underlying asset in the model is following multiplicative binomial distribution, and “binomial” indicates that the asset can only follow one of the two possible branches of each time step.

![Binomial Tree](image)

The starting node is the underlying assets value at $t = 0$. The probability of $u = e^{\alpha\sqrt{\Delta t}}$ and $d = e^{-\alpha\sqrt{\Delta t}}$.

This indicates the probabilities of up or down are very dependent on returns volatility. A high volatility creates large fluctuations in the assets value highlighting the sensitivity on this parameter. The volatility is therefore very important and it is essential to focus on, in achieving a realistic estimate (Mun, 2005).

### 3.2.5.6 Binomial Tree 2. Valuation of Option

Similar as for the underlying asset, a binomial tree is set up enabling the calculation of the real option for every node in the tree. It is necessary to estimate the risk neutral probabilities for up or down, exercise price on option and the value of the underlying asset. The binomial lattice seems to be very intuitive and user friendly, but as one builds the model it becomes difficult to estimate the required variables needed.
in order to calculate the option value. Figure 8 presents the calculation process, wherein a European call option is calculated, where the exercise price (EX) has been subtracted to find the expected pay-off in the final nodes, which then is discounted to find its present value. Management chooses to exercise the option, if the value is higher compared to keeping it open. The present value (OV\textsubscript{0}) is calculated using the risk neutral probabilities (p and q), which has been calculated using the volatility. The minimum value is zero as management can decide not to exercise.

\[ O_V = \text{Max} \{uS_2-EX,0\} \]
\[ O_V = \text{Max} \{dS_2-EX,0\} \]
\[ O_V = \text{Max} \{pOV_2+qOV_3,0\} \]

Source: Author’s Own Creation based on Cox, Ross and Rubinstein (1979)

3.2.5.7 Estimating Variables

It becomes clear, that as in the DCF a substantial amount of difficulty assessing variables needs to be estimated. Of most interest is the process of estimating the market uncertainty and the underlying asset, which will be discussed below. These and the other necessary variables will in practice be estimated in chapter 8.

3.2.5.7.1 Volatility

The market uncertainty variable is defined as the volatility, expressed as the uncertainty an asset is exposed to on the market (Copeland 2003). Market uncertainty shall not be confused with the concept of market risk used in the in the DCF model, as it differs in two ways. First, market uncertainty includes both risk and chance. Second, market uncertainty is the total uncertainty from being on the market and includes both diversifiable and non-diversifiable risk.

Estimating the volatility of the underlying asset is relatively simple for tradable assets. But for real options it is one of the major challenges, and academics disagree about the different estimation techniques. However, it is important to do it properly as the volatility is a key value driver for options. The financial literature proposes two different alternative approaches to estimating volatility. These can be grouped into either an internal approach or an external approach.
The internal approach is intuitive in the sense that, the operational project is our underlying asset and it is this project’s volatility that should be estimated directly. To do this, the two internal approaches are presented; management estimates and Monte Carlo simulation. The Monte Carlo simulation approach is advocated by Copeland and Antikarov (2003), is coherent in the sense that it makes explicit assumptions about the nature of the volatility and uses historic data in the estimation process. They propose that the analyst should quantify the uncertainty of all (market) variables that influence the volatility of the project’s cash flow and translate this into a single figure volatility using Monte Carlo simulation. Sceptics point at the individual volatilities and their correlations over time as rendering the method invalid. However by understanding and investigating correlations between variables and carefully choosing probability distributions these issues can partly be overcome.

Mun (2005) describes how using the management estimates approach is built on the assumption that managers have a good knowledge of the project’s uncertainty, which likely is the case, but translating this into a volatility estimate is difficult. The drawback of relying on expert opinions is that these are can be biased and thereby unreliable. On the other hand the advantage is its simplicity.

The idea behind the External approach, is to use a market proxy to estimate the volatility of the project, which in some sense it a “classic” way of estimating the volatility of the project (Borison 2005). Dixit and Pindyck (1994) state that for commodity based projects it is possible to use a market proxy or “twin security’s” price to find a reasonable approximation for the volatility. Market proxy comparables is used when market-, sector-, or industry-specific data is available. The drawback is that this is can be hard to find the right benchmark, which could result in an over or underestimation of the volatility.

The alternative external approach would be to use either historical or implied stock volatilities. Finding traded options with a similar maturity and risk profile, are difficult if not impossible. Implied volatility is therefore not usable on Danisco. However Monte Carlo simulation of project dependent variables often requires using historic data on commodities when estimating the volatility, which is relevant for Danisco. Ultimately, both the internal and the external approach provide insight and this thesis seeks to apply a combination of both when estimating the volatility later on in chapter 8.

3.2.5.7.2 Underlying Asset

The present value of the underlying asset functions as the starting point in the binomial tree. Estimating this is often difficult; as real options are not traded meaning it is not possible to find a liquid

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11 Copeland et al. (1994) also suggested this method for appropriate, thereby indicating the work in progress in relation to volatility estimation.
underlying asset benchmark as with financial options. Copeland & Antikarov (2003) and Mun (2005) describe how it is therefore a good approximation to estimate the underlying asset value, using a standard DCF approach. The absolute real option value is thus the modelled real option value subtracted the initial starting DCF value. Given the literatures intense criticism of the “inflexible” DCF model, it is somewhat puzzling and counter intuitive why most real option theory presents it as the appropriate model for estimating the underlying asset. It must be in the lack of a better model and given the DCF’s usability and recognition why this makes sense. The real option value will thus be a DCF model plus the value of incorporating managerial flexibility, which makes it intuitive and understandable.

3.2.6 Evaluation of Binomial Model
This section summarizes the findings on the advantages and limitations of the deduced applied real option model – namely the binomial lattice.

<table>
<thead>
<tr>
<th>Fundamentals</th>
<th>User Friendly</th>
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<tbody>
<tr>
<td>Object of Analysis</td>
<td>Modelling</td>
</tr>
<tr>
<td>Project</td>
<td>Probability of up and down</td>
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<table>
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<tr>
<th>Assumptions</th>
<th>Flexibility</th>
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<tbody>
<tr>
<td>Option value</td>
<td>Risk</td>
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<tr>
<td>Follows GBM</td>
<td>Volatility</td>
</tr>
</tbody>
</table>

It is evident that the model has an intuitive feel, but is difficult to actually implement due to the complexity of accurately estimating the required input. The financial theory recommends this model compared to Black & Scholes and Monte Carlo simulation, as it includes management’s flexibility and is better suited for the biotechnology firm such as Danisco. Significant real options in Danisco will most likely be found in the R&D pipeline and manifest themselves as compounded options either to abandon or grow a particular product.

3.3 Part Conclusion – Are DCF and ROA Complementary?
In this chapter it became clear that the standard DCF model makes sense in situations of limited uncertainty and stable cash flows, but is not able to properly incorporate the value of active decision making. ROA on the other hand does not as such put a price on cash flows, like the DCF, but prices risk by
incorporating risk explicitly and not implicitly like the DCF. Real options can in that way apply uncertainty a positive value, while uncertainty has a negative effect on value in the DCF approach as higher uncertainty will equal higher risk, equalling a higher discount rate, which in the end will give a lower value of the firm. ROA has been identified as a more accurate model and is recommended for investments having the properties of high uncertainty, reversibility and low correlation.

The boundary of ROA is that - theoretically - an infinite number of options exist within a firm. However some only have small strategic impact, while others have the chance to define the competitive future. It is not possible to encompass all real options in a valuation, but important to identify appropriate ones and adopt a suitable model to capture these. There will be significant differences in the size of the options and the amount of options in a given firm. Biotechnology firm such as Danisco with large intangible assets and R&D expenses will likely have large growth or abandonment options in the R&D pipeline.

Different option pricing models exist, but the binomial model is highlighted by theoretical and empirical investigations, as it can handle the specific issues related to Danisco – namely the sequential product development phases.

As suggested above, it is important to recognize that the DCF and ROA are not mutually exclusive, but should be used complementary, as this facilitates a better understanding of Danisco’s current and future competitive situation. Furthermore it is not possible only to use ROA, given the infinite number of options in Danisco. The infinite number and their correlation with each other renders it impossible for an investor to comprehend and consequently to value all these options. ROA should thus only be applied to a situation where it adds additional information beyond the DCF model. Thus dividing Danisco up into a part sorely valued using DCF will be relevant if stable cash flows are present, while another part is more accurately valued used ROA, as uncertainty and strategic flexibility is present.
4. Strategic Analysis

Strategy has been a widely discussed subject within academic literature with numerous divergent opinions on how best to capture the inherent complexity of future contingent strategic initiatives and challenges. Our approach to untying all the treads in Danisco is to utilize the concept of Strategic Fit (Grant, 2008) in which the strategist focuses attention on grasping and unravelling a firm’s internal capabilities and relating them to the competitive environment. Critics accentuate that market conditions have become increasingly complex, volatile and competitive, and therefore the notion of a formalized purposeful mapping of a firm’s position is put under pressure (Andersen & Knudsen 2006). It is a common recognition that the future cannot be accurately predicted. Hill & Jones (2001) describe how under uncertain market conditions, rather than stating one strategic path, incorporating strategic flexibility enables an understanding of the dynamic and complex nature of the environment. Real options utilize a similar ontology, where future contingent market conditions play an integral part.

Within the financial literature there is a tendency to downgrade strategy as only a process of identifying a short list of key parameters, such as growth rate and volatility, to enable a functioning technical model (Bromiley & James-Wade, 2003). This fairly simplified notion of how to measure strategy would limit our understanding and thus reduce the validity of our later models. Grant adopts a medical analogy to describe the process of strategic analysis; “The first task is to determine the state of health of the patient and then determine the reason for any sickness“ (Grant, 2008).

4.1 Analytical Framework

This analysis applies acknowledged theoretical frameworks, enabling an understanding of the key challenges and success factors. Respectively the paradigm of market structure¹² based and resource-based models are utilized. Based on various theoretical conceptions the models enable us to depict and predict Danisco’s current and future competitive position.

In the market structure models the assumptions are, that it is the environmental factors that control the firm’s strategic behaviour. These models’ primary function is to define the external competitive conditions, whereof the availability of economic rents is derived. Hereafter resource and capabilities

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¹² Porter’s five forces (Porter (1979) and Porter (1980)), PEST-model, Porter’s national diamond (Porter (1990)), Product life Cycle (Levitt (1965), plus the BCG-model, is used within this analysis.
models\textsuperscript{13} are used to position Danisco within the competitive scope of the industry. These models assume that distinctive valuable resource, coupled together creates a unique “profile” and core competence. Furthermore, the chapter builds on the presentation of Danisco in chapter 2, wherein it was defined as a biotechnology firm.

4.2 Industry Analysis

Strategic analysis typically takes its starting point in depicting the firm’s overall playing field through an environmental analysis. The comprehensive PEST analysis can be found in the appendix and its conclusions are embedded in the drawn conclusions below. This section seeks to investigate Danisco’s markets and draw conclusions regarding what the key success factors and challenges are. This is done using five forces, which identifies four structural variables that influence competition and profitability. In practice, there are a number of features that affect the intensity of competition and profitability of an industry. Using five forces will enable a classification and analysis of central parameters (Porter, 1979).

4.2.1 Industry Rivalry

Danisco has a solid position within each of its three markets. Consolidated there are at least 20-22 active firms within the markets. However, the markets are highly differentiated with a majority of the market-shares being held by a few large companies. Many takeovers, alliances, and divestitures have occurred in the past few years as a result of eroding prices (Frost & Sullivan, 2008). This has enabled firms to reduce the trend of decreasing prices and profits have therefore remained fairly stable. This has furthermore decreased the incentive for entering into price competition.

Danisco’s markets can be characterized as highly differentiated in terms of products, as each firm targets specific segments. The industry has a dualistic structure and firms attempt to match end-consumers demand while further developing more efficient products, innovation followed by cost optimization. Stackelberg (Frank, 2005) would argue that being first mover on these markets is incremental as it is during this period revenue is generated. Vast investments in R&D are intended to postpone competitors from achieving similar technological platforms. After a period, when the technological advantages have gone obsolete, the market structure will move towards a Bertrand (Frank, 2005) state, were firms are competing on prices. Taken from micro economics these are simplifications, partly because differentiation plays such a central role on Danisco’s markets.

\textsuperscript{13} Value-Chain Analysis (Porter, 1985), Generic Strategies (Porter, 1980) is applied.
4.2.1.1 Food

Figure 10 – Food Ingredients Market (2009)

Source: Business Insight (2010) and Thomas Reuters

The general tendency on the food ingredients market is that firms are struggling to maintain profit margins as a result of an intensified competitive scope. Hence, manufacturers are attempting to streamline production, chasing improvements in profitability.

Danisco operate and service a narrow niche within the consolidated dkk 135 bil. market, constituting dkk 56 bil. The general market growth is forecasted at 3.5 percent to 2013 (Frost & Sullivan, 2008). This niche (Enablers and Cultures) has not been as affected by the decreasing profits as a consequence of intensified competition. Barney (Grant, 2008) describes a situation where a few number of successful firms engage in similar actions and describe this strategy as competitive parity. Enablers and Cultures can be identified as such, where differentiation allows Danisco, DSM and Chr. Hansen all to achieve economic profits. Offering an extensive product portfolio is thus an essential competitive parameter in food. This is achieved by addressing the differences in geographical regional demands.

Enablers is entering maturity while cultures is still in the growth phase of its product life cycle (Levitt, 1965). Management therefore adopt different strategies to each division. Management seeks to consolidate sales by maximising RNOA in enablers. Cultures have a lower RNOA and EBIT margin, which might be explained by motives to continue growth. Within these two segments Danisco is the market leader, which has yielded numerous opportunities to achieve a sustainable competitive position using geographical advantages, economies of scale and proprietary technology.

The sweeteners market experienced a technological paradigm shift, with the launch of Aspartam, leaving Danisco’s compound Xylitol obsolete. As the competitive situation intensifies management have adopted a harvest strategy, which is typical within declining markets (Grant, 2008). This is evident from the recent
restructuring program aimed at increasing production efficiency not regaining market shares. Profit margins within sweeteners are thus low.

4.2.1.2 Feed

![Figure 11 – Feed Market (2009)](image)

Source: Business Insight (2010) and Thomas Reuters

The feed market is a highly differentiated market resulting in a low competitive intensity. Feed is under the Genencor umbrella, meaning that products are highly sophisticated, developed using cutting edge technology. Danisco are able to utilize a superior combination between an extensive product portfolio, product features and location to achieve a strong position on the market, as visualized in the figure above.

The market can largely be characterized as an oligopoly with a selected few firms dividing the market between each other. Within an oligopoly behavioural finance provides tools to understand the individual actions and incentives. Currently the actors have reached an equilibrium in which all achieve economic profit, thus nobody has incentive to disturb the peace (Hendrikse, 2003). This has enabled Danisco to achieve a growth rate of 8 percent per anno, which is close to the forecasted yearly market growth from 2006 to 2013 of 9 percent (Frost & Sullivan, 2008).

The stable market situation has also limited the incentive to develop new products and thereby harvesting more consumer surplus for each product (Frank, 2005), whereof a derived consequence is that this enables other firms enough time to develop more efficient products. This would lead to enhanced competition and lower growth.

4.2.1.3 Industrial Enzymes
The market for industrial enzymes is a new and emerging market with a large unmet demand. The competitive intensity is minimal as two firms dominate the market. Early investments in the market have yielded technological leadership. This has meant advantages in obtaining low-cost production and a favourable geographical reach, though research has shown that being technology leader in most industries diffuse among competitor rapidly and first mover advantages are short lived (Grant, 2008). Danisco is investing heavily in R&D in order to improve the enzyme solutions and manifest its position.

The global market for industrial enzymes is estimated at around dkk 16 bil. with an estimated annual growth of 6-8 percent (Business Insight, 2010).

Products, such as detergents and textiles, are entering maturity. Other products such as bio-fuels are in a phase characterized by high growth, uncertainty and potential.

The current duopolistic market structure is not under threat, but the fact that market structures are not fully established requires management to retain flexibility in terms of dealing with the high uncertainty.

The strategic choice in terms of product standards puts pressure on management to choose the correct economic path. There is a war on standards being fought between Novozymes and Danisco within bio-fuels, which has lead to a number of patent infringement lawsuits (Børsen, 12.05.2010). As competitors over time build their technologies it is likely that competition will increase and product life cycles will become shorter.

4.2.1.4 Bio-ethanol Market

About 79 percent of US ethanol production comes from conventional corn-based, dry-milling plants, also called 1st generation ethanol. The profitability of these plants escalated in the early 2000s and this stimulated rapid growth of investments in ethanol production facilities. In 1999, the total production
capacity of the US ethanol industry was about 6.4 bil. litre. By 2007, it had increased to about 20.8 bil. litre. This expansion of industry capacity was accomplished by a combination of expansions of existing small plants and a faster pace of new large plant construction. However, with increasing prices of corn and natural gas, concern about the energy efficiency of ethanol as a biofuel, and increased debate over government mandates for use of ethanol, investments in ethanol plants, have also faced greater uncertainty in recent years. The 2nd generation bio-ethanol has the potential to overcome much of these concerns. As 2nd generation bio-ethanol does not rely on corn, which can be used for human food, but on the waste of the corn production, which is non-edible, the 2nd generation does not compete for the same biomass input. There is also uncertainty in the market price of ethanol. For example, the annual average free on board (FOB) price of ethanol in Omaha in January 2001 was $1.77/gallon, but it increased to about $2.59/gallon in April 2008.

These factors have contributed to shifting profitability in the ethanol industry along with changing volatility of costs and profits for ethanol producers. Pederson & Zou (2009) state that for small-to-medium ethanol producers, those with production capacities less than 60 mil. gal., the ability to generate an acceptable rate of return on invested capital is a key objective. Also Tiffany & Eidman (2003) study the factors that significantly affect the profitability of dry-milling ethanol plants. They draw the general conclusion that the key determinants affecting ethanol plant profitability are corn price, ethanol price, natural gas price, and feedstock conversion factors. Thus, price uncertainty in the 2nd generation ethanol industry derives largely from variability in the cost of process heat energy, and variability in the price of ethanol. In part due to the expanding scale of the ethanol industry and the resulting higher domestic demand for corn, there has been upward pressure on US corn prices. This is not the case for 2nd generation producers, as corn prices do not affect the price of the farming waste.

The 2nd generation ethanol market, is defined as the same market as the one for ethanol. This is because customers are not willing to pay extra for 2nd generation bio-ethanol, and it competes on the same market as 1st generation bio-ethanol. The ethanol is sold at market prices, even though there can be geographic differences, as with gasoline for cars. Danisco’s 2nd generation research project (DDCE) plant is located in Vonore, Tennessee, just south of the corn and grain belt in U.S.A, chosen mainly because of they will be close to the biomass input.

Subsidies from the U.S government have made it possible for bio-ethanol to compete in ethanol fuel market, and the U.S. government has made the “Renewable Fuels Standard” (EPA, 04.11.10), which dictates that 36 bil. gal. of renewable fuel should be blended in to transportation fuel by 2012, and in
combination with the subsidies this should help the process of having more producers of bio-ethanol. The same efforts have been made in the EU, but as DDCE is focused on U.S.A, we assume that this is the DDCE market. As the required amounts of RFS are not nearly produced, and projections say they will not be either, it is possible for producers of bio-ethanol to sell as much fuel they can produce as there are no market restrictions in the future (Frost & Sullivan, 2008). As the 2nd generation bio-ethanol is produced from biomass as e.g. corn-cobs and switch grass, the producers have unlimited access to the main input of bio-ethanol production, as the U.S biomass is much larger than needed in production (Business Insights, 2010). The main factor of success in the market is the price of ethanol, and the technology to produce at a price that can make a profit, and this seems to be the biggest challenge for DDCE at this point in time.

4.2.1.5 Competitor Analysis
This section intends to position Danisco against its main competitors. It became evident from above that Danisco operate on several different markets each with its own competitive dynamics. Subsequently Danisco has a large array of competitors and it is difficult to compile a representative peer group. However when looking at competitor’s strategy, market size and market potential only a handful can be defined as direct competitors and overlapping into Danisco’s competitive sphere. These are:

- Novozymes: Market leader in industrial enzymes (textiles, detergent and bio ethanol), feed ingredients
- DSM: Food ingredients, niche player in industrial enzymes
- Chr. Hansen: Closest competitor in Cultures
- Kerry Group: Strong position in food ingredients
- ABF: Niche player in industrial enzymes with a promising R&D pipeline, most revenue generated within the unrelated segment of processed foods
- Cargill: the largest food ingredients firm
- BASF: Market leader in Feed

The figure below visualizes the specialization within the Danisco’s product markets and positions each competitor against Danisco as either a direct threat (v) or a niche player (*).
It is important to recognize that Danisco’s global position should been seen compared to its direct competitors and not on the markets as a whole, e.g. in Food, where Danisco generally only hold a small market-share, but second within its product segments. Among the competitors Novozymes, Chr. Hansen and Cargill are of most interest as these firms are actively shaping Danisco’s markets and directly affecting its growth possibilities. These firms are able to achieve this either due to their innovative products or sheer size as with Cargill. A comprehensive analysis can be found in Appendix B.

The main findings from the competitor analysis are: Within Danisco’s two main growth markets, namely Cultures and Industrial enzymes the company will in the future face more intense competition. Novozymes seeks to sustain its “first mover” position in Industrial enzymes, through new innovative research programs such as within bio-fuels. Chr. Hansen has after the IPO obtained substantial capital and now seeks to continue recent year’s large growth. This is worrisome for Danisco as Chr. Hansen’s main product market is Cultures, wherein the firm has a competitive advantage. Danisco will need to increase R&D in Cultures to address this threat.

Cargill is a tough competitor with access to all markets, offering a wide range of products. Part of Cargill’s product portfolio is focused at sweeteners and is one of the main reasons why Danisco’s revenue within this segment has declined. In relation to Danisco it is positive that the firm is not engaged in other of Danisco’s business areas. As the intensity within the food ingredients market is high and increasing Danisco’s is in a vulnerable position within this market. With an enhanced R&D focus on Cultures and
bio-ethanol, Danisco might be overrun by its larger peers on the other food ingredients market. Section 5.3 will continue this discussion in relation to financial performance.

4.2.2 Threat of Entry
The general competition intensity can be characterized as moderate and growth is still fairly high. This signals that abnormal economic profit can be achieved. Moreover this increases the potential for new entries. However the entry barriers are very high, making it almost a domain of a few strong participants (Porter, 1980). As the industry requires substantial investments in research and development, new entries will have to suffer negative cash-flow before product launch. Danisco is a capital-intensive firm with over 9000 patents protecting against copies (Danisco.com). Patents typically last 25 years, and through various strategies it is possible to prolong them (Patent Reform Act, 2005).

Economies of scale are an essential competitive parameter, which the leading firms are able to achieve because of wide product portfolios, large revenues and a global presence. Economies of scale furthermore enables firms to produce with lower margin costs compared to new entries, which usually has to start at a lower scale, conquer market shares and position their brand.

4.2.3 Competition from Substitutes
The availability of substitutes is low, as each ingredient or enzyme offer a specialized benefit that is difficult to achieve and requires substantial economies of scale. There is a risk of substituting technological solutions capturing market-shares. An example of this is Danisco’s Xylitol, which used to be a market-leader within Sweeteners and was overtaken by superior quality products such as Aspartam. However the risk of this is small as such innovative products are difficult to innovate. On the other hand research indicates that the development is going in the opposite direction as enzymes in the long run has the possibility of replacing a number of chemical and fossil based processes (Børsen, 05.05.2010).

Within bio-ethanol substituting products are an important parameter. Substituting technological solutions could be fuel cells or hydrogen instead of 2nd generation bio-ethanol. Research is being conducted worldwide to develop a sustainable hydrogen solution. However adopting hydrogen requires gas stations to restructure its filling stations, involving substantial costs. The risk is hard to quantify but is important to notice that this development is not only technologically determined, but to a large extent political. As can be seen in section 4.2.1.4 policy makers are pushing bio-ethanol as a sustainable solution compared to hydrogen solutions.
4.2.4 Buyer Power

Danisco’s overall long-term dependence on individual customers is assessed to be relatively limited. The ten largest customers account for 16 percent of revenue, representing a total customer base of around 10,000. Customers are either multinationals or local production firms, which are highly informed both ex post and ex ante in terms of product quality and performance. Given that most of Danisco’s markets are characterized by only a few suppliers, buyer power is low and they likely prefer longer contracts. As production is a complicated process, Danisco is also likely to prefer such long contracts, thereby reducing the sensitivity to falling resource prices. The fact that Danisco can provide scientific evidence further decreases the information asymmetry between them and buyers, which heightens the incentive to enter a longer contract (Hendrikse, 2003).

Switching costs for buyers are fairly high as each enzyme has a particular function, which can only be achieved through large investments in specialized production facilities. However as the parties’ core competencies are unique and significantly different, upstream investments are unlikely. Recent years have seen customers put pressure on enzyme prices, however as the industry is highly consolidated and buyer power is fairly weak this has only had a limited effect. Competition among buyers is intense and resembles perfect competition, where marginal costs are a deciding factor.

To reduce the risk of added price pressure and limit buyers ability of switching, long-term sales contracts are utilized. Recent agreements include marketing/distribution alliances in the UK, Australia, China and France (Business Insight, 2010). Danisco is highly dependent on acquiring a local perspective. Through alliances asset specific knowledge is transferred, enabling an efficient marketing strategy. This however creates codependence between Danisco and its sales subsidies. When the cost and risk is assessed too high, Danisco often uses acquisitions to expand its global reach and to expand product development capabilities. Acquisitions amounted to DKK 506 million in 2009. Danisco thus utilizes vertical integration to reduce distributional and R&D risks. Horizontal integration is also a utilized strategy as complementary technology is frequently bought (Teece, 1986)

Within Industrial enzymes the majority of revenue is generated through a few large contracts among others with Procter & Gamble (Genencor Strategy Presentation, 2008). This has lead to an increased pricing pressure. To overcome this, transaction specific investments have been made, such as in the DDCE project (Williamson, 1991).

4.2.5 Supplier Power

Raw Materials:
Suppliers’ negotiation power is strong because there are few suppliers of required raw materials (vegetable oil, palm oil, Soya oil). There are few substituting products. Danisco is dependent on oil in the manufacturing process. Resource suppliers have an infinite number of potential customers, which again increases the bargaining position. The industry is thus vulnerable to increases in resource prices providing an incentive for longer contracts.

*Technology:*
The industry uses technological advanced resources in its production. Production requires high technological equipment. There are few suppliers and they are put under strict legislative qualitative requirements. This also includes the raw materials and resources used in production. Establishing a production facility often involves a price competition among contractors, where in the best is chosen. Buyers usually have the best bargaining position.

*Human:*
Recruiting and sustaining knowledge is an essential competence in the industry. Because firms essentially compete on innovation, having the brightest and best minds is a vital resource. Vertical integration is often a used strategy to acquire desired knowledge, as with the Dupont joint venture.

### 4.3 Key Success Factors and Challenges
From an external focus, key industry success factors have been identified as:

- *Economies of scale* in terms of distribution and low production costs,
- *Wide product portfolio*, accounting for regional differences
- *Product differentiation*, superior quality and specialized functions enables higher prices
- *Strong technological platform*, as innovation within new application areas is the segment with the highest growth potential (e.g. Bio-ethanol)

The main challenges include:

- *Shorter product life cycles*, pressuring firms to put more emphasize on product innovation (higher R&D spending throughout the industry)
- *Increased pressure on price*, customers demand lower prices on enzymes as these firms being pressured from low-cost producers in the developing world.
4.4 Internal Analysis of Danisco

Strategists describe two main sources for achieving superior profitability: industry attractiveness and competitive advantage (Grant, 2008). Above, industry attractiveness was analysed to be high. The resource-based view of the firm (RBV) is an influential theoretical framework for understanding how competitive advantage within firms is achieved and how that advantage might be sustained over time. This perspective focuses on the internal organization of firms, and so supports the traditional emphasis of strategy on industry structure and strategic positioning within that structure (Eisenhardt and Martin, 2000). In particular, RBV assumes that firms can be conceptualized as bundles of resources and these are recognizable (Barney, 2002). Critics point out that RBV has an inherent tautological ontology as successful firms are successful because they have unique resources and thus the relationship between rents and resources becomes circular (Porter, 1994).

4.4.1 Performance by Segment

As mentioned above Danisco’s products can be divided into four divisions, food ingredients consists of Enablers, Cultures and Sweeteners and Genencor includes technical enzymes in food, detergents, biofuels and feed ingredients. It is important to note that these ratios are calculated using the principals followed in the reclassification of Danisco’s financial statements. This means that goodwill and special items are included when calculating EBIT and operating assets. Danisco has chosen not to include these items as it significantly increases RNOA (see financial analysis below).
The food ingredients division had consolidated revenue of dkk 9.1 bil. equalling 67 percent of total revenue. Within ingredients, Enablers has in 2010 continued the positive trend, where stable prices and higher capacity utilization has strengthened the earnings margins. Enablers experienced a modest growth of 4 percent.

At Cultures the profitability has been strengthened due to the shift from bulk to fresh starter cultures. This change leads to a shorter production time, more stable production and being less staff intensive. The segment has subsequently seen rising margins across the board, a leading factor being a yearly growth rate of 8 percent. Cultures revenue and EBIT is driven by several tendencies in the market. First, an increasing part of the global cultures market is changing from being niche to becoming commercial increasing the consumer population (European Enzymes market, Frost & Sullivan, 2010).

Sweeteners is still the problem child as the sale of Xylitol continues to decline, which contributes 50 percent of total segment revenue (Annual Report, 2010). Because of intensified competition, margins have been decreasing since 2008. The financial year 2010 saw Sweeteners with an EBIT margin of -54 percent and negative growth of 5 percent. The poor performance is reflected in write downs in goodwill. A recovery plan has been initiated, which involves a dkk 100 mil. investment in streamlining the division. Management describes how the investment should enable Sweeteners to reach its overall goal of an
EBIT margin of 10 percent (Børsen, 14.06.2010).

Genencor saw advances across the board as the demand for industrial enzymes continues to increase (Business Insight, 2010). Yearly growth has been stable at around 10 percent largely driven by increased sales in bio-fuels and feed ingredients. Textiles and Detergents, which contributes 11 and 22 percent of segment revenue, saw little growth in 2010 (Annual Report, 2010). The high RNOA and EBIT margin indicate the attractiveness of this segment.

4.4.2 Value Chain Analysis

The link between resources and economic rents is analyzed using Porter’s value chain analysis (Porter, 1996). A value chain analysis separates the activities of Danisco into sequential steps distinguishing between primary and support. This decomposition enables identification of what activities creates value (Grant, 2008). The primary activities are those involved with the transformation from inputs to end-customers. Supporting activities constitute the foundation for production, and includes firm structure, technological development, human resource management and procurement. Because technological development is so closely linked with achieving a competitive advantage it has been deemed necessary to treat it as a primary activity within operations.

![Figure 15 – Value Chain Analysis](image)

Source: (Porter, 1985)

The Porter’s Value Chain model as depicted above shows which activities Porter broke the chain down to; inbound logistics, operations, outbound logistics, marketing and sales and lastly service.

4.4.2.1 Vertical Integration

Recent years have seen a major reconfiguration of Danisco’s value chain as Sugar and Flavours have been divested. Prior to these divestitures, Danisco had a dualistic focus, partly cost advantage within sugar and differentiation within ingredients and industrial enzymes. The current strategy is more focused and the value chain is configured in such a way to achieve differentiation advantages (Porter, 1986).
Danisco has a wide competitive scope due to engagement in three separate and different markets; Food, feed and industrial enzymes. This has lead to a high degree of vertical integration in the value chain. However synergies are present as the product structure is closely linked in terms of technology, distribution and production. This enables Danisco to achieve economies of scope (Barney, 2002).

Danisco’s firm structure is characterized as a product structure as hierarchally management centers around Enablers, Cultures, Sweeteners and Genencor (see figure 48 in appendix A). However the geographically the structure has matrix tendencies as sales is spread-out worldwide and if market size requires it a local production facility is constructed, else production is centralized in Denmark or the US. Also in product development a matrix structure is favoured as each product division largely relies on the same technological foundation, thus sharing know-how across division is vital.

After reviewing the overall strategic intent combined with the primary activities a value chain analysis can be constructed below.

![Figure 16 – Danisco’s Value Chain](image)

<table>
<thead>
<tr>
<th>Value Chain Element</th>
<th>Value Creating Activities</th>
<th>Value Generation</th>
</tr>
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<tbody>
<tr>
<td>Inbound Logistics</td>
<td>Dependent on suppliers for raw materials</td>
<td>Low</td>
</tr>
<tr>
<td>Operations – Production</td>
<td>Economies of Scale</td>
<td>Low</td>
</tr>
<tr>
<td>Operations - Product</td>
<td>Technological platform</td>
<td>High</td>
</tr>
<tr>
<td>Development</td>
<td>Wide product portfolio</td>
<td>High</td>
</tr>
<tr>
<td>Outbound Logistics</td>
<td>Global distribution network</td>
<td>High</td>
</tr>
<tr>
<td>Marketing/Sales</td>
<td>Partly outsourced</td>
<td>Medium</td>
</tr>
<tr>
<td>Service</td>
<td>Logistical support</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Technological support</td>
<td>Low</td>
</tr>
</tbody>
</table>

Source: Author’s own creation

*Inbound logistics* for raw materials has been outsourced as the link carries little value to Danisco and it does not add actual value to the end product; therefore it is viewed to be a link which should be as cheap as possible. A negative consequence is an added sensitivity to volatile resource prices, which has the potential to dilute profits. Human capital is another incremental input required to produce such a technological founded product. In terms of gathering information, a global platform of scientist adds
value as new trends might be spotted sooner. The disadvantage is that this unique information could be lost in the organizational hierarchy due to information overload (Rothaermel, Hitt and Lloyd, 2006). Within *Operations*, achieving an efficient production process that exploits structure and strategy is essential. The choice of adopting a differentiation strategy in general means greater production costs. The incremental choice between low-costs or differentiation is thus a trade-off.

Danisco has adopted a geographically diversified production strategy, which is intended to minimize costs whilst maximizing local responsiveness. An internationally diversified production strategy adds value in the sense that a specific regional segments’ demand, can be satisfied more efficiently. However this also implies a less efficient production process, as adapting functionality adds time and costs. Third-party distributors are only used in markets with insufficient business volume to justify a subsidiary (Danisco Equity Story, 2010).

Comparing production efficiency in Genencor to Novozymes it can be noted that while Genencor’s production is spread out over 9 sites, Novozymes only has 4 sites, producing twice the volume. Subsequently, the current manufacturing structure at Danisco, which yields EBIT margins at 12.7 percent in 2010 is nowhere near the scale economies achieved in Novozymes yielding 20.0 percent EBIT margins in 2010 (Novozymes Annual Report 2010). In Food Ingredients (Enablers, Cultures and Sweeteners), the 2010 EBIT margin of 14.5 percent can be compared to the 21.3 percent generated by Danish ingredients peer Chr. Hansen (Chr. Hansen Annual Report, 2010). This highlights that Danisco face a challenge of improving production efficiency.

*Operations – The product development process* is centralized in Denmark (ingredients) and the US (feed and industrial enzymes). At Danisco’s core stands a proprietary technology stretching its arms into its three product divisions. Simply stated it is the process of creating enzymes faster and of higher quality, which is at the heart of the firm. The purchase of Genencor added another branch and unique know-how. The embedded limit was further enhanced by this technology, granting the firm a competitive advantage.

Obtaining new knowledge has primarily been accomplished through acquisitions. Partnerships have also been used a great deal, exemplified by the DDCE venture. The rationale is to internalize difficult achievable tacit knowledge and use this in new or existing products. According to a recent study undertaken by management-consultants at McKinsey, breakthrough innovation only accounts for 3 percent of new products in the industry (McKinsey, 2009). Consequently the local responsiveness and production adaptation becomes a central driver for value creation in the future. The figure below outline competitors’ end result of R&D.
Danisco and Novozyme’s focal point is the industrial enzyme market, while DSM and Chr. Hansen focus on cultures within food. However Novozymes is clearly the most innovative firm within this framework. Outbound logistics is internationally diversified with owned distribution on 90 percent of markets (Danisco Equity Presentation, 2010). The strategic aim is to reduce shipping costs and achieve a global reach, hard to match for competitors. The cost of duplicating Danisco’s extensive geographical location acts as an entry barrier and facilitates a competitive advantage.

Marketing and Sales; Numerous partnerships with local firms should enable efficient promotion within the specific region. Danisco has adopted a glocal (global and local) strategy, which means a central governing marketing strategy is adapted to regional environment (Hollesen, 2002). This strategy is costly as external marketing firms have to be hired, but also efficient as the complexity of the local environment is addressed. Subsequently this adds medium value in the value chain.

Service; Danisco functions as a subcontractor to manufactures of food, feed and bio-fuel, and are thus far away from the end consumer. Within business to business, Danisco delivers a product addressing a small but key element of the overall manufacturing. As described above Danisco’s bargaining power is limited and thus the product failure rate has to be low. This step subsequently adds little value to the products as these are expected to function without error.

4.4.2.2 Core competence
The availability of financial, intangible and production resources have enabled Danisco to adopt a more focused strategy seeking consolidation on existing markets while expanding further in newer ones. The degree of competition in food and feed is moderate, but food-manufactures experience increasingly difficult market conditions, due to the fact that consumers require higher enzyme activity while
demanding lower prices. Therefore Danisco will be unable to maintain its current prices and the industry will have to look for innovative ways to address this negative price threat in the future. Three ways was identified above:

- *Economies of Scale*
- *Rationalizing distribution*
- *Differentiation of products*

Superior performance within these key value-adding-activities is essential competitive parameters. Danisco’s core competencies lie in the latter two, while production costs is a working progress but have seen significant improvements in 2010 (Annual Report 2010).

The other main challenge facing Danisco in the future is the increasing R&D costs, coupled with shorter product life cycles. Danisco has unique capabilities in R&D largely focused at the bio-ethanol market. This changed focus is explained by both the food and feed market being close to maturity in its product life cycles.

### 4.5 Future Industry Profitability

This section use the findings from the external and internal analysis in an effort to address whether Danisco’s strategic “fit” allow for a sustainable competitive position in the future. To achieve a coherent measure, the BCG matrix framework is adopted (Tutor2u.net). The model describes the relationship between market growth rate and market share relative to competitors. Criticism of the model includes an overemphasis on growth, as declining markets are not addressed. Moreover markets with intense competition would require an allocation of substantial amounts of resources in order to improve the market share. Adopting a real option logic, managers have to assess whether these resources could make a larger impact on another business area (Copeland & Antikarov, 2003). The dualism between market potential and core competencies is essential in positioning Danisco’s product divisions within the BCG Matrix.

*Food ingredients*

Within its three niche markets, performance and growth potential can be divided into categories of *ups* and *downs*.

*Enablers* is the largest division accounting for 42 percent of revenue. While competition on the market is intensifying Enablers have carved out a profitable niche. Modest growth of 2.7 percent was seen in 2010
however the EBIT margin saw significant improvements to 16.2 percent, nearly a 5 percent increase from 2009. Enablers benefitted from stable resource prices and improved asset utilization in 2010. No further product development has been instigated, indicating that a consolidation strategy is pursued. The expected development of Enablers given the contingent market dynamics and the unique product qualities is that growth will continue at its current level. The product is currently close to maturity given the characteristics described above it can be characterized as a **Cash Cow**.

**Cultures** is playing a more and more important role in Danisco, experiencing an 8 percent year on year growth in revenue, over the last 2 years. Cultures are another niche product, but as opposed to Enablers the market is still growing.

The cultures division saw improved production efficiency as RNOA rose to 11.9 percent, which contributed to an EBIT margin of 19 percent, 3.5 percent better than the prior year. As Cultures are one of the few ingredients markets with high growth and moderate competition, it is assumed that Chr. Hansen and Danisco can share the market between them and thus we expect the division to sustain its current a growth rate of 8 percent. Cultures can be characterized as a **Star**.

**Sweeteners**, the problem child have experienced a dramatic descent towards unprofitability. Negative EBIT and revenue growth over the last 2 years have occurred as management have been forced to make massive impairment write downs on goodwill, meaning that the value of intangible knowledge embedded in Sweeteners is obsolete or unusable. This has resulted in a RNOA of -64 percent in 2010. Subtracting these write downs Sweeteners would have had positive EBIT of dkk 20 mil., a decrease of dkk 57 mil. from 2009. Despite these negative tendencies the division is still functioning and a dkk 100 mil. restructuring program is underway. Given the current situation on the Sweeteners market it is doubtful whether this will have any effect. Paradoxically a light in the darkness and the saviour of Xylitol could be a new sweetener called Stevia, which is not even produced by Danisco. Because goodwill write downs are non-recurring, EBIT will see significant improvements in the coming years. Our estimate for Sweeteners is that the restructuring program furthermore will bring modest improvement in profitability, whilst revenue growth will be zero. Sweeteners is situated on the border between **dog** and **cash cow**, the division has very little growth opportunities but will in the coming years generate free cash flows for investors. The trade-off between divesting to a competitor able to utilize synergies or holding on and feeding on the last drops is an important decision in terms of value maximization.
Genencor

As described Genencor is an umbrella for numerous products, however they are all based on similar technology, characterized as industrial enzymes.

Detergent and Textiles both operate in markets close to maturity with little growth. Detergents and textiles, account for 7.4 percent of total revenue and showed a modest growth of 3 and 4 percent respectively in 2010. Because of high entry barriers, low production costs and the geographic universal product characteristics coupled with only a modest competitive intensity, Danisco will be able to sustain the current growth in the coming years. As the market has oligopoly characteristics, both detergents and textiles are positioned in the lower market share end within Cash cows.

Feed has throughout the last three years seen a growth rate of 8-10 percent, which is above the estimated feed market growth rate of 3.5 percent. This has been achieved on a market, analysts characterize as having reached maturity, which further stresses the achievement. Danisco has been able to use its longstanding historic involvement in the market and by leveraging its core competencies of efficiently servicing a global customer population.

As above, the feed market is an oligopoly, however as farmers are pressured on manufacturing prices there is a negative price threat, which leads to added competition both on prices and product functionality. Danisco has been able to exploit this, but it is doubtful whether the firm can achieve similar growth rates in the coming years. The expected development is; revenue growth will continue at 8 percent, but will revert towards the market growth rate at 3.5 percent after a number of years. Feed is a definite Cash cow.

Bio-ethanol has been identified as a key source in achieving abnormal growth. Whilst first generation bio-ethanol is experiencing revenue growth of 20 percent per annum, even larger expectations are attributed to the forthcoming launch of a second generation enzyme. Currently bio-ethanol only accounts for 3.3 percent of total revenue, but this is expected to grow as political legislation is shifting towards bio-ethanol as the optimal alternative to fossil fuels.

Analysts suggest that the future market structure for bio fuels is not characterized by the individual products, as the market - if successful - will be profitable enough to support many firms. The deciding factor will instead be whether the industry as a whole will be able to build the required infrastructure enabling cheaper production (Børsen, 29.07.2010). World economic forum reports, that the market for bio-fuels will have trebled in 2020 generating more than 545 bil. Dkk (Mckinsey, 2010). The market for
pre-treatment enzymes is estimated to yield dkk 60 bil. by 2020. Companies such as Novozymes and Danisco are well-positioned to establish new businesses within this area. Danisco and Novozymes currently divide the market between them, the latter being market leader. Subsequently Danisco will be able to sustain its current growth rate at least until 2013, which is the planned launch of 2nd generation bio-fuel enzyme. Novozymes also plans on releasing a similar solution, which has lead to court cases regarding patent infringements amongst the two (Børsen, 12.05.2010). These duopoly market tendencies point at the fact that Danisco will be able to sustain its high growth rate and market share.

Bio-ethanol can thus be characterized as a Star.

Overall Genencor can be characterized as a star, as the division has a high market share (21 percent) and reports a high growth of 12 percent. However, because focus has been to maximizing growth in bio-ethanol EBIT is below that of Enablers and Cultures at 13.5 percent. However Genencor is the division with the highest production efficiency with a RNOA of 20.4 percent, a little better than Enablers. Growth in Genencor is expected to increase over the coming year, facilitated by feed and bio-ethanol.
5. Financial Analysis

5.1 Accounting Principles (Account implementation)
In the financial analysis section we will analyze historical key figures to find relevant financial ratios, which will be used later in the thesis. We have used annual reports from 2005 to 2010, and Danisco are compliant with the IFRS accounting principles and has been so in the period we are analyzing. Important value drivers will be derived from the reclassified financial statements, taken from the annual reports, and it is therefore important to assess the validity of these reports. When auditing the relevance, reliability, comparability and the prudence are looked at, and as the reports were deemed correct by the auditing companies, in respect to IFRS, we must assume that the reports are presenting the financial status of the company correctly.

As the financial statements only to a certain extent divide the creation of value into operational and financial activities, we find it necessary to reclassify the annual reports before the real creation of value from operations and financing can be evaluated. The reclassification helps us make the profit and losses of Danisco more transparent, which in the end will give us a better view of the efficiency and profit of the company.

Danisco has written down the value of their assets on the income statement for several years, giving a much lower EBIT in these years. Special items are classified as non recurring costs, and the special items post cannot be expected to be as high the forthcoming years. The special items costs have been high because there have been large write downs on Sweeteners and Sugar goodwill. According to IFRS, goodwill is not amortized as of IFRS 3 in 2005, but an annual impairment test is made to assess the real value of these intangible assets. These impairment write downs shall be recognized on the income statement according to IFRS (IASB, 2010). Therefore we have chosen to include these costs in the reclassified financial statements, which evidently will affect the performance ratios of Danisco, but we find that this is the most correct way. We will of course look at these as non-recurring, but this will be adjusted for in our forecast where both the strategic and financial analysis will be used. In this way we hope to incur these costs the best way possible in making our valuation of Danisco. The reclassified financial statements can be found in appendix D.

5.2 Key Ratios
In the following we will make an analysis of profitability and use this to make an analysis of the growth, which in the end will be used to make our forecasts for the DCF valuation. After reclassifying the financial
statements, we have used these to calculate key ratios that can be used to get a more intricate understanding of how Danisco has been performing, and how they are generating value to shareholders.

5.2.1 Profitability of Danisco

The analysis will be made by decomposing the Return on Common Equity (ROCE) ratio on the reclassified financial statements, as this ratio is a representative ratio for the value of the shareholders. This is also called the DuPont model, where the analysis is divided into three decomposed levels and functions as the framework used in the reclassification of Danisco financial statements (Penham, 2007). The DuPont model, is a well renowned method for assessing performance as the model describes the relationship between the financial figures. It is important to note that OI = NOPLAT and ROIC = RNOA = OI / NOA (ibid).

Danisco has made several changes to the structure of the company the last 5 years, which also is evident in the firms ROCE and RNOA depicted below.

\[
\text{Return on common equity (ROCE)} = \frac{\text{Comprehensive income}}{\text{Average common equity}}
\]

![Figure 18 – Return on Common Equity](image)

Source: Authors own creation based on reclassified financial statements

In the case of Danisco, it is hard to derive information directly from the ROCE. In order to depict the impact of special items, ROCE is compared to “ROCE without special items”. ROCE is a key ratio as it can be used to relate return on equity to investors cost of capital. If the ROCE is lower than the WACC, the shareholders have not been fully compensated for the risk they have been undertaking in holding Danisco stock. Under the risk return trade-off investors, would be better off investing in a fully diversified the market portfolio (Brealey, Myers & Allan, 2008). WACC is in section 7.2.1 found to be 7.342 percent.
The special items post consists of restructuring costs and write-downs. These write-downs have been the major part of the special items posts in 2006, 2009 and 2010, at over dkk 700 mil. for each year. These costs are classified as non-recurring costs, and as they are very large compared to NOPAT, which is used in RNOA or total income in ROCE this have a great influence on both ratios. One could argue that the best measure of the performance of Danisco is the ratios without the special items to analyze the historical performance of Danisco in a forecasting perspective, but these should be analyzed with the special items cost incurred, as the IFRS says that they should be incurred in the Income statement and not the Balance Sheet. It must be said that these costs are not paid directly but are non-cash items. For ROCE without the special items it can be seen, that these are not as fluctuating, and that current it is almost at 2006 level, after the divestiture of the Sugar division, and the restructuring of the Sweeteners division. In decomposing the ROCE using RNOA we will use the ratios with the special items costs included.

5.2.2 Decomposition of ROCE

RNOA describes the utilization efficiency of operating assets and is thus directly related to Danisco’s profitability. The connection between RNOA and ROCE is defined as:

\[ \text{ROCE before MIN} = \text{RNOA} + (\text{FLEV} \times \text{SPREAD}) \]

Return on Net Operating Assets (RNOA) is calculated as:

\[ \text{RNOA} = \frac{\text{Operating income}}{\frac{1}{NOA_t} - 1} = \frac{\text{PM} \times \text{ATG}}{\text{NOA}_t} \]

**Figure 19 – Return on Net Operating Assets**

Source: Authors own creation based on reclassified financial statements
The Financial Leverage (FLEV) has fallen significantly from 1.1 to 0.36 from 2006 to 2010. This is because Danisco has repaid huge amounts of debt using the proceeds from the sugar divestiture (Danisco press Release 07.2008).

From 2006 to 2008 both assets and operating income have fallen, consequently RNOA has remained virtually unchanged, but with the current lower amount of debt and expected lower write-downs in special items, it is probable that the operating income will increase in the following years, all other things equal. As one would expect, all other things will not be equal, and therefore we will go a level deeper in finding the drivers of performance and profit, thus investigating the profit margin and asset turnover.

**5.2.3 Profit Drivers**

<table>
<thead>
<tr>
<th>PM drivers</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grossprofit</td>
<td>34.60%</td>
<td>34.60%</td>
<td>41.00%</td>
<td>40.10%</td>
<td>44.10%</td>
</tr>
<tr>
<td>Research and development expenses</td>
<td>-4.50%</td>
<td>-4.10%</td>
<td>-5.40%</td>
<td>-5.70%</td>
<td>-6.40%</td>
</tr>
<tr>
<td>Distribution and sales expenses</td>
<td>-12.60%</td>
<td>-13.30%</td>
<td>-17.10%</td>
<td>-17.70%</td>
<td>-18.10%</td>
</tr>
<tr>
<td>Administrative expenses</td>
<td>-6.60%</td>
<td>-6.60%</td>
<td>-7.70%</td>
<td>-7.10%</td>
<td>-6.80%</td>
</tr>
<tr>
<td>Special items</td>
<td>-3.70%</td>
<td>-1.00%</td>
<td>-0.80%</td>
<td>-5.70%</td>
<td>-5.80%</td>
</tr>
<tr>
<td>PM</td>
<td>4.60%</td>
<td>7.70%</td>
<td>10.90%</td>
<td>0.60%</td>
<td>4.30%</td>
</tr>
</tbody>
</table>

Source: Authors own creation from reclassified annual reports

The profit margin has experienced fluctuations but is currently at 2006 levels. As can be seen gross profit has risen from 34.6 percent in 2006 to 44.1 percent in 2010. The reason for this can be found in the divestiture of the sugars division, which was less profitable, but had large revenues. As these drivers are calculated by using revenue, it is logical that the research and development expenses are a relatively larger cost, as revenue has fallen. It is interesting to see that the special items in 2009 and 2010 are relatively large compared to the other years, and compared to e.g. the research and development expenses for these years. The larger gross profit margins have been “eaten” up by higher research and development expenses, higher distribution and sales expenses and the special items giving almost the same profit margin in 2010 as in 2006.

Absolute profit has fallen, but so has the absolute revenue, giving the same profit margin. This is a bad sign, looking only at the numbers, but in connection with the strategic analysis, and with the comments from the management of Danisco. The intent has been to create a more profitable organization due to higher profit margins by means of a focused strategy.
5.2.4 Asset Turnover

To see what part of the company that drives the profit we have chosen to look at the asset turnover drivers, called ATO.

\[ ATO = \frac{Sales}{NOA} \]

We use \( 1/ATO \), which makes more intuitive sense to look at, as it indicates the amount of NOA used to generate 1 DKK of sales. If the ATO is 2 this would mean that the company uses 50øre of NOA to generate 1 DKK of sales.

\[ \frac{1}{ATO} = \frac{NOA}{Sales} \]

**Figure 21 – Asset Turnover Drivers**

<table>
<thead>
<tr>
<th>ATO drivers (inverse)</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intangible assets</td>
<td>0.563</td>
<td>0.627</td>
<td>0.859</td>
<td>0.686</td>
<td>0.594</td>
</tr>
<tr>
<td>Tangible assets</td>
<td>0.433</td>
<td>0.462</td>
<td>0.684</td>
<td>0.515</td>
<td>0.392</td>
</tr>
<tr>
<td>Financial assets</td>
<td>0.008</td>
<td>0.008</td>
<td>0.008</td>
<td>0.004</td>
<td>0.005</td>
</tr>
<tr>
<td>Goods and Inventory</td>
<td>0.278</td>
<td>0.291</td>
<td>0.444</td>
<td>0.326</td>
<td>0.203</td>
</tr>
<tr>
<td>Trade receivables</td>
<td>0.163</td>
<td>0.178</td>
<td>0.258</td>
<td>0.203</td>
<td>0.174</td>
</tr>
<tr>
<td>Other Operating Assets</td>
<td>0.083</td>
<td>0.106</td>
<td>0.145</td>
<td>0.134</td>
<td>0.120</td>
</tr>
<tr>
<td></td>
<td>1.528</td>
<td>1.672</td>
<td>2.398</td>
<td>1.869</td>
<td>1.487</td>
</tr>
<tr>
<td>Operating Liabilities</td>
<td>-0.286</td>
<td>-0.312</td>
<td>-0.466</td>
<td>-0.350</td>
<td>-0.266</td>
</tr>
<tr>
<td>1/ATO</td>
<td>1.243</td>
<td>1.360</td>
<td>1.932</td>
<td>1.519</td>
<td>1.221</td>
</tr>
<tr>
<td>ATO</td>
<td>0.805</td>
<td>0.735</td>
<td>0.517</td>
<td>0.658</td>
<td>0.819</td>
</tr>
</tbody>
</table>

Source: Authors own creation based on reclassified financial statements

It can be seen that the overall inverse ATO was 1.243 in 2006, rose to 1.932 in 2008 and fell again to 1.221 in 2010. The rise and fall was due to the fall in revenue in 2008 and afterwards fall in NOA which made the 2010 inverse ATO lower than in 2006. This shows that Danisco has managed to use their assets more efficiently as fewer NOA are used to generate revenue. Especially the inverse ATO of intangible and tangible assets have fallen, due to the sugar sell off, and later write-downs. Operating liabilities have likewise decreased considerably since 2008, stressing management’s efforts to streamline production.

Another important driver to consider is the relationship between financial expenditures and net financial obligations.

**Figure 22 – Net Borrowing Costs Driver**

<table>
<thead>
<tr>
<th>NBC- drivers</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial costs in %</td>
<td>5,10%</td>
<td>5,20%</td>
<td>5,20%</td>
<td>10,70%</td>
<td>10,70%</td>
</tr>
<tr>
<td>Financial income in %</td>
<td>2,50%</td>
<td>2,40%</td>
<td>3,90%</td>
<td>10,10%</td>
<td>8,30%</td>
</tr>
<tr>
<td>NBC- drivers</td>
<td>2,60%</td>
<td>2,80%</td>
<td>1,30%</td>
<td>0,60%</td>
<td>2,40%</td>
</tr>
</tbody>
</table>

Source: Authors own creation based on reclassified financial statements
As debt has been paid off, the net borrowing costs (NBC)\textsuperscript{14}, is currently at 2006 level due to the fact that, NFO have fallen significantly and the net financial expenses\textsuperscript{15} have fallen correspondingly. NBC describes the average cost as a percentage of net financial obligations.

### 5.2.5 Cash flow analysis

**Figure 23 – Reclassified Cash Flow Statement**

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash flow from operating activities</td>
<td>2646</td>
<td>2203</td>
<td>1044</td>
<td>1288</td>
<td>2592</td>
</tr>
<tr>
<td>Cash flow from investing activities</td>
<td>-1420</td>
<td>-1178</td>
<td>-702</td>
<td>-1416</td>
<td>-841</td>
</tr>
<tr>
<td>Cash flow from financing activities</td>
<td>-1566</td>
<td>-1194</td>
<td>-3410</td>
<td>-5115</td>
<td>-1705</td>
</tr>
<tr>
<td>Cash flow from discontinued operations</td>
<td>-11</td>
<td>144</td>
<td>3067</td>
<td>5243</td>
<td>306</td>
</tr>
<tr>
<td>Change in cash and cash equivalents</td>
<td>-318</td>
<td>-39</td>
<td>-30</td>
<td>-22</td>
<td>378</td>
</tr>
<tr>
<td>Cash and cash equivalents end of period</td>
<td>411</td>
<td>372</td>
<td>342</td>
<td>320</td>
<td>698</td>
</tr>
</tbody>
</table>

Source: Authors own creation based on reclassified financial statements

It can be seen from the cash flow statement that cash flows from operating activities have increased from 2008 after a decline due to the sugar divestiture. In this the cash flows from Sugar operating activities are put in the cash flows from discontinued operations. Danisco has had a negative change in cash and cash equivalents (C&CE) from 2006 to 2009, which basically means that Danisco is spending more cash than they earn. This is despite earnings from discontinued operations of dkk 3 bil. and dkk 5.2 bil. The fact that C&CE, equity and retained earnings have remained unchanged despite such large non-recurring incomes, does not necessarily mean that management is doing bad business as the cash could just be reinvested in projects expected to generate higher cash flow in the future. Management decided to utilize these earnings to pay off large amounts of debt, as seen from financing activities in 2008 and 2009. Cash flow from investing activities is mainly driven by acquisitions of other firms.

Overall cash from operations has improved tremendously from 2008 to 2010; however it is only in the latter year that this has amounted in increased C&CE.

### 5.3 Peer Group Analysis

Many of the key financial figures above highlight different tendencies, but require a peer group benchmark in order to assess Danisco’s relative performance. It is thus important to highlight that these benchmarks are intended to function more as guidance than actual financial figures for the individual firms.

\[\text{NBC} = \frac{\text{Net financial expenses}}{\left(\text{NFO}_{t-1} + \text{NFO}_t\right)}\]

\[\text{Net financial expenses} = \text{financial costs} - \text{financial income}\]
The following will provide average comparable key figures based on research reports prepared by institutions following Danisco and its relevant competitors. The construction of the peer group is based on findings from the strategic analysis, in which relevant competitors were chosen based on; product similarity, market share and growth strategies (Ref. Section 4.2.2.5).

The following was identified as a representative peer group for Danisco: Novozymes, DSM, Chr. Hansen, Kerry Group and ABF. Cargill and BASF have not been included because the firms are privately held and consequently the availability of data is limited. The firms above have been selected as they represent and are active within the chemicals industry, however some of the firms such as BASF and ABF are large conglomerates engaged in other none related business areas. This could lead to misleading comparisons and an invalid forecast. These differences are overcome by incorporating group average, which should remove most discrepancies. Peers should be directly comparable; except from Novozymes this has not been possible. However the selected firms all overlap into Danisco’s competitive sphere and are therefore relevant.

The data used is not directly comparable as the companies do not have the same fiscal year; Danisco for instance has a fiscal year that runs from 1st of May to the 31st of April and Novozymes has one that runs from the 1st of January to the 31st of December. In order to be directly comparable, the peer group needs to have the same accounting practices. It is assumed that the companies traded on European stock exchanges use IFRS as those are the standards required to be used by European law. Cargill however obey by US law and use GAAP and is thus not directly comparable. Furthermore data used to calculate financial ratios is the publicly available data in the annual reports and not found through a comprehensive reclassification. Firms follow strict IFRS and GAAP rules. This is supported by the fact that external auditors have accepted the financial statements. The thesis have utilized financial analysts expected earnings for 2010 for peers, which was deemed relevant to construct a valid benchmark and we are aware of the large insecurities in these figures.

Other methodological issues are that the peer group is assumed to have a correct market capitalization, hence there is an implicit assumption of market efficiency and therefore that Danisco should also be correctly priced. The above creates a paradox as this thesis is based upon a flawed market valuation of Danisco and thus an inefficient market pricing (Fama, 1970).

5.3.1 Revenues
The table above illustrates\(^\text{16}\) two overall tendencies regarding Danisco’s main competitors; firstly, firms engaged in food ingredients or/and feed ingredients have struggled to maintain previous revenues. This includes Kerry Group, BASF and DSM. Secondly; firms engaged in growth segments such as industrial enzymes and cultures within food ingredients have been able to prosper and sustain a positive growth in revenue during the period. This includes Novozymes, ABF and Chr. Hansen. These tendencies signal a high correlation between growth in revenue and being engaged in emerging product segments.

Despite large restructuring costs and many strategic initiatives, Danisco have been able to sustain a modest growth from 2008 and onwards. Danisco and Novozymes have had similar continuous annual growth rates from 2008 to 2010 of 3.9 and 5.1 percent.

The described tendencies in the development of revenue are in line with findings from the strategic analysis, in which it was highlighted how Food and Feed have entered maturity with limited future growth. To secure future profits firms are required to act and cannot rely on previous successes. In search of future profitability firms have followed two distinctive strategies; one, added investments in R&D. Two, streamline the value chain especially production and distribution. This will be analyzed below.

### 5.3.2 EBIT and Profit Margin

\(^{16}\) Enterprise value is calculated as market cap plus debt, minority interest and preferred shares, minus total cash and cash equivalents.
Saying more than the various revenues for the peer group, is the EBIT to revenue margin shown in the figure above. This highlights how Novozymes and Chr. Hansen are able to sustain higher profit margins, which again indicate that the firms are engaged in more profitable business areas. Danisco’s EBIT margin has been fairly volatile compared to peers. However the EBIT Margin for Danisco still remains above its ingredients competitors. From 2009 to 2010 Danisco’s EBIT doubled while revenue only saw a small increase, this has resulted in an improved EBIT Margin. It has to be considered that the firm has continued to write-down its goodwill mainly due to the failing sweeteners division. This has meant a substantially lower EBIT in 2008 and 2009.

In terms of its ingredients competitors, Danisco is just above them, but compared to the more biotechnology focused peers Novozymes and Chr. Hansen the firm is far behind. This is furthermore reflected in the firms’ enterprise value, were Novozymes and Chr. Hansen by far has the highest, despite lower revenue. Enterprise value is an indicator of investors’ projections for the future. Despite a low EBIT margin, investors have a positive opinion regarding Danisco’s future profitability. This has however not been reflected in an improved EBIT margin. The peer group average EBIT margin is close to 12 percent throughout the period, which again positions Danisco as average. The problem does not seem to originate from the demand side as the divisions’ revenue continues to grow year on year, except from Sweeteners. It thus becomes relevant to compare the operating efficiency within the peer group.

5.3.3 RNOA\(^7\) of peer group

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\(^{17}\) RNOA is sometimes called return on invested capital (ROIC) (Penham, 2007)
An important strategic issue for Danisco has been the improvement of its operating efficiency. The inability to achieve similar margins, as peers, on its RNOA further stresses this problem. However it is vital to notice that much of the assigned operating assets base is goodwill.

Danisco’s aggressive acquisition strategy has subsequently decreased the RNOA margin. Novozymes has not found it necessary to acquire external know-how through large acquisitions and is thus able to sustain a high RNOA (Novozymes Annual Report, 2010). In general Novozymes also has higher profitability margins, which again contributes to a higher RNOA. RNOA has risen in 2010 and is still below the group average in 2009, but is expected to increase substantially in 2011 due to the non-recurrence of further goodwill write-downs. A supporting argument can be derived by assessing asset efficiency in relation to revenue. Danisco’s ATO is positioned a little below the group average and similar to Novozymes. ATO does not take into account Danisco’s large special items, which affect income and thus RNOA (Penham, 2007).

Expenditures in R&D are a key factor, and as described Danisco has increased its investment aimed at developing innovative solutions, mainly within industrial enzymes. Danisco spends more on R&D than most of its peers, due to entering the promising markets and untapped market of industrial enzymes, which is a positive strategic as food and feed markets reaches maturity. Market leader within industrial enzymes, Novozymes also by far has the highest capital investments in R&D. Compared to number of product launches, Novozymes released 9 products, which is double the amount released by Danisco, Chr. Hansen and DSM. The latter firms all have R&D to revenue ratios of approximately 4-5 percent.

**Figure 26 – Peer group analysis of Asset Utilization and investments in Research & Development**

<table>
<thead>
<tr>
<th></th>
<th>RNOA</th>
<th>ATO</th>
<th>R&amp;D/Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Danisco</td>
<td>5.7%</td>
<td>6.2%</td>
<td>1.4%</td>
</tr>
<tr>
<td>Novozymes</td>
<td>20.7%</td>
<td>18.8%</td>
<td>18.0%</td>
</tr>
<tr>
<td>DSM</td>
<td>6.7%</td>
<td>9.3%</td>
<td>6.0%</td>
</tr>
<tr>
<td>Chr. Hansen</td>
<td>-</td>
<td>-</td>
<td>4.2%</td>
</tr>
<tr>
<td>Kerry Group</td>
<td>11.7%</td>
<td>9.2%</td>
<td>10.0%</td>
</tr>
<tr>
<td>ABF</td>
<td>8.2%</td>
<td>7.4%</td>
<td>6.8%</td>
</tr>
<tr>
<td>Group Average</td>
<td>10.6%</td>
<td>10.2%</td>
<td>7.7%</td>
</tr>
</tbody>
</table>

Note: RNOA is taken from Datastream to limit calculation errors
Source: Datastream, Annual Reports
5.3.4 Financial Gearing

As can be seen from the figure below, all firms have decreased their financial leverage. This is a consequence of the added risk associated with the recession. Firms suddenly faced an uncertain future in terms of profitability and with a substantial debt gearing the implied default risk increased. Cost of capital is derived from the rate on debt and investors demand on equity. Debt typically has a lower required rate and is therefore preferred, but only to a certain point when the exposure becomes so large that the rate on debt increases exponentially (Miller & Modigliani *proposition II*, 1958).

![Figure 27 – Financial gearing of peer group](image)

Source: Annual Reports, Thomas Reuters

Firms such as Kerry Group and Danisco have operated with a high debt gearing. Within Danisco the large debt exposure is a consequence of an aggressive strategy to achieve a global reach in terms of distribution and production. With the divestments of Flavours in 2007 and Sugar in 2009 the leverage has been reduced substantially and NIBD currently constitutes 28 percent of total equity. DSM and Novozymes have reduced its stable and lower financial leverage even further and is currently operating with very little debt. Within capital budgeting theory the hypothesis of an optimal debt gearing is often discussed. Applying Myers (1984) pecking order theory on the peer group it becomes obvious how the industry is in transition, going from tangible know-how in production, to intangible in R&D. The added risk associated with uncertain R&D projects leads to a higher interest rate on debt, as the expected cash flows are more risky. Therefore reinvesting earnings is the preferred source of capital.

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18 Chr. Hansen is excluded as the firms have a historic financial leverage of 1072 percent in 2007 and 105 percent in 2010. The high leverage is because previously the firm was privately owned.

19 NIBD/Total Equity
5.4 Part Conclusion

The reclassification of Danisco’s financial statements has provided an insight into the main drivers of the profitability. What we find as the most rational and logic conclusion on the financial analysis is that Danisco has made radical changes to their financial structure. It is obvious that this has been done, to achieve a more focused firm and thereby being more efficient in those sectors that they believe will be more profitable in years to come. This has mainly been achieved by selling of the Sugar division, which was less profitable relative to RNOA. By selling of sugar, they repaid non-current debt lowering their financial leverage significantly. The inverse ATO has also fallen, as the remaining business sectors are able to use NOA more efficiently.

This line of thought has to be stressed, as performance over the previous years has been very disappointing compared to peers. Especially the profit margin and RNOA was substantially lower than peers. However this underperformance is not reflected in the share price, which has doubled from late 2009 to 2010, mainly due to the recent positive shift in profitability. By treating special items as a non-recurring event, ROCE and RNOA would be pushed upwards in 2011, all things equal. This would expectedly position Danisco above the peer group average both regarding RNOA and ROCE. This transition period has thus restored the confidence in Danisco, and the margins are expected to see substantial increases over the coming years. Furthermore the risk associated with the FGEAR and FLEV has been reduced to an acceptable level compared to industry standards.

One might speculate whether raising FLEV by taking more loans, and using these loans to expand in their remaining businesses, would make it possible to earn a larger profit than before with the same NOA and FLEV. As Danisco moves closer to being a chemical and pharmaceutical enterprise the Beta will rise giving a higher WACC, all things equal, which will give a lower value of the company. In the same direction, the lowering of debt will make the WACC higher, again all other things equal. The opposite effect will come from the lower risk of the company. The lower risk in the company will lower new debt rates, and the cost of capital for investors will also fall. It will be an important issue for the heads of Danisco to solve, as the right capital structure is very important in the years to come, especially after they have left the old production company behind and chosen a more research and development heavy future. We believe that Danisco will lower debt even more, as to complete the transition to a more focused biotechnology company. This is to be in line with the peer-group competitors, and to adjust to the more risky business in which they now operate.
Part III – Valuation of Danisco

6. Identifying Real Options in Danisco
This chapter seeks to recognize, whether it is possible to identify valuable real options in Danisco. This builds on a dualistic approach to valuation, wherein both the DCF and ROA was identified as relevant. We are able to separate Danisco into areas best priced using the standard DCF and other areas, which fulfils real option criteria, where ROA best captures the value.

The chapter utilizes our constructed three dimensional identification model (Ref. Figure 6). The model was constructed based on Copeland and Keenan’s (1998) and Gamba (2002). The three criteria were: 1) High uncertainty, defined as the likelihood of receiving new information facilitating a better informed decision. 2) Managerial flexibility, defined as the ability to actively affect the strategic outcome of an investment, thereby changing the value. 3) Correlation, defined as option interdependencies. This three dimensional model enables us to frame actual real options in Danisco and what triggers their exercise.

6.1 Real Options in Danisco
This section will investigate the presence of real options in Danisco utilizing the acquired in depth understanding provided by the case study analysis and figure 6 developed based on the findings from section 3.2.3 and 3.2.5. Using our found criteria three potential real options have been framed in Danisco, which hereafter will be discussed.

6.1.2 Firm as a Bundle of Options
As mentioned earlier, a firm can be seen as an infinite number of options. Besides the cumbersome and complex problem of valuing all options, the issue of correlation becomes increasingly important. It is only possible to see the value of Danisco as the sum of all the options, if these options are uncorrelated (Triantis, 1999). Even though almost all options will have some sort of correlation due to conjoined dependencies on the same fixed assets and intangible knowledge, some options will be less correlated with the rest of them.

Real options could be identified on a broader strategic and organizational level. The option to change a firm’s overall focus, manufacturing- or distribution-strategy can be viewed as a large real option. However as a firm is a comprehensive entity, implementing large decisions requires years of managerial power, an example being Danisco’s strategic change. Tom Knutzen identified the need for a strategic
shift early on, but it took years to implement. An apparent problem is present, as many corporate decisions are difficult to reverse and often requires substantial conversion costs (Trigeorgis, 1996).

Referring to figure 6, major strategic decisions include both high uncertainty and high managerial flexibility. However, real options high in the value chain have the inherent problem of correlation, as the decision would influence several underlying assets thus creating numerous other options. These underlying options would then have to be calculated individually increasing the complexity of the valuation model. Subsequently this matrix of option is impossible to assess and appraise.

6.1.3 Product Divisions
The product divisions Enablers and Cultures do not fulfil the real options criteria. This is due to the small uncertainty regarding earnings and product development in these divisions. Consequently, even if management is faced with continuous decisions, which could alter the strategic outcome of the divisions, these choices is not likely to be of substantial value, as uncertainty is low. In Enablers a consolidation strategy is pursued as limited growth opportunities exists within the mature market. No further product development has been instigated, substantiating a low market and product uncertainty. Cultures have seen high growth and operate on an oligopolistic market, meaning little competition. These factors demonstrate the key reason behind not appraising potential real options in these divisions, as stable cash flows and growth rates are fairly predictable, thus resulting in low volatility and thereby a minimal option value. Conclusively Enablers and Cultures can best be valued using the DCF model as cash flows are fairly predictable and therefore managerial flexibility only adds little value rendering it unnecessary to adopt the cumbersome ROA. This is also the case for Genencor, where a duopolistic market has created a stable situation with high growth rate, thereby little uncertainty or managerial flexibility exists, leaving the division best valued, using DCF with reference to figure 6.

6.1.4 Abandonment Option on Sweeteners
The Sweeteners division has been performing poorly over the latter years, resulting in negative RNOA and EBIT margins. Management is faced with a decision either to shut-down production, attempt to improve profitability or to divest. The option to abandon or sell the division is equivalent to a put option. This action of abandonment may become rational when the present value of the assets falls below the liquidation value.
Within a real option logic, management chose not to exercise the abandonment option by investing dkk. 100 mil. in a restructuring plan to improve profitability. The strategic motive behind desisting to exercise
the abandonment option is the option of increased sales due to synergies with competing sweetener product Stevia. Furthermore the large impairment write-downs have diluted the intangible value and thus reduced the liquidation value. Despite poor performance, the present value of assets by continuing, is higher that abandoning the division.

Sweeteners was identified as being on the border between dog and cash cow, the division has very little growth opportunities but will in coming years generate free cash flows for investors (Ref. section 4.5). The market is driven by low cost and fairly homogenous products resulting in a highly competitive market.

The underlying asset (Sweeteners) has limited uncertainty thereby minimizing the value of the inherent option. Managerial flexibility exists but because of the relative low liquidation value, the value of the put abandonment option is low. The necessary real option criteria are thus not fulfilled and a DCF approach is more appropriate.

6.1.5 Compound Option on DDCE

As identified earlier, the DDCE joint venture has a virtually unlimited growth potential since the bio-fuel market continues to expand, driven by legislative requirements regarding the market size. This qualifies it as a real option within our three criteria. The following section will discuss whether DDCE fulfils the set forth criteria.

6.1.5.1 Uncertainty

DDCE is a follow-on product from Danisco’s 1st generation bio-ethanol enzyme. The 2nd generation bio-ethanol enzymes have the ultimate goal of improving cost- and output-effectiveness and to have prices comparable with regular gasoline removing the current reliance on subsidies. The upside potential within this new product is basically unrestricted, only limited by Danisco’s ability to deliver the specified characteristics in terms of price and performance (McKinsey, 2010).

DDCE are subject to the three forms of uncertainty defined by Dixit and Pindyck (1994). DDCE hope to minimize the technical uncertainty, defined as factors management can affect, by increasing the investments in DDCE to dkk 107 mil. a year. This technological uncertainty is the primary source of uncertainty, as many specialists doubt that Danisco is able to reduce production cost to a level, where subsidies are not required (Business Insight, 2008).

Input cost uncertainty is a major parameter for bio-ethanol as the volatility in gasoline price can remove the ability for DDCE to earn a profit. The third form of uncertainty relates to the impact of legislation on
the bio-ethanol market. Currently governments have set regulatory benchmark targets for what percentage bio-ethanol should constitute of total gasoline consumption in 2012. DDCE is thus vulnerable to changes in legislation and the removal of subsidies. The only way to convince governments not to find alternative energy solutions is to develop the technology to reduce bio-ethanol production below or on par with gas production costs.

Given limited information regarding the products, market potential and the fact that DDCE is still in the research phase the criteria of high uncertainty is upheld.

6.1.5.2 Managerial Flexibility

DDCE is a research development project, meaning that it can be viewed as being path-dependent. DDCE is path-dependent on other options as the development process is composed of several stages. At the end of each stage, Danisco uses the technological and market information revealed up to that point to decide whether to abandon or continue development of the compound. DDCE development process consists of three phases:

- Phase 1, Lab to pilot scale (2000 – 2010)
- Phase 2, Demonstration Scale (ex. 2010 – 2012)
- Phase 3, Commercial Scale, large scale plant (ex. 2013 - )

DDCE is currently in phase 2 with expected launch in 2013. Ollila (2000) suggests that the importance of a growth option is highest during the early years of the new drug development process and again after the launch of the final product. Additionally, the value of the option to abandon is highest at the end of phase 2, before entering into the phase 3. DDCE is currently in phase 2, which implies that in this stage a clear proof-of-concept has been developed, but most of the costs are still ahead as phase 3 is the most expensive due to the large production plants needed to be tested and built. Management are thus faced with a choice of whether to continue or abandon the project, if the product specifications do not perform up to standard.

The current bio-ethanol market can have duopolistic tendencies as Danisco and Novozymes basically divide the market between them. Danisco’s management faces a strategic choice of whether to pursue first-mover advantages or adopt a “wait-and-see” strategy. As time passes, management are likely to receive additional information enabling a better informed decision, however postponing the launch of DDCE would eliminate first-mover advantages as Novozymes also plan to launch in mid 2012 (TV2 Finans, 20.07.2010). Other competitors such as DSM are also planning eventually to enter the market. Danisco is
therefore likely to pursue a first mover role before competition intensifies. The criteria of *high managerial flexibility* is thus fulfilled as management are faced with an abandonment decision and further on an expand decision.

### 6.1.5.3 Correlation

Because of the high associated risk with developing a sustainable 2\textsuperscript{nd} generation bio-ethanol compound Danisco allied with Dupont and formed a separate organizational entity, DDCE. Through vertical integration Danisco and Dupont, specialist in separate fields, can combine forces to offer a superior product and thus create a competitive advantage on the market, as stated by Tom Knutzen (Reuters, 18.03.2010).

DDCE being organized as a separate entity is advantageous, as research costs, employers and profits can be directly attributed to it, and in case of abandonment the entity will be shut down. This limits the correlation as other product divisions are not as affected by a potential shutdown as otherwise. An example could be if Danisco decided that Enablers should be launched on a new geographical market (an expand option), this strategic choice would have both positive and negative synergies with the other product divisions as the launch would require capital, labour and management focus, leaving less for the others. Herein lies a correlation that is difficult to measure as the total value is not just the value of the expand option on Enablers, but requires a comprehensive analysis of cause and effect on the other product divisions.

DDCE can thus be seen as having a *low correlation* with other options in Danisco making it possible for us to utilize the ENPV method, wherein an additive nature of DCF and option premium is assumed.

### 6.1.5.4 Type of Real Option

DDCE can be characterized as a sequential compound growth option, defined as path-dependent option to commercialize a product. A growth option is a call option on the underlying asset with an exercise price equal to the costs of expansion (Mun, 2005). In case of DDCE the growth option can also be identified as an American expand option as management has the option to expand production from its current level at 189 mil. Litres with an additional expand option to increase production to 378 mil. litres and again to 756 mil. litres. These expand options are of significant value as the key competitive variable is whether Danisco are able to produce at 2.54 Dkk/L, which is below the base case market price of 2.99 Dkk/L. The market is not driven by competitive intensity but by individual production capabilities (Ref. Section 4.2.1.4)
Moreover an abandonment option is present as Danisco can divest DDCE throughout the horizon period. As with other R&D projects, the option of abandonment can be of significant value. DDCE is vulnerable to the price development on ethanol relative to gasoline, and as a consequence the option to sell is a valuable alternative given an unfavourable development in prices. An abandonment option is an American put and functions as hedge against poor development in the underlying asset.

DDCE is an American option however managerial decision is restricted to 1 year periods of choosing either to abandon, continue and later to expand or not. Management has already decided to exercise prior options to continue the research, and subsequently DDCE is currently in phase 2. The success rate probability of entering phase 3 and commercialize DDCE has been included in the estimation of volatility and is therefore not an explicit parameter.

Expiry of the option occurs if the technology becomes obsolete or if production costs cannot be reduced to the necessary level. Scientists have already begun filing patents for third generation bio-ethanol produced using Algae, however commercialization is unlikely to occur before 2025 (Emerging Markets Online, 2008).

In order to capture the complexity of launching DDCE it is important to model all three valuable options. The options are sequential in nature, as the option to expand is dependent on prior choices to continue the project and thereby the decision to launch in 2013. Hereafter management face the decision to expand production to 378 mil. litre and if this is decided, management can exercise the option to expand a second time. The payoff profile of the options in DDCE is depicted below.

Source: Author’s own Creation
As figure 28 shows, the real options payoff profile looks similar to a long strangle, purchase of a call and a put with separate strike prices. It is important to recognize that these options are separate, and the intermediate space between the two options does not mean, they are worthless. This intermediate space visualizes when it is favourable to keep the option open by waiting to exercise. This occurs when the costs of expanding outweigh the benefit and the value is still higher than the salvage value.

DDCE’s maximum profit is unlimited and achieved when the value of DDCE is larger than the cost of expanding. The abandonment option is exercised when the value of DDCE is below the salvage value. As we have discussed earlier, this one-year-sequential and non-continuous way of viewing DDCE’s development is not realistic. However, it is questionable if more value and realism would be added if DDCE were seen as a pure American option, meaning the possibility of continuous exercise. While a simplified notion of DDCE development is adopted it enables us to calculate the value by setting up two nodes wherein management decides on the ventures future.

6.2 Part Conclusion
DDCE fulfils the real option criterion, as uncertainty and possible payoff is high, combined with management’s ability to react, as new information becomes apparent. Given that DDCE is organised as a separate organizational entity results in a low correlation. Given these characteristics ROA is an appropriate method for valuing DDCE as it captures management’s contingent strategic decision better than the DCF. The DCF however is the preferred method for valuing the rest of Danisco, as earnings from its current product divisions are fairly predictable and management’s strategic decision does not contain similar value compared to DDCE. While real options can be identified throughout Danisco, it is important to distinguish between the ones that have a major influence on the stock price and those that only contribute little value.

In the following two chapters the extended net present value model will be applied on Danisco utilizing the findings from this chapter and the case study analysis. Chapter 7 will apply the DCF on Danisco’s current operations, while chapter 8 will apply ROA on the research project of DDCE.
7. Discounted Cash Flow Valuation of Danisco

This chapter will perform a DCF valuation of Danisco’s current operations, meaning that DDCE is not included as this was identified as best captured through a real option valuation.

7.1 Prognoses and Budgets

This section builds upon the strategic and financial analysis conducted earlier, with an aim of forecasting on Danisco’s financial statements over a ten year period. Best-practice highlight that a comprehensive forecast involves many drivers, but in most cases it is structured around the behaviour of a few key drivers. Typically these are sales growth, profit margin, asset turnover and derived of hereof; net operating asset (Elling, 2005) & (Penman, 2007).

The forecasting model also builds on a few key assumptions regarding the firm’s prospective competitive position. In order to refrain from pure speculation, prior performance is the primary source in determining the future development. The fiscal year of 2010 functions as the benchmark for the forecast. However forecasting requires not only knowing what the “normal” patterns are but also having the expertise to identify those areas that will differentiate from the norm. Empirical research highlights an inherent mean-reverting behaviour of firm performance, especially in relation to sales growth and return on common equity (Palepu & Healy, 2008). Identifying a firm’s short-term and medium-term competitive advantage period thus becomes an essential part of forecasting.

A trade-off between accuracy and the length of an estimation period always exists in forecasting. Financial literature does not present on simple solution when choosing the forecasting length, but one theory is relevant for Danisco: The period where ROCE is higher than cost of capital, indicating the competitive advantage period. The terminal value is when the firm enters competitive equilibrium. (Brealey, Myers & Allan, 2008) and (Penham, 2007).

Choosing the development of key variables involves anticipating the dilemma of whether it is “business as usual” contra increased competition and decreased profit margins. The arbitrary nature of the terminal value and its impact is diminished through the longer chosen forecast period. The Forecast aims to give as realistic as possible outlook on the future of Danisco. However, not all uncertainties can be mitigated given the complex character of products, markets and macro environment. As the forecast is made on a deemed most likely scenario, findings from the strategic analysis suggests, that a 10 year competitive advantage period is most plausible (Ref. Section 4.5)
7.1.1 Strategic assumptions

Danisco is entering a post-sugar period where the massive restructuring has created a leaner, more focused organization, which enables Danisco to adopt a growth orientated strategy, and begin to increase asset turnover. Our fundamental analysis provided insight into Danisco’s core competence in achieving economies of scale through diversified distribution and differentiation via innovation of profitable niche products. Especially Feed and Cultures were identified as having a large embedded growth potential. A feasible assumption is therefore that Cultures and Genencor will experience improvements in revenue growth. Enablers are active within a mature market and it is assumed that growth and profit margin will continue, at current levels (Ref. Section 4.5).

The average market growth rate on revenue in food processing industry is 4.63 percent from 1998 to 2008\(^{20}\). Compounded annual growth rate of Danisco (2008-2010) has been on par with the market at 4.2 percent, accounting for distribution of revenue among the divisions. A major negative factor has been the poor performance of Sweeteners, which in 2010 had negative revenue growth of 5 percent. Given the launch of Stevia and management’s internal restructuring program our forecast assumes that Sweeteners revenue will remain stable and regain a modest profit margin of 4 percent. Despite recent performance this scenario seems likely as no goodwill is left in the division thus eliminating further impairments. Subtracting impairments, Sweeteners have in recent year been at break even. Given these findings a feasible assumption is that Danisco will be able to generate a competitive advantage over the forecast period (2010 – 2021). As products are pulled by customers as mentioned in the strategic analysis, marketing schemes are not employed, and revenue is more dependent on products. The increased revenue will therefore come from better products and more accept of these by customers. With the growth rates of the divisions in mind, and the massive restructuring in recent years, it is believed that the CAGR of 4.2 % from 2008-2010, will be 6% from 2011-2021.

The Free Cash Flow of the Terminal Period has been chosen as the average of the 10 year forecast in the budget period, as this is the best forecast for the future. A sensitivity analysis on this will be made later. The mean reverting nature of sales growth is reflected in the terminal value estimate, which assumes the market has entered maturity after ten years and has reached a competitive equilibrium. The terminal period from 2021 and onwards is thus seen as a perpetuity, with growth equal to that of the consumer product index based on the assumption that Danisco’s competitive advantage has vanished. The terminal period should not be seen as a growth continuation, of the last year of the budget period, but rather as a

\(^{20}\) Data from http://pages.stern.nyu.edu/~adamodar/
period with separate growth. There will be fluctuations in the growth of the terminal period, but the best assumption is the mean-reverting process, with a drift of 2 percent. As the positive and negative fluctuations will offset each other over time, a consistent growth of 2 percent will be the best approximation, as this has been the historical CPI/inflation looking 50 years back (Bureau of Labour Statistics, 2010).

Income from associates, which includes DDCE was identified as having the characteristics of a compounded growth real option and thus deemed too imprecise and insecure to appraise using DCF. DDCE income and costs are therefore set to zero within this valuation, but will be valued in the following chapter.

The rest of the required variables in the budget will be explained and derived below within its context.

7.1.2 Financial Assumptions

Primary forecasting assumptions revolve around the development in Profit Margin and Asset Turnover. A rise in revenue will partly be offset by the required increase in operating assets and subsequently liabilities, all other things equal. Any earnings not paid out as dividends or repayments of debt are reinvested in operating asset to sustain growth. Interesting findings from the peer group analysis have been incorporated into the forecast. Competitors have been reducing firm debt exposure thereby reducing default risk, likely due to the financial crisis and the current low interest rate making refinancing attractive. As Danisco has changed the focus of the firm to a focus more on biotechnology, it has been necessary to lower leverage. When cash flows are more risky, it is not possible to uphold as high leverage partly due to debt repayments but mostly because this would constitute a higher discount rate putting pressure on the cash flow earned. Typically a growth strategy involves taking on additional debt, but in Danisco’s case it is likely that the debt levels will fall to limit the risk exposure, as they are entering a more risky market, and to be in line with peer group. Main competitor Novozymes deploys a significant percentage of earnings into research and development, which in the future could leave Danisco’s products obsolete. An expected financial strategy is therefore that Danisco will also reduce its debt due to and increase its R&D expenditure, and this has been incorporated in the forecasted profit margins and Asset Turnover. This is all facilitated by an expectation of improved earnings based on the financial analysis.
### 7.1.3 Income Statement Forecast

The income statement has been prepared using a percentage of gross profit margin method (Penham, 2007). Our forecast relies on historic performance and variables have been altered to incorporate the expected competitive situation.

Given the situation in 2010, where a fairly large net income was achieved despite large impairments of goodwill, substantial improvement is expected in 2011. The authors expect this situation to persist throughout the period and Danisco’s financial situation will become significantly better from 2011 and onwards (Ref. Financial Analysis of Danisco).

**Figure 29 – Income Statement**

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</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>13,706</td>
<td>14,528</td>
<td>15,400</td>
<td>16,324</td>
<td>17,304</td>
<td>18,342</td>
<td>19,442</td>
<td>20,609</td>
<td>21,845</td>
<td>23,156</td>
<td>24,545</td>
<td>26,018</td>
</tr>
<tr>
<td>Cost of Sales</td>
<td>7,661</td>
<td>7,991</td>
<td>8,470</td>
<td>8,978</td>
<td>9,517</td>
<td>10,088</td>
<td>10,693</td>
<td>11,335</td>
<td>12,015</td>
<td>12,736</td>
<td>13,500</td>
<td>14,310</td>
</tr>
<tr>
<td>Gross profit</td>
<td>6,045</td>
<td>6,538</td>
<td>6,930</td>
<td>7,346</td>
<td>7,787</td>
<td>8,254</td>
<td>8,749</td>
<td>9,274</td>
<td>9,830</td>
<td>10,420</td>
<td>11,045</td>
<td>11,708</td>
</tr>
<tr>
<td>Research and development expenses</td>
<td>-884</td>
<td>-984</td>
<td>-1,095</td>
<td>-1,219</td>
<td>-1,357</td>
<td>-1,510</td>
<td>-1,680</td>
<td>-1,781</td>
<td>-1,888</td>
<td>-2,001</td>
<td>-2,122</td>
<td>-2,249</td>
</tr>
<tr>
<td>Administrative expenses</td>
<td>-936</td>
<td>-992</td>
<td>-1,052</td>
<td>-1,115</td>
<td>-1,182</td>
<td>-1,253</td>
<td>-1,328</td>
<td>-1,407</td>
<td>-1,492</td>
<td>-1,581</td>
<td>-1,676</td>
<td>-1,777</td>
</tr>
<tr>
<td>Other operating expenses</td>
<td>-54</td>
<td>-57</td>
<td>-61</td>
<td>-64</td>
<td>-68</td>
<td>-72</td>
<td>-77</td>
<td>-81</td>
<td>-86</td>
<td>-91</td>
<td>-97</td>
<td>-103</td>
</tr>
<tr>
<td>Total expenses</td>
<td>-54</td>
<td>-57</td>
<td>-61</td>
<td>-64</td>
<td>-68</td>
<td>-72</td>
<td>-77</td>
<td>-81</td>
<td>-86</td>
<td>-91</td>
<td>-97</td>
<td>-103</td>
</tr>
<tr>
<td>Depreciation</td>
<td>750</td>
<td>742</td>
<td>786</td>
<td>833</td>
<td>883</td>
<td>936</td>
<td>993</td>
<td>1,052</td>
<td>1,115</td>
<td>1,182</td>
<td>1,253</td>
<td>1,328</td>
</tr>
<tr>
<td>OI - NOPAT</td>
<td>610</td>
<td>1,298</td>
<td>1,421</td>
<td>1,462</td>
<td>1,501</td>
<td>1,537</td>
<td>1,569</td>
<td>1,663</td>
<td>1,763</td>
<td>1,868</td>
<td>1,981</td>
<td>2,099</td>
</tr>
<tr>
<td>Financial income</td>
<td>523</td>
<td>292</td>
<td>249</td>
<td>286</td>
<td>283</td>
<td>279</td>
<td>275</td>
<td>271</td>
<td>267</td>
<td>263</td>
<td>259</td>
<td>254</td>
</tr>
<tr>
<td>Financial net</td>
<td>-152</td>
<td>-85</td>
<td>-84</td>
<td>-83</td>
<td>-82</td>
<td>-81</td>
<td>-80</td>
<td>-79</td>
<td>-78</td>
<td>-76</td>
<td>-75</td>
<td>-74</td>
</tr>
<tr>
<td>Tax shield (25 Percent)</td>
<td>38</td>
<td>21</td>
<td>21</td>
<td>21</td>
<td>21</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>19</td>
<td>19</td>
<td>19</td>
<td>18</td>
</tr>
<tr>
<td>Net Income</td>
<td>496</td>
<td>1,234</td>
<td>1,358</td>
<td>1,400</td>
<td>1,440</td>
<td>1,476</td>
<td>1,509</td>
<td>1,604</td>
<td>1,704</td>
<td>1,811</td>
<td>1,924</td>
<td>2,044</td>
</tr>
</tbody>
</table>

The management in Danisco expects consolidated revenue of 14.5 billion Dkk in 2011, equalling a growth of 6 percent. The authors deem management’s expectations fairly accurate; however achieving an EBIT close to dkk 2 bil. is unlikely based on our analysis and would require substantial cost reductions in operating liabilities. Our forecast assumes the firm is entering a period characterized by stabilization in costs and these are expected to increase proportionally with sales. This is based on all products having been on the market for some years, thereby enabling insight into cost drivers and how to reduce these. Furthermore our forecast finds it necessary to increase R&D expenditure, as described above, to mitigate threats from competitors beyond the forecast period, and thereby holding profit margin and Asset turnover at budget period levels. Investments in R&D, as part of costs are set to increase 5 percent a year until in 2016 when the post accounts for 8.6 percent of revenue, to be in line with peer group levels. Hereafter R&D is set to increase proportionately with sales. This dramatic increase is furthermore
founded in the management’s choice to increase investments in R&D to mitigate future threats (Danisco Annual Report, 2010).

The forecast assumes the same income tax rate of 24.41 percent and utilize the historic depreciation rate of 13 percent. Tax on financial income has historically been 25 percent.

All in all, based on the incorporated assumptions, the profit margin will in 2011 equal 8.9 percent and 8.1 percent in 2021. No reoccurrence of special item expenditures is set, but this increase in profit margin is somewhat offset by increases in R&D (figure 64 Appendix E, to see full percentage of sales forecast assumptions)

7.1.4 Balance Sheet Forecast

![Figure 30 – Balance Sheet Forecast](image)

This forecast adopts a proportionate cost model. This is implemented as the growth rate for expenses follows the one for sales, depending on asset turnover. The literature describes this as a simplified model biased either to over or under estimate earnings. This is because the relationship between fixed costs and variable costs are unavailable to outsiders (Kim & Prather-Kinsey, 2010). While this is a valid concern, looking at Danisco’s RNOA and ATO, it seems likely that the assets and liabilities will remain rather stable as a further streamlining of the value chain is not anticipated. As RNOA is comprised of PM x ATO, we see the RNOA rising as ATO is. Recent years have seen low RNOA, mainly due to the large impairment write downs influencing PM, as they were incurred in the income statement. Our forecast assumes that goodwill will remain constant, despite a small impairment write down of dkk 106 mio., which is expected by management in 2011.
As goodwill is only acknowledged on the balance if acquirements with premiums are made, goodwill will be held constant in the balance as no further acquirements are expected. Subsequently this will result in substantial increases in RNOA and ATO from 2011 and onwards as goodwill proportionately will contribute less and less over the forecast period, as this does not change proportionately to sales growth. ATO will increase from 0.85 to 1.07, indicating a better usage of the asset base. Under normal conditions a firm’s ATO does not change over the short-term, but this is driven by a lower impact of goodwill throughout the forecast period, and goodwill does not rise proportionately with other assets (see figure 65 in Appendix E for assumptions made in forecasting on the Balance Sheet). Goodwill is measured yearly, and we believe that the goodwill in the balance will be used to generate higher asset turnover, during the budget period.

The relationship, operating assets to sales, is held constant as improvements are not expected, which means additional investments in current and fixed assets are driven by sales growth. Liabilities are also reflected in the development of sales.

As mentioned above it is anticipated that Danisco will reduce the financial risk associated with having a fairly high financial leverage, compared to peers. Furthermore as the firm moves more and more towards biotechnology, the management is likely to prefer equity instead of debt in the capital structure. Therefore both short-term and long-term debt will decrease throughout the forecast at a 5 percent yearly rate. This will not influence the value of equity, but seems like an optimal way to utilize part of earnings (Brealey, Myers & Allan, 2008). Overall the improved ability to sustain earnings is reflected in the development in equity, which sees a large rise.

Because the cash flow statement is derived from items in the balance, equity statement and the income statement as such does not carry any forecasting variables, this has not been forecasted. This is supported by the fact that certain variables are only specifically dealt with in the cash flow statement and therefore it would be necessary to build in additional assumptions straight into the forecast thus increasing the level of speculation.

All in all, the assumed forecasted scenario would yield increased profitability and improved asset utilization as visualized below. Given Danisco’s competitive advantage based on differentiation, extensive distribution chain and economies of scale, this is very plausible, validating the forecast.
Figure 31 – Forecasted Profitability Drivers

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<tbody>
<tr>
<td>EBIT Margin</td>
<td>5.9%</td>
<td>11.8%</td>
<td>12.2%</td>
<td>11.9%</td>
<td>11.5%</td>
<td>11.1%</td>
<td>10.7%</td>
<td>10.7%</td>
<td>10.7%</td>
<td>10.7%</td>
<td>10.7%</td>
<td>10.7%</td>
</tr>
<tr>
<td>PM</td>
<td>4.3%</td>
<td>8.9%</td>
<td>9.2%</td>
<td>9.0%</td>
<td>8.7%</td>
<td>8.4%</td>
<td>8.1%</td>
<td>8.1%</td>
<td>8.1%</td>
<td>8.1%</td>
<td>8.1%</td>
<td>8.1%</td>
</tr>
<tr>
<td>ROCE</td>
<td>4.0%</td>
<td>9.7%</td>
<td>10.2%</td>
<td>10.0%</td>
<td>9.8%</td>
<td>9.6%</td>
<td>9.3%</td>
<td>9.4%</td>
<td>9.5%</td>
<td>9.6%</td>
<td>9.7%</td>
<td>9.8%</td>
</tr>
<tr>
<td>RNOA</td>
<td>3.6%</td>
<td>8.0%</td>
<td>8.5%</td>
<td>8.4%</td>
<td>8.3%</td>
<td>8.2%</td>
<td>8.0%</td>
<td>8.2%</td>
<td>8.3%</td>
<td>8.5%</td>
<td>8.6%</td>
<td>8.8%</td>
</tr>
<tr>
<td>RNOA (+ GW &amp; Financial Asset)</td>
<td>6.8%</td>
<td>15.4%</td>
<td>16.0%</td>
<td>15.5%</td>
<td>15.0%</td>
<td>14.5%</td>
<td>14.0%</td>
<td>13.9%</td>
<td>13.9%</td>
<td>13.9%</td>
<td>13.9%</td>
<td>13.9%</td>
</tr>
<tr>
<td>ATO</td>
<td>0.85</td>
<td>0.88</td>
<td>0.90</td>
<td>0.92</td>
<td>0.94</td>
<td>0.96</td>
<td>0.97</td>
<td>0.99</td>
<td>1.01</td>
<td>1.03</td>
<td>1.05</td>
<td>1.07</td>
</tr>
<tr>
<td>FLEV</td>
<td>28.4%</td>
<td>27.2%</td>
<td>25.5%</td>
<td>24.0%</td>
<td>22.6%</td>
<td>21.2%</td>
<td>19.9%</td>
<td>18.7%</td>
<td>17.5%</td>
<td>16.4%</td>
<td>15.3%</td>
<td>14.3%</td>
</tr>
<tr>
<td>NIBD/EBITDA</td>
<td>1.53</td>
<td>1.37</td>
<td>1.31</td>
<td>1.24</td>
<td>1.19</td>
<td>1.13</td>
<td>1.08</td>
<td>1.01</td>
<td>0.93</td>
<td>0.87</td>
<td>0.80</td>
<td>0.74</td>
</tr>
</tbody>
</table>

EBIT margin and Profit margin, will see significant increases in 2011, but remain fairly stable hereafter. The small reduction is driven by increased capital expenditure in R&D. Financial leverage will decrease over the period as the improved profit margin results in higher net income, which subsequently increases equity. It is assumed that the dividends payout policy reverts to 357 mil. dkk a year after a management doubled the amount in 2010.

The management in Danisco put forward financial ambitions to accomplish an EBIT margin > 13.5. Based on the forecast this seems unlikely, mainly driven by a lack of cost reductions, which Danisco foresee. Subsequently, as R&D spending rises the authors forecast does not enable Danisco to achieve its ambitions of an RNOA > 11 percent. However management will increase the financial flexibility by having a NIBD/EBITDA<sup>21</sup> < 1.5 (Overall strategic and financial goals, Ref. Section 2).

In relation to the peer group analysis it becomes evident that based on the forecast, Danisco’s position will improve. Currently the peer group has an average EBIT margin of 12 percent, which is similar to that of Danisco. This should be seen in the light that authors have chosen to repay debt and increase R&D spending, instead of focusing on maximizing EBIT margin of the short-term. Authors deem these increases necessary in order sustain its competitive advantage over the whole period. This is naturally a choice of forecast on the authors’ side, but seems most plausible given the changes of the company in recent years in mind. Throughout the horizon period Danisco’s RNOA will in 2011 lie with the current peer group average at 8.0 percent meaning better asset utilization. However it is likely that competitors will also focus on minimizing costs as the product life cycles begin to mature at the end of the period (Ref. Section 5.3 Peer Group Analysis).

<sup>21</sup>Net Financial Obligations / EBITDA
7.2 Valuation – Discounted Cash Flow

Having established the forecasts, the valuation can be done. Performing a discounted cash flow valuation requires estimating contingent variables that account for the risk and capital structure of Danisco. These have to be estimated prior to the actual valuation.

7.2.1 Weighted Average Cost of Capital

The weighted average cost of capital is as described above crucial in valuation of cash flows, as it accounts for risk and financing. Estimating WACC requires estimating the variables in the formula below:

\[ WACC = \frac{E}{V} \times R_e + \frac{D}{V} \times R_d + (1 - T_c) \]

7.2.1.1 Capital Asset Pricing Model (CAPM)

Considered best practice, this thesis will utilize the model to estimate equity risk (\( R_e \)) associated with investing in Danisco (PwC - Valuation Methodology Survey, 2009). The CAPM addresses a fundamental question of how the risk of an investment should affect its expected return. CAPM is a one factor model in the sense that investors cost of capital is a function of the firm’s covariance with the market portfolio, given as beta (\( \beta \)). One important property is of significant importance for this analysis. It is the assumption that; total risk = market risk + unique firm risk, which ultimately means that investors are only willing to pay for market risk as firm risk can be diversified away (Copeland, Weston & Shastri, 2005). Market risk premium is an investor’s required rate of return above the risk free rate, given firm risk.

\[ E(R_I) = R_f + \beta_{im} \times (E(R_m) - R_f) \]

CAPM has been criticized through empirical research, showing how the embedded assumption in the model\(^{22}\) depicts an idealized view of the world (Fama & French, 1992) and (Roll & Ross, 1994). One critique of central importance for this thesis is the assumption of homogeneous expectations, meaning that investors have access to the same information. The point is that there is a real chance that CAPM can over or undervalue assets. Although the model is not perfectly validated by empirical tests, its main implication holds – namely that beta is a valid measure of risk. Practically there are several challenges

\(^{22}\) CAPM relies several assumptions; First, investors are risk averse. Second, capital markets are perfect. Third, all investors can borrow and lend at the risk-free rate.
and uncertainties associated with the procedure of estimating the risk free rate, market risk premium and beta.

7.2.1.2 Beta

Another primary task for calculating WACC is to establish the associated risk for investing in Danisco. This risk is later to be used in pricing the required interest on equity for Danisco. The risk of a company is given by its beta value, where a beta value of 1 suggests volatility equal to the general volatility of the entire market and a volatility of zero is the volatility of a risk free investment.

Performing linear regressions on return data from Danisco compared with OMX20 and Standard & Poor 500 over a 5 year horizon equals beta values of 0.93 and 0.85 (see figure 66 and 67 in Appendix E). This range estimate is coherent with our strategic analysis, which emphasizes a fairly low elasticity in customer demand given changes in the general economy.

The regression results are based on the development in share price and does consequently take Danisco’s financial gearing into consideration. By looking at the unlevered beta of the industry the increased risk associated with debt is removed and subsequently the beta is lowered. This enables a comparison against the industry to validate the found beta’s above. Based on 121 food-processing firms the average D/E ratio is similar to that of Danisco at 29.31 percent, with a beta of 0.86\textsuperscript{23}. The unlevered beta\textsuperscript{24} of the industry is equal to 0.69 compared to Danisco’s at 0.66. Based on this analysis the fair value beta is assumed at 0.85

7.2.1.3 Risk Free Rate

In reality there is no such thing as a risk free rate; the closest approximation is using government bonds Brealey, Myers and Allen, 2008). For this calculation the authors have chosen to use an average of the 10 year and 30 year US treasury bonds\textsuperscript{25} as the risk free rate since the US government is expected to have minimal risks of defaulting.

The risk free rate is in that case found to be \((2.99\% + 4.06\%)/2 = 3.53\text{ percent pr. annum}\).

\textsuperscript{23} Data from 19 of September (http://pages.stern.nyu.edu/~adamodar/)
\textsuperscript{24} Beta_{Unlevered} = Beta_{Levered}/(1+(1-Tc)\times(D/E)), Beta_{Unlevered} =0.85/(1+(1-0.2441)\times(0.36))
\textsuperscript{25} Rate as of (08.02.2010) http://www.ustreas.gov/offices/domestic-finance/debt-management/interest-rate/yield.shtml
7.2.1.4 Market Risk Premium

The market risk premium (MRP) is the required rate of return an investor expects, when investing in the market portfolio. MRP is defined as the market rate of return less the risk free rate, where the market rate is assumed to be given for a beta (risk) equal to one.

\[ R_p = R_m - R_f \]

Fernandez & Campo (2010) performed a comprehensive survey among finance and economics professors’ MRP and found premiums of 6.0 percent in US, 5.3 percent in Europe and 3.6 percent in Denmark. The survey had 1500 total responses divided into 462 US, 243 Euro and 5 Danish. While the Danish responses had a low standard deviation of 1 percent, the statistical significance is questionable. Traditionally the reason attributed to the low Danish MRP is the relative higher yield on government bonds.

The world index has annually had a historic MRP of 4.4 percent from 1900 to 2009 (Credit Swiss Global Investment Returns Yearbook, 2010). An approximation of this was calculated using historical return data\(^{26}\) on the S&P 500 over a 10, 20 and 30 year period, equalling 1.22, 8.69 and 9.67 percent returns. The latter two corresponds quite accurately with the premiums set forth above for the World Index, the US and Europe, subtracting the calculated risk free rate.

The authors argue that a fair estimation for the MRP is an average, as to a certain extent removes the subjectivity. Furthermore, as all of the estimates above lay within such a limited range, this approach is validated. By means of the found risk free rate, the MRP is then found to be 5.10 percent (figure 68 Appendix E).

The level of detail behind estimating \( R_e \) lies in the weight this factor has within the valuation. Danisco operates with fairly low financial leverage, meaning that \( R_d \) play a proportionately smaller role.

The \( R_e \) can then be calculated to be:

\[ 3.52\% + 0.85\% \times 5.10\% = 7.87\% \]

This estimate is lower than the forecasted ROCE of app. 9 percent, which can serve as a proxy. Whenever ROCE is higher than \( R_e \) investors are compensated for taking on additional risk.

\(^{26}\)Calculation based on Thomas Reuters Datastream, to find average yearly return over the given periods
7.2.1.5 Cost of Capital on Debt

The fundamental theorem set forth by Modigliani and Miller (1958) is: “Given complete and perfect markets, the cost of debt is equal to the risk free rate”. However in reality taxes and default risk plays an important role and our modelling of the cost of debt has to include these factors. A fair proxy for the cost of debt is the interest rate on book value of debt – defined as the net borrowing cost in this thesis. However this proxy assumes a stable capital structure and that market interest rates have not changed significantly since the time the debt was issued (Palepu & Healy, 2008). These assumptions are not fulfilled in Danisco, as yield curves have been downwards sloping and the debt ratio is assumed to decrease as equity increases over the forecast period.

The Net Borrowing Costs were calculated in the reclassified financial statements as increasing from 5.1 percent to 10.7 percent in 2010, this includes both short-term and long-term debt. The capital structure has seen significant changes, as the financial gearing has decreased from 1.08 to 0.36 over the period 2005 to 2010. Given this change and the current historically low interest rates, using NBC could overestimate the actual risk associated with Danisco debt.

Danisco funding has been obtained at floating rates and is converted to fixed rates via interest rate swap contracts. Currently the proportion of fixed interest rate debt is 79 percent compared to 59 percent in 2009 (Danisco Annual Report, 2010). These swaps have an interest rate ranging from 3.9 to 4.5 percent with maturity in 2015 and 2016.

By calculating the average interest coverage ratio27 of Danisco it is possible to construct a synthetic rating estimation (see full rating figure 69 in appendix E). The limitation of this estimation process is that it does not include leases, however as Danisco does not report any lease agreement it is assumed to be zero, rendering this a valid estimate for the cost on debt (Damodaran, 2008). Given its interest coverage ratio of 4.05, Danisco would have a “A”- rating corresponding to a 1.5 percent default risk premium on the calculated Rf of 3.53 percent. Based on the derived information it is assumed that the interest rate on debt is equal to the calculated 5 percent.

7.2.1.6 Calculating WACC

The WACC should be based on market value for debt and equity. The equity used in the WACC calculation is directly observable through the market cap. Even though this thesis is based on the assumption that the market value of the company can be questioned, the WACC must still reflect an investor, that chooses between stocks in the market portfolio, and this WACC should therefore reflect

27 Interest Coverage = EBIT / Net Interest Expense
that cost of capital. Consequently we find that using the observable market value of equity is valid in using for the initial WACC calculation.

The book value of the debt is considered a good approximation for the market value and will be used as reported by Danisco, as the duration is only 4.4 years, and therefore tends to be close to market value (Sweeney, Varga & Winters, 2001). Using the market capitalization on the 22 of September, 2010, the initial WACC is estimated to 7.331 percent.

This initial WACC will be used to calculate our value of Danisco using the iteration method by (Elling, 2005). This is done as there is a contradiction in using the observable market cap and using this to calculate our own market cap. The iterative method tells us to use the new found market cap, and use this to find a new WACC which will give a new market cap. Using the function of solve in Excel, it is possible to find the market cap, which these equal. The actual used WACC is thus equal to: 7.342 percent.

7.2.1.7 Implications of Capital Structure Change

It is assumed that the WACC remains constant over the forecast period, despite debt decreasing proportionally to the capital structure. Intuition tells us that this assumption is not plausible, but looking more intricately on the movements of the variables in the WACC due to the capital structure change tells us that this is a correct assumption, as the WACC is a robust variable.

This assumption relies on reduced credit and interest rate risk as financial leverage decreases. As more weight is put on $R_e$, the decreased financial risk will reduce $R_d$, thereby offsetting an increase in WACC. Furthermore, as financial leverage decreases the tax shield advantage also decreases. Consequently it is a fair assumption that WACC remains constant throughout the forecast period.

7.3 DCF Valuation

Incorporating the findings above with the forecast, the discounted cash flow valuation of Danisco can be performed.
Free Cash Flow

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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>OI - NOPAT</td>
<td>610</td>
<td>1.298</td>
<td>1.421</td>
<td>1.462</td>
<td>1.501</td>
<td>1.537</td>
<td>1.569</td>
<td>1.663</td>
<td>1.763</td>
<td>1.868</td>
<td>1.981</td>
<td>2.099</td>
</tr>
<tr>
<td>(–) Δ NOA</td>
<td>-1.347</td>
<td>388</td>
<td>683</td>
<td>646</td>
<td>688</td>
<td>732</td>
<td>779</td>
<td>785</td>
<td>832</td>
<td>882</td>
<td>935</td>
<td>991</td>
</tr>
<tr>
<td>(+) Depreciation</td>
<td>750</td>
<td>742</td>
<td>786</td>
<td>833</td>
<td>883</td>
<td>936</td>
<td>993</td>
<td>1.052</td>
<td>1.115</td>
<td>1.182</td>
<td>1.253</td>
<td>1.328</td>
</tr>
<tr>
<td>Free Cash Flow, firm</td>
<td>2.707</td>
<td>1.652</td>
<td>1.524</td>
<td>1.650</td>
<td>1.697</td>
<td>1.741</td>
<td>1.782</td>
<td>1.930</td>
<td>2.046</td>
<td>2.169</td>
<td>2.299</td>
<td>2.437</td>
</tr>
<tr>
<td>Net Borrowing costs</td>
<td>-106</td>
<td>-85</td>
<td>-84</td>
<td>-83</td>
<td>-82</td>
<td>-81</td>
<td>-80</td>
<td>-79</td>
<td>-78</td>
<td>-76</td>
<td>-75</td>
<td>-74</td>
</tr>
<tr>
<td>Free Cash Flow, Equity</td>
<td>889</td>
<td>1.532</td>
<td>1.403</td>
<td>1.528</td>
<td>1.575</td>
<td>1.618</td>
<td>1.657</td>
<td>1.804</td>
<td>1.919</td>
<td>2.041</td>
<td>2.169</td>
<td>2.306</td>
</tr>
</tbody>
</table>

Financial literature often distinguishes between investments in short-term working capital and long-term capital expenditure, when forecasting and performing valuations. Penham (2007) combines these under the name net operating assets.

Terminal cash flow is estimated using an average from our forecast 2011 to 2021.

![Figure 32 – Free Cash Flow](image)

The share price value for Danisco is found to be **512 Dkk**, using the iterated market cap, which is higher than the observed share price on September 22nd 2010 of 500 Dkk. This implies, based on the valuation that the fair value of Danisco is 2.5 percent higher than the observed share price on the market, from a DCF perspective. However this value is without including the potential added value derived from incorporating a real option valuation of DDCE.

### 7.7 Sensitivity Analysis

The projections discussed thus far represent the most likely price given the scenario depicted. This section aims to analyze the sensitivity associated with the found fair DCF value for the share price on Danisco, given changes in key variables.
We have initially chosen to look at the sensitivity on the variables, WACC and the growth in the terminal period. The terminal growth is chosen as one of the sensitivity variables as this variable is the one we have the least information on, to make our decision. One could therefore argue that the choice is more based on theory of markets, than practical information. The two-dimensional matrix, is a standard measurement used in assessing the sensitivity, and it has therefore been chosen (Damodaran, 2008). The forecast envisioned that Danisco’s competitive advantage vanished after 2021, and would revert towards a more competitive market state, and therefore the long run terminal growth of 2 percent was chosen.

The financial theory highlight how the terminal value often is a simple perpetuity with 0 percent growth, however this would be a wrong assumption, as the inflation rate is already incurred in Rf and thereby Danisco’s earnings would be diluted over time. In this way the terminal value would not be compensated for the WACC discounting which includes the inflation. Therefore it is assumed that product prices are expected to increase with the inflation.

To elaborate on the findings from the two-dimensional sensitivity model above, two other variables have been measured using a tornado diagram, with the results below.

**Figure 34 – Sensitivity Analysis on WACC and Terminal Growth**

<table>
<thead>
<tr>
<th>Growth in Terminal Value</th>
<th>6.00%</th>
<th>6.50%</th>
<th>7.00%</th>
<th>7.34%</th>
<th>7.50%</th>
<th>8.00%</th>
<th>8.50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00%</td>
<td>539</td>
<td>491</td>
<td>450</td>
<td>425</td>
<td>414</td>
<td>383</td>
<td>355</td>
</tr>
<tr>
<td>0.50%</td>
<td>569</td>
<td>515</td>
<td>469</td>
<td>442</td>
<td>430</td>
<td>396</td>
<td>366</td>
</tr>
<tr>
<td>1.00%</td>
<td>605</td>
<td>543</td>
<td>492</td>
<td>462</td>
<td>449</td>
<td>411</td>
<td>379</td>
</tr>
<tr>
<td>1.50%</td>
<td>649</td>
<td>577</td>
<td>519</td>
<td>485</td>
<td>470</td>
<td>429</td>
<td>393</td>
</tr>
<tr>
<td>2.00%</td>
<td>703</td>
<td>619</td>
<td>551</td>
<td>512</td>
<td>496</td>
<td>449</td>
<td>410</td>
</tr>
<tr>
<td>2.50%</td>
<td>774</td>
<td>671</td>
<td>591</td>
<td>545</td>
<td>526</td>
<td>473</td>
<td>429</td>
</tr>
<tr>
<td>3.00%</td>
<td>867</td>
<td>737</td>
<td>640</td>
<td>586</td>
<td>564</td>
<td>503</td>
<td>452</td>
</tr>
<tr>
<td>3.50%</td>
<td>998</td>
<td>826</td>
<td>703</td>
<td>637</td>
<td>610</td>
<td>538</td>
<td>480</td>
</tr>
<tr>
<td>4.00%</td>
<td>1195</td>
<td>951</td>
<td>788</td>
<td>704</td>
<td>671</td>
<td>583</td>
<td>514</td>
</tr>
</tbody>
</table>

**Figure 35 – Sensitivity Variables - Share Value & WACC**
The above tornado diagram shows the sensitivity of four key variables. This has been made by changing the base case variables one at a time, +/- 25%, and observing the individual sensitivity. The tornado diagram is an intuitive way of testing which variables are more important. From Figure 35 left it can be seen that the WACC is the most sensitive variable. Compared to the other three variables this is of course because the WACC influences all cash flows. It must also be noted that the free cash flow of the terminal value perpetuity is also an influential factor, and therefore the average of the budget period was used.

As WACC was found to be the most influential variable, we have chosen to go a level deeper, in decomposing the WACC in terms of the variables, which it is compounded on. This is done in the same way as the previous method and the results are depicted in figure 35 right. Rd is seen as a small factor influencing the WACC. This is logically due to the low gearing of Danisco, which means that Rd is of small importance. In a company with higher gearing this factor would of course be larger. As Danisco is competing in a market, where the peer group companies all have low financial leverage, we believe this will continue in the future, making Rd a less influential variable. Even though the tornado diagram is helpful in assessing the sensitivity of the WACC variables, one must know that these changes in each variable, all other things equal is a contradictory assumption, as a change in D/E could change Rd, as the company would become more financially risky.

It is evident that ß and the risk free rate are the two most important factors in determining the WACC. It should be mentioned that R_m (the market premium), is as influential as ß, as these are a “product” - in the mathematical sense - in the WACC equation and therefore are equally influential. The correct choice of ß and R_m is therefore important, but it is still the choice of the analysts to choose these. The ß is more dependent on the market, which is chosen for the company, and the R_m is more dependent on the historical length one chooses. The ß must therefore be chosen with great care, and is why we choose to make our own regressions in determining the appropriate ß, and thus we are confident in our estimates.

The valuation of Danisco has not explicitly been divided into business divisions because unfortunately the specific figures are not disclosed with enough detail to validate it to be incorporated. A derived sensitivity analysis on growth and profitability within each division would be based on weak assumptions and therefore no further sensitivity analysis has been conducted. The fair value of Danisco is however, very sensitive to the growth prospects for its different segments such as Cultures and Genencor. In the budget period these could be forecasted quite well, but external factors will inherently influence the different markets in the long run, but strategic choices will make it possible for the management to follow the direction of the markets, should they take a radical turn in one direction leaving one
technology obsolete, as the divestment of sugar has shown. As it is not possible to forecast the external factors, it is the best alternative for forecast on the empirical data that are currently available, which is an overall assumption of the terminal growth.

Our sensitivity analysis highlights the validity of the constructed model as while being vulnerable to changes in WACC the sensitivity against terminal growth was small. As our estimates of Rf and Beta are fairly precise, while having a high sensitivity these cannot invalidate the valuation. Furthermore the forecast on Enablers, Cultures, Genencor and Feed can be executed fairly precisely as the products have stable market shares on oligopolistic markets with few competitors. Conclusively the valuation of Danisco above provides an accurate value given the set forth assumptions.

7.8 Part Conclusion - Is the Future Completely Random?

As the sensitivity analysis showed, the value of Danisco is dependent on key assumptions regarding the variables, which are used in the DCF valuation model. The assumption that Danisco will have the same organizational structure and that the markets in which they currently operate will be the same in the future is not plausible. There will inherently lay several options for the management to change these. If no assumptions were made, and one regarded everything as unforeseeable, in theory all firms would have the same unpredictable outlook, and would have the same value. As we know this is not the case analysts choose a method, which they find most precise, and lay emphasis on historical data. The key in making a valuation is therefore to make necessary assumptions and thoroughly analyze the given company and the contexts in which they operate. As the theoretic section showed us it is not possible to calculate the value of a company using an infinite amount of options, which a company actually consists of. This is because of the immense data and calculation, but also because of the lack of mathematical knowledge to find correlation among these. In the theory section and in the identification of options section we acknowledged that it was not possible to find all the options. This choice was made based on the financial and strategic analysis, and concluded that the insecurity of our forecasts would be minimized by separating one option from the rest of the DCF model. Given the inherent drawbacks of the DCF the DDCE joint venture on bio-ethanol is more accurately valued using the real options approach, which is done in the following chapter.
8. Binomial Real Option Valuation of DDCE

This chapter will apply the real option approach on the DDCE bio-ethanol venture in Danisco, as this was identified as a real option in chapter 6 and thus fulfils Copeland & Keenan’s and our proposed criteria of uncertainty, contingent investment decisions and being uncorrelated. Within the theoretical scope of the thesis were DCF and ROA complement each other, the value of DDCE is seen as an option premium. The chapter begins with a short introduction regarding the literature’s view on the implementation process. Hereafter we turn to the estimation of the option parameters and calculation of DDCE value.

8.1 Introduction

The DCF valuation above proved accurate in valuing the fairly stable cash flow from its current business operations. One reason is the availability of historic data and market information enabling us more precisely to forecast the individual inputs. However the model is inadequate in attributing value to an uncertain project with limited available information, as risk always will decrease cash flow because of a higher discount rate. Subsequently ROA has been adopted in an attempt to unravel value “hidden” in the DCF model as uncertainty herein adds value while limiting the downside.

In literature the typical examples of real options, in practice include natural resource investments and pharmaceutical development projects. This makes intuitive sense as such investments fulfil many of the criteria where ROA add value, such as high uncertainty and the presence of contingent investment decisions. ROA has been popular within natural resource investments due to the possibility of estimating volatility based on a single commodity price. The dependence of one particular commodity price and the sequential development process is fairly similar to that of DDCE. Especially the application on pharmaceutical products can be used as a benchmark methodology as these are innovative with sequential development phases and has virtually unlimited upside. However typically within the application on pharmaceuticals generic inputs regarding success rate probabilities, R&D expenditures and average time consumption in each phase is derived from previous empirical research (DiMasi & Grabowski, 2007) and (Bogdan & Villiger, 2008). Herein DDCE differs; as similar generic data is not available and no previous studies using ROA on comparable projects has been performed.

Our particular problem can thus be seen as new, which creates a number of challenges for its application. The focus of the ROA application can therefore be seen as two fold; Firstly, we seek to demonstrate ROA applicability in practice on DDCE. Secondly we aim to highlight how ROA leads to more accurate results. The first point is closely related to an often-cited criticism of real options relating to academia’s focus on precision over practicality. Triantis (1999) describes how the affection for precision
is one of the main reasons behind the lack of interest among investor in using real options when performing valuations, as the models quickly becomes very complex and mathematical. Focusing on practicality and user-friendliness has a tendency to reduce precision, but this loss of information we see as necessary in order for investors to accept real options as a general valuation model.

8.2 Six Steps in Real Option Valuation

Focusing on practicality we have composed a 6 step model for implementing ROA, which seeks to create an overview and logical path for investors to follow when performing valuations (see figure below). The steps are inspired by Mun (2005) and are constructed using the acquired insight (in chapter 3) on the use of the binomial lattice.

![Figure 36 – Six Step Real Option Process](image)

Source: Author’s own Creation, inspired by Mun (2005)

Step 1 identifies real options in Danisco (performed in chapter 6) and discusses whether ROA is the appropriate valuation model. Step 2 calculates the value of the underlying asset using the DCF model, in this case DDCE. Step 3 consists of the estimation of the underlying assets’ cash flow volatility, using Crystal Ball software. Step 4 is the estimation of required variables needed to construct the binomial lattice, time to maturity, length of steps and using estimated volatility the risk neutral probabilities of ups and downs. Step 5 using the estimated variables in the previous steps the two binomial lattices are constructed to find the real option value of DDCE. Lastly in Step 6 the results are discussed in a sensitivity analysis.

8.3 Step 1 – Framing Real Options

This section builds on the knowledge acquired in chapter 6 were DDCE was identified as encompassing real options of substantial value. The strategic analysis provided insight into the ethanol market dynamics and it was highlighted how more than competitive intensity or market share prosperity the
market was driven by DDCE’s production capabilities. Many firms have crumpled searching for ways to reduce production costs. The bio-ethanol market is projected to become of such a magnitude that talking about market shares is irrelevant.

DDCE was identified as a sequential compound option to choose between abandonment and expansion, coupled with a follow-on possibility to expand once again. Currently DDCE is in phase 2, with expected commercialization in 2013, herein the first option exists, as management has to decide whether to abandon or continue and commercialize. The strike price of the abandonment option is equal to 5 percent of initial investment (Slade, Bauen and Shah, 2009) Danisco has since 2005 invested more than dkk 550 mil. and is expected to invest dkk 107 mil. a year until 2013, overall equalling a total initial investment for Danisco of dkk 97 mil. (Danisco Annual report, 2010). As DDCE is a 50/50 joint venture it is assumed that Dupont has had similar investment costs equalling a total dkk 1,956 mil. Where of 5 percent results in a salvage-value of dkk 98 mil.

Theoretically it might be argued that the salvage value should change over time, as management exercises the expansion options and builds more plants. However a counter argument is that, it is the technology that holds most of the value and not specifically the production plants. Danisco’s investments up until commercialization should be seen as investments in a technology, which in this case, largely is a way of producing ethanol more cheaply. Holding the salvage value constant is thus seen as a fair assessment.

Secondly, if the commercialization option is chosen management has the option to expand production to 378 mil. litres after 2013, or continue with its current 189 mil. litres production capacity. Expansion cost is Dkk 1100 mil. per plant facilitating a doubling of production, this is equal to the strike price on the expansion option (Danisco presentation, 30.03.2010). Given a favourable development of the underlying asset Danisco has the option to expand production once again by constructing an additional plant at the same costs and performance as mentioned above. This expand 2 option is dependent on the prior expansion option being exercised by management.

DDCE is an American option with decision nodes each year to simplify the construction of the binomial tree. We assume management in Danisco always seek to maximize utility, as otherwise potentially valuable option might not be exercised (Gamba, 2002).

Conclusively DDCE comprise of several important real options, which we seek to value. Including such a wide range of options is important as management face a highly uncertain market wherein the production capacity is the critical competitive parameter. The option to abandon is relevant as DDCE is still not launched and only in phase 2, while the likelihood of abandonment is fairly low, given that
construction of a 189 mil. litre plant has already commenced. However because the price of ethanol is so volatile, there is a change of DDCE not being worth anything. The three identified real options are sequential in nature as they depend on the prior being exercised.

Before actually being able to model the abandonment option, expand 1 option and expand 2 options the underlying asset’s value has to be established. This is done in the next step below.

8.4 Step 2 – Underlying Asset Value – DDCE

This second step seeks to estimate the value of the underlying asset. This is done via a static DCF valuation of DDCE (Myers, 1984) (Copeland & Antikarov, 2003). This DCF is hereafter used as a base case scenario, in investigating the managerial flexibility option value of DDCE.

DDCE is still in development and thus available information is scarce regarding financial figures. Subsequently it is not possible to construct a full detailed income statement and balance sheet for DDCE. Similar to the previous valuation of Danisco (chapter 7) this will build on a few well-documented facts regarding the potential of DDCE. These will be presented below and utilized to construct a forecast.

Typically when performing real option analysis of biotechnology research projects, the forecasted cash flow is modified using the technological and market specific risk (Shockley, 2007). The technological risk typically describes the probability of the compound option going through the different development phases, in this case III (Copeland & Antikarov, 2003). As the risk in DDCE is not whether it passes through the clinical phases, but if a given production price can be achieve it would not make sense to implement technological risk as success probabilities. Technological risk should on the other hand be seen as DDCE’s vulnerability to production costs and is included in this way in the estimation of the volatility of the DCF cash flow (see step 3 for how the volatility in estimated). Market risk describes the post launch competitive dynamics, where the primary concern relates to the price of ethanol. This is also included in the estimation of the DCF volatility.

Both technological and market risk is included and treated in the DCF as the discount factor, which also influences the volatility used in the binomial lattice.

8.4.1 Strategic Assumptions

The strategic analysis provided insight into the drivers of the bio-ethanol market. The primary driver was identified as the production cost and whether this was below the market price on ethanol. The renewable fuel standard has dictated that the amount of bio-ethanol used in the US is 136 bil. litres as of 2012. This visualizes that the market is of a magnitude so that many firms can be active. Given that a
huge market exists it is a conundrum how come it has not be saturated by other firms. However the main challenges was recognized as production capabilities and many firms similar to Danisco has failed, as they were incapable in the long run to compete with regular gasoline prices, despite subsidies. The emergence of 2nd bio-ethanol promises competitive production prices due to the fact that the main source of input is farm waste product. The competitive requirement of production capabilities is very much in line with Danisco’s core competencies of economies of scale and unique technological capabilities. Both of these are especially important for the success of DDCE as achieving a profitable production price is highly reliant on the enzyme technology being efficient.

The access to production input is very important, as transportation costs are high. This also explains Danisco’s reason for solely targeting the US market. The position of the production facilities are therefore critical and DDCE is located in the “farmer’s belt” with easy access to input (Business Insight, 2010). Subsequently the volatility on production input is not very volatile limiting the risk exposure of rising prices.

8.4.2 Financial Assumption
The forecast for DDCE is constructed around three known variables; the production cost, the market price on ethanol and the fixed cost associated with running DDCE.

A few empirical studies have investigated the profitability of venturing into the 2nd ethanol market and in terms of the costs associated with running a plant. Leistritz, et al. (2007) estimates that producing 200 mil./L per year ethanol would incur a variable cost of 87 percent of sales. Management in DDCE argue that the production price will maximum be 2.9 and minimum 2.18 Dkk/L (Danisco Presentation, 19.05.2010). A fair assumption is therefore that a mean production price is used, equalling 2.54 Dkk/L. This equals a variable cost of 82 percent of sales, which is very close to what the empirical study found. The variable costs cover raw materials, labour and depreciation. Transportation cost is also an important factor, but as DDCE has placed its plant in a strategic beneficial position these should be minimized and it is assumed that they are 3 percent of sales (Slade, Bauen & Shah, 2009).

The production capacity of Danisco is in the forecast set at fairly low level at 189 mil. litres per year based on management expectations, with production commencing in 2013 (Danisco Annual Report, 2010) and (Danisco Presentation, 30.03.2010). The reason behind only assuming that a single plant is build is due to scarce information regarding the building strategy and because in this way the real option analysis can highlight the possible benefits of expanding production.
The fixed costs consist of the construction costs of building a commercial plant and derived hereof the yearly costs of maintaining it. Management stated that constructing a 189 mil litre plant will cost 1100 mil. Dkk. and Danisco estimates to spend dkk 107 mil. a year in fixed costs until 2012 (Danisco Presentation, 30.03.2010). As DDCE is a joint venture it is assumed that expenditures are shared proportionately and thus Dupont will also pay dkk 107 mil a year, equalling a total of dkk 214 mil. a year. Hereafter the fixed costs are assumed to be in line with empirical evidence at 24 percent of sales (Leistritz et al., 2007). This equals, running fixed costs of 50 mil. Dkk in DDCE from 2013 and onwards, covering working capital and research expenditures.

The market price of ethanol can be estimated using the current price and by looking at projected forward rates. The price of ethanol is as described vulnerable to increases corn and gasoline yields, while demand will in the future be stable given the regulatory requirements. The current quoted ethanol price is 2.79 Dkk/L. The projected forward rate in 2011 is 2.99 Dkk/L\textsuperscript{28}, meaning that the market is expecting the price to remain stable. However this should not be interpreted as a low volatility, but more as a signal that prices cannot be precisely forecasted. The forecast assumes that the 2013 ethanol price will remain stable throughout the horizon period.

Subsidies are a debated field within renewable energy industry as previously firms have been dependent on massive governmental funding to remain competitive. Bio-ethanol is not different and while governments again and again propose to remove subsidies this would render DDCE unprofitable on the short term and would eventually bankrupt the whole industry. US government currently provides a subsidy of 0.741 Dkk/L (Fundamentals of a Sustainable U.S. Biofuels Policy, 2010). However this law expires on Dec. 31, 2010 and experts find it questionable whether this is extended. Just recently, the rising federal budget deficit also makes it challenging for Congress to extend the ethanol tax credit (Gustafson, 2010). However this thesis assumes the subsidiary will be extended and persist throughout the period. If it is not renewed then the abandonment option is likely to be exercised already in 2011 as this is the optimal strategy.

An initial investment of dkk 500 mil. since 2005 is considered a sunk cost and is not included in the DCF valuation. Furthermore it is assumed that the demonstration facility is seen as a research lab and DDCE will not produce or sell from this facility. The forecast and valuation of DDCE can be found below, after the appropriate discount rate has been estimated.

\textsuperscript{28} (29 of September, 2010 - NYMEX.COM)
8.4.3 Horizon Period

A 6 year horizon period has been decided on, because then management will have three years of testing whether the venture is viable. As the profit margin within DDCE is fairly small management has to expand operations in order to earn considerable profits. As the DCF functions as a conservative base case, we found it more appropriate to analyze the expansion option in the binomial model. After 2016 a neutral approach is assumed and production will remain stable. Subsequently the terminal value is calculated as perpetuity with a 2 percent growth, equivalent to the consumer product index, which is similar to the inflation rate (Damodaran, 2008).

8.4.4 Discount Rate

It is important to estimate a risk-adjusted discount rate to account for the substantially higher risk associated with DDCE, compared to that the whole of Danisco, as was done in Chapter 7 (Mun, 2005). Determining the appropriate discount rate to be used with the cash flows, is done using the CAPM model. Within the DCF scope of DDCE it is a fair assumption that a number of the variables in the CAPM calculation from chapter 7 can also be applied here. These include the cost of debt, as it must be assumed that the higher default risk associated with DDCE is accounted for in Danisco overall default risk. The debt to equity ratio is also assumed to be identical as DDCE is a product division not unlike Enablers or Cultures. The fact that DDCE is organized as a separate entity does not influence the overall financing. However one factor stands out, as being of significant difference, and that is the beta of DDCE. The beta accounts for the technological risk associated with DDCE, this being the uncertainty regarding the ability to reach the necessary production price. Slade, Bauen & Shah’s (2009) empirical study on ethanol production found utilized a beta of 2.37. This is comparable to that of the average petroleum industry beta, which is equal to 2.46\(^2\). The mentioned study suggests this beta value, for the first plant on cellulosic ethanol projects. As DDCE has only made plans for one commercial plant, we believe this assumption to be an adequate estimate.

Another argument regarding the high beta is the ethanol prices vulnerability to the corn harvest. In June 2010 the ethanol price was lower than that of gasoline resulting in renewable enthusiast to proclaim that ethanol now was competitive. However in September the price had risen to 60 percent above the gasoline price (Rapier, 2010). This highlights the sensitivity of the ethanol price and validate why such a high beta is appropriate.

\(^2\) Data from 28 of September (http://pages.stern.nyu.edu/~adamodar/)
As the DDCE is a joint venture one could argue that the project’s discount rate should be an average of the rate at which Danisco and DuPont would use. As the purpose of our valuation is to find the value for Danisco, we choose to use the discount rate for Danisco only, as it is the value for their shareholders we are interested in finding.

The appropriate discount rate for DDCE is thus found utilizing the newly estimated beta, accounting for the higher technological risk, and applying CAPM to estimate $R_e = 3.53\% + 5.1 \times 2.37 = 15.62\%$.

This gives us a discount rate or project $WACC = 87.28\% \times 15.62\% + 5.00\% (1 - 25\%) \times 12.72\% = 14.11\%$

As the thesis central focal point is to assess the value of Danisco, the Danish tax rate of 25 percent is deemed appropriate, despite DDCE being a joint venture with an American Firm.

### 8.4.5 Valuation of DDCE

The assumptions made above provided the relevant information to construct a forecast for DDCE from 2010 to 2016. The forecast should be seen as a conservative estimate on the development of DDCE. Our conservatism is due to the high uncertainty of whether the required production price can be achieved, and that only one plant has been planned.

All in all the provided variables results in negative earnings for DDCE the first 3 years This naturally is because the product has not been commercialized yet. Fixed costs account for the development of a functioning 189 mil. litre plant standing ready in 2013. After commercialization it is assumed that DDCE is only marginally profitable, which is supported by Slade, Bauen & Shah (2009). However the pre-launch expenses outweigh the profits made hereafter meaning that the terminal value accounts for the majority of the value. However this is not unlikely as a large untapped market persist after 2016. Terminal growth is as described estimated to follow the consumer price index at 2 percent, which is supported by (Damodaran, 2008).

This yields an underlying asset value for DDCE as depicted in the figure below.
The value of the underlying asset “DDCE” is found to be equal to 362 mil. dkk, which means a static DCF share premium of 7.60 dkk per share without accounting for ownership structure. Danisco’s proprietary 50 percent ownership equals a share premium of 3.80 Dkk per share.

The underlying logic behind why Danisco consider DDCE such an important project becomes questionable after having found that it only marginally improves the share price. However this again highlights the relevance of analysing the option to expand production as achieving economies of scale was identified as the main source of economic prosperity within this market.

This base case value of DDCE will be used in Step 3, to estimate the volatility associated with the input variables in the DCF valuation. Furthermore the value functions as the underlying asset in the binomial model.

8.5 Step 3 – Estimating Volatility

This step intends to estimate the volatility of our DDCE’s cash flow, which then determines the progression of the underlying assets as it moves through the binomial tree. The volatility of the underlying asset is the primary value driver for the real option value (Brealey, Myers & Allen, 2008). Furthermore, the volatility is the most challenging parameter to determine and validate. At the same time, the challenge of estimating the volatility is one of the main reasons that practitioners are reluctant to adapt ROA (Shockley 2007). This section intends to obtain a valid volatility result and to mitigate some of the worries that practitioners might have.
Because of the complexity involved in estimating the volatility, the methodology has been divided into; 1) evaluate which variables are important for the cash flow, 2) determine each of these parameters’ volatility and lastly 3) combine these into a total volatility of the underlying asset (Ref. Section 3.2.5.7.1)
Given the innovative nature of DDCE, access to data is scarce and it has not been possible to find traded options, with the same risk parameters, to base the volatility estimate on. Subsequently it has not been possible to estimate an implied volatility and market traded assets. The methodology utilizes management estimates and market proxies to estimate the volatility (Mun, 2005).

8.5.1 Dependent Variables
The strategic analysis of DDCE indicated reliance on two central parameters, identified as ethanol price and production price. Subsequently these are held variable in the simulation to estimate the sensitivity to changes in these. This methodology is in line with Copeland and Antikarov (2003) that argue how uncertainty normally can be attributed to no more than 2-3 variables, which are of great importance. The volatility of the ethanol price is a market proxy affecting the profitability of DDCE. This represents DDCE’s market risk. Production prices are based on management estimates and is supported by secondary empirical studies all suggesting that expenditures will lie within a certain range (Danisco Presentation, 30.03.2010) and (Slade, Bauen and Shah, 2009). This is viewed as the technological risk. As described above both risk types are important to consider in order to construct a valid DCF model (Ref. Section 3.2.5.7.2).

8.5.2 Monte Carlo simulation and Final Volatility Estimate
This section has the purpose to find the total volatility for the underlying asset, measured as the volatility of the cash flow in the static DCF model. To perform these simulations the add-in software in Excel, Crystal Ball is used. The practical guide to estimating volatility suggested that one should find the value of the asset by changing its dependent variables. This is exactly what Crystal Ball aims to do, as it combines 50,000 Monte Carlo simulations and is therefore able to capture the complexity of DDCE’s volatility.

The dependent variables are simulated assuming that they follow a Geometric Brownian Motion, meaning that time = 1 builds on the cash flow in time = 0 multiplied by a growth factor. In our model the drift (growth factor) is assumed to be zero, as both production price and ethanol price are held constant over the period. The simulation is setup to capture the effect of changing these variables.
For the two defined variables it is necessary to define *volatility, mean* and *distribution* in order to run the simulation, which will be done below. Correlation between the variables is also important as this could have a major impact on how each reacts to changes in the other.

The correlation between production prices and ethanol prices are high, but this is mainly true for 1\textsuperscript{st} generation ethanol. Studies that have performed regression analysis indicated a 0.77 positive correlation coefficient for production costs due to changes in the market price of ethanol (O’Brien and Woolverton, 2009). 1\textsuperscript{st} generation ethanol uses corn and as corn prices are the primary driver of ethanol prices this results in a high correlation coefficient between these two of 0.63 (CME - Ethanol Outlook Report, 2010).

2\textsuperscript{nd} generation ethanol is contrarily not as reliant on corn, as production uses farmers waste product “switch-grass and corn-stover”, which has a huge supply, and is not competed for. In 2\textsuperscript{nd} generation ethanol, production is still dependent on a successful harvest, which again increases the correlation with corn.

However as the required figures for 2\textsuperscript{nd} generation ethanol is not available enabling us to perform the necessary regression analysis to identify the correlations we assume that 1\textsuperscript{st} generation figures are representative if the correlation to corn is accounted for. Regression theory suggests that in a multiple regression analysis it is possible to do one regression identifying the relationship between ethanol price and corn price on production price. This tells us, as above, that 0.63 of the correlation coefficient comes from corn, whereof only 0.14 is the rest, which could include gasoline or other significant raw materials.

All else equal it is a fair assumption that the correlation coefficient between production costs and corn prices are somewhat lower than the found 0.77.

Based on this discussion it would be fallible to conclude a zero correlation between ethanol prices and production prices, but a fair assumption could be that correlation is lower than the declared 0.77. This is because much of this correlation is explained by the development in corn prices. The volatility analysis below will assume a correlation coefficient of 0.4 between production price and ethanol price. Subsequently we have included a correlation assumption ranging from minimum 0.14 to maximum 0.77, with mean 0.4. We model the correlation using a triangular distribution as this better captures the higher likelihood of the coefficient falling in the tails (see figure 74 in appendix).

Another central factor that influences correlation is the fact that bio-ethanol is not produced in quantities large enough to affect the general price of ethanol, meaning that the level of production does not affect the general ethanol price and a correlation of zero is assumed.
8.5.2.1 Ethanol Price

This section seeks to discuss the mean, distribution and volatility assumptions of the ethanol price. As described the price of ethanol is an important variable for DDCE’s cash flow.

In terms the ethanol price this was found to be 2.99 Dkk/L. From 10 year historical data we found the yearly ethanol price volatility to be 31.04 percent (US Department of Energy, 27.10.2010). As any estimate used in financial analyses – it counts for the volatility - that it is improbable that it remains constant over time. Our estimated volatility is based on a time series data and will therefore reflect the past, but not necessarily the future. Theoretical literature generally argues that the current volatility is the best approximation of the future. Our estimate is based on 10 years of ethanol price data, but if too short a horizon was chosen this could misinterpret the equilibrium volatility and due to the ghosting feature extraordinary circumstances could have a major influence of the estimated volatility (Jorion, 2006).

The standard binomial model assumes that the value of underlying asset follows a GBM. Pinto, Brandão and Alves (2009) tested this whether ethanol prices followed a GBM and found it statistically significant. Subsequently we find it a valid to assume that the price on ethanol follows a GBM, wherein the next period price is dependent on the previous price. Ethanol price is therefore assumed to follow a normal distribution (see figure 72 in Appendix F). Consequently we are able to use the standard binomial model as recommended in chapter 3.

8.5.2.2 Production Cost

The production price is also a significant variable affecting the profitability of DDCE and is therefore included in the estimation of the final volatility.

The production cost is simulated as the yearly production price and will fluctuate from year to year and the most important factor influencing the production cost is the technological risk and not input price.

DDCE foresees the production cost to have a mean of 2.54 Dkk/L within a range with a minimum of 2.18 Dkk/L and a maximum of 2.91 Dkk/L (Danisco Presentation, 30.03.2010). DDCE’s closest competitor supports this price range indicating that these can be used with a certain confidence (Novozymes presentation, 03.06.2010). It is assumed in this model that management have a deep insight into the production costs and these estimates are relative precise, naturally knowing that some uncertainty surrounds them (see figure 73 in Appendix F).
We do not expect these production costs to assume a normal distribution, as we find no empirics suggesting this. Choosing a triangular distribution means that production costs are more likely to fall within the tails of the range.

8.5.3 Volatility Simulation using Crystal Ball

Using the Crystal Ball simulation tool, we are able to simulate the volatility of the yearly cash flow in DDCE. The program simulates the volatility by changing the two variables, ethanol price and production cost from year to year.

The number of simulations that are made can have an effect on the results, as the program uses a random number generator, which is of course dependent on the variable distributions. As these numbers are still random, each simulation run will give different results in mean and volatility. Making 10,000 trials saw volatility fluctuations from run to run on up to 1%, while 50,000 simulations only saw 0.1%. As the time consumption of making the extra simulations are not large, and where 10 times as precise, 50,000 simulations were made, giving the results below.

![Figure 38 - Cash Flow Volatility Simulation on DDCE](image)

Source: Output from Crystal Ball Calculation

This shows a relative standard deviation of 89.40 percent, which is to be used in the binomial model. Without including correlation between variables the standard deviation would have been 98.50 percent. The estimated volatility is high, but is supported by Bogdan and Villiger (2008), who identified a volatility of 50-80 percent as common for biotechnology firms. As DDCE is highly uncertain and profitability is dependent on volatile variables our estimate does not seem unrealistic. The fact that 30 percent of all biotechnology projects are abandoned again supports the high estimate of the volatility in DDCE (Dimasi,
2001). It has to be noted that both studies have investigated the pharmaceutical industry and not as such the area where DDCE operates. However as definite similarities are present we believe these figures can be applied here as a comparable benchmark.

The distribution of our DCF value is assumed to be normally distributed, which is a core assumption using the binomial tree method in real option pricing. Looking at the figure it is evident that assuming a normal distribution is an accurate assumption, as data are placed around a mean of zero. The Beta distribution had a marginally better fit, but the normal distribution is assumed.

8.6 Step 4 – Estimate Binomial Model Variables
Having found the volatility and the value of the underlying asset this step will elaborate on the remaining necessary real option input enabling the construction of a valid model.

8.6.1 Time to maturity
The first parameter that is determined is the time to maturity of the options. A sequential compound option is a series of staged options and thus each option has in theory different maturity parameters that need to be addressed.

Expiry of the expand and abandonment option occurs if the technology becomes obsolete or if production costs cannot be reduced to the necessary level. Scientist has already begun filing patents for third generation bio-ethanol produced using Algae, however commercialization is unlikely to occur before 2025 (Emerging Markets Online, 2008). Furthermore the patents surrounding DDCE expires in 2025 as they were filed in 2005 and follows the normal patent life cycle of a 20 year exclusivity (Danisco - Annual Report, 2010). While patent extensions, especially on very innovative products such as DDCE usually are accepted, this thesis assumes not to occur in this situation to refrain from speculation and simplify the calculations. Whether this will eradicate DDCE earnings are questionable as the required capital and technology is difficult and costly to acquire. However it is assumed to have an influence on DDCE and the expiry of the expand options are set to 2025.
Furthermore is it assumed that throughout this period competitors cannot replicate DDCE’s enzyme technology making it valuable for them despite a development of the underlying asset.

8.6.2 Length of Time Steps
In the binomial model, the length of the time steps needs to be evaluated, as the model is constructed in discrete time. This decision is split between two considerations. On one hand, it is undesirable to have
too many time periods, as this will make the binomial tree unnecessarily large – influencing the intuition and overview of the model. On the other hand, increasing the amount of time steps improves the precision of the model (Mun, 2005), as decisions can be made at any point in time. Based on these considerations the chosen time steps is set one each year, equalling a total of 16 steps in our model. However as we attempt to model DDCE as an American option management can exercise within each of these nodes.

### 8.6.3 Estimating Risk-Neutral Probabilities and Up and Down Movements

As described in section 3.2.5.5 the risk neutral probabilities \( u \) (up) and \( d \) (down) are used to model the value of the underlying asset in the future, therefore these has to be identified. The estimated volatility on the DCF for DDCE is used. This is done using the formulas introduced in chapter 3. First the up and down movement for the underlying asset are calculated from the volatility and the length of the time steps. Following this, the risk-neutral probabilities can be estimated.

\[
    u = e^{0.9 \sqrt{1}} = 2.460; \quad d = e^{-0.9 \sqrt{1}} = 0.407; \quad p = \frac{e^{0.353(1)} - 0.407}{2.460 - 0.407} = 0.495
\]

### 8.7 Step 5 – Real option Modelling

The previous steps have enabled us to calculate the value of incorporating a real option methodology on DDCE. Using the binomial lattice it has been necessary to construct two binomial trees to calculate the value and one investigating the embedded managerial flexibility.

Three relevant options have been identified and all enhancing the complexity of the lattice. The options are seen as sequential compounded meaning that it has been required to structure the model in a manner where these path dependencies were included. The options are seen as American and can be exercised at each node. The tree comprise of 16 steps with one-year intervals.

#### 8.7.1 Binomial Tree 1 – Value of Underlying

Herein the value of the underlying asset model is found using the risk neutral probabilities for \( up \) and \( down \) movements. The static DCF value of DDCE was found to be Dkk 365 mil. with a volatility of 89.40 percent.
It is evident that as we move through the tree, given our high volatility, the more nodes are introduced the larger the spectrum of possible outcomes is. Subsequently the value of the underlying asset can end up being much higher or lower than the initial value. However it has to be noted that the likelihood of ending up in one of these extreme scenarios is very low.

8.7.2 Binomial Tree 2 – Real Option Value

In Figure 40 below the sequential compound option is modelled. The sequence of solving this tree is reverse to the underlying tree above, as it is solved recursively, starting with the values from the final nodes of the asset value tree. At each node is discounted with the risk-free rate and weighted with the risk-neutral probabilities $qu^{30}$ and $qd^{31}$, to estimate the value one step backwards. At the nodes, where the option is exercised, meaning a payoff above zero, the exercise price is subtracted from the option value. If the payoff is lower Danisco will not exercise, but hold the option “open” or “expand” if this is profitable. The abandonment option and expand option have opposite payoffs profiles and thus function as a hedge against adverse developments in the value of DDCE. It is through this the model incorporates the asymmetric payoff of options, as management can choose the optimal strategy, which is when the payoff is highest.

Modelling three path dependent options has been challenging as each different payoff profiles, these are defined as:

$$qu = e^{r_f} - d / e^{r_f} * (u-d)$$

$$qd = 1 / (e^{r_f} - qu)$$
Abandonment (Put Option); Max [(Salvage Value (5% of cost) – Value of Underlying Asset (V(t)); 0)]

Expand 1 (Call Option); Max [(V(t) x Increase in production (x2) – Investment Cost (1.100 Mil. Dkk; 0)]

Expand 2 (Call Option); Max [V(t) x Increase in production (x4) – Investment Cost (2.200 Mil. Dkk; 0)]

The research development period (see figure below) is until 2012. Herein management can decide between keeping DDCE alive via “Open” or “Abandonment” and thereby saving any future expenditure and earn the salvage value, which has been defined as 5 percent of the investment equal to dkk 98 Mil. Choosing to continue DDCE is calculated as the maximum value between discounted value of previous periods (using qu and qd) or the salvage value.

Hereafter DDCE is commercialized in 2013 and the value of expanding production once and twice is modelled. Management still has the option to abandon pending poor developments. Expand 1 is measured as the DCF value in time (t) multiplied by 2 and subtracted the cost of building a plant equal to 1.100 Mil. Dkk. This assumption that an expansion of production is a doubling of the DCF is a simplification, but in line with Danisco’s strategy, wherein additional expansions are expected. Furthermore, the DCF of DDCE highlighted a very narrow profit margin highly dependent on the price of ethanol and subsidies, meaning that economies of scale are necessary in order for DDCE to earn considerable profits (Danisco Presentation, 30.03.2010). Expand 1 is exercised when its value is higher than abandonment or holding the option open.

Expand 2 is dependent on expand 1 being exercised and is itself exercised when its value is higher than all the latter; Abandonment, open and expand 1.

All these assumption and calculations are embedded in the figure below depicting the real option valuation of DDCE.
The model shows that the total value of DDCE, including the real options is dkk 1.361 mil. equalling, a share premium for Danisco of 14 Dkk per share. The real options are equal to dkk 999 mil.. Modelling the three options individually functions as a test of whether our model is correctly set up (see appendix for the full models of individual options).

\[
\begin{align*}
\text{Expand 1} & = 318 \\
\text{Abandonment} & = 57 \\
\text{Expand 2} & = 624 \\
\text{Sum of individual options} & = 999
\end{align*}
\]

Because the modelled options are sequentially compounded, whenever one is exercised the others forfeit, except for expand 2. However the value of the forfeited choice is still included in the total value. This means it is possible to add the individual modelled option and this should equal the sequential compound option, which it does. Conclusively we can assume our model is accurate.

It becomes evident that the growth options (Expand 1 and expand 2) contribute most of the value, whilst the abandonment option only has a marginal value. Especially Expand 2 is of significant value, which is in line with the strategic analysis that highlighted economy of scale as a key competitive parameter.
8.7.3 Binomial Tree 3 - Managerial Flexibility Choices

As mentioned above the different options all contribute value to DDCE and subsequently it is relevant to construct a figure depicting the Danisco’s managerial choices, wherein it is assumed that the optimal strategy is pursued. This is visualized in the figure below.

Management’s initial choices are, either to keep option open or abandonment. After commercialization two additional choices are included, expand 1 and derived from this expand 2. Expand 2 contributed most of the value above, but is only exercised whenever the underlying asset ends up in very successful scenarios. As time passes management acquires additional valuable information regarding its production competencies and market dynamics, which all will contribute to a lower volatility. Subsequently the range that the underlying asset can land in will be narrowed. This model attempts to model the current situation and the derived value hereof is consequently very dependent on the high volatility of DDCE’s cash flow.

8.8 Step 6 – Real option Sensitivity Analysis

As with the primary DCF valuation, we have chosen to assess the sensitivity of the value we have found in our real option valuation. It has been done using the same method as earlier, by changing each variable with +/- 25% from the base case variable and observing the change in our real option valuation. From figure 42 it can be seen that the β is the most influential variable on the real option value. β influence the DCF of DDCE, which is the underlying asset of our real option valuation but not the binomial real option valuation. The risk free rate R_f variable, influences both the DCF of DDCE, as it is incurred in the WACC, but also the real option modelling in step 4, as used in the calculation of the parameters used in the model.
The volatility was simulated in the base case DCF calculation of DDCE, from the two variables of ethanol price and production price. The volatility was found to very high (89%), and is somewhat higher than other biotech projects.

Pharmaceutical project volatilities are often found to have volatilities of up to 80%. We feel that our high volatility, is as high as 89%, as we have even more insecure assumptions of the future of the production prices, and the production price that DDCE can produce to. This is due to the fact that no empirical data on such technological projects are available as the enzymes and chemicals used in the process are very new. Pharmaceutical products can often be categorized, and data on the probability of success can often be used, narrowing the spectrum of possible outcomes, and thereby the volatility. We do not have prior information of the probability of success, and the volatility thereby ends up being even higher than the otherwise normally very risky pharmaceutical projects. The success rate of DDCE is modelled by the two variables and their distributions instead.

8.9 Part Conclusion – The Value of DDCE

DDCE was identified as a “sequential compound option of expansion or abandonment” (Ref. Chapter 6), hereafter Mun’s six step real option methodology was applied, which is compliant with the overall ENPV approach.

The base case DCF valuation of DDCE was found to have a value of only 3.80 Dkk per share. It should be noted our estimate is conservative and reflect the most likely scenario. Incorporating management flexibility, namely expand 1, expand 2 or abandonment yielded an option value of 25.2 Dkk per Share. This equalled a option premium for Danisco of 14 Dkk per Share.
Given these results it can be concluded that DDCE has a small effect on the total share price of Danisco. If an investor only looked at the DCF value of DDCE, it would probably be neglected due to insecurities in the valuation. We found that the primary value of DDCE lay in the management’s strategic choices. Continuing the project as it is now will not provide significant cash flows for either Danisco or DuPont, but the chance of the market evolving in a favourable manner adds significant value and by including management’s real options the value of DDCE is tripled. Furthermore despite a limited value, it should be highlighted that the assets in DDCE are of minimal book value, meaning not much money has been bound in the venture, actually giving a high value compared to the rest of Danisco.

Surely the ROA approach is introduced to capture the possibilities of growth under uncertainty, but setting an infinite value on the expansion of DDCE facilities is unrealistic. In this way the ROA approach can be criticized for the same limitations, which were used on ROA’s behalf in criticising the DCF model. We chose to set a quadrupling of the ethanol output of DDCE, in the expansion options, and believe that this option will not have significant value after 2025. Had one chosen DDCE, having the option of choosing output to be timed by 10 or 100, surely the value of DDCE would be much higher. As with all theoretical methods and approaches, assumptions have to be made by the analyst, and a degree of subjectivity will be inevitable.
PART III – Conclusions

9. Discussion of Results
This thesis has investigated the ENPV method via a case study in Danisco. This section will discuss our results and in particular reflect on the valuation model criteria “practicality, validity and implementation process” of using real options as a complementary model. (Ref. Section 1.3.4.2).

9.1 Fair Value of Danisco
Combining our two valuations – the DCF model (Ref. Chapter 7) and adding the real option premium (Ref. Chapter 8) equals a fair value of Danisco of 526 dkk per Share. This is comparable with a share price of dkk 500 as of September 22, 2010 and our recommendation for investors is to buy the share.

9.2 Analysts Valuation
While the derived value for Danisco is interesting, it is with a special curiosity that valuations from other analysts are investigated for similarities and discrepancies.

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<tbody>
<tr>
<td>Model Type (Main Driver)</td>
<td>DCF/ROA</td>
<td>DCF</td>
<td>Multiples (EBIT/DA)</td>
<td>DCF</td>
<td>Multiples (EPS)</td>
<td>Multiples (EV/EBIT)</td>
</tr>
<tr>
<td>Price (12 month Target)</td>
<td>526</td>
<td>545</td>
<td>625</td>
<td>620</td>
<td>530</td>
<td>521</td>
</tr>
<tr>
<td>Growth</td>
<td>6.0%</td>
<td>2011 = 7.9% Average = 5.2%</td>
<td>2011 = 12.2% Average = 5.25%</td>
<td>2011 = 9.7% Average = 6.2%</td>
<td>2011 = 10% Average = 5.7%</td>
<td>2011 = 9.1% Average = 6.3%</td>
</tr>
<tr>
<td>ROE(Period)</td>
<td>9.7%</td>
<td>9.3%</td>
<td>9.1%</td>
<td>10.2%</td>
<td>10.5%</td>
<td>9.6%</td>
</tr>
<tr>
<td>P/E(Period)</td>
<td>20.4</td>
<td>18.7</td>
<td>18.2</td>
<td>17.1</td>
<td>17.3</td>
<td>19.7</td>
</tr>
<tr>
<td>EBIT Margin(Period)</td>
<td>11.8%</td>
<td>13.8%</td>
<td>13.7%</td>
<td>15.7%</td>
<td>14.0%</td>
<td>13.2%</td>
</tr>
<tr>
<td>WACC</td>
<td>7.3%</td>
<td>6.8%</td>
<td>N/A</td>
<td>8%</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>DDCE Value</td>
<td>14 Per Share</td>
<td>Not Explicit Priced</td>
<td>-31 Per Share</td>
<td>109 Per Share</td>
<td>Not Explicit Priced</td>
<td>Not Explicit Priced</td>
</tr>
</tbody>
</table>

Source: Author’s Own Creation, Based on Valuation Reports from (Jyske Bank, Nordea Markets, SEB, Chevrux and Carnegie)
After looking through the various analysts reports it becomes evident, that the “analyst consensus” is, across the board, to recommend investors’ to buy. These values are based on stable 5-7 percent growth and a ROE above the cost of capital. Comparing our estimates with analysts’, there is one item that is of particular interest. Our model does not lead to the management achieving its financial expectations of an EBIT margin higher than 13.5 percent. This might be because DDCE earnings are negative in 2011 or a result of analysts expecting a higher growth in 2011. Our higher P/E indicates that intangible value, accounts for more in our model compared to analysts. However our P/E is still lower than that of Chr. Hansen and Novozymes\footnote{Our P/E Chr. Hansen and Novozymes have an expected P/E ratio of 25.7 and 28.2 respectively, which is considerable higher than the general consensus among analysts following Danisco (Thomas Reuters).}, indicating our model and analysts attribute substantially less value to intangibles. However the P/E ratio cannot capture the value of DDCE, as we expect negative earnings over the next years.

\section*{9.2.2 Valuation Assumptions}

An interesting perspective is the seemingly superficial treatment of the DDCE venture by analysts. SEB attempt to price DDCE however their valuation methodology is not explicitly stated and equals a value of dkk 103 per share, which cannot be defended within our model. Nordea utilize a DCF model and end up with a negative value, which is a paradox seen from our methodology. This point at: either analysts find the project irrelevant or they do not have the required tools at their disposal valuate it. This latter theory seems highly unlikely, as investment banks would be assumed to have the resources and skills for this. When using multiples, it can be difficult finding market proxies for innovative projects still in its R&D phase. Within multiple valuations the assumption, that peers are accurately priced, is prevalent; otherwise the foundation would collapse as the selected peers could not function as valid benchmarks. The authors see it as a conundrum and troublesome that such emphasis on accurate peer valuations is made in depicting the value of Danisco. This gives a tautological relationship between comparable stocks, as each stock is affected by the performance of the others. In this way a stock in the peer would rise if the EBIT margin of the peer group should rise, all else equal. Often the relationship is the reciprocal, as stocks often react negatively to better performance by competitors. The multiple analyses will often not stand alone, and this relationship will not be directly observable, but the theoretic implications of using multiples based on peer results, are flawed.
Within the multiple view, innovative projects, such as DDCE, would not be priced at all, as the associated immaterial value cannot be assessed looking at earnings or at performance against peers. Subsequently the valuation will inevitably become a choice of assessing whether future performance is “better” or “worse” than peers. If better; a buy recommendation is accredited to the share. Furthermore we found it difficult to compile an appropriate peer group constellation as Danisco operates in multiple markets, each with unique competitive dynamics. Herein one can question the validity of the benchmarks used by analysts, which are so vital in the valuation.

Our lower EBIT reflects an increase in R&D expenditures as this is seen as an incremental long-term competitive parameter for Danisco. Within the ENPV view, research creates opportunities and herein real options. Analysts are thus faced with a difficult trade-off decision as whether to prefer a higher EBIT now or increasing the potential of creating new potentially profitable opportunities by increasing research expenditure. As analysts’ horizon periods are fairly short, and a firm maximizing EBIT over the short run is often preferred by investors. The difference in investment horizon could thus be a reason for the investors not utilizing the ROA neither in the practical nor the theoretical aspect. The option premium simply relates to events that are too far in the future, and the short term horizon does not acknowledge this value. When the option values are closer to the present, and the effects can be related more directly to key indicators such as the EBIT margin, one would expect the investors to include this value. Analysts are not willing to include this value, as it is deemed too insecure, due to the horizon of the cash flows. This is peculiar as a classic criticism of the DCF points at the arbitrary nature of the terminal value, which often accounts for more than 50 percent of the share price (Brealey, Myers & Allan, 2008).

Another issue related to the practical usability of ROA is the assumption that managers’ choices are rational and in compliance with maximizing real option value. This can be debated, as an agency problem exists between managers and investors. Situations will arise, where managers will not act as investors anticipate, and decision makers and shareholders incentives needs to be aligned. The critique of the ROA could be the assumption of an active rational decision maker. Managers’ “irrational” behavior could be a reason why analysts do not incorporate real option in their valuations. This could manifest itself in DDCE, as failing to exercise the growth option, thereby rendering the project practically worthless for investors. The investors react to news regarding stocks they hold. Quarterly results lower than prior expected will yield negative effects on the stock price. In this sense investors take a bet on the next quarterly results using their forecasts. As they bet on the future, but with most emphasis on the next quarterly or yearly results, the distant future option premiums affects share price less.
9.3 A More Informed Investment Decision

This section seeks to discuss, based on our findings, whether it is value-adding to incorporate real option approaches in the valuation model. The thesis adopts an investor perspective, and herein the only value of importance is to maximize shareholder value. Within the analyst valuation above, evidence suggesting the incorporation of real options was not found.

Real option fundamentalists argue that valuing the embedded managerial flexibility provides additional value, and in theory real options is a technique to incorporate and account for uncertain projects, precisely as DDCE. The analysis provided insight into the viability of DDCE, and the fact that a large share premium could not be vouched for, is just as important, as if a substantial premium was found. Through our analysis the information asymmetry is reduced, as we are able to dig deeper into one of Danisco’s most promising projects and reject the hypothesis that substantial value can be attributed to DDCE at the moment.

In the application of the different models (Ref. Chapter 7-8) we saw, that despite the standard DCF model generally being commended as intuitive and applicable, the input estimation was not straightforward. In relation to usability, the often heard critique – that real option rests on unrealistic assumptions – can be dismissed. The necessary assumptions are not stricter than the ones that the DCF rely on, and as a result the critique is unjust. In this way the authors can conclude that the validity of the models is just as sound as the DCF. It is relevant to discuss whether it is actually meaningful to develop very advanced models to perform valuations, given the significant uncertainty of the input estimates. This critique explains the scepticism found among practitioners towards advanced valuation models.

What is important to emphasize is the fact that, while it can be discussed if the ROA actually provides a more precise financial valuation, it clearly provides a better understanding of the uncertainties and options of a project and is therefore able to deliver valuable managerial insights. Even though one could find a significant option value, the saying: “garbage in – garbage out” will apply, meaning the result you get from the application will not be more accurate than the inputs. In this way our 3 dimensional model (Ref. Section 3.2.4 and figure 6), is quite helpful in determining whether one should try to calculate the value or if another valuation model is more appropriate.

9.4 Concerning Validity

The most important requirement of a valuation model is the validity of the result. It does not matter if the implementation is easy and the theory behind it is sound, if the results are not valid. The DCF results
are deemed valid as the implementation has been refined by its frequent use and refinement, but the real options are still lacking the trust of investors in that respect.

We have used the six step model by Mun (2005) to calculate the DDCE venture. In following the six steps we found that step 2 was the hardest to estimate. This step seeks to calculate the value of the underlying asset – the base case ROA-DCF. We believe that this ROA-DCF is somewhat different, than that which is made for the stable cash flows in the ENPV model. Most importantly, much less information is available in the ROA, making the ROA-DCF forecast much harder, and less valid. As the purpose of the ROA valuation is to capture the value of uncertainty, it can be argued that it is best to refrain from speculation in the ROA-DCF, and make a conservative prediction, in contrast to the main DCF, where the aim is to set what one believes is most probable, and it should capture the entirety. The reason for this is the difference of the models, as the option premium on the ROA-DCF is to capture the value of uncertainty. It is also in this step, crucial to decide whether the information, one has available in making the ROA-DCF, is valid as to use in calculating the value of the option. If this is not the case, it would be better to use the information at hand in a strategic analysis, and defer from adding the option premium to the ENPV.

9.5 Information Equals Value

What is the value of using real options, if it – as in our case – only yields a marginal extra value; is this not contradictory to our valuation aim? There are different types of value-adding activities attained by using real options, is the immediate answer. Firstly and preferably, real options can be identified and calculated. Secondly, real options can provide additional information enabling a more efficient depiction of Danisco future earnings potential, affecting the value of the DCF. Thirdly, if the added level of information acquired does not yield an ability to change the forecast it should not be included and the method is not relevant.

The framework of the real options method forces the analyst to assess other aspects of the firm, than one would otherwise do, when just using the DCF approach. On the other hand one could argue that the method will not add value to a valuation analysis, if the method does not directly add value, on a price per share basis. This must be true, as information that would not make us able to change the value of a firm, will not add value to a valuation. Instead of thinking of the ROA approach as a value adding tool, one could easily reverse the thought, and use it for removing value.
10. Conclusion

The thesis builds on Stewart’s (1984) extended net present value methodology (Static DCF + Real Option Premium) and sought to test the applicability and relevance through a case study in Danisco. Traditional best practice valuation models, such as discounted cash flow was identified as deficient, especially in pricing research projects in biotechnology orientated firms. Thereby the relevance of incorporating real options on Danisco was established, in particular the binomial lattice was found to be relevant. The standard DCF model cannot be rejected as it can accurately capture the intrinsic value in situations where historic data is present combined with stable competitive dynamics.

A three dimensional real option identification model was established facilitating the implementation of ENPV, highlighting the required presence of high uncertainty, high managerial flexibility and low correlation. Distinguishing between relevant and irrelevant real options was established through this model and DDCE was identified as fulfilling the criteria. It was concluded that real options should be able to stand alone, without correlation with the rest of the company, as it was not possible to calculate if this was prevalent. DDCE was identified as a sequential compound option with choices of abandonment, or given favourable market condition, expanding via a doubling or quadrupling of production.

The ENPV model was found to be relevant and appropriate in estimating the fair value of Danisco, as its current operations most accurately was appraised using the standard discount cash flow model, while the research project DDCE in 2nd generation bio-fuel was accurately priced using a real option model.

The strategic and financial viability of Danisco was found to be positive, after the rigorous restructuring, which created a more focused company. The fair value of Danisco was estimated equal to dkk 526 per share as of 22 of September 2010, wherein the DCF of current operations constituted dkk 512 per share and the real option premium in DDCE accounted for dkk 12 per share. This leads to a recommendation for investors to buy the stock. We still believe the Danisco stock to be undervalued, despite the strong share price performance, during the previous 12 months. While the option premium relative to the combined share price is marginal, the inclusion of managerial flexibility tripled the value of DDCE as the base case DCF constituted dkk 3.8 per share. In light of this real options had a substantial impact.

10.1 Refined Valuation Model

The method breaks barriers as the investor has to assess what strategic flexibility is present and what potential value this generates. The real option valuation wherein the depicted six steps seems
straightforward, but can be hard to implement and requires a comprehensive understanding of the strategic dynamics of the firm, and financial theory, in order to assess the variables. The drawback of ENPV is thus the fairly cumbersome methodology. In particular the underlying asset and embedded cash flow volatility was identified as difficult to obtain, due to the limited information available. It was noted in the application of both valuation models that despite the standard DCF model generally being commended as intuitive and applicable, the input estimation was not straightforward. The criticism of limited applicability and user friendliness of ROA can thus be dismissed as both rests on a foundation of unrealistic assumptions. It is therefore recognized that the investor needs to critically review the validity of all the required variables and assess whether these are empirically sound.

In our case, the underlying asset value of DDCE was estimated based on management expectations, regarding the production-capacity and -price, which was related this to its main competitor on the market, Novozymes. Based on the literature, the derived volatility is accurately estimated by identifying the key sources of uncertainty in DDCE’s cash flow. Ethanol price functions as a market proxy and is normally distributed, whereas for production price a triangular distribution is assumed. Using this to construct a Monte Carlo simulation of the volatility offers practitioners an intuitive and transparent approach. Subsequently, through our six step ROA model and herein insight into the drivers of underlying asset value and volatility, our case study seems like a step in the right direction of achieving a consensus among practitioners to accept real options in their valuations.

It must be said that the ROA part of ENPV is still not refined enough to capture value made by decisions high in the value chain. Management decisions to make organizational changes – as with the Sugar divestiture – cannot be incorporated in the ENPV model, even though a decision of this magnitude greatly affects the value for Danisco. This is due to inherent correlation, such decisions have on several other factors in the company. Often real options can only be used to value smaller parts of the company, as large managerial choices inherently will affect several factors in the company, making the options incalculable.

10.2 More informed Investment Decision
In the light that DDCE only yielded a marginal option premium the relevance of real options can be questioned and validating a ROA, must reside in decreasing the information asymmetry between Danisco and investor’s. It can be concluded that ROA clearly provides a better understanding of the uncertainties
and options of a project and therefore delivers valuable managerial insights. However this information is only relevant if either we are able to accept or reject, as in DDCE case, substantial real option value attained and influencing the total firm value. It was identified that analysts following Danisco, at least not explicitly, utilized real options when pricing DDCE and mostly it was rendered irrelevant to include, which was likely due to its inherent insecure nature. Utilizing ROA on DDCE, provided valuable insight enabling a strategic and financial rejection of the general market hypothesis, that DDCE could secure Danisco’s future growth. Both SEB and Nordea ascribed large share premiums to DDCE, which could not be vouched for in our model.

Overall ENPV provides a framework for investor’s to distinguish between and identify significant real options and hereafter utilizing the six steps ROA model find a fairly accurate real option premium, or at least estimate whether a project contains the expected potential. The added work load attributed with ENPV should not obstruct its applicability among investors as it provides a unique insight into the value creation in projects. It is therefore the author’s opinion that the advantages with ENPV exceed its weaknesses and the lack of acceptance among practitioners is undeserved.
11. Perspectives

The conclusion advocated the practicality of ENPV for investors and pointed at its ability to decrease the inherent asymmetric information. In investment decisions, risk has traditionally been viewed negatively, as investors and companies can lose money due to risk and therefore we typically penalize companies for taking risks. However what is the embedded causality of adopting a real option lens. When the primary value driver in options is volatility, the managers in Danisco are likely to engage in more risky endeavors as herein a potential reward is larger. However what is the downside of favoring riskier investments, and in this perspective it should be debated whether real options broader use should be promoted seen from stakeholders.

Incorporating real option has a propensity to find upside potential in negative NPV investment, in the traditional sense, as in DDCE’s case. Including managers’ managerial flexibility seldom, if not never, equals a negative value. The advocacy for real options points to a general tendency in firms that in search of profits they are driven towards maximizing utilization of resources. In this way capital is always bound in profitable assets, leaving a smaller buffer for situations of tail losses, in market crisis scenarios. Studies about growth tend generally to focus only on the average rate of growth, both at the aggregate or in a per capita basis and thus neglect the volatility of profits (Rajan, 2005). Economic theory tells us that firm specific risk can be diversified away by the investor, and thus a manager should not try to diversify project risk (Hopkins, 2010). The evolution of capitalistic markets shows that weak companies become extinct, leaving only healthy and profitable ones behind. As real options becomes best practice it contributes added risk taking, and subsequently a higher occurrence of defaults can be expected. A higher volatility of capital market and an elevated frequency of defaults is of great detriment to employees.

The markets nowadays are more defined as one global market and financing is much easier (Rajan, 2005). In this way it has become easier to get financing for risky projects, companies would otherwise have given up on. The question remains whether this easier access to financing is in line with the new theories of taking on riskier projects, from a prudent perspective. Prudency in the financial world, seems to be a word of the past. We believe that the ENPV model can help to distribute resources in a company more efficiently, seen from a market perspective, but remain undecided as to whether it is in the best interest of society.
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Appendix A: Chapter 2 – Presentation of Danisco

Markets
As the figure below illustrates the two largest markets - US and Europe - constitutes 65 percent of revenue while emerging markets such as Asia/Pacific and Rest of World has the highest growth (Figure 49). European sales also reported a substantial growth of 10 percent, mainly due to increased sales of Genencor.

Danisco has in recent years increased its research and development expenditure to 6.5 percent of revenue. Continuous new product launches are an important competitive parameter within ingredients, as individual food items require specifically engineered solutions.

Sales are made at a business to business level to large food manufactures, 16 percent of revenue is generated from the 10 largest customers. The ingredients market has in recent years been put under pressure from food manufactures, which has to cut cost in order to stay competitive with low-cost producers from the developing world. This puts downward pressure on ingredients to reduce prices. Subsequently Danisco has had to improve cost effectiveness in production to sustain profitability margins.

Economics
The fiscal year of 2010 saw revenue increase to DKK 13.706 billion a growth of 5.5 percent from the previous year33. 2009 was dominated by a global financial recession resulting in volatile food and resource prices, which pressured Danisco’s profitability. As a consequence the financial gearing was in 2009 reduced by re-paying debt of DKK 5 billion.

Continuous efforts to optimize the distribution and production led to a reduction of assets, which consequently has resulted in improved margins. The reorganization of Danisco’s production structure has contributed to improving the capacity utilization and thus enhanced cost effectiveness (Annual Report, 2010). The company furthermore benefited from stable prices on commodities and energy as well as falling freight prices (see figure 54 in appendix).

33 This calculation has already subtracted revenue generated from the sugar division
Corporate Governance

Danisco has a two tier governance structure, meaning that shareholders elect a board of directors, which subsequently selects the CEO. The board participates in deciding the overall strategy and supervises the daily management, the performance and the general company organization. On the other tier there is the top management who has the day to day responsibility for Danisco’s operations and decisions. The tiers are separate according to Danish law and no person is a member of both (see appendix for description of management).

To encourage and address the agency problem, top management have been given performance based options related to the share price (Williamson, 1979). 580.000 new options were granted on 1. September 2009 and can be exercised from 2012 to 2015 at a strike price of DKK 239 (Annual Report, 2009). Since then the share price has increased 62 percent to 389 as of May 18 2010. Management thus has incentive to maximize share price in 2012, which is in line with the formulated 2012 strategic goals.

We can question the rationale behind awarding options in September 2009, with the inherent volatility of the market of that time, as increased risk enhances the value of an option (Beasley, Myers & Allan, 2008).

Danisco currently has 47.625.000 number of outstanding shares in August 2010 at a market price of DKK 435 equaling a market capitalization off DKK 20.716.875.000. Danisco has a diluted ownership structure with 62,600 shareholders of whom 72 percent are professional investors. The Danish pension fund ATP holding 7.9% of share capital is the only shareholder holding more than 5% of the share capital. This indicates that shareholders have a disincentive to interfere with managements decisions, as their shares most likely can be sold without diluting the share price. As voting power is highly dispersed, the ability of the management to make significant changes, without having to negotiate with controlling shareholders, is strengthened. This flexibility Tom Knutzen has utilized to change the strategic path of Danisco.

---

**Figure 44 – Basic Financials**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assets</strong></td>
<td>23.265</td>
<td>31.385</td>
<td>27.943</td>
<td>21.278</td>
<td>20.508</td>
</tr>
<tr>
<td><strong>Liabilities</strong></td>
<td>19.536</td>
<td>18.436</td>
<td>15.041</td>
<td>9.138</td>
<td>8.003</td>
</tr>
<tr>
<td><strong>Equity (all shareholders)</strong></td>
<td>12.726</td>
<td>12.949</td>
<td>12.542</td>
<td>12.140</td>
<td>12.505</td>
</tr>
<tr>
<td><strong>Operating Income</strong></td>
<td>2.372</td>
<td>2.013</td>
<td>1.457</td>
<td>1.248</td>
<td>1.745</td>
</tr>
<tr>
<td><strong>Net income</strong></td>
<td>622</td>
<td>1.079</td>
<td>1.299</td>
<td>72</td>
<td>481</td>
</tr>
</tbody>
</table>

*Source: Annual Reports and own calculations*
Figure 45 – Board of Directors in Danisco

**Board of Directors at 30 April 2009**

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Nationality</th>
<th>Elected</th>
<th>Independent*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anders Knutsen, Chairman</td>
<td>62</td>
<td>Danish</td>
<td>1997</td>
<td>Yes</td>
</tr>
<tr>
<td>Jørgen Tandrup, Deputy Chairman</td>
<td>62</td>
<td>Danish</td>
<td>2002</td>
<td>Yes</td>
</tr>
<tr>
<td>Håkan Bjöklund</td>
<td>53</td>
<td>Swedish</td>
<td>2004</td>
<td>Yes</td>
</tr>
<tr>
<td>Peter Højland</td>
<td>58</td>
<td>Danish</td>
<td>1998</td>
<td>Yes</td>
</tr>
<tr>
<td>Matti Vuoria</td>
<td>58</td>
<td>Finnish</td>
<td>1999</td>
<td>Yes</td>
</tr>
<tr>
<td>Kirsten Drejer</td>
<td>53</td>
<td>Danish</td>
<td>2006</td>
<td>Yes</td>
</tr>
<tr>
<td>Lis Glibstrup</td>
<td>61</td>
<td>Danish</td>
<td>2002</td>
<td>Employee-elected</td>
</tr>
<tr>
<td>Flemming Kristensen</td>
<td>49</td>
<td>Danish</td>
<td>2005</td>
<td>Employee-elected</td>
</tr>
</tbody>
</table>

* Based on own analysis and NASDAQ OMX Nordic Exchange

Figure 46 – Management Structure in Danisco

**Management Structure**

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tom Knutzen</td>
<td>47</td>
<td>CEO</td>
</tr>
<tr>
<td>Søren Bjerre-Nielsen</td>
<td>56</td>
<td>CFO</td>
</tr>
<tr>
<td>Ole Søgaard Andersen</td>
<td>56</td>
<td>Chief Sales &amp; Marketing</td>
</tr>
<tr>
<td>Iain Witerington</td>
<td>47</td>
<td>Corporate HR</td>
</tr>
<tr>
<td>Fabienne Saadane-Oaks</td>
<td>51</td>
<td>President, Bio Actives</td>
</tr>
<tr>
<td>Tjerk de Ruiter</td>
<td>49</td>
<td>CEO, Genencor</td>
</tr>
</tbody>
</table>

Source: Annual Report 2009

Figure 47 – Ownership Structure in Danisco

**Ownership Structure***

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2008</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional investors</td>
<td>72%</td>
<td>75%</td>
<td>-3%</td>
</tr>
<tr>
<td>Private investors</td>
<td>28%</td>
<td>25%</td>
<td>3%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100%</td>
<td>100%</td>
<td>-</td>
</tr>
<tr>
<td>International investors</td>
<td>38%</td>
<td>28%</td>
<td>10%</td>
</tr>
<tr>
<td>Domestic investors</td>
<td>62%</td>
<td>72%</td>
<td>-10%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100%</td>
<td>100%</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: Annual Report 2009

* ATP major shareholder with 7.9%
Figure 49 – Geographic distribution of Revenue and growth in Q3 2010

Source: Own construction based on Quarter 3 Report 2010 figures
Appendix B: Chapter 4 – Strategic Analysis

Environmental analysis (PEST analysis)

Political
A key political driver is governmental support, as Danisco operates in a sensitive political sphere where the end-consumer daily interacts with their products. Especially within food, feed and detergents, policy is an influential factor. The impact of regulations is quite different for food ingredients and industrial enzymes. In the case of food ingredients, legislation varies from country to country and sometimes, local food regulations need to be consulted. EU is proposing harmonizing legislation; however no actual policy has been approved34. On the other hand, the regulatory environment does not play a major role in the commercialization of industrial enzymes. As can be seen below, within bio-ethanol political support and legislation is a deciding success factor.

Development of enzymes for the bio-ethanol industry has received a lot of attention in recent times and it can be stated that the developmental efforts are driven by factors such as rising oil prices, a need for the use of alternative energy sources and the subsequent political support. Former US President George Bush prioritized making cellulosic ethanol cost-competitive by 2012. As a result of political support, government grants are also pouring in for solutions, indicating a strong dedication. President Obama’s new energy bill in 2008 supported this and set legislative requirements demanding 36 Bil. Gal. of ethanol is blended into gasoline by 2020 (Bryce, 2009). (Ref. Section 4.2.2.4 on Bio Ethanol Market).

Policy makers in the EU signed a legislation stating that 20 percent of total energy consumption by 2020 should come from renewables. Furthermore an ambitious target of biofuels constituting 10 percent of fuel by 2020 has been agreed upon35.

Economic Factors

Macro economic overview
The current macro economic situation has already and is expected to have an effect on Danisco. However the ingredients and enzyme market is not elastic in terms of demand. Despite lower disposable

---

34 EU legislation on food and feed ingredients
35 European Union – Legislation on BioFuel Quota
income, end-consumers still demand food that tastes better, are healthier and have longer expiration dates (Business Insight, 2010).

The economic instability has resulted in more volatile resource prices. Danisco has a significant dependence on stable raw material prices (see figure 54 for development in resource prices). The company does not utilize financial options to hedge the risk of unfavourable price trends, which pressures the earnings capacity.

Danisco operates on an international sphere from a Danish platform. Currency and interest rate exposure is a risk. Forward contracts and swaps are used to manage this risk. A significant exposure still persists mainly on the EUR and USD. A change in the EUR and the USD exchange rates of 1 percent, respectively, will impact equity by 77 Mil. Dkk and 33.9 Mil. Dkk in 2009. Recent time’s financial instability in EU as a consequence of Greece’s massive deficit has resulted in a declining Euro relative to the US dollar\(^\text{36}\).

Danisco benefits from a weaker Euro as its international customers can buy ingredients at a lower price. With a globally diversified export strategy Danisco’s competitive position on the US and Asian markets are improved. The international monetary fund warns that, a weaker Euro can lead to increased inflation as energy, resources becomes more expensive (IMF.com, 2010).

Industry economic overview
An economic driver is the ability to develop superior ingredients and enzymes using industrial enzymes technology. Moreover using industrial enzymes has facilitated a cost reduction in production. Thus the price disadvantage that the ingredients previously had compared to generic manufactures has been reduced. This is considered an essential future growth driver in the industry. Moreover the increased competition emphasizes the importance of obtaining economies of scale.

Normally the cost of producing bio-ethanol has been quoted as the restraint in the adoption as a substitute to fossil-based fuel. However, recent advances in enzyme technology have resulted in reducing the cost of production. Thus the price disadvantage that the enzymes had over chemical processes is not considered as a major factor in the current industry scenario. Firms such as Novozymes have reduced the production 10 times over three years (Frost & Sullivan, 2008). The emergence of second generation bio-ethanol promises to increase both production and performance efficiency (Dupont Danisco Presentation, 2009).

\(^{36}\) EPN (27 October, 2010)
Furthermore, industry growth will be driven by increased demand for consumer products from emerging markets such as Brazil, China and India due to an increase in disposable income in these regions. This will moreover promote development of ingredients that address the specific regional tastes and preferences.

**Social Factors**
The global market for ingredients is influenced by a range of push and pulls factors. Consumers are demanding better tasting foods, with healthier characteristics or added functionality, ideally made from organic ingredients (Business Insight, 2008). End-consumers also demand more convenient food formats, which is a push against the organic health wave. However consumers are often reluctant to pay a premium, which pushes margins downward. A key driver is thus to offer food with an improved nutritional profile. Another main driver within the industry is high-tech food ingredients where industrial enzymes are added to increase quality and functionality. Danisco has utilized this strategy in developing its cultures.

A key challenge is to benchmark the benefits contra the disadvantages of using genetically modified ingredients and enzymes. Increased consumer awareness of the perceived health risks involved in the consumption of engineered food could possibly challenge new product development. Thus it is important for firms to adopt a strategy of research and development transparency. Understanding these social and cultural habits is an important non-financial driver for success on the market.

The change in role between developed and developing countries will characterize major shift in importer/exporter relations in the industry, however guaranteeing a continuous growth of the markets. Slow and steady growth is a long-term underlying feature of the markets, which is less prone to economic fluctuation because of the necessary role it continues to play for consumers (The Economist Intelligence Unit, 2005).

**Technological Factors**
The main technological factor affecting Danisco is the rising research costs. Developing a new innovative compound have and will become increasingly more expensive, driven by customer’s more specialized demand and the fact that the ingredients and industrial enzymes industry have existed for years now making it difficult to differentiate yourself from competitors (Business Insight, 2008).

Advances in biotechnology using genetic engineering are key drivers as this facilitates increased functionality and product efficiency. A key limitation of product innovation is increased regulatory
requirements regarding health claims. A new product needs to be backed-up with scientific evidence, which will increase the cost of innovation. This may restrict the scope of new product developments.

**Competitor Analysis**

**Novozymes**

Novozymes is the world leading developer of enzymes and microorganisms and had revenue of DKK 8.448 billion an increase of 3.7 percent. This equals a consolidated annual growth of 6.1 percent from 2005 to 2009, which accentuates management’s ability to find new markets and products. The firm has 4000 employees in more than 30 countries and 42 subsidiaries, whereof approximately 12 have production and 9 perform R&D (Novozymes Annual Report, 2009). Novozymes is a highly focused firm, which is a major strength in addressing consumer’s needs. The firm currently has about 100 R&D projects within its pipeline. Most promising is the second-generation bio-ethanol, which places them as a direct competitor to Danisco (Novozymes Annual Report, 2009). Both firms have sought out the bio fuel market as a key component in their growth strategies. Currently its first generation bio-ethanol constitutes 18 percent of revenue, which is the same in value as Danisco. Novozymes deploy 14.2 percent of its revenue into R&D indicating a heavy focus on developing new products (Novozymes Annual Report, 2009). Novozymes’s have been able to exploit “first mover” advantages in industrial enzymes and is positioned as market leader, which is its main strength (Kotler & Keller, 2006). Its main weakness is the changing competitive dynamics within the industry, with shorter product life cycles and increasing competitive intensity.

**DSM**

DSM was the ninth largest food and drink ingredients company with consolidated revenue of DKK 44,390 billion in 2009. The firm is a typical conglomerate engaged in several unrelated businesses, such as plastics, synthetic fibers, pharma, industrial chemicals and nutrition. Brealey, Myers & Allan, 2008) attribute diversification in conglomerates negative associations as the effect can be obtained more efficiently by individual investors and synergies are illusive, and hard to obtain. With an inherent need for continuous product development the lack of focus can result in an inability to manage the unrelated businesses equally well. As a result DSM intends to divest the non-core business areas such as chemicals enabling a more focused R&D strategy (DSM Annual Report, 2009)
Relevant segment revenue was approximately DKK 16,213 billion in 2009, an increase of 4.2 percent. This equals a compound annual growth of 8.0 percent from 2005 to 2009, placing them as a one of the firms achieving the highest growth in revenue (DSM annual Report, 2009).

The firm’s main strength is its large portfolio of bio ingredients, which consist of yeast extracts, enzymes, starches and vitamins that are aligned to the needs of emerging specialty food segment. Future growth strategies involve leveraging its R&D capabilities and presence in the food enzymes industry to develop ingredients used in organic and functional foods. Main weakness is the firm’s lack of geographic diversity, as a major portion of its revenue is derived from European markets (specifically the Netherlands) (Business Insight, 2010). Similar to Danisco, DSM utilizes acquisitions to enhance product development capabilities. As many firms seek to fill its technological gap via vertical integration the premium for knowledge intensive firms is pushed up and the benefit from the purchase is reduced. However one might argue that firms have to make these large investments to sustain its position as competing firms otherwise would get a competitive advantage. The opportunity cost of not pursuing an aggressive accusatory strategy is thus perceived as being higher than the mark up on potential knowledge intensive firms.

**Chr. Hansen**

Chr. Hansen is a relative small firm engaged in enzymes & cultures, color and nutrition with revenue of Dkk 2.9 billion in 2009 an increase of 7.2 percent. Relative to its larger rivals Chr. Hansen have been able to sustain a high growth rate, accentuated by impressive growth in cultures and nutrition, which respectively grew 10 and 26 percent. Despite this profit was negative by Dkk 103 million due to substantial investments in the supply chain, the evolution of the product mix and debt repayments (Chr. Hansen Annual Report, 2009). In 2010 the firm had an initial public offering in 2010 providing it with large volumes of capital for future growth.

It is especially the development within cultures that it is worrisome, as this particular market has been identified as a key component in Danisco’s growth strategy. This direct competition may result in pricing wars and Danisco have to address the threat and invest more in cultures R&D, which has already happened (Danisco Annual Report, 2009). This removes means from other potential R&D areas. In terms of shareholder value the Chr. Hansen IPO provides a benchmark for Danisco’s cultures division, which highlights the attractiveness of cultures and this might push the share price up.

55 percent of Chr. Hansen’s turnover is generated within Europe, indicating a weaker geographic diversity than Danisco. Because of its smaller size the firm’s R&D expenditure is 5.8 percent of total
revenue equalling a total spending of Dkk 172 million, significantly less than Danisco. Chr. Hansen’s main strength is the fact that despite a global recession, growth has been sustained. Furthermore growth has been well-balanced in terms of geography, products and industries, indicating a unique product portfolio (Chr. Hansen Annual Report, 2009).

**Cargill**

Cargill is a privately held company that dominates the global food ingredients market through its large scale of operations and extensive ingredients portfolio. Cargill operates in 68 countries through its subsidiaries and affiliates. The firm had revenue of Dkk 587 billion, whereof segment revenue is estimated at Dkk 29 billion, a decline of 3.2% from 2008. Overall revenue has seen as compounded annual growth of 13 percent from 2005 to 2009, which signals that substantial financial resources are available (Cargill.com). This emphasizes that Cargill is a tough competitor with access to all markets, offering a wide range of products. Part of Cargill’s growth strategy is to emphasize healthier foods. Part of Cargill’s product portfolio focused at sweeteners and is one of the main reasons why Danisco’s revenue within this segment has declined. In relation to Danisco it is positive that the firm is not engaged in other of Danisco’s business areas. As the intensity within the food ingredients market is high and increasing Danisco’s is in a vulnerable position. With an enhanced R&D focus on cultures and bio-ethanol the firm might be overrun by its larger peers.

![Graph](source: Danisco Q3 2010 Presentation)
Source: Yahoo Finance, 19 of March, 2010

Source: OECD economic Outlook 2009
Appendix C: Chapter 3 – Theoretical Framework

Definition
DCF assumes that future cash flow streams are highly predictable and thereby adopts a deterministic view. The effects of uncertainty are therefore tackled implicitly by discounting the expected value of the cash flows at the cost of capital rate (Penham, 2007).

The aim is to identify the free cash flow\(^{37}\) available to owners, this is model over a budget period and in a terminal period and are dependent on the following variables\(^{38}\):

\[
\text{Budget period:} \quad N\text{PV} = I_0 + \sum_{t=1}^{\infty} \frac{FCF_t}{(1+r)^t}
\]

\[
\text{Terminal period (perpetuity):} \quad N\text{PV} = \frac{FCF_1}{r-g}
\]

Source: (Brealey, Myers and Allen, 2008)

Forecasting Free Cash Flow
An accurate forecast enables the investor to find the free cash flow. Penham (2007) defines the free cash flow to the firm (equity and debt holders) as: *Operating Income + Depreciation and Amortization – Changes in Net Operating Assets* (change in Capital Expenditures and Working Capital).

The free cash flow is the amount available after all expenditures have been paid and should reflect the firm’s core business. Seemingly this is a quite strict definition, but there are many interpretations and factors that influence the free cash flow. Especially the forecast is an uncertain factor influenced by subjectivity. The usual forecast methodology attempts to overcome this by relying on historical data, to

\(^{37}\)Penham (2007) defines the free cash flow to the firm (equity and debt holders) as: *Operating Income + Depreciation and Amortization – Changes in Net Operating Assets* (change in Capital Expenditures and Working Capital). This is discounted using the appropriate risk adjusted rate accounted for the distribution of debt and equity.

\(^{38}\)The estimation and assumptions within each of these variables and their estimation process will be discussed in chapter 7. This includes CAPM, \(R_s\), \(R_f\), \(R_d\) and WACC.
assess whether this pattern will repeat itself or deviate in the future. The validity of the process relies on the investor’s ability and luck to interpret the firm and the future state of the economy.

Discount Rate
The rate, at which the present value of the forecasted cash flows is found, has different approaches. The most common approach is to use the Weighted Average Cost of Capital (WACC). The WACC consists of a weighted average of financial cost of debt and equity. E.g. the price of the equity and liabilities used to acquire the assets that drive the company and cash flows.

The price of equity is most often calculated using the Capital Asset Pricing Model (CAPM), which is used to determine a theoretically appropriate required rate of return of assets, if that asset is to be added to an already well-diversified portfolio, which means finding the systematic risk (PwC - Valuation Methodology Survey, 2009). The CAPM uses β’s (Beta) of a given company, corresponding to the appropriate risk of the company. Often the beta of the specific company can be found, or estimated using historical data on returns, correlated with market returns. The CAPM has a lot of assumptions in its use, and these assumptions will be discussed when using this model, in our valuation of Danisco.

Often a company will use a different rate than the CAPM suggests, when making an internal valuation of projects. Managers will have more information on project risk, enabling a more informed decision compared to the market. This is not the case for the external analyst, who only has the publicly available information and often needs to use only one rate for the entire company. Publicly available information is scarce and seldom allows investors to perform segment based valuation. This increases the uncertainty as each business division could have different risk profiles associated with operations.

The value of the debt used to calculate the WACC should be the market value of the debt, and not the book value as theory suggests (Palepu & Healey, 2007). The market value of the debt is easily found if the company has publically traded bonds. If this is not the case theory suggests that one should use the target weights and market values of debt and equity. As the market value of debt is difficult to obtain, as one needs the yield to maturity, which is the rate of debt, for all the company’s debt. But as outside investors often do not have access to the current prices of a company’s outstanding bonds, and these are not often traded or have up to date prices, this is not possible. Sometimes, companies also have large amounts of bank loans, whose market value is not easily found. Credit ratings provided by Moody’s
or Standard and Poor’s are a fair estimate, but for firms without publicly traded bonds the cost of debt is difficult to estimate. However, often the market value and book value of debt are close to each other. This holds true especially for firms, which have not seen significant changes in the capital structure and in a stable economy (Palepu & Healy, 2008).

The Terminal Period
When the analysis of the company is made, these insights should be used to predict cash flows for a budget period, and to calculate the value of the terminal period. The most common method of valuing the terminal period is to set a future growth rate, and calculate it as perpetuity. Miniscule changes in perpetuity growth rate and discount rate will give large changes in the value of the terminal period, and therefore great thought should be used in settings these values, and terminal at all should have solid reasons.

The Valuation
When all the different variables have been assigned a value, it is possible to calculate an enterprise value of the company. At this point the following variables have to be estimated, and assumptions regarding these have to be made.

Figure 53 - Discounted Cash Flow Variables

Source: Authors Own Creation
Assumptions of a future economy with reliable CAPM and assumptions of the same rate in the future will have to be made to use the DCF model.

Many choices have to be made, that will be different depending on the person making them, and even though many analysts would have corresponding insights and of course one would assume that the analyst making these choices is well informed and therefore will make qualified choices. But, the pure amount of variables will inherently give different values of the company.

To assess the level of uncertainty, the valuation is often supplemented by a sensitivity analysis or scenario analysis. Sensitivity analysis, in its simplest form, involves changing the value of a variable from its base case in order to test its impact on the final result. It is often undertaken to complement a DCF analysis to identify those uncertain or risk variables that are likely to have the most significant effect on DCF value, if they move from their base-case values. These are often the terminal growth variable and the WACC.

Real Option Theory

Black & Scholes Model

This category is wide, and several different methods lie in this category. In the finite difference or analytical approaches as the category of the Black & Scholes model is usually categorized, we are dealing with European style options only. These methods rely on a simple mathematical formula, but this practically implementation is often difficult, as variables are deduced from partial differential equations (PDE), which is a complicated process. PDE becomes increasingly more difficult to deduct as the number of inputs increase, and are therefore hard to use when several options are included (Mun, 2005)

The Black & Scholes model is the most known and used of the analytical approaches. One of the assumptions of the model, is that the price of the underlying asset follows the Geometric Browning Motion (GBM). This means that the price of the asset has constant drift and volatility, and the returns are log-normal distributed, what can often imply the efficient market hypothesis.

The Black & Scholes method is best suited for a simple project with the following traits. The project has a known time frame, and cannot be stopped in the midst. Historical data is at hand, from prior similar projects, which can help to estimate the volatility, and the value of the project is only dependent on one variable e.g. as many variables most often causally influence the outcome of a project, it is seldom applicable. And this is only in the instance of one single project; and companies have several projects
that influence each other interdependently, which would make this method cumbersome to apply. Subsequently the model is not recommended and relevant for modelling Danisco’s projects as managerial flexibility is not included.

**Monte Carlo Simulation**

The basic principle of Monte Carlo simulation is to simulate many different pathways of an underlying asset, based on the variance of the asset. This has a discrete view of time, and for every step the value of the asset will change depending on the volatility of the asset. Every pathway will end up with a value, and the average of these pathways will be the value of the asset. Different geometric motions are underlying for the asset movement, where the GBM, is the most used in option pricing.

Monte Carlo simulation has the advantage of being able to model uncertainty consistently compared to cash flow based models like the DCF. In the same time the drawback of this model, is the lack of dynamic programming as in the binomial lattice model, as the model is static because choices are made in the beginning and continue throughout the time period chosen. It therefore lacks the opportunity to capture the value of choice that is embedded in real options, called managerial flexibility. Real options can make it possible to minimize losses in bad scenarios or capitalize on good market conditions. The option of managerial choice is therefore not embedded, as the Monte Carlo can be described as a European option, whereas the choices lie in the American style options (Gamba, 2002). Given this, that the model does not include managerial flexibility, it is not recommended for use on Danisco. However the via simulations we are able to capture and understand the volatility of a project and thereby the model is relevant in estimating one of the key parameters when calculating the real option value. This will be further dealt with below and in chapter 8, when practically applying our model.
## Appendix D: Chapter 5 – Financial Analysis

### Figure 54 – Income Statement as Reported

<table>
<thead>
<tr>
<th>DKKm</th>
<th>30 April 2005</th>
<th>30 April 2006</th>
<th>30 April 2007</th>
<th>30 April 2008</th>
<th>29 April 2009</th>
<th>30 April 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>17,835</td>
<td>20,912</td>
<td>18,802</td>
<td>12,219</td>
<td>12,991</td>
<td>13,706</td>
</tr>
<tr>
<td>Cost of sales</td>
<td>-12,084</td>
<td>-13,672</td>
<td>-12,303</td>
<td>-7,204</td>
<td>-7,783</td>
<td>-7,661</td>
</tr>
<tr>
<td><strong>Gross profit</strong></td>
<td>5,751</td>
<td>7,240</td>
<td>6,499</td>
<td>5,015</td>
<td>5,208</td>
<td>6,045</td>
</tr>
<tr>
<td>Research and development expenses</td>
<td>-557</td>
<td>-943</td>
<td>-773</td>
<td>-661</td>
<td>-743</td>
<td>-884</td>
</tr>
<tr>
<td>Distribution and sales expenses</td>
<td>-2,031</td>
<td>-2,637</td>
<td>-2,505</td>
<td>-2,089</td>
<td>-2,301</td>
<td>-2,476</td>
</tr>
<tr>
<td>Administrative expenses</td>
<td>-1,015</td>
<td>-1,390</td>
<td>-1,244</td>
<td>-936</td>
<td>-922</td>
<td>-936</td>
</tr>
<tr>
<td>Other operating income</td>
<td>119</td>
<td>157</td>
<td>128</td>
<td>168</td>
<td>65</td>
<td>50</td>
</tr>
<tr>
<td>Other operating expenses</td>
<td>-54</td>
<td>-55</td>
<td>-92</td>
<td>-40</td>
<td>-59</td>
<td>-54</td>
</tr>
<tr>
<td>Share-based payments</td>
<td>-127</td>
<td>-213</td>
<td>21</td>
<td>42</td>
<td>-15</td>
<td>-54</td>
</tr>
<tr>
<td><strong>Operating profit before special items</strong></td>
<td>2,086</td>
<td>2,159</td>
<td>2,034</td>
<td>1,499</td>
<td>1,233</td>
<td>1,691</td>
</tr>
<tr>
<td>Special items - incl. Impairment loss GW</td>
<td>-128</td>
<td>-768</td>
<td>-179</td>
<td>-95</td>
<td>-738</td>
<td>-769</td>
</tr>
<tr>
<td><strong>Operating profit</strong></td>
<td>1,958</td>
<td>1,391</td>
<td>1,855</td>
<td>1,404</td>
<td>495</td>
<td>922</td>
</tr>
<tr>
<td>Income from associates and joint ventures</td>
<td>45</td>
<td>-</td>
<td>-</td>
<td>-46</td>
<td>-65</td>
<td></td>
</tr>
<tr>
<td>Financial income</td>
<td>347</td>
<td>483</td>
<td>433</td>
<td>611</td>
<td>1,062</td>
<td>523</td>
</tr>
<tr>
<td>Financial expenses</td>
<td>-656</td>
<td>-980</td>
<td>-939</td>
<td>-812</td>
<td>-1,130</td>
<td>-675</td>
</tr>
<tr>
<td><strong>Profit before tax</strong></td>
<td>1,694</td>
<td>894</td>
<td>1,349</td>
<td>1,203</td>
<td>381</td>
<td>705</td>
</tr>
<tr>
<td>Income tax expense</td>
<td>-443</td>
<td>-261</td>
<td>-409</td>
<td>-433</td>
<td>-250</td>
<td>-197</td>
</tr>
<tr>
<td><strong>Profit from continuing operations</strong></td>
<td>1,251</td>
<td>633</td>
<td>940</td>
<td>770</td>
<td>131</td>
<td>508</td>
</tr>
<tr>
<td>Profit from discontinued operations</td>
<td>-</td>
<td>-11</td>
<td>139</td>
<td>529</td>
<td>-59</td>
<td>0</td>
</tr>
<tr>
<td><strong>Profit</strong></td>
<td>1,251</td>
<td>622</td>
<td>1,079</td>
<td>1,299</td>
<td>72</td>
<td>508</td>
</tr>
<tr>
<td>Distribution of profit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equity holders of the parent</td>
<td>1,201</td>
<td>564</td>
<td>1,058</td>
<td>1,251</td>
<td>108</td>
<td>480</td>
</tr>
<tr>
<td>Minority interests</td>
<td>50</td>
<td>58</td>
<td>21</td>
<td>48</td>
<td>-36</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>1,251</td>
<td>622</td>
<td>1,079</td>
<td>1,299</td>
<td>72</td>
<td>481</td>
</tr>
</tbody>
</table>
## Figure 55 – Balance Sheet as Reported

### Balance sheet at 30 April 2010

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assets</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Current Assets</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inventories</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raw materials and consumables</td>
<td>1.305</td>
<td>1.147</td>
<td>1.155</td>
<td>838</td>
<td>870</td>
<td>671</td>
</tr>
<tr>
<td>Work in progress</td>
<td>553</td>
<td>655</td>
<td>588</td>
<td>580</td>
<td>609</td>
<td>580</td>
</tr>
<tr>
<td>Prepayments for goods</td>
<td>62</td>
<td>49</td>
<td>54</td>
<td>34</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total Inventories</strong></td>
<td>6.081</td>
<td>5.563</td>
<td>5.371</td>
<td>5.485</td>
<td>4.988</td>
<td>2.980</td>
</tr>
<tr>
<td><strong>Receivables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trade receivables</td>
<td>3.408</td>
<td>3.390</td>
<td>3.297</td>
<td>3.018</td>
<td>2.268</td>
<td>2.488</td>
</tr>
<tr>
<td>Corporation tax</td>
<td>65</td>
<td>149</td>
<td>290</td>
<td>94</td>
<td>195</td>
<td>190</td>
</tr>
<tr>
<td>Receivables from associates</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other receivables</td>
<td>735</td>
<td>913</td>
<td>878</td>
<td>733</td>
<td>249</td>
<td>915</td>
</tr>
<tr>
<td>Prepayments</td>
<td>113</td>
<td>97</td>
<td>81</td>
<td>133</td>
<td>140</td>
<td>108</td>
</tr>
<tr>
<td><strong>Total Receivables</strong></td>
<td>4.312</td>
<td>4.549</td>
<td>4.546</td>
<td>3.998</td>
<td>2.852</td>
<td>3.201</td>
</tr>
<tr>
<td>Cash and cash equivalents</td>
<td>729</td>
<td>411</td>
<td>372</td>
<td>342</td>
<td>320</td>
<td>698</td>
</tr>
<tr>
<td><strong>Non-Current Assets</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intangible assets</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goodwill</td>
<td>10.878</td>
<td>10.689</td>
<td>10.399</td>
<td>8.110</td>
<td>7.538</td>
<td>6.996</td>
</tr>
<tr>
<td>Other intangible assets</td>
<td>692</td>
<td>1,276</td>
<td>1,213</td>
<td>1,267</td>
<td>906</td>
<td>834</td>
</tr>
<tr>
<td><strong>Total intangible assets</strong></td>
<td>11.570</td>
<td>11.965</td>
<td>11.612</td>
<td>9.377</td>
<td>8.444</td>
<td>7.830</td>
</tr>
<tr>
<td>Property, Plant &amp; Equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land and buildings</td>
<td>3.152</td>
<td>2.990</td>
<td>2.986</td>
<td>2.601</td>
<td>1.930</td>
<td>2.048</td>
</tr>
<tr>
<td>Plant and machinery</td>
<td>5.502</td>
<td>4.728</td>
<td>4.744</td>
<td>4.361</td>
<td>2.507</td>
<td>2.593</td>
</tr>
<tr>
<td>Fixtures, fittings, tools and equipment</td>
<td>390</td>
<td>400</td>
<td>359</td>
<td>339</td>
<td>290</td>
<td>266</td>
</tr>
<tr>
<td>Prepayments and assets under construction</td>
<td>400</td>
<td>502</td>
<td>604</td>
<td>721</td>
<td>629</td>
<td>476</td>
</tr>
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Figure 57 - Reclassified Income Statement

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<td>1.147</td>
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<td>580</td>
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<td>Finished goods and goods for resale</td>
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<td>4.033</td>
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<td>54</td>
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<td>913</td>
<td>878</td>
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<td>135</td>
<td>126</td>
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<td>65</td>
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<td>242</td>
<td>199</td>
<td>158</td>
<td>246</td>
<td>133</td>
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<td>554</td>
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<td>419</td>
<td>551</td>
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<td>31.013</td>
<td>27.601</td>
<td>20.958</td>
<td>19.810</td>
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| **Operating Liabilities** |          |          |          |          |          |          |
| Other payables           | 49        | 134       | 82       | 54       | 29       | 454       |
| Pension liabilities      | 436       | 448       | 442      | 370      | 131      | 172       |
| Deferred tax liabilities | 1328      | 1278      | 1302     | 1262     | 819      | 479       |
| Other provisions         | 273       | 376       | 314      | 134      | 141      | 131       |
| Finance lease obligations | 6         | 4         | 4        | 4        | 2        | 2         |
| Trade payables           | 1260      | 1252      | 1396     | 1336     | 638      | 834       |
| Corporation tax          | 378       | 272       | 270      | 346      | 242      | 209       |
| Other payables           | 2190      | 1897      | 1888     | 1721     | 1395     | 1435      |
| Deferred income          | 43        | 85        | 42       | 86       | 5        | 4         |
| Other provisions         | 108       | 126       | 120      | 217      | 151      | 32        |
| **Total operating Liabilities** | 6.071 | 5.872 | 5.860 | 5.530 | 3.553 | 3.752 |


| **Net Financial Obligations** |        |        |        |        |        |        |
| Cash and cash equivalents    | -729   | -411   | -372   | -342   | -320   | -698   |
| Mortgage debt non-current    | 205    | 190    | 175    | 155    | 30     | 515    |
| Non-current credit institutions | 5912 | 5279 | 6104 | 4805 | 3661 | 1982 |
| Finance lease obligations   | 64     | 41     | 37     | 33     | 33     | 29     |
| Mortgage debt Current        | 15     | 16     | 17     | 18     | 6      | 7      |
| Current credit institutions  | 8249   | 8138   | 6243   | 4860   | 1855   | 1718   |

| **Minority interests**    | 333    | 318    | 305    | 283    | 6      | 7      |
### Figure 60 – Net Financial Expense

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<td>Operating Profit</td>
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<td>Change in Working Capital</td>
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<td>-1.203</td>
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<td>1288</td>
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**Investing Activities**

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<td>Investments in Property, Plant &amp; Equipment</td>
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<td>-752</td>
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<td>-679</td>
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<td>Other investments in financial and intangible assets</td>
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**Financing activities**

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<th>2008</th>
<th>2009</th>
<th>2010</th>
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<tbody>
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<td>Dividends Paid</td>
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<td>-328</td>
<td>-361</td>
<td>-356</td>
<td>-357</td>
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<tr>
<td>Change in debt</td>
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<td>-798</td>
<td>-2476</td>
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<td>Other Financing cash flow</td>
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<td>-602</td>
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<td><strong>Cash flow from financing activities</strong></td>
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<tr>
<td>Cash flow from discontinued operations</td>
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<td>144</td>
<td>3067</td>
<td>5243</td>
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<tr>
<td><strong>Total Cash Flow</strong></td>
<td>-318</td>
<td>-39</td>
<td>-30</td>
<td>-22</td>
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<tr>
<td>Cash and cash equivalents prev period</td>
<td>729</td>
<td>411</td>
<td>372</td>
<td>342</td>
<td>320</td>
</tr>
<tr>
<td><strong>Cash and cash equivalents end of period</strong></td>
<td>411</td>
<td>372</td>
<td>342</td>
<td>320</td>
<td>698</td>
</tr>
</tbody>
</table>

Source: Authors own creation based on reclassified financial statements

### Figure 61 – Profit Margin peer group analysis

Source: Annual Reports, Thomas Reuters
The profit margin depicts a similar picture, however the situation has become worse compared to above as Danisco here is the least profitable among its peers. Furthermore the profit margin has been highly volatile, which in relation to the financial analysis above is described by large repayments of debt. The question is whether Danisco still has too high contingent interest payments or if the firm is unable to obtain the required operating asset efficiency needed to be competitive within the market.

**Share Price Index Analysis**

Share price index is a prominent tool for assessing the relative performance of comparable firms. Share price is in theory a representation of a firm’s intrinsic future earnings and derived hereof its competitive position(Copeland et al, 2000). Calculating a monthly share price index is done to remove most idiosyncratic events and only see the average development of the share price. The graph below visualizes the relationship between Danisco and the peer group.

![Figure 62 – Share Price Index for Peer - June 9, 2007 to June 9, 2010](image)

The large fluctuations in share price for all five companies also support the general tendency in the market where almost every company has faced a high volatility in market cap. This has most likely happened as there has been a general run for cash for investors. After a large drop in late 2008 investor confidence has been restored and all firms are again close to index 100. Danisco is in close proximity of its peers, which is somewhat surprising based on the analysis above. Danisco have reported poor
financial ratios compared with Novozymes and DSM. Despite positive financial ratios it has not manifested itself in an improved share price. The fiscal year of 2010, again saw improved margins in Danisco and performing the worst in the middle of 2009 the share price has since doubled. This reflects investor’s belief in a brighter future relative to before for Danisco. For Novozymes and DSM, the absent positive upswing, based on its prominent financial ratios, could be because investors already anticipated this level of profitability.

Figure 63 – Share Price Index for Equity Index - June 9, 2007 to June 9, 2010

The movement of Danisco and relevant equity indices is depicted above. The strong correlation ranging from 0,68 with EU Chemicals, 0,76 with Nasdaq Biotech and 0,86 with OMX indicates that all indices are appropriate benchmarks. Danisco has outperformed the OMX index stressing the positive development Danisco has gone through.
### Appendix E: Chapter 7 – Discounted Cash Flow Valuation

#### Figure 64 – Income Statement Forecast Assumptions

<table>
<thead>
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<tr>
<td>Gross profit</td>
<td>44.10%</td>
<td>45.00%</td>
<td>45.00%</td>
<td>45.00%</td>
<td>45.00%</td>
<td>45.00%</td>
<td>45.00%</td>
<td>45.00%</td>
<td>45.00%</td>
<td>45.00%</td>
<td>45.00%</td>
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<tr>
<td>Research and development expenses</td>
<td>-6.45%</td>
<td>-6.77%</td>
<td>-7.11%</td>
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<td>-7.84%</td>
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<td>-8.64%</td>
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<td>-18.07%</td>
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<td>-6.83%</td>
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<td>-6.83%</td>
<td>-6.83%</td>
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</tr>
<tr>
<td>Other operating expenses</td>
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<td>-0.39%</td>
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<tr>
<td>Income from associates and joint ventures</td>
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<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
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<td>0.00%</td>
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<tr>
<td>Share-based payments</td>
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<td>-0.39%</td>
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<td>-0.39%</td>
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<td>Special items</td>
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<td>PM from sales before tax</td>
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<td>11.48%</td>
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<td>Tax from sales</td>
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<td>-2.71%</td>
<td>-2.61%</td>
<td>-2.61%</td>
<td>-2.61%</td>
<td>-2.61%</td>
<td>-2.61%</td>
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<td>Profit Margin</td>
<td>4.25%</td>
<td>8.93%</td>
<td>9.23%</td>
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#### Figure 65 – Inverse Asset Turnover Assumptions

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<td>Goodwill</td>
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<td>1.067</td>
<td>1.047</td>
<td>1.027</td>
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<td>0.988</td>
<td>0.971</td>
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<td>0.938</td>
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<td>0.973</td>
<td>0.993</td>
<td>1.012</td>
<td>1.030</td>
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Page 152 of 158
### Figure 66 - Regression on Danisco and OMX20, using 5 year daily data

**Regression Statistics**

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<tr>
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<tr>
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#### ANOVA

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<td>0.21513</td>
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<td>Residual</td>
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<td>0.425833422</td>
<td>0.000327</td>
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#### Coefficients

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<th>P-value</th>
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<th>Upper 95%</th>
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<th>Upper 95,0%</th>
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<td>Intercept</td>
<td>0.0000261173</td>
<td>0.000500441</td>
<td>0.521886</td>
<td>-0.000720584</td>
<td>0.00124293</td>
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<td>X Variable</td>
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<td>0.036471909</td>
<td>25.65679</td>
<td>0.864202107</td>
<td>1.007302283</td>
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<td>1.007302283</td>
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</table>

Source: Thomas Reuters Darastream

### Figure 67 - Regression on Danisco and Standard & Poor’s 500, using 5 year daily data

**Regression Statistics**

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
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#### ANOVA

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#### Coefficients

<table>
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<th>Standard Error</th>
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<th>P-value</th>
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<th>Upper 95%</th>
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<td>1.20388477</td>
<td>-0.000693126</td>
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<td>X Variable</td>
<td>0.852736119</td>
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<td>22.21361928</td>
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</table>

Source: Thomas Reuters Darastream

### Figure 68 - Estimation of Market Risk Premium

#### Risk Free Rate

<table>
<thead>
<tr>
<th>Dataset</th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Survey (2010)</strong></td>
<td></td>
</tr>
<tr>
<td>US</td>
<td>6.00%</td>
</tr>
<tr>
<td>EU</td>
<td>5.30%</td>
</tr>
<tr>
<td>Denmark</td>
<td>3.60%</td>
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<tr>
<td><strong>S&amp;P Historic Calculated</strong></td>
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<tr>
<td>20 Year</td>
<td>5.16%</td>
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<tr>
<td>30 Year</td>
<td>6.14%</td>
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<tr>
<td><strong>Credit Swiss</strong></td>
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<tr>
<td>World Index (1900 - 2009)</td>
<td>4.40%</td>
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#### Market Risk Premium

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<thead>
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<tr>
<td><strong>Risk Free Rate</strong></td>
<td>3.53%</td>
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<tr>
<td><strong>Market Risk Premium</strong></td>
<td>5.10%</td>
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</table>
### Figure 69 - Synthetic Rating Estimation

#### Figure 70 – Danisco Synthetic Rating Estimation (2005 – 2010)

<table>
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<th>Interest coverage ratio</th>
<th>Rating</th>
<th>Spread</th>
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<tr>
<td>&gt;</td>
<td>D</td>
<td>5.60%</td>
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<tr>
<td>0.2</td>
<td>C</td>
<td>12.00%</td>
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<td>0.8</td>
<td>CC</td>
<td>10.00%</td>
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<td>1.25</td>
<td>B</td>
<td>5.50%</td>
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<td>1.5</td>
<td>B</td>
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<td>1.75</td>
<td>B+</td>
<td>4.25%</td>
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<td>2</td>
<td>BB</td>
<td>4.03%</td>
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<tr>
<td>2.25</td>
<td>BB+</td>
<td>3.50%</td>
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<tr>
<td>2.5</td>
<td>BBB</td>
<td>2.00%</td>
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<tr>
<td>3</td>
<td>A-</td>
<td>1.50%</td>
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<tr>
<td>4.25</td>
<td>A</td>
<td>1.25%</td>
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<tr>
<td>5.5</td>
<td>A+</td>
<td>1.05%</td>
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<td>AA</td>
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<td>8.50</td>
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</table>

Source: 19 of September (http://pages.stern.nyu.edu/~adamodar/)

---

<table>
<thead>
<tr>
<th>Interest coverage ratio</th>
<th>4.05</th>
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<tbody>
<tr>
<td>Estimated Bond Rating</td>
<td>A-</td>
</tr>
<tr>
<td>Estimated Default Spread</td>
<td>1.50%</td>
</tr>
<tr>
<td>Estimated Cost of Debt</td>
<td>4.99%</td>
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</table>

Source: Author’s own Creation
Appendix F: Chapter 8 – Real Option Valuation

Figure 71 – DDCE Production Cost (CAPEX and Working Capital)

<table>
<thead>
<tr>
<th>SELECT INPUT VARIABLES</th>
<th>Initial May 2008</th>
<th>Status Nov 2009</th>
<th>Commercial Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enzyme Cost (% of original)</td>
<td>100%</td>
<td>50%</td>
<td>22%</td>
</tr>
<tr>
<td>CAPEX - 2008$ per Gal</td>
<td>$8+</td>
<td>$5 to $7</td>
<td>-$3 to $5</td>
</tr>
</tbody>
</table>

| PROCESS RESULTS | |
|----------------|------------------|-----------------|-------------------|
| Total process yield - Gal/T | 67 | 85 | 90 |
| Ethanol Titer - g/L | 63 | 82 | 90 |
| COM - $/Gal | ~ $3.00 | <$2.00 | $1.50 |

Source: DDCE Presentation - Commercializing Cellulosic Ethanol Technology, Kyle Althoff, March 2010)

Figure 72 - Assumptions on Ethanol Price

Assumption: Ethanol Price

Normal distribution with parameters:
Mean: 2.99
Std. Dev: 0.90

Correlated with: Production Price
Coefficient: 0.40

Source: Output from Crystal Ball Calculation

Figure 73 - Assumptions on Production Costs

Assumption: Production Price

Triangular distribution with parameters:
Minimum: 2.1794
Likeliest: 2.5427
Maximum: 2.9069

Correlated with: Ethanol Price
Coefficient: 0.40

Source: Output from Crystal Ball Calculation
Figure 74 – Correlation assumptions in Crystal Ball

**Assumption: Correlation**

Triangular distribution with parameters:
- Minimum: 0.14
- Likeliest: 0.40
- Maximum: 0.77

Figure 75 – Crystal Ball Volatility Simulation Output
### Figure 76 – Value of Expand 1 Option

<table>
<thead>
<tr>
<th>Research Development</th>
<th>Expand 1 Only</th>
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<td>680</td>
<td>1,684</td>
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<td>267</td>
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<td>102</td>
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<td>38</td>
<td>96</td>
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<tr>
<td>14</td>
<td>35</td>
</tr>
<tr>
<td>5</td>
<td>12</td>
</tr>
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</table>

**Input**
- Risk Free Rate: 0.0353
- Length of Steps: 1
- Risk Neutral probability (p): 0.3099
- Risk neutral discount rate up (q): 0.0281
- Risk neutral discount rate down (q^-): 0.6672
- Exercise Price (Investment Cost): 1.100
- Production Increase: 2

**Expand Option Value (as of Jun, 2010): 711,357 – 338,13**

### Figure 77 – Management Flexibility – Expand 1

**Managerial Flexibility - Expand 1**

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<tbody>
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<tr>
<td>1,334</td>
<td>3,264</td>
<td>8,128</td>
<td>20,140</td>
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**Input**
- Risk Free Rate: 0.35%
- Length of Steps: 1
- Risk Neutral probability (p): 0.3099
- Risk neutral discount rate up (q): 0.0281
- Risk neutral discount rate down (q^-): 0.6672
- Exercise Price (Investment Cost): 1.100
- Production Increase (Expand 1): 2

### Figure 78 – Value of Expand 1 + Expand 2 Option

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<tr>
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</tr>
<tr>
<td>181</td>
<td>407</td>
</tr>
</tbody>
</table>

**Input**
- Risk Free Rate: 0.35%
- Length of Steps: 1
- Risk Neutral probability (p): 0.3099
- Risk neutral discount rate up (q): 0.0281
- Risk neutral discount rate down (q^-): 0.6672
- Exercise Price (Investment Cost) (1st Round): 1.100
- Production Increase (Expand 2): 4
- Exercise Price (Investment Cost) (2nd Round): 2.200

**Expand 1 + Expand 2 Option Value (as of Jun, 2010): 1,418 – 540**

**Value of Expand 2 Option only: 1,418 – 540**

---

**Note:**
- Choice: "Expand 1" if Underlying Asset * increase in Production - Investment Cost
- Choice: "Expand 2" if Underlying Asset * increase in Production - Investment Cost
- Choice: "Open"
Figure 79 – Management Flexibility of Expand 1 + Expand 2

Managerial Flexibility (Cannot Expand 2 before Expand 1 is Exercised)

<table>
<thead>
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Figure 80 – Value of Abandonment Option

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</table>

Option Value = Total value - DCF value = 96

Input:
- Risk Free Rate: 3.53%
- Length of Steps: 1
- Risk Neutral probability (p): 0.309
- Salvage Value: 98

Abandonment Option Value (as of Jan 2010) = 57.00

Choice between "Open" and "Abandon", Formula = Max(183.697/98)

Figure 81 – Management Flexibility – Abandonment Option

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