Leverage – Striking the Right Balance

Using Real Option Models to Assess Optimal Leverage Ratio

Case company
H+H International A/S

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Executive Summary

Years of irrational exuberance[1] created in many cases excessive growth plans during the mid-2000s in the construction sector. With hindsight it seems easy to criticize, without hindsight, less so. The thesis is therefore concerned with creating a model to evaluate the choice made on leverage, using H+H International A/S, an aircrete producer, as an example.

H+H indebted themselves just prior to the crisis in order to pursue a growth strategy, just as investments were finalized the economy halted and H+H was left with more debt than they could cope with - resulting in a forced and expensive equity issue.

With the scenario in mind, the thesis devotes itself to create a valuation model that could have warned H+H by using a 'value-creation' mindset. In order to do so the thesis proposes a solution using two well-known models – the Discounted Cash Flow Model and the Binominal Model - named the expanded Discounted Cash Flow model (eDCF). The eDCF model is explained in detail and the underlying asset and its volatility, used in the binominal model, is explained in-depth as no relevant literature exists.

The model uses the DCF model to compute the cash flow value, on top of the DCF valuation the Binominal model is used to value the leverage option. The real option part makes use of a delta value between two strike prices; one without leverage- and one with leverage-room. The delta value of the two strike prices suggests the leverage room that should be kept less the leverage ratio of the minimum WACC. The leverage delta is then included to calculate a new discount factor - using less leverage – to value the cash flow. Simultaneously the delta value is used to calculate the leverage room value in a distressed situation (leverage being pushed above optimal level).

Testing the model shows that H+H's 2007 leverage target was destroying value, but also that its 2012 target is much aligned with the eDCF models result. Finally it's concluded that applying both the DCF- and Binominal model adds value in the quest for the correct leverage ratio.

[1] Expression coined by Alan Greenspan in his December 5th 1996 speech on "The Challenge of Central Banking in a Democratic Society". The expression has later been used to describe the boom years of the mid-to-late 2000s.

Table of Content

CD-ROM attached to the back-cover, containing the Excel file and the thesis in PDF-format.

1) Master Thesis, H+H International Real Option Valuation.xlsm , and

2) Master Thesis, Leverage - striking the right balance.pdf

Part 0: Introduction

There are two sides to the balance sheet, the left side and the right side, as we all know. In addition to this statement some unfortunate firms might add:

"On the right side there is nothing left, and on the left side there is nothing right"

This thesis focuses on getting the right side, the liabilities, right, so that a firm would have sufficient funds through any time of crisis so that the right side would in effect have something left.

Before starting my Masters degree I have had some working experience, in both the construction industry and the financial sector through one the worst financial crisis in 80 years. Having had close contact with some of the most highly leveraged sectors through such troublesome times questions such as; they should have seen it coming, often comes to mind. But the fact is, very few actually did.

Prior to the credit crunch leverage seemed like a 1st class ticket to the fortune 500 list.

"In recent decades running a business or household with a conservative balance sheet has been a bit like being the only person in an opium den not to inhaled"[2]

However as the crisis caught up with most, the attitude changed

"It used to be that equity, as well as lunch, was for wimps. Not anymore"[3]

In retrospect it is clear that it had to have an end, but it is much less clear why so many believed that the economic growth would never stop. That the *Bear* had died and only *Bull* was left[4].

This crisis, just like the ones before, therefore calls for new and stronger measurements to indicate rational financial indicators. In this case I find it interesting to look for a model to indicate reasonable levels of leverage, taking historical track records of some measure into account. With that experience in mind I wish to develop 'leverage' warning-lights specifically for a construction industry participant.

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[2] The Economist, 30.4.2009, The sensible giants
[3] The Economist, 30.4.2009, The sensible giants
[4] *Bull* and *Bear* is a banking terminology often used as a an expression for expanding and contracting market conditions

My attention to expanded cash flow models and the inclusion of real option theory was brought to my attention during my bachelor. Its potential as warning lights, thus avoiding distressed situation, seemed plausible.

Developing such a model one must of course take a given company's value creation into account along with the industry within it operates, the latter might even be the more important of the two.

The thesis also reflects my interest in the construction industry, since the construction industry is where I had my first years of corporate experience - both in good times and later in a distressed company that ended with nothing left on either side

0.1 Problem statement

H+H International is a publicly traded company, hence it is to satisfy a large numbers of investors, some short-sighted others more long termed. In both cases it is of value to be able to argue and explain your decisions and doings with facts and analysis. In all cases decisions should be done with value creation in mind. Applying valuation models is a standardized approach for any analyst, but in the light of the recent development and performance of H+H International I believe these models have greatly exaggerated the valuations. No sign of warning was flagged in regards to H+H debt levels compared to industry, size and historical performance. This leads us to the thesis primary question:

Could a valuation model be developed to address the complications of the leverage option?

Using the above statement as starting point I wish to elaborate on the issue using these sub-question

- How is real options best applied to add value to a valuation analysis with regards to financial gearing?
- Would the usage of an Expanded DCF Model have shown that H+H was destroying value simply by its leverage target?
- Could the model have successfully been applied to other industries in the construction sector?

0.2 Limitations

The goal of this thesis is to create a company specific valuation model using standardized valuation tools such as the Discounted Cash Flow model and Real Options theory[5]. More specific the thesis is to create a financial model that is to measure the optimal leverage ratio of H+H International taking value creation into account.

As the thesis is limited in regards to pages, the focus of the assignment is to create a link between the specific industry/company and the more advanced financial modelling work. To reach this goal with limited space available limitations can be observed in two areas, A) industry and company description and analysis, and B) a smaller scope in regards to searching for most applicable model.

A) The industry and company description and analysis is to create a common platform between author and reader, and is not a complete industry analysis, just as the company budget modelling is not rooted in an analysis but a simple 'status quo' projection of financials.

B) The assignment should be seen as hypothesis driven, and therefore the theory, to some extent, is selected out of interest prior to the project. Hence the thesis should be seen as a test of the hypothesis rather than a careful analysis between multiple financial models. Some references will of course be made throughout the thesis to make the reader aware of obvious alternatives to the selected path.

0.3 Method

The thesis is one part case study and one part theoretical founded. Further, the thesis is to be defined as a deductive work[6], this relation is valid both in the use of the industry analysis and the general financial theory used in union to define a descriptive model of the financial decisions made by H+H International's management. The thesis starts by explaining the general sector and its drivers, while also explaining the well-recognised DCF model and the less so real option theory, ending up with uniting the two in a general interpretation of decisions and happenings. Throughout the thesis three

[5] It could be discussed how 'standardized' real option valuations is: Investment Valuation, A. Damodaran, 2002
[6] Deductive reasoning links premises with conclusions. If all premises are true, the terms are clear, and the rules of deductive logic are followed, then the conclusion reached is necessarily true.
Source: http://en.wikipedia.org/wiki/Deductive_reasoning

general sources of information are used. 1) Footnotes will be used extensively to refer to literature[7], 2) external sources, in the form of present and former colleagues[8] who has been informally interviewed in order to confirm important details, and 3) my own knowledge from working in construction, banking and previous studies of leverage financial modelling[9]. Also, to some extent the footnotes are used for additional information less relevant for the body text.

0.4 Structure & process

Figure 1 adds an easy overview of the structure and process laid down for the thesis.

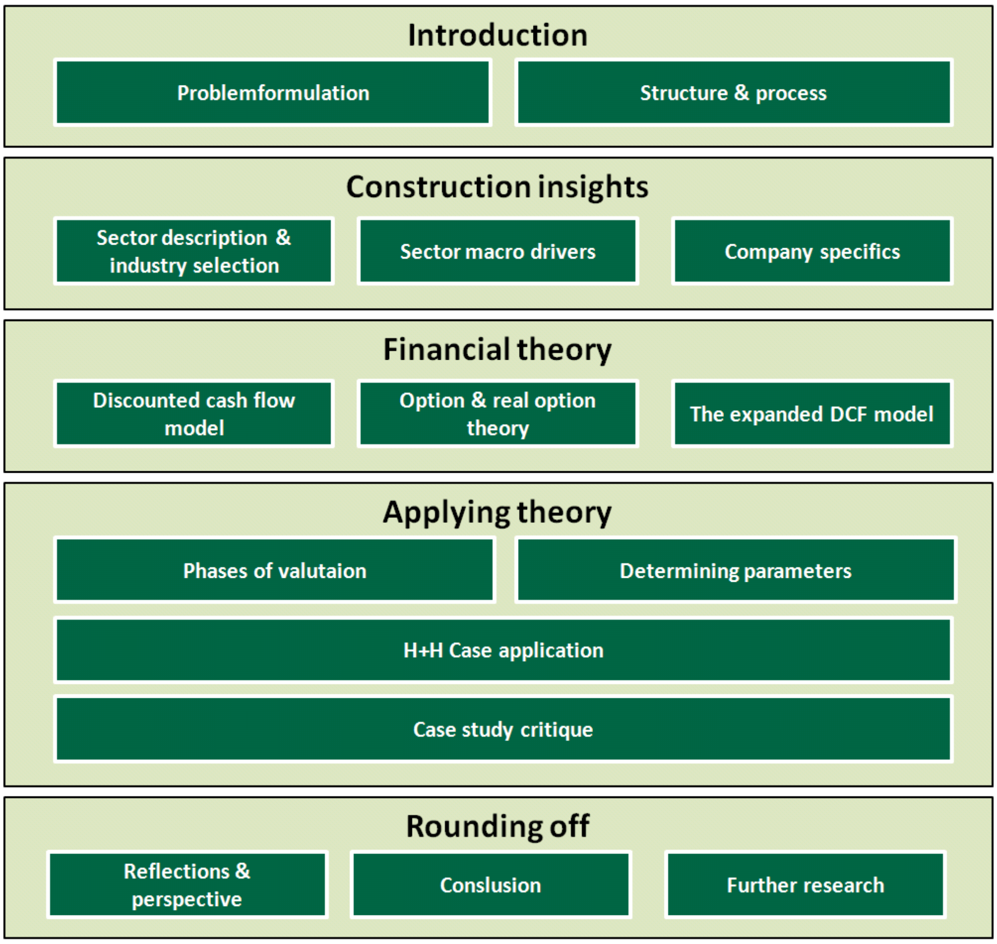


Figure 1 Structure of the thesis (own design)

[7] The complete list of literature can be found in the bibliography on the last pages of this thesis
[8] Former colleges include contractors from the construction industry and management consultants. Present colleges include Danske Bank employees.
[9] M.T. Alding, Bachelor project; Financial Flexibility, Real Options and Private Equity Valuation, CBS, 2010

Construction insights

This section will introduce the reader to the sector, the individual industries and its drivers, while giving an explanation of the value chain and the industries within it. Also, it will be explained what each industry adds of value in the value chain. Going forward a description of the sector and/or industry drivers is provided for the reader to obtain a picture of the risk associated. Finally, the section decides on a company on which the remaining thesis is building its case study on.

Financial theory

The theory of the Discounted Cash Flow model (DCF model) will be introduced in short, including the input parameters, and an explanation of the output that follows the inputs. The use of the model in practice will be described as this shows a caveat, on which some of the reasoning in the thesis will based, e.g. the limited input parameters when calculating the WACC smile. Moving on, option theory will be explained and the theoretical foundation on which it is based will be introduced to the reader. The link to real options theory will be made and a theoretical example will be used to link theory to the self-developed real option model used going forward. In the final part the connection between the DCF model and real option theory is made and a collective model including input parameters is described. This makes it possible for me to calculate the leverage equilibrium in an uncertain world, maximizing value including the leverage option using my own developed model with the unique feature of leverage ratio as the underlying asset.

Applying theory

First part of the section is a description of the phases in the valuation process using the expanded DCF model. Next step is an extensive number exercise, reformulating annual accounts, extracting and calculating input parameters. Following the initial phase the present value of H+H is calculated followed by the calculation of the real option adjusted value. The value created through leverage is then optimized using computer power. Finally the case study and its underlying assumptions will be criticized in order to highlight the possible pitfalls and the weaknesses of more generic assumptions.

Rounding off

The thesis ends by concluding on the usability of the developed financial model and its findings. At the end, the complete work is put into perspective in order to highlight whether the work entails further considerations or work.

Part 1: Introduction to the construction sector

The construction sector is in this thesis defined as all companies that are professionally involved in construction or in some way involved in the process. The participants within the sector can be divided into various blocks depending on contractual arrangements as well as national and legislative regulations and standards. As my assignment takes an outset in Denmark, I will take an outset in the Danish definition of the industry, as described in Figure 2.

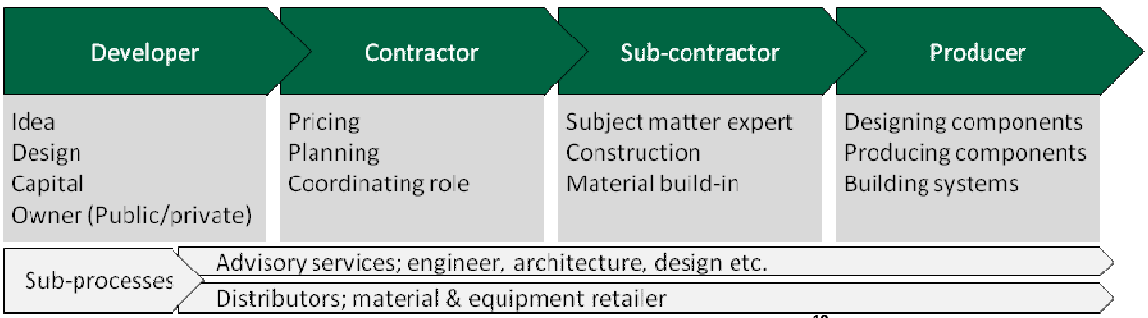


Figure 2 The construction industry in Denmark, simplified process[10] (Own design)

Despite the focus on the Danish setup, the industry is to a large extent homogenous across countries, only various sub-processes and add-ins creates the small, by appearance, differences but large in effect. In order for the reader to have a better understanding of the context in which this thesis is set, I will walk through the 4+1 steps of the value chain shown in Figure 2[11].

1.0.1 Developer

The developer is the initiator of any construction project. It is he who has the initial idea and starts the process by approaching advisors for a first estimate of design and cost. The amount of detail put

[10] Byggebranchens værdikæde, PA Consulting Group, 14.11.2008
[11] As stated in my introduction I have had professional experience within the construction industry, why the industry description, to a large extent, is based on my intrinsic knowledge.

into the design is all depending on the contractual agreement[12]. Depending on the investment horizon of the developer he can have a long- or short-term view in regards to quality/price tradeoffs, which in the end determines material and design quality.

1.0.2 Contractor

The design criteria, high level or complete in detail is put up for tender, most often using price, time and quality as tender criteria. If the tender material is very high level the contractor is often obliged to partner up with additional advisors to finish the design as part of the tender. The tender winner then becomes legally obliged to execute the project within a set timeframe. If exceeding the timeframe it will have financial consequences. During the building phase the contractor is overseen by the developer's advisors. The contractor rarely completes a project without outsourcing part of the project to sub-contractors.

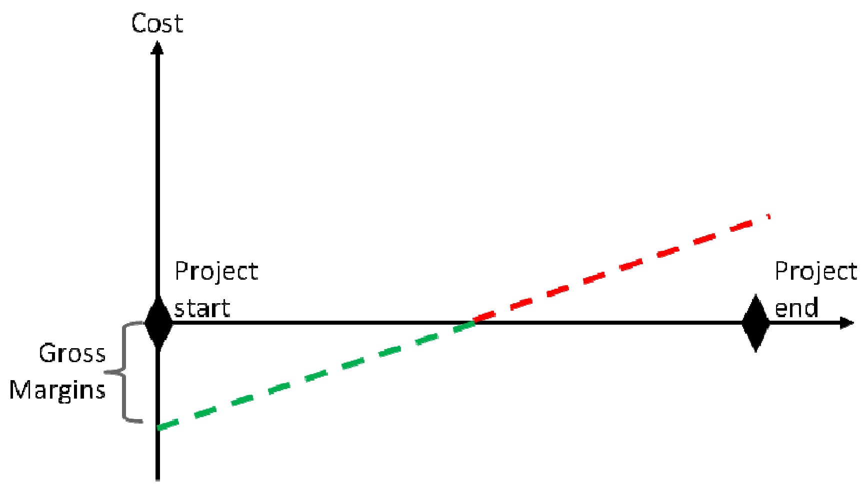


Figure 3 The risk of contractors gross margins becoming negative increases over time

Contrary to ordinary belief contractors are quite often price takers when it comes both to buying and selling their services. When the contractor wins a tender the price is usually locked at nominal value at project start (see Figure 3) despite the project may run for years. This poses a threat to the

[12] Simple examples of different design responsibilities with developer and contractor can e.g. be seen in standard contracts, such as AB92 and ABT93. See AB 92 og ABT 93

contractor's gross margins as cost is difficult to lock in as well[13]. The threat materializes as the project progresses and the contractor sources materials and manpower to the various phases in the project[14] (this is illustrated in Figure 3 where the x-axis illustrates a timeline where the progress of time reduces gross margins until a loss occurs – see dotted line). Further to this a single project is very often a substantial percentage of the contractors yearly revenue, making this an additional risk.

1.0.3 Sub-contractor

In most projects the contractor buys in sub-contractors to execute part of the project. In bigger projects the chain of sub-contractors can reach several levels. The sub-contractor's role is to do the actual physical construction work, whereas it is the contractor's job to coordinate the sub-contractors and keep the project on the right track. In Denmark, where weather conditions are an important factor, the summer period is by far the most productive period. In contrast to the contractor the project timeline for sub-contractor is usually shorter than the contractors, why the risk explained in Figure 3 doesn't pose the same danger. Being at the lowest part of the food chain some sub-contractors simply becomes so small that a micro-economic analysis of leverage levels no longer makes sense.

1.0.4 Producer

The producers are the ones delivering the material(s) to be built in. Projects increasingly consist of pre-assembled components delivered by this part of the value chain, why their role increases in importance along with their profits. Producers is the only part of the value chain which is not a project oriented business compared with contractors, sub-contractors and construction advisory, why it is more suitable for debt financing, due to smaller single customer risk[15]. The Producer sales process can be divided into two, 1) Business to consumer, and 2) Business to business. The former is done through hardware stores/DIY stores[16] where the consumer browses the stores selection, purchases the artefacts, brings them home or gets them delivered. The latter, is more complex: The products are

[13] Byggebranchen markedsnyt 2012, Deloitte, october 2012
[14] Entreprenører: Katastrofeår med konkurser piner branchen
[15] Input from Henrik Hoffmann, Head of Credit & Risk, Business Banking, Danske Bank
[16] DIY is a widely used acronym for Do It Yourself

often unmistakeably described in the tender material; hence the contractor/sub-contractor is left choice less. However, the products are in most cases bought through the hardware store, just as the private consumers.

1.0.5 Sub-processes

As construction projects are complex projects many aspects of the design phase needs advisory functions that is able to handle, and used to handle, such complexity. These phases are often handled by architects. Seen from the developer's viewpoint, the complexity of a project often dictates the need of project manager who is to assist the developer in guaranteeing the quality and design of the project as it was originally intended. During the design phase various engineers are involved in dimensioning load carrying components, heating and heat loss, ventilation and air-condition[17]. During recent years new advisory roles has appeared, mostly concerned with various forms of developer advisory services and quality management.

As one might have noticed from the section on producers; hardware stores/DIY stores play a big role as distributor of most building components – small and large. An example; a large delivery of bricks might be delivered straight from the factory to the building site; nonetheless the purchase is still invoiced though the hardware store. A smaller part of the hardware stores business is rental of light- and heavy machinery. In cases of very large-scale equipment rentals (e.g. tower cranes) such business are often standalone businesses, and provides a service so essential to the construction phase that it is to be seen as a sub-contractor. A material distributor often has quite heavy investment needs, both in fixed assets and working capital. The distributor in most cases needs large areas where material can be stored and be readily available for customers, this doesn't come cheap. Further to this a rather large inventory is needed

1.0.6 Picking part of the value chain

As mentioned this thesis is concerned with developing a financial tool to give a target company an adequate leverage ratio to handle contingencies and more specifically to develop such a model for a construction related company. Such modelling is of course concerned with the downside risk – e.g.

[17] The three disciplines are often shorten as HVAC in English literature

whether or not leverage is too high if a recession occurs. Hence what is a suitable leverage level? A downturn must of course hit the first part of the value chain first; the developers. However as I will explain the three first parts of the value chain is not very suited for the analysis.
Developers can be divided into two kinds, 1) the ones who develop assets with the purpose of selling, or 2) develop assets who is maintained in order to receive a steady cash flow, e.g. from apartment rental or infrastructure facilities such as a bridge. The former disqualifies itself since there is no long term holding period, as assets are sold as soon as possible. The latter is more compelling due to its long term holding period and the fact that projects are usually high leverage due to the high value of the fixed asset as collateral. Assets, as well as corresponding loans (liabilities), are often being kept in separate legal entities why an actual company leverage ratio is practical non-existence[18].

When it comes to contractors and sub-contractors the two parts of the value chain can be treated equally when it comes to their financial characteristics. The essence of a contractors work is to carry out projects, hence the distribution of the contractors income is very single-name dependent, meaning few clients constitute the majority of the contractors income. As projects are the working form and no major asset investments is needed as part of the business model, the need for leverage will be due to offsets in the projects cash flow, why a need for working capital financing is the most likely need in cases of growth. Due to these two characteristics; working capital financing (minimum need of asset financing) and large single name risk (project oriented business model) the contractor and sub-contractor part of the value chain is less bankable[19].

Very similar to contractors, advisory services are project oriented and asset-less companies why debt entirely is a working capital issue and not an asset investment or a long term funding need. Also, they are quite often very small companies. Therefore I will exclude them from further analysis.

[18] An example of this is the recent bankruptcy of Sjælsø Gruppen, who gave up its reconstruction but in practice only gave up on selective projects. See article: Sjælsø Gruppen er gået i graven, 17.08.2013
[19] Input from Henrik Hoffmann, Head of Credit & Risk, Business Banking, Danske Bank

The generic value chain description now leaves me to choose between the two remaining pieces of the chain: The Producer and the distributor.

The Distributor is without doubt in need of finance, both in regards of fixed assets as well as working capital (usually stock and inventory) making a long term capital plan very plausible. Also its customer base consists of many customers with a possibility of a geographical wide footprint, without large single-name exposures. Producers are very much alike. There is a need for big fixed asset investments along with bigger or smaller funding needs due to working capital needs. In short, from a financial viewpoint the risk is somewhat alike.

As the thesis is to analyse a specific company and as an outcome indicate a (more?) suitable leverage level, it would benefit the case and interest of my later findings if the selected company is, or has been in a distressed situation. That company fits perfectly with H+H International A/S – a light concrete producer who has been under much financial stress in recent years due to too high a debt level[20] and falling demand, while betting on an expansive growth strategy[21].

1.1 Construction in a macroeconomic content

The industry has in the recent decade been subject to much attention – first half of the period there was much attention on the immense value creation the industry created, the second half of that decade it was practically impossible to find a story that wasn't about value destruction.

Such volatile story telling is often a proxy for a volatile industry. This is no exemption for the Danish construction industry. As in many other countries, construction serves as a spending and investment valve. If society is in need of spending, through times of crisis, public tax rebates and discounts are given to private persons or companies willing to spend money during times of crisis. There are multiple examples of this, e.g. the Danish tax authority's initiative to give deduction for craftsman work[22] (Håndværkerfradrag) to boost private spending and thereby the economy. Also large public infrastructure projects are often launched during hard times to drive economic growth. An example of

[20] ATP og LD vinder slaget om H+H, Berlingske Business, 19. maj 2012
[21] H+H får underskud i presset marked, Berlingske Business, 21. november 2012
[22] https://www.skat.dk/SKAT.aspx?oId=1947018 , 12.08.2013

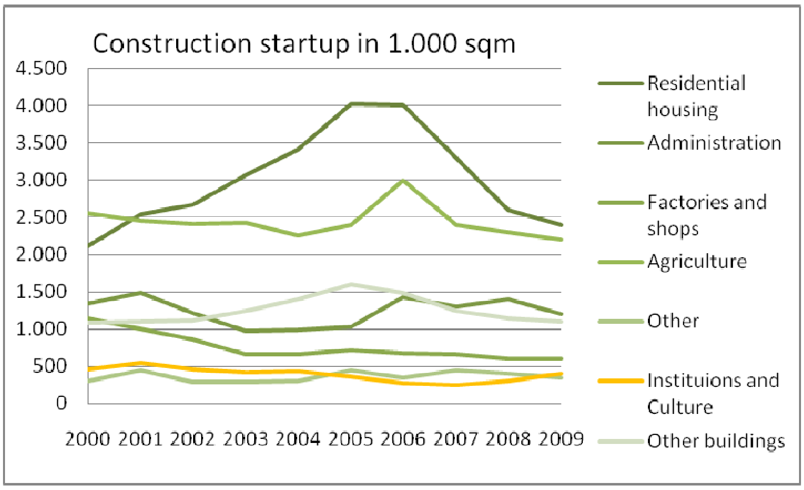
this is Denmarks Growth plan DK (Vækstplan DK) where construction is by far the largest part of the investment plan.

Initiatives to increase public investment, etc.. *DKK bn*	2013	2014	2015	2016	2017	2018	2019	2020
Increasing planned public investment	-	2,0	1,0	1,0	1,8	2,5	3,0	4,0
Activity Effect from the renovation of social housing	0,4	1,2	1,2	1,2	0,0	0,0	0,0	0,0
"BoligJobordning" in 2013 and 2014	1,5	1,5	0,0	0,0	0,0	0,0	0,0	0,0
Funds for growth and employment initiatives	-	0,0	0,6	0,8	0,8	0,8	0,8	0,8
Demolition and renovation of rural areas	-	0,2	0,2	0,0	0,0	0,0	0,0	0,0
Advance of activities in the Fehmarn Belt	0,4	0,8	-1,0	-0,1	0,0	0,0	0,0	0,0
More and better adult education and training	-	0,1	0,3	0,3	0,3	0,0	0,0	0,0
other initiatives[23]	-	0,2	0,0	0,0	0,0	0,0	0,0	0,0
In total	**2,3**	**6,0**	**3,1**	**3,1**	**2,9**	**3,3**	**3,8**	**4,8**

Table 1 Investment initiatives in accordance with Growth plan DK (Vækstplan DK)[24]

The table shows that governmental investment drivers for growth are by large based on capital expenditure within construction.

Without going into a discussion of whether, or why, construction is a lever for driving governmental-driven growth initiatives I simply reason that it is the case, given the large proportion of funds directed to construction[25].



Graph 1 Time series of new construction start-up, measured in 1.000 sqm.

[23] Even other initiatives is only including miscellaneous construction investments
[24] Vækstplan DK - Teknisk baggrundsrapport 2013, Finansministeriet, Mar. 2013
[25] I can refer to; Olivier Blanchard, Macroeconomics, if the reader is interested in learning more on macroeconomic drivers and how to stimulate economies.

However big the public spending budget on construction may seem the private sector constitutes by far the largest proportion of construction investments and spending.
From Graph 1 the large gap between public and private spending on construction can be seen. The green toned lines in Graph 1 are related to private consumption where the orange is related to public spending. Despite the large sums added to public spending as shown in Table 1 it is still way short of the 'making up' for the huge decline in private spending as we approach 2009. A short conclusion on construction and the macro environment is consequently that despite the public effort to stimulate the sector by public spending, it will definitely feel the pain from lack of private consumption. In other words, construction is indeed a volatile business, with public focus and incentives to stabilize consumption, but probably without much effect. As this being the final words I move on to the company introduction and H+H International A/S.

Part 2: The case company - H+H International A/S

H+H International A/S is today the world's second largest aircrete producer. Aircrete is a lightweight concrete product that provides two functions, structure as well as insulation.

H+H can trace its first activities back to 1909 where it was carrying out sand and gravel activities. Its current core activity started in 1937 where it was one of the pioneer producers of aircrete. In 1962 the old entity was split into two, one being the H+H International we know today and the other Rockwool International - another renowned Danish brand within construction material. Aircrete is primarily used in residential building as walls elements, but is also widely used in the industry and in some connection as foundation and roof elements[26].

H+H states that its vision is

"To be market leader and preferred supplier of innovative,sustainable and cost-efficient aircrete building solutions."

And its mission

[26] www.hplush.com September 24th 2013

"To supply value-added and innovative aircrete solutions for construction in Europe in profitable partnerships with distributors, contractors and housebuilders."

In 2008 the financial crisis hit H+H. Already by march 2008 H+H revised its results for the year due to expected lower level of the building of residential dwellings in Denmark and the United Kingdom. By the end of the year UK registered a 40% decline in housing units from 2007 levels and the lowest level in 8o years[27]. In Denmark the development was very much the same (see Graph 1). As a result H+H went from record earnings (profit before tax of DKKm 200) in 2007, to PBT of DKKm 1,4 in 2008 due to a revenue drop of approximately 20%.

Segment information

	UK		Germany, Denmark and Benelux		Eastern Europe		Nordic countries		Eliminations and unallocated items		Total	
DKKm	**2008**	**2007**	**2008**	**2007**	**2008**	**2007**	**2008**	**2007**	**2008**	**2007**	**2008**	**2007**
Revenue	380.9	695.1	437.2	475.5	429.0	436.1	238.3	286.0	(45.9)	(42.5)	1,439.5	1,850.2
EBITDA	23.8	123.3	76.6	123.7	65.1	106.8	12.0	22.0	(42.0)	(28.7)	135.5	347.1
EBITA	(14.0)	80.5	29.1	77.8	41.9	87.1	4.9	14.6	(42.9)	(29.5)	19.0	230.5
EBIT	(14.0)	72.4	29.1	77.8	41.9	87.1	4.9	14.6	(42.9)	(29.5)	19.0	222.4
Profit (loss) before tax*	(19.1)	67.9	16.4	67.7	31.2	76.8	1.0	10.9	(28.1)	(18.2)	1.4	205.1
Non-current assets	278.2	390.3	401.1	403.7	818.7	468.3	50.6	50.9	10.3	48.5	1,558.9	1,361.7
Addition of intangible assets and property, plant and equipment	19.2	41.3	48.8	21.5	417.4	192.0	5.2	6.0	2.1	2.2	492.7	263.0
Depreciation for the year	37.8	42.8	47.5	45.9	23.2	19.7	7.1	7.4	0.9	0.8	116.5	116.6
Assets	383.6	544.2	522.0	549.6	768.1	532.6	108.9	130.6	140.2	26.7	1,922.8	1,783.7
Equity	157.6	233.3	204.1	224.8	144.9	146.6	22.8	20.9	213.8	364.7	743.2	990.3
Liabilities	226.0	310.9	317.9	324.8	632.2	386.0	86.1	109.7	(73.6)	(338.0)	1,179.6	793.4
Average full-time equivalent staff	264	317	203	201	662	688	136	158	17	15	1,282	1,379

* The H+H Group's consolidated profit before tax, management fee, etc.

Table 2 H+H International segment information

The financial downturn was an un-welcoming experience as H+H in the light of the bull-years had planned an aggressive growth plan, building additional production facilities in Russia, Poland and the Czech Republic. The aggressive but focused 'path' was initiated in 1998, when H+H started divesting its non-aircrete activities while investing in aircrete businesses and facilities abroad. The investments amounted to approximately DKKm 500 in 2008 with some inevitable investments left for 2009 in order to finalize facilities. The group ended up with increasing production capacity by 700.000m^3 or

[27] H+H International A/S, Annual Report, 2008

40% of capacity compared to 2008 numbers. Also the investments were to a large extent debt financed.

By the end of 2008 H+H endured a substantial drop in revenue especially due to the large drop in residential housing (see also Graph 1 for Danish trend line) – on which H+H products is widely used in all its markets.

By the end of 2008 revenue had dropped to such an extent that H+H International had broken multiple of its covenants, making it possible for its bank to abandon its loan obligations, inevitable forcing H+H International into insolvency[28]. The drop in revenue and financial strength forced H+H to abandon its M&A and general expansive growth strategy and instead apply the much more conservative and financial less demanding strategy of organic growth using existing facilities. As time progressed the strategy included closing down factories with below satisfactory returns – making tactical cost reductions increasingly important compared to short- to midterm strategic organic growth.

Date	Transaction	Share capital, prior	Nominal change	Share capital, after	Share price	Number of shares after change
May 16th 2001	capital reduction payment to shareholders	124.006.300	-8.006.300	116.000.000	794,81	1.160.000
July 31st 2008	capital reduction payment to shareholders	116.000.000	-7.000.000	109.000.000	1.325,74	1.090.000
November 27th 2009 (prior issue)	contingent capital reduction to transfer to a special fund	109.000.000 (24.000.000 A-shares & 85.000.000 B-shares)	-54.500.000 (12.000.000 A-shares & 42.500.000 B-shares)	54.500.000 (12.000.000 A-shares & 42.500.000 B-shares)	100,00	1.090.000 (shares sizes is changed from DKK 100 to DKK 50)
November 27th 2009 (after issue)	capital increase and merger of share classes	54.500.000	436.000.000	490.500.000	108,00	9.810.000

Table 3 H+H International equity transactions

[28] H+H International A/S, Prospekt 2009

Up until November 2009 the shares of H+H was split between A and B shares with 10:1 voting rights respectively with 100% of the A-shares owned by Henriksen & Henriksen I/S giving them 74,31% of voting rights. As the share issue was a prerequisite of H+H survival, additional condition was put forward by the bank, the major change being that A & B shares were eliminated and that only one share class remained.

Summarizing the latest decades of H+H International it is un-doubtful that they have suffered greatly by management's judgement, however reasonable their choices must have looked. However management have not been the only ones making misjudgements, so have investors and bankers. The remaining part of the thesis will therefore look into a financial model that could have indicated that the inherent risk of the leverage level exceeded the upside it came with. Before approaching such a valuation the coming sections on theory and how to apply is carefully explained. Part 6 is dedicated to applying the finalized model developed to highlight the leverage risk and value of keeping a 'conservative' balance sheet.

As explained the coming sections will first concerns itself with explaining and developing an appropriate model.

Part 3: The basic valuation model – the DCF model

As the choice of DCF model is half of our joint financial model, I start by introducing the reader to the most commonly used models. The criteria on which I pick the model to take forward are 1) the model must make use of WACC as discount rate, and 2) the model should be easy understandable and common practice, as complexity will increase considerably with the addition of the option element. The former criteria will become apparent as the thesis progress, the latter criteria are somewhat subjective, especially if reader and author is of a different opinion on what is understandable/common practice.

In the book, Valuation, by Aswath Damodaran he states in his first chapter[29], that the discounted cash flow model is the basis on which most valuations are done, and is one out of three approaches to

[29] A. Damodaran, Valuation, 2002. page 11

valuation[30]. The two other being 1) relative valuation – comparing assets with pricing on comparable assets such as cash flow earnings, revenue etc., and, 2) option valuation – which, of course, uses option pricing models to value assets with option characteristics both in regards to financial assets as well as real assets[31]. As you probably figured out, this thesis will apply 2 out of 3 models. Beyond the above mentioned models, I should just mention the liquidation model, a very practical approach to valuation used with companies' no longer in going concern[32].

As this thesis is also concerned with applying a practical approach we decided beforehand to make use of the widely used model – the DCF model[33] [34]. The model is most simply stated as

(Eq. 01) $$\text{Net Present Value (NPV)} = \sum_{t=1}^{t=n} \frac{\mathrm{CF_t}}{(1+\mathrm{r})^{\mathrm{t}}}$$

Where *n* is the life of the asset generating the cash flow, and *t* is a given period in that lifespan. *r* is the discount rate. At first sight the model seems straight forward and easy to grasp – and it is. The function is understandable – the bigger the cash flow (CF), the higher the value (NPV). A high *r* reflects higher risk, hence a lower value and finally if CF and *r* remain constant and *t* is increased this increases value.

As we are to determine the value of a firm, lifespan is not depending on the asset – as they are renewed – instead the lifespan of the firm should be seen as the probability of liquidation. Therefore the risk includes a measure of liquidation probability. This means that we need to model the cash flow of the company for eternity. In practice, this is commonly done by adding the horizon value, also called terminal value, as it is the last cash flow value computed in a row of cash flows.

[30] The view is also supported by T. Koller et al, Valuation, 2005, page 132
[31] The latter (real assets with option characteristics) is what is called real options, which is later included in the thesis.
[32] T. Plenborg et al., Regnskab for beslutningstagere, 2005
[33] T. Plenborg et al., Issues in valuation of privately held firms, / T. Koller et al., Valuation, 2005
[34] T. PLenborg et al., Implementering og anvendelse af kapitalværdibaserede værdiansættelses modeller i praksis, 2003. T. Plenborg et al. refers to the more specific DCF model, wherein WACC is used for discounting the cash flow – hence it is the cash flow to firm (FCFF). In this assignment DCF is initially used to describe the cash flow models in general, whereas I later use it more specific.

(Eq. 02) $$\text{Net Present Value (NPV)} = \sum_{t=1}^{t=n} \frac{CF_t}{(1+r)^t} + \frac{CF_{n+1}}{(r-g)}$$

The only difference is that the formula has been split in a definite and an indefinite part. The *g* nominates the expected growth rate after the definite budget period.

Deciding on DCF is however not enough. When looking at the composition of a given firm (see Figure 4), it's apparent that both assets and liabilities can be subdivided, hence the generation and consumption of cash flows can be tracked to different origins/destinations, which again dictates different risks of the cash flows. This possible 'splitting' of balance sheet also dictates a different approach to valuation.

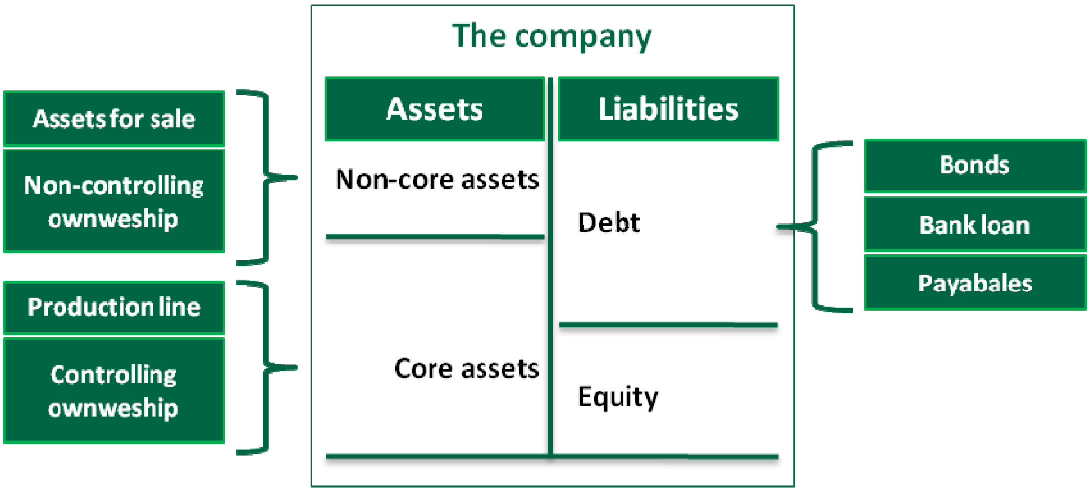


Figure 4 A given firms balance sheet structure

T. Koller et al. explains that this 'splitting' also is considered when applying a DCF model. Hence they split the DCF model into the following, A) Enterprise DCF model, B) Economic Value Added (EVA©[35]) model, C) Adjusted Present Value (APV) model, and D) Equity valuation[36]. In the DCF selection process we can start by eliminating the two latter models (C and D) as they don't apply WACC[37] as the discount factor - the APV model use discount rates matching the type of claim made on the firm

[35] The EVA model was developed by the consultancy company Stern-Stewart, who coined and copyrighted the name. The model is also known as Economic Profit or Residual Income
[36] T. Koller et al, Valuation, 2005, chapter 5
[37] WACC = Weighted Average Cost of Capital - this subject will be explained in detail later in the thesis.

assets (e.g. equity adjusted risk rate to discount cash flows to equity and similar with e.g. corporate bonds), while the equity model uses the cost of equity as discount rate[38].

The EVA model is best described as the difference between return on capital and cost of capital[39] multiplied with investment. The model has its biggest advantage if there is a need to cascade incentive down through a big organisation, especially where such an organisation consist of varying businesses with varying risk and investment profile/capital intensiveness[40]. EVA is often used on present year profits without discounting future cash flows, in order to compare present firm/business unit results[41]. As T. Koller et al. shows[42] the EVA model does equal the enterprise DCF model – and therefore any financial engineering still results in changes measured using WACC, however as it appears the enterprise DCF is the base on which models are compared, why I deselect the EVA model.

As the EVA model now has been eliminated we are now left with the enterprise DCF model. It fits with my two selection criteria's – simplicity and its use of WACC as discount factor. If we look back at equation 01, we can now detail this further,

(Eq. 03) $$\text{Net Present Value (NPV)} = \sum_{t=1}^{t=n} \frac{\text{CF}_\text{t}}{(1+\text{r})^\text{t}} = \text{Value of Firm} = \sum_{t=1}^{t=n} \frac{\text{CF to firm}_\text{t}}{(1+\text{WACC})^\text{t}}$$ [43]

As one can see from the equation, firm value is a function of WACC – the lower the better, and cash flow to the firm – the higher the better. If starting with the numerator it is important to keep the definition in mind when calculating the cash flow to the firm, regardless of capital structure. To do this we must start by defining Net Operating Profit Less Adjusted Taxes (NOPLAT), which is Operating Profit (EBIT),[44] subtracted operating taxes[45] - notice that we get the tax benefit from depreciations as operating taxes are calculated using EBIT. Following operating tax, depreciations are added back

[38] A. Damodaran, Valuation, 2002. page 12-13
[39] In this case cost of capital equals company WACC
[40] A. Damodaran, Valuation, 2002. Chapter 13
[41] T. Koller et al, Valuation, 2005, chapter 416-417
[42] T. Koller et al, Valuation, 2005, Appendix B
[43] A. Damodaran, Valuation, 2002. Page 404
[44] Earnings Before Interest and Tax
[45] Operating taxes is defined as EBIT multiplied with the tax rate. T. Koller et al., Valuation, 2005, page 165.

(along with impairments on operating assets[46]). New investments and working capital is the delta value between *t-1* and *t*. Finally you get Free Cash Flow to Firm (FCFF).

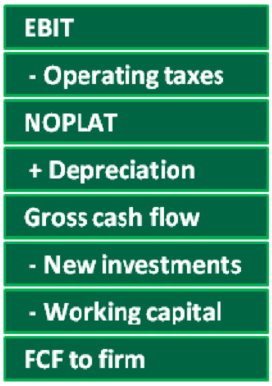


Figure 5 The revised cash flow statement for analysis

The denominator, the Weighted Average Cost of Capital (WACCC), includes more parameters than FCFF and is more dynamic when considering effects from financing. WACC is defined as

(Eq. 04) $$\mathrm{WACC} = r_E \frac{\mathrm{E}}{(\mathrm{E+D})} + r_D \frac{\mathrm{D}}{(\mathrm{E+D})}(1-\mathrm{t_c})$$

Where r_E is the cost of equity, r_D is the cost of debt and t_c the tax rate. The two fractions common denominator, E+D, is the enterprise value at market value(equity+debt)[47]. It should be noted that a company could consist of various debt types, which would simply result in added parts in the WACC equation.

As explained by R.A. Brealey et al. the value of a company is defined by its assets, not the claims on them. Why then the fuss on capital structure and financial engineering? The answer lies in the tax shield. As governments across the globe provides tax discounts on income from interest paid on debt, the income from assets can be divided between fewer equity holders as parts of the firm is financed using debt, while receiving a discount on the returns paid to debt holders[48].

[46] Divergence between American teaching books and Danish standards exits. In Denmark *The Danish Society of Financial Analysts* has a different approach. They calculate NOPLAT from operating tax on EBITA (incl. Amortization), where after they add both depreciation and impairments on operating assets. The difference is not so much a difference in perception but seems more like a difference in detail. In the case of H+H international reversals of impairments becomes an issue.

[47] R.A. Brealey et al., Principles of Corporate Finance, 2008, chapter 20

[48] R.A. Brealey et al., Principles of Corporate Finance, 2008, chapter 18 and 19

Before going into the details, I will just recap on the initial thoughts on leverage before taking the value of tax-shields into consideration.

In Table 4 two identical companies are portrayed, with only a difference in leverage. If results are high, you clearly see that equity holders of the leveraged firm have an advantage on the other hand you also see that poor earnings can leave equity holders of a levered firm with no or little earnings. This clearly tells us that leverage increases risk, in a pragmatic way – but not how much risk increases, how the risk is divided between instruments and in what fashion risk increases with leverage.

	Un-levered firm		Levered firm	
	Low result	High result	Low result	High result
Shares	1.000		500	
Price per shares/Market value	10/10.000		10/5.000	
Debt	0		5.000	
Interest on debt (10%)	0		500	
EBIT	500	1.500	500	1.500
Interest	0	0	500	500
Earnings per Share	500/1.000=0,5	1.500/1.000=1,5	0	1.000/500=2

Table 4 Simplified effect of leverage on Earnings per share (EPS)

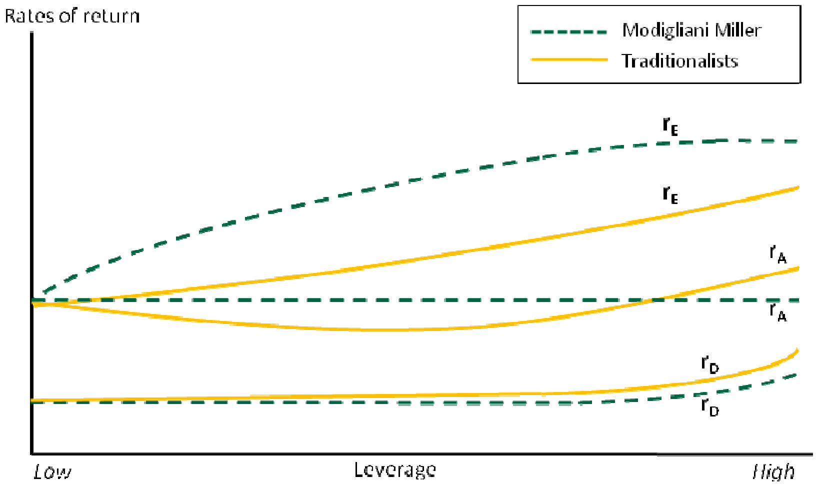
On this matter two opposing views stand tall; The Modigliani-Miller (MM) theorem and the Traditionalists. As it is seen in Graph 2 MM believes that the weighted –average cost of capital (r_A) is constant and that leverage has no influence. Traditionalists believes that leverage has a positive influence on r_A, and leverage has very little effect on r_E with little leverage and only 'shots up' with excessive borrowing (see Graph 2).

Looking at MM's proposition it is expected that returns on firm assets equals "expected operating income" divided by "market value of all securities". As Brealey et al.[49] writes; operating income doesn't change regardless of how it is split. You could also say

"A bag of goodies doesn't become larger just because you share it – sharing with your little sister might be a different story."[50]

[49]R .A. Brealey et al., Principles of Corporate Finance, 2008, chapter 18

As most will know capital markets consists of very few “little sisters” who are fooled to fund any firm with a discount[51]. Why MM’s proposition appears correct.



Graph 2 Rates of return - the two opposing views[52]

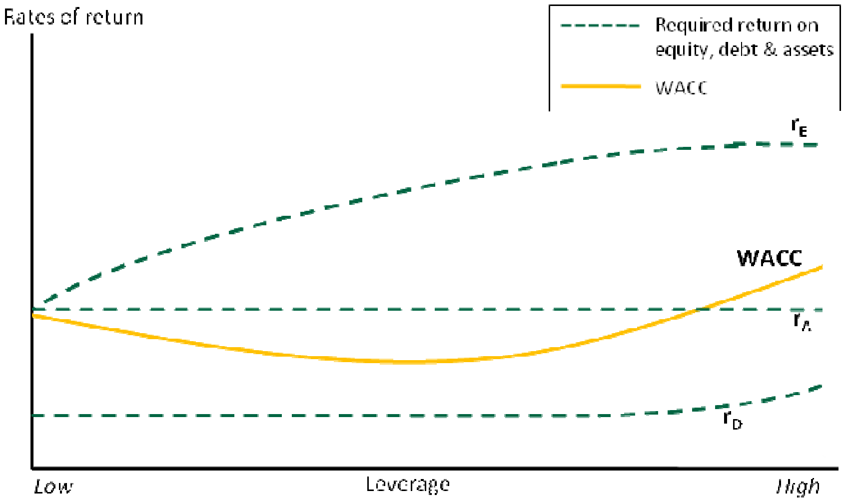
In regards to the traditionalists view they argue the case that return on assets/the required return on capital, decreases up to a certain point of leverage, this is due the fact that equity holders does not require any larger returns due to ‘minor’ leverage. This point however seems to ignore the fact that equity holders demands higher returns not only for default risk but also for operating income[53]. As indicated by Table 4 one can tell that a equity in leverage firm has a higher risk on its earnings per share, while this of course would indicate a higher demanded return – not a lower.

As a final conclusion on the matter, I must join MM in there thinking, stating as they did; in a world without taxes capital structure is irrelevant.

But, as we know, the world does have taxes; hence there is a gain on leverage due to the interest tax shield. The gain does have a cap – increasing leverage will cause r_E and r_D to increase, ending up in the benefits of the interest tax shield to be eaten away. Instead of Graph 2 we can draw Graph 3 which shows the WACC smile. As one can conclude from the curvature, there is a certain capital structure

[50] Own quote
[51] I am here disregarding the fact that e.g. additional bond issuing could lower the value of older bonds and thereby provide cheaper funding than what the risk would otherwise indicate – this would benefit holders of equity.
[52] Inspired by R .A. Brealey et al., Principles of Corporate Finance, 2008, Figure 18.2 and 18.3
[53] R .A. Brealey et al., Principles of Corporate Finance, 2008

that will optimize enterprise value (EV). To avoid the reader making any mistakes, don't misinterpret the r_A in Graph 2 with the orange WACC below.



Graph 3 The WACC "smile"

As previously stated the Modigliani Miller proposition still holds as one can tell from the dotted lines. Also it is seen from the graph that WACC, in theory, can increase above r_A, in effect making a firm/a project un-attractive due to the high required return.

As we will see in later chapters of the thesis, WACC is dynamic when it comes to adjustments in leverage changes. However this volatility goes in both directions. As Graph 3 boldly suggest WACC should be kept at minimum value to optimise firm value. Despite the recalculation of WACC, it only incorporates the leverage effects passively; it doesn't adjust for the possibility/risk of having to say no to investment or fending off a financial blow with excess financial resources[54]. The former issue is not to be dealt with, but the latter is the purpose of the thesis. The next chapter is therefore to introduce the reader to options and more specific real options. Real option valuation allows for valuing flexibility and is therefore well-suited for adding this financial flexibility dimension to the 'inadequate' DCF model.

[54] A. Damodaran, Investment Valuation, 2002, page 808 subject also addressed in M. T. Alding, Financial flexibility, Real Options and Private Equity Valuation, 2010.

Part 4: The extended valuation tool – Real Option Model

As stated in the previous chapter the DCF model is inadequate to value financial flexibility. The flexibility in this case is the ability to absorb company- and macro risk affecting leverage in a negative fashion, in other ways not due to additional investments in NPV positive investments, but unforeseen hardships encountered due to external forces – e.g. the credit crunch. This chapter takes us through the Black-Scholes model and the Binomial model, to select the most appropriate of the two to take forward.

"An option is a security giving the right to buy or sell an asset"[55]

So starts the famous article written by Fischer Black and Myron Scholes who by this article was the inventor of the commonly known Black & Scholes option pricing model for which they later received the Nobel price[56].

From this initial statement we can derive the following.

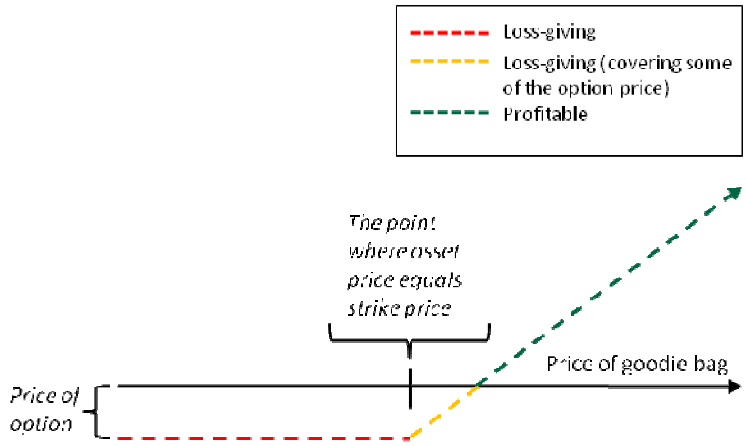
- An option derives its value from the underlying assets on which it has the right to buy or sell, but also it can be said that
- The value of the option is then conditional on the occurrence of specific events on the underlying asset.

Comparing the two statements with our initial wording of the issue, we extract the correlation

- There is an option to increase financial flexibility in regards to leverage, and that this option must have a value as it in effect influences leverage ratio
- The value of flexibility strikes when an event of financial strain causes leverage to shift, and the calculated option allows for this without loss of value, due to increased cost of capital.

[55] F. Black et al., The Pricing of Options and Corporate Liabilities, 1973
[56] Robert C. Merton, coined the name Black-Scholes option pricing model in a later article. The development of the of the model was in large part due to all three, but due to Fischer Blacks death in 1995 he was not eligible for the Nobel price, as they (presumably) are not given to death people – a little footnote to show him the respect☺

An example: An option to buy a bag of goodies within the next 2 years only has a value if the bag has the possibility of varying in price. If the price is fixed with certainty, then the option value equals zero. If however the price of goodies jumps up and down it might be worthwhile to pay for an option in order to know your maximum price[57]. As seen from the call option in Graph 4 an option can be loss giving. Profit from an option is only obtained if the assets exceed the strike price (the price at which the option gives you the right to buy the asset) – the opposite is the case for a put, which is the right to sell an asset at a given price.



Graph 4 Payoff profile on an call option (the right to buy an asset at a fixed price)

To price an option five (in some cases six) variables is needed. These are 1) current value of the underlying asset, 2) the variance in value of the underlying assets, 3) strike price of the option, 4) time to expiration of the option, 5) riskless interest rate corresponding to the life of the option, and finally 6) dividends paid on the underlying assets. The 6 parameters does not influence the option price in the same way, Table 5 give an overview of the movement each parameter causes the option to take. These 6 parameters also goes by the name of 'Greeks', where the 'Greek' for each parameter tells how much a given move in e.g. asset will cause the option price to move. Table 5 shows the names and letters for each of the Greeks. Besides the 5 Greeks in the table there is also Gamma (Γ) which measures the change of value in delta when there is a change in the price of underlying assets.

When valuing an option there are two common approaches that can be used, the Black-Scholes model or the Binominal model. The Black-Scholes was the first to be developed, whereas Cox, Ross

[57] As one might be able to tell from the wording, an option is (only) a right, not an obligation to buy the underlying assets. Hence the maximum possible loss if buying an option is the option price.

If this parameter increases…	… the value of a call option	Greeks
1) Value of underlying asset	Increases	Delta Δ
2) Variance of underlying asset	Increases	Vega[58]
3) Strike price of the option	Decreases	N/A
4) Time to expiration	Increases	Theta θ
5) Riskless interest rate	Increases	Rho ρ
6) Dividend on underlying asset	Decreases	Psi Ψ

Table 5 The influence of parameters on call option price[59]

and Rubinstein later developed the binominal model based on a limiting case of the Black-Scholes(B&S) model[60].

Further to these models it should be mentioned that these models have been developed to value financial assets, such as stock and bonds. A real option is more abstract as these examples might highlight

- *The option to delay a project*: a project requires an upfront investment for the project to generate a future positive cash flow. This might have a negative NPV but changes in the future might change this. Hence there is an option element in the investment.
- *The option to expand*: a firm might invest in a market as to gain presence and knowledge of the market, this project might suffer a negative NPV, but will supply management with additional knowledge to make better and more worthwhile investment in the future. Otherwise they abandon the project/market as a whole only having suffered the small initial investment, seen as the option price
- *The option to abandon*: a shipping company have ordered a ship to be delivered in 7 years time, as they are worried that the ship will be a bad investment (negative NPV) they have an option to cancel the order with the shipbuilder. This example is one of the areas where real options are commonly used.

[58] Vega is not a greek letter, hence it has no signature letter
[59] Z. Bodie et al., Investments, 2009
[60] J.C. Cox et al., Option Pricing: A Simplified Approach, 1979

- *Valuing highly distressed firms*: as a holder of equity in a distressed company, stock can be seen as an option on the firms survival as the stock owner has limited liability, and can only loose what little price he paid for the stock.
- *Option on financial flexibility*: when managers make financial decision on leverage they also take a decision on the ability to take on new investments. The slack they might keep in leverage has a cost, but the pay-off comes when an investments opportunity arises which can be taken due to the available capital.

These are some of the most ordinary examples of real option valuation you stumble upon in text books and articles[61]. None of the above fits with the needs of this thesis, and as far as I am aware no real option model has yet been developed to value the leverage-level beyond what is dictated by the WACC smile. However, the latter description of financial flexibility offers some resemblance to the issue of this thesis.

Before setting up a model, we must first decide on a option model. This is done in the coming chapters.

3.1 The Black-Scholes model

In the respect of taking things in there right order, I start by describing the B&S model. In 1979 Scholes and Black created the B&S formula using a simple principle of a hedge position consisting of a long position in the underlying asset (a stock) and a short position in the option, all other inputs were known constants, making it possible to find the price for a European call option[62]. In deriving the formula Black and Scholes assume "ideal conditions" in the market, stating that;

a) The short term interest rate is a known constant
b) The stock price follows a random walk in continuous time with a variance proportional to the square of the stock price[63]. Also the variance is constant.

[61] A. Damodaran, Investment Valuation, 2002
[62] A European option is an option that can only be exercised at a specified future date, contrary to an American option which can be exercised at any point in time until expiration.
[63] Thus the distribution of the possible stock prices at the end of any finite interval is log-normal.

c) The stock pays no dividend[64]

d) The option is a European option

e) No transaction cost

f) Borrowing can be done at the short term interest rate (see condition a)

g) There are no penalties for short selling

As stated, the B&S model values the option in continuous time[65], making it more relevant to price financial assets than a 'real' asset. Using their own deductive reasoning, Black, Scholes and Merton derived the formula:

(Eq. 05) $$C_0 = S_0 N(d_1) - Xe^{-rT} N(d_2)$$

Where d_1 and d_2 can be defined as

(Eq. 06 & 07) $$d_1 = \frac{\left(\frac{S_0}{X}\right) + \left(r + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}}, \quad \text{and} \quad d_2 = d_1 - \sigma\sqrt{T}$$

The variables in the formula are the following: C_0=Call option value, S_0=Current stock price, N(*d*)=the standard normal cumulative distribution function, X=strike price, *e*=the natural log function, *r*=the risk free rate with same maturity as option, T=time to expiration of option, ln=natural logarithm function and finally σ=standard deviation of the annualized continuously compounded rate of return[66]. Complicated as it may seem, and is, the reasoning will become more intuitively understandable once the binominal model is explained later in the chapter.

As our option model should be able to value real life possibilities the financial approach of the B&S model limits the use to some extent as two conditions stands out. The model only works for a European option and dividends on underlying asset is not included. The first condition would make the model highly theoretical over longer time periods, as this would indicate managers unable to take decisions until the end of a period (until the expiration of the option). The latter condition would to some extent neglect the changes that could occur on the underlying assets that management was to

[64] Notice that this condition have been relaxed prior in the thesis
[65] F. Black et al., The pricing of Options and Corporate Liabilities, 1979
[66] Z. Bodie, Investments, 2009

decide on. A model for valuing an American call option with a single dividend exists and is called the Roll-Geske-Whaley fomula, the equation is stated in footnote 67[67]. It is quite clear that the handling of the real option issue becomes quite complex in these closed form equations. As we shall see, the Binominal model has a breakdown structure of the B&S model that makes it more intuitively understandable and provides us with nodes at defined points in time where alteration in the value of the underlying assets can be altered, e.g. dividends could be paid.

3.2 The Binominal model

The binominal model is, as stated, a limited 'edition' of the B&S model. It was initially developed by John C. Cox, Stephen A. Ross and Mark Rubinstein in 1979. Beyond the simplified approach the model also incorporates the opportunity of a premature exercise of the option (American option).

The principle behind the binominal model is that it uses a lattice to both calculate the development of the underlying asset as well as pricing the option at a given point in time, indicated by each end-node /node. Figure 6a shows a very simple lattice with only two outcomes of the development in the stock price from today until t=1. The price of the option at t=0 then becomes a rough average calculation of the two end nodes, as the lattice is subdivided (Figure 6b and c) the option price at t=0 becomes increasingly precise. If one imagines the subdivision being done continuously, creating infinite small nodes within the lattice (see Figure 6d) you in reality would get the same result as the Black-Scholes model[68].

Cox, Ross and Rubinstein in other words uses discrete time to calculate the option price. To do so they use two sets of lattices, one to calculate the price development of the stock, and one to calculate the inherent price of the option. The price development lattice is the first to be determined. In this case

[67] Roll, Geske og Whaley's formula for an American call option with dividend.

$$C = (S_0 - D_1 e^{-rt_1})N(b_1) + (S_0 - D_1 e^{-rt_1})M\left(a_1, -b_1; -\sqrt{\frac{t_1}{T}}\right) - Ke^{-rT}M\left(a_2, -b_2; -\sqrt{\frac{t_1}{T}}\right) - (K - D_1)e^{-rt_1}N(b_2),$$

where $a_1 = \frac{ln[(S_0 - D_1 e^{-rt_1})/K] + (r + \frac{\sigma^2}{2})T}{\sigma\sqrt{T}}$ og $a_2 = a_1 - \sigma\sqrt{T}$

Furthermore $b_1 = \frac{ln[(S_0 - D_1 e^{-rt_1})/S^*] + (r + \frac{\sigma^2}{2})t_1}{\sigma\sqrt{t1}}$ og $b_2 = b_1 - \sigma\sqrt{t_1}$. OFD, technical note no. 4 og 5.

[68] R.A. Brealey et al., Principles of Corporate Finance, 2008

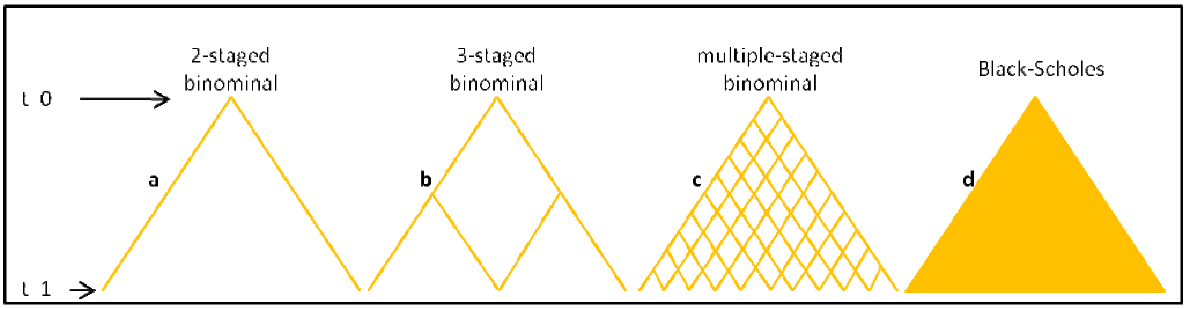


Figure 6 The binominal model and its connection to the Black-Scholes model

you start with the present value of the stock which then can follow an up-motion (*u*) or down-motion (*d*). The up- and down movement uses risk-neutral simulation with only two inputs needed, Δt= a time interval (often as fraction of year) and σ= standard deviation of stock returns (continuously compounded), with this *u* and *d* can be defined

(Eq. 08 & 09) $u = e^{\sigma\sqrt{\Delta t}}$ then $d = 1/u$

Using the two simple equations, the stock price lattice can be developed. The inherent proberties of the lattice also makes it re-combining, meaning that *uud*S* equals *duu*S*. The probability of each of the movements can be defined by

(Eq. 10) $p = \frac{e^{r_f \Delta t} - \mathrm{d}}{u - d}$

To align with previous description of the B&S model the binominal model includes no dividends. Notice that when using the continuously compounded returns in the lattice, no matter how many steps downwards the value will remain positive. Also as the lattice is divided into smaller sub-nodes each set of nodes will continue to total *p*=100% - this can be seen as the movements in the stock becomes increasingly smaller as the number of nodes increases in numbers[69].

Working with binominal models, the approach can be divided into 3 steps

1) Setting up and calculating the lattice for the price development of the underlying asset. Using equation 8 and 9.

[69] R.L. Mcdonald, Derivatives Markets, 2006

2) Setting up a similar lattice in dimension to calculate the option value from terminal node to start (backwards). The terminal node is calculated using equation 11.
3) Finally the remaining, end nodes are calculated until the option price at *t*=0 has been found using equation 12.

The process taking place in Figure 7 is a multiplicative process, meaning that each node is multiplied with the outcome from the previous note.

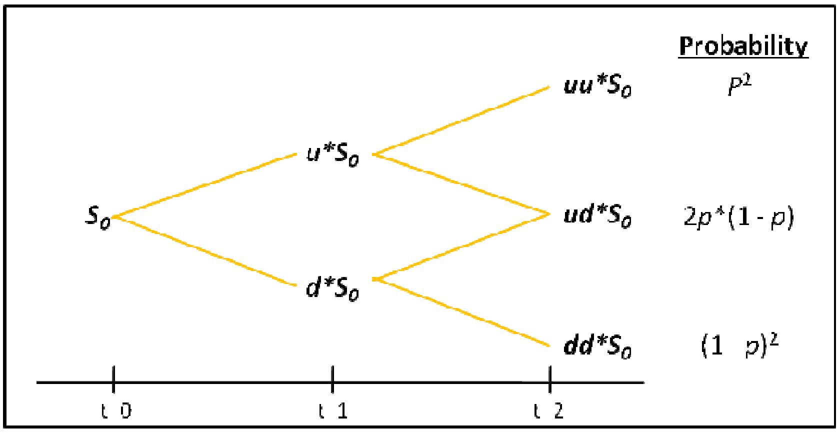


Figure 7 Lattice of stock price development

The probability of each end note has been stated in Figure 7. The logic of this is rather simple. To reach the top node there is only one path that is *uu**S, hence $p*p$ or p^2, reaching the middle node, it is one step up and one down $2*p*(1 - p)$[70]. The bottom node should speak for itself.

Next step is to calculate the option value at each note. As stated we start with the end node going from right to left. At the end node we evaluate which of two options is the better. Maximum of Stock price minus strike price or zero, in the following notes the same methodology is used, but with a twist. Here the choice is between the maximum value of the weighted average of the two previous options or the current stock price minus the strike price[71].

(Eq. 11) $C_t = MAX(S_T - X; 0)$ which is the value of the call at the end node

[70] You might ask yourself while we multiply with 2. Remember that we need to adjust for the fact that it is the second node from the *t*=0

[71] R.L. Mcdonald, Derivatives Markets, 2006

(Eq. 12) $C_t = MAX(\frac{p*C_{t+1}^u+(1-p)*C_{t+1}^d}{e^{r_f \Delta t}}; S_t - X)$ which is the call value at all other nodes

The reasoning behind the principles in the binominal model is in fact rather simple. Standing at the *t*=2 node, being the investor, your simple choice is to either use the strike to buy the more expensive stock or you don't, if the strike costs more than the stock, hence the value is zero - you of course opt for the better alternative. At *t*=1 you again have the option to use your strike on the more expensive stock or you can wait another period – you choose the latter option if the weighted value of the two discounted call's at *t*=2 has a higher value than you achieve by exercising the option today.

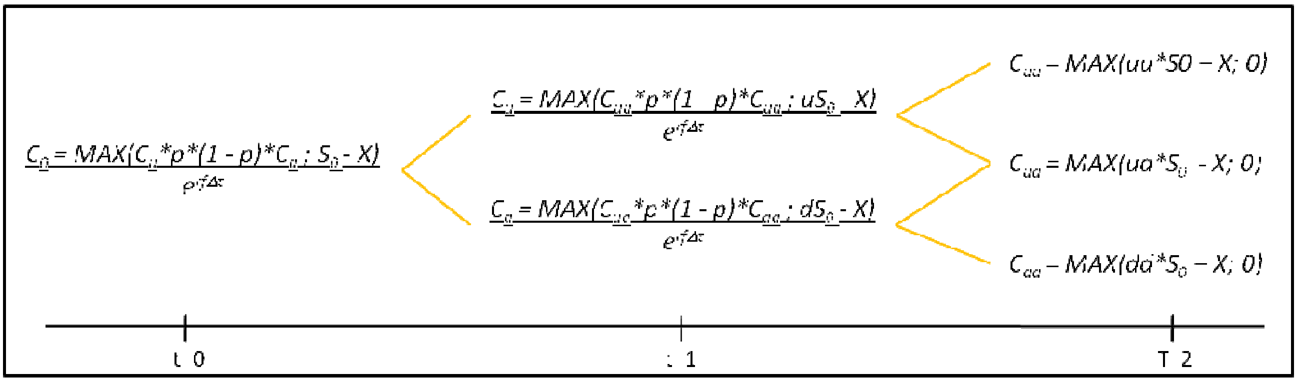


Figure 8 Option value lattice for call option

As seen in equation 12 we use *p* and (1 - *p*), the risk neutral probabilities and the risk free rate, r_f, to discount the values. In Figure 8 the complete setup is described with appropriate formulas for each node – as long as they are used from right to left. It could be added that sometimes an additional lattice is used to describe whether the option should be exercised or not – this however does not affect the value of the option, it only indicates the probable timing of the exercise.

3.3 Model choice – the suitable option valuation model

Going through the models the binominal model seems like the better choice. The B&S model has it biggest advantage in its quickness to compute the correct result, however due to its closed formula setup it can be hard to follow the results and what the triggers are. The binomial model on the other hand separates the stock price development and the option pricing, making the process more transparent and intuitive. Also the merger with the DCF model seems likely to be more appropriate with the opportunity to make adjustments at each node/period. To validate the models qualitatively I have set up criteria's which I find key when applying an option model in combination with the DCF model. The criteria's and the assessment of them are stipulated in Table 6

Criteria	Black-Sholes model	Binominal model
Intuitive understandable for non-thesis writer	High need for mathematical understanding	Results can be followed node by node, on both stock- and option price
Handling American options	Possible, but with a high degree of complexity	Handles it with ease, with hardly any added complexity
Previous use for valuing this specific real option case	None – that I have been able to find	None – that I have been able to find
Handling input complexity	For every additional input the model increases considerably in complexity	Handles it with ease, with hardly any added complexity
Implementable as decision tool	Easy to 'plug in the numbers' but difficult to evaluate the importance of inputfactors	More intuitively understandable. Variables can be changed midway and evaluated

Table 6 Criteria for choosing option model

Summing up Table 6 the binominal model is the better, while I will implements its use in the Expanded Discounted Cash Flow Model (eDCF model).

Part 5: The extended Discounted Cash Flow model

In the former chapters I picked the building blocks of the extended Discounted Cash Flow model (eDCF). The foundation will be constructed by the well-known DCF model while the add-on to evaluate the option value will be using the binominal model.

As the model to be developed has no theoretical foundation in financial literature. It is based on own skills and, of course, from known literature used as the financial foundation and building blocks. The first touch of inspiration came during my bachelor, where I accidently acquainted myself with A. Damodaran and his financial flexibility example. To give the reader a better understanding of where I'm coming from, I will briefly explain A. Damodaran's model.

5.1 The inspiration – Aswath Damodaran and financial flexibility

In A. Damodaran's terminology, financial flexibility is the capacity to undertake future investments or meet unanticipated contingencies. To meet investment needs and contingencies companies maintain large cash pools or excess debt capacity. The value is of course that the company is able to undertake investment or meet contingencies if needed. On the other hand the company endures cost as well, as the large cash pool might earn below market returns while the excess debt capacity indicates that the company is giving up some value as it has a higher cost of capital. Addressing both future investment opportunities and contingencies in his introduction, Damodaran only develops a model to value capacity to undertake future investments[72]. This model is shortly described below.

To value financial flexibility as an option, Damodaran sets up the following criterias. Underlying assets is the company's expected future investments based on an average from previous years as percentage of enterprise value (EV). The volatility of investment is simply the swings in investments year-by-year. Damodaran then sets up two options, 1) no extra capacity to undertake investments, and 2) additional debt capacity to undertake investments. The remaining parameters in the option are simply time and the risk free rate. Damodaran then calculates both the options and subtracts the one from the other as to tell what the added value of the additional flexibility is worth as a percentage of EV. The article can be revisited in both Damodaran's book "*Investment Valutation*" and the article "*Promise and Perils of Real Options*". I can highly recommend both. Below I have reproduced Damodaran's input variables to calculate the option(s)[73].

Before going into the details of the model development, I need to describe the option that H+H International has in regards to leverage while adding information to the parameters so that it can be sufficiently defined.

[72] A. Damodaran, Investment Valuation, 2008
[73] A. Damodaran, Valuation Investment, 2008

Input to Model	Measure	Estimation approach
S) The underlying asset	Expected annual reinvestment needs as percent of firm value	Use historical average (net cap ex + Change in noncash working capital)/Market value of firm
X) Exercise price	Annual reinvestment needs as percent of firm value that can be raised without /with financing flexibility	If firm does not want to or cannot use external financing: (Net income – dividend + depreciation)/Market value of firm If firm uses external capital (bank debt, bonds or equity) regularly: (net income + Depreciation + Net external financing)/Market value of firm
σ^2) Volatility of underlying asset	Variance in reinvestment needs	Variance in the reinvestment as percent of firm value (using historical data)
t) For time	Measured in years	To get an annual estimate of the value of flexibility

Table 7 A. Damodarans Inputs to Option Valuation of Financial Flexibility

5.2 H+H International's option on leverage

As shown previously there is a clear connection with leverage and minimum discount rate (WACC). This minimum can be calculated mathematical, and should ideally optimize the value of H+H. However as history has shown H+H would probably have wished for a lower level of leverage, as recent performance and economic performance has pushed it into a very uncomfortable zone with increased cost of capital as a consequence and with the urgent need of additional funding[74]. Of course the leverage of H+H International was not exclusively done, due to a leverage target, but also as consequence of the heavy investments H+H did in the 'boom' years[75].

Today nobody would be in doubt that H+H was leveraged above and beyond reasonable levels. The question is how a suitable leverage level could have been calculated using real option theory. We start by stating the option H+H would have faced if they were/had used this special case of real option theory during the hay days.

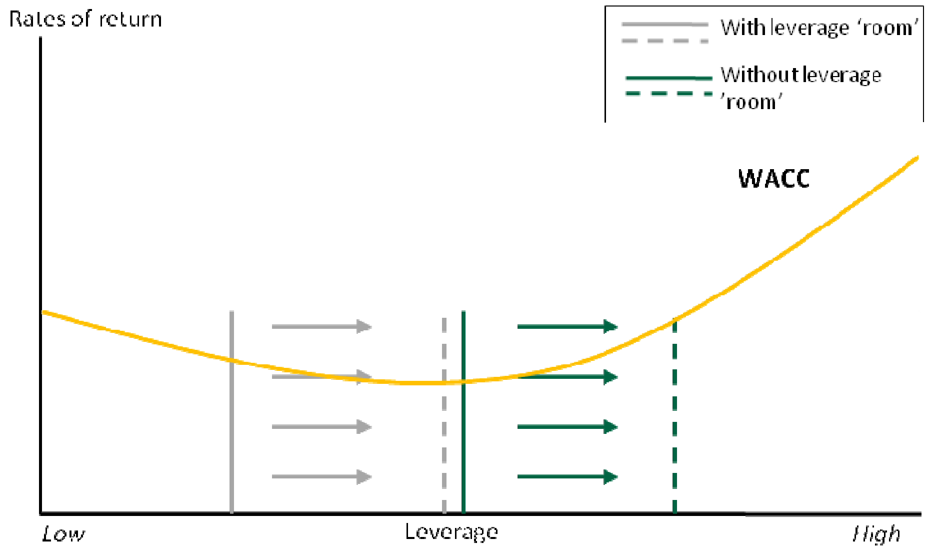
[74] T. Johannesson H+H reddet af kapitaludvidelse, Børsen, 2010
[75] Multiple newpaper articles highlights this such as C. Madelaire, H+H International satser i Tjekkiet, 2006; C. Venderby, H+H International køber polsk betonfabrik, 2005 and A.K. Hasen, H+H International køber aktieandele i polske selskaber, 2005. Also H+H International annual report shows the growth of geography and core business stock investments.

In a steady state world, WACC could be optimized and kept at just the right level, in order to maximize firm value. As A. Damodaran[76] shows, volatility in investments gives additional leverage 'space' a value, as there is capacity to grab these investment opportunities. However the argument I wish to put forward in this thesis is along the same lines but the option is not to be able to grab investments, but to keep leverage at a reasonable level through the cycle[77]. The option can then be defined as keeping leverage at a lower state contra increasing it to a minimum leverage.

5.3 The theoretical building blocks

Very few people have had luck with predicting a financial downturn. Why I would argue that an option to mitigate excess leverage could be needed at any point and should therefore be valued so that it can be exercised at any point in time. In other words it has the shape of an American option. The insurance that H+H is buying with a de-levering option is an insurance against an economic downturn and/or financial hardship due to own internal circumstances. This looks somewhat similar to a put option, which gives the right to sell an asset at a certain price if the price should fall. Looking closer though, what in fact would happen in times of hardship is that leverage would increase[78] - moving the leverage ratio[79] from left to right in Graph 5.

[76] A. Damodaran, Investment Valuation, 2002, page 808
[77] Through the cycle is an economic expression, that refers to the ability to keep a steady state through economic up- and downturns.
[78] Debt would increase due to income losses and postponed obligations that would have a negative net-cash flow effect in times with falling revenue. This is ofcourse on the condition that, H+H International does not raise capital in other ways.
[79] Notice that in such a case net financial cost would probably increase in a status quo situation due to a general added risk premium in the market in such a scenario.



Graph 5 A changing WACC picture during times of crisis

If H+H disregarded the possibility of hard-times and levered there business at the point of where WACC reached its minimum value (green solid line in Graph 5) they would push their cost of capital towards the right, increasing cost. Had they kept a more conservative balance sheet they would instead have lowered their cost of capital (the move from solid grey line to dotted grey line in Graph 5). This actually shows us that the option is an American call option as the underlying asset increases in value.

Looking at Graph 5 one might start to wonder that the cost of the option (keeping a lower than optimal leverage) equals the cost of surpassing the optimal leverage point to the right. What the later case calculation and reasoning tells us is that this is unlikely to be the case. As leverage increases the more expensive equity is substituted with cheaper debt. The risk premium on equity rises as risk increases, but the interest tax-shield more than offsets this, why there is a gain. As leverage reaches un-healthy proportion, the cost of debt shoots up, and equity continue its steady increase as well. However the equity premium levels off at point. As the explanation goes, WACC seems to have more of a *J*-curve, instead of a bowl where the cost of either side is the same (low or high leverage). In other words there seems to be a case to keep a conservative balance sheet after all.

As previously stated there has not so far been conducted any leverage analysis of this kind using option theory, however to make things more appetizing for the critical reader I will take an outset in the building blocks provided by A. Damodaran in his valuation of financial flexibility[80].

Some of the variables are of course simple default inputs such as the risk free interest rate, time, and volatility as it is depending on what underlying asset our valuation makes use of. We are then left with a lack of a precise definition of the underlying asset and the exercise price/cost of exercise.

In Damodarans article "*The promise and Perils of Real Option*", he argues for the case that companies should maintain financial flexibility to have the option to undertake unexpected investments, and do so by keeping large cash balances or keeping excess debt capacity. These of course provide the firm with costs in terms of below market returns on cash or a higher cost of capital.

Damodaran's approach to valuing this flexibility with real options is somewhat abstract but very enlightening. He first calculates the option value of the investments that would have been undertaken with the available funds from operations as a percentage of firm value. The option would be exercised every time the investment was bigger than the funds available. Following that he then calculates a new option value but this time including both available funds from operations and available leverage (up until optimal debt ratio). This option would then exercise any investment opportunity bigger than the total funds available. Separately these two options makes less sense, but if the first one is subtracted from the latter you exactly have the value of an option equal to the investment that would be available to a firm if it had the financial flexibility defined by the difference between the two strike prices.

In Table 8 the comparison between Damodaran's somewhat similar work and the Leverage option has been elaborated. The definition of the underlying asset is reasonable self explainable, the variance on the asset likewise. On the latter some investigation should be done once computing the actual variance as volatility in leverage might as well have been caused by a change in leverage policy

[80] A. Damodaran, The Promise and Peril of Real Options, 2005

Variable	Financial flexibility option	Leverage option
S) The underlying asset	Expected annual reinvestment needs as % firm value	Expected annual leverage (by default as % of firm value)
X) Exercise price	Annual reinvestment needs as percent of firm value that can be raised without financing flexibility and with flexibility	Annual free funds as % of firm value that can lower leverage and free funds incl. leverage 'room'
σ^2) Volatility of underlying asset	Variance in reinvestment needs	Variance in leverage

Table 8 Defining the underlying option variables

or a 'one-off' investment. One must not forget that equity plays a vital role in leverage volatility as earnings are accumulated – both negative and positive.

Using Damodarans approach I am to first define a strike price that includes the funds available to H+H International as a percentage of firm value. Following that I define a strike price that adds available funds and a portion of exactly the available leverage needed to optimize between having the financial power to withstand a blow to the balance sheet while weighing the opportunity cost of the increased cost of capital (WACC). As one can tell from the wording of the latter option this requires computational power in order to make the necessary repetitive calculation.

To define the strike more precise we need to look into what funds our case can draw on as a source. I categorize them into three, 1) funds from operation, more exactly as Free Cash Flow to Firm (FCFF), 2) additional debt capacity, meaning whatever slack there is between optimal debt level and current level, and 3) equity financing through a secondary public offering – just as H+H did in 2009[81]. For the 'first' strike I will include funds from operations, and in the 'second' strike I will include additional debt capacity along with FCFF. I will in both cases exclude equity. The reason for excluding equity as a funding tool is that equity would be issued in a time of financial need (distress) - not due to

[81] T. Johannesson H+H reddet af kapitaludvidelse, Børsen, 2010

operational investment or similar positive investment cases. Investors would without a doubt demand higher returns in such scenarios, increasing cost of capital – which would be quite contradictory to this thesis goal, which is to show that the cheaper cost of capital is somewhat lower than what is otherwise advisable when using the logic behind the WACC smile.

The option that is presented or should I say, should have been presented to H+H International, in the hay days is split into two.

- The first option is to calculate the value of an option to mitigate unsound increased leverage levels without additional financial room
- The second option is to calculate the value of an option to mitigate unsound increased leverage levels with additional financial room
- Finally the nominal option value can be calculated as in equation 13

(Eq. 13) $$Call_{lev..opt.} = Call_{X_{ex.}} - Call_{X_{incl.}}$$

Figure 9 shows how the possible path of leverage, while the orange and green boxes indicates the strike prices of each of the two options. Notice that 'green' strike price will exercise p_1 to p_7 and 'orange' strike price will exercise p_1 to p_4. Notice that when the option are subtracted from each other you are left with exactly the additional value created by financial room – in this case the value between p_5 to p_7.

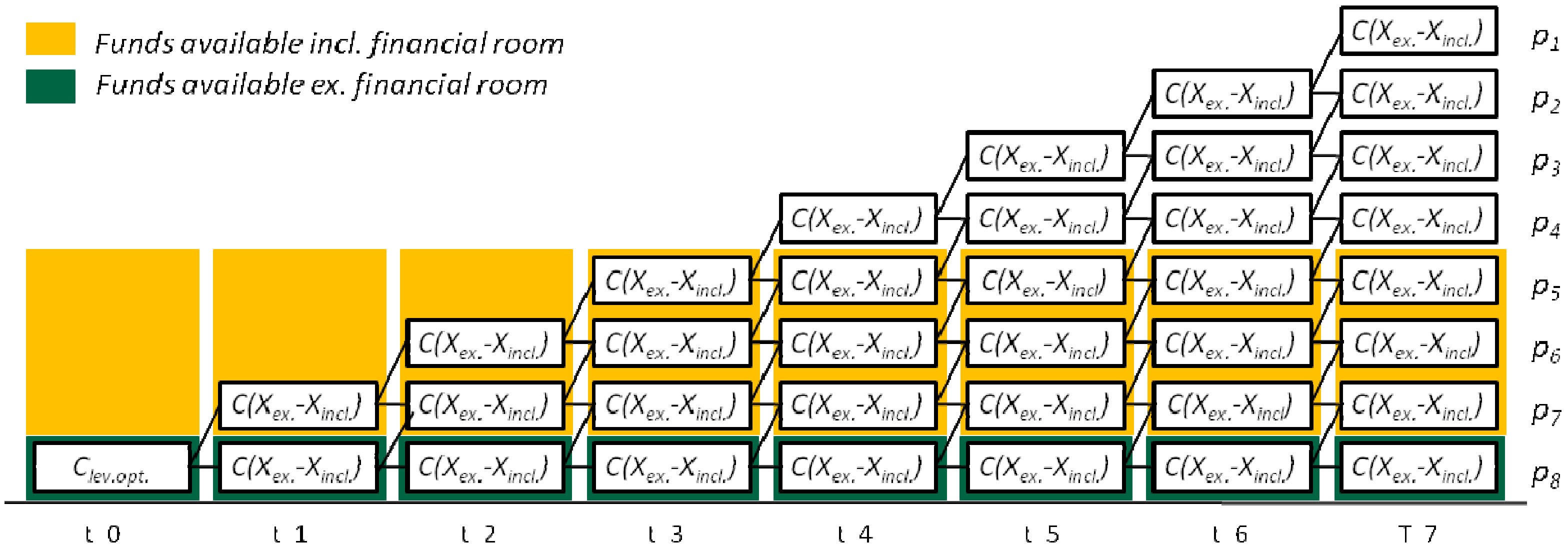


Figure 9 Binominal tree for the leverage option and the two strike prices - excluding and including financial room

The previous section described how the option available to H+H International could be handled by somewhat common financial models. The following section will setup the expanded discounted cash flow model (eDCF) and explain how to approach it practically.

5.4 The expanded Discounted Cash Flow model

As valuation using the option theory is not a stand-alone valuation H+H International must be valued using a basic DCF valuation, on which the option valuation can be based on. The combination and optimization of the two in unison is what I call the eDCF model. The first step in the process is to value H+H International using the standard DCF model, then the option value of H+H is calculated and added to the value computed by the DCF model. One must remember that the option is simply to value a flexibility not a regular asset.

The total value of H+H International can then be summarized to

(Eq. 14) $eDCF = DCF + option\ value$, which again can be detailed further to

$$EV = \sum_{t=1}^{t=n} \frac{\mathrm{CF_t}}{(1+\mathrm{r})^{\mathrm{t}}} + \mathrm{Call_{lev.opt.}}$$

Both valuation models are evaluated at *t*=0, why there value are corresponding to each other at first sight. However, the DCF model values a firms cash flow for 'eternity' through the use of a horizontal/terminal value. This is not the case for the option value which is calculated using a definite timeframe. To relate to the base valuation this definite timeframe corresponds to the timeframe of the budget period.

Also the two different valuation methods uses different measures of value, but are to some extent depending on the same parameters and value drivers – this subject I will return to.

5.4.1 Base valuation setup

When doing a DCF valuation of a company a prerequisite is a budget period of a sufficient amount of years. To produce such a budget it is necessary to get to know the business and the industry and sector in which it operates. A good start is of course to extract all relevant industry analysis, market reports, news articles, annual report and what else. Having worked your way through this, an analysis of historical value drivers and financial results can highlight the true performance of the company. Overall this analysis process can be divided into three steps

1) Information gathering, accounts- and key figure analysis
2) Prediction of the strategy going forward and associated budgeting
3) Valuation using free cash flow and the DCF model

Each step is of course equally important to make a valuation possible. The first step is nevertheless the most qualitative and demanding part of the analysis, creating the basis for the remaining parts of the valuation. Especially the extraction of the free ash flow and the value drivers of the case company. Next, I will shortly explain the 3 steps and what they each entail.

1) Information gathering, accounts- and key figure analysis

In valuing any company it is important to understand the drivers of the performance so far. This should also be seen in a context of the macroeconomic environment. E.g. how resilient is the company's performance to swings in the general economy. As figures are dissected and value drivers and free cash flow is extracted, a historical level is identified in a macroeconomic context. Also the company's core and non-core activities are separated along with financial income and expenses. Hence core income from operations can be encircled and investments and net-working capital from operations can be defined e.g. as a percentage of revenue. Resulting in the free cash flow to firm (FCFF). It is important to notice that I extract the cash flow to the firm as I later value the firm as a whole. Hence I need to know the cash flow before it is divided between equity and debt of any kind. The approach is described in Figure 5, showing the overall approach used. It is important to point out that the cash flow analysis is using input from both the Profit and Loss along with the balance sheet, as the profit and loss only registers income and cost directly associated with sales.

In the end the reformulation of the financial statement should end up in a combined income statement and balance sheet (see appendix) that assures that the numbers still adds up in order to secure the dynamics of the balance sheet and income statement – e.g. that earnings after tax is added to equity.

2) Prediction of the strategy going forward and associated budgeting

Any corporate finance book will within the first pages tell you that any asset should be valued using the expected future cash flow of that assets - this is the foundation of any valuation. In order to do so we need to forecast the future cash flow of the target company. In real life, the company would start by laying down a strategy for an extended period of time, to be able to predict investments, income, expenses etc. going forward. The strategy needs to contain two periods within the future cash flow forecast. This is due to the formula used for valuation. If you look back at equation 2, the valuation is divided into a budget period and a terminal value. In practice this divides the forecast into a year-by-year approach where each year is carefully forecasted with revenue growth, earning-ratios, working capital, investments etc. this leads to a annual cash flow forecast that is discounted. This year-by-year specification is continued until a steady state is reached. The steady state is the final part of the forecast where the company has reaches a level where abnormal growth rates are no longer an option, investments is a function of a steady state income along with working capital etc., in other words, there are no strategic extraordinary items that causes a need for specific forecasting. The company has reached a steady state that is predicted to continue into eternity with a long-term sustainable growth rate, also it is seen as good practice to use a earnings ratio that implies a return on invested capital (ROIC) equal to the cost of capital (WACC). The reason for this alignment is that economic theory tells us that abnormal profit would be eliminated during time by competition. This rule can in some cases be 'overruled' by the company's or industry's ability to continuously achieve abnormal returns[82].

3) Valuation using free cash flow and the DCF model

As step 1 and 2 has now been carried out, it is now time to discount the cash flows from the budget and terminal period. In order to discount with the appropriate discount rate the proper discount factor must be calculated. This is done using the WACC formula with yearly adjustments. The re-calibration is done using market values of both debts and equities. In regards to debt, the market value is the debt at which current outstanding bonds are traded, going forward it is of course not possible to adjust with existing market values, why I must use the nominal value determined by the

[82] R.A. Brealey et al., Principles of Corporate Finance, 2008

fluctuations in cash flows. In regards to equity, the market value can by equal measures be determined by tracking the price at which the stock is traded. However, recalibrating market value of equity into the future, one can use the DCF model as the approach can value equity in any budget period.

The process of calculating WACC and value equity at market value is in this fashion interrelated, as we need the one value to calculate the other and vice versa. Hence calculating the two involves a principle of circularity which is solved by multiple iterations until WACC and equity value is at par with one another[83].

As leverage ratio is determined earlier on as a result of financial policies, the WACC is determined to a large extent in the pre-condition made in step 2. If leverage ratio is kept fixed within a tight interval, then WACC would in most cases remain constant throughout the forecasts, however if no leverage policies are in place leverage would be determined from the spill-over effect from operations – positive cash flows would decrease leverage as debt would be paid back, and poor cash flow would increase debt. As leverage changes so does financial expenses, making debt and the calculation of interest an iterative process as well as equity and WACC.

As the thesis is concerned with finding the optimum leverage ratio using option theory *and* valuation, I must also decide on the optimum leverage ratio without making use of option valuation. To do so I detail the determination of how WACC is calculated and hence how the optimum leverage ratio is defined[84].

5.4.2 Estimating a correct WACC

In order to value the cash flow at present day, it needs to be discounted with the risk weighted average cost of capital – WACC. As the cash flow is worth the most when WACC has the smallest value, this section is to define how to reach that level using leverage as the lever.

[83] A. Damodaran, The Promise and Peril of Real Options, 2005
[84] R.A. Brealey et al., Principles of Corporate Finance, 2008

Looking at WACC as a function of leverage, I will approach the calculation as a function of leverage, disregarding any other factor that might influence [85]. As defined earlier WACC is written as

(Eq. 04) $$WACC = r_E \frac{E}{(E+D)} + r_D \frac{D}{(E+D)}(1 - t_c)$$

As one can extract from the formula, WACC consists of 3 parameters depending on leverage, they are a) r_E, return on equity, b) r_F, interest on debt, and c) t_C, the company tax rate.

As the tax rate is defined by authorities and beyond the control of the company, I take this factor as a fact. The two remaining parameters I carefully explain going forward.

5.4.3 Estimating the return on equity

The required return on equity can be calculated using various approaches. The most standardized approach would be the Capital Asset Pricing Model (CAPM) which is referred in most, if not all literature, on my literature list. In short the CAPM calculates the required return as a function of the risk adjusted return compared to the market return added the risk free return.

(Eq. 15) $$r_E = r_f + \beta\left(E(R_{m)} - r_f\right)$$

Where r_f is the risk free rate as referred to earlier on in the thesis. $E(R_m)$ is the expected return of the market. β, or beta as it is called is the measure for risk relative to the market. This again totals 3 parameters that needs to be quantified in order to compute r_E.

The expected market return

A chapter on method and another chapter on what method to use could easily be justified, but the focus of this thesis doesn't allow it. Instead we simply use the values often indicated in corporate finance text books which is stated as 4,5%[86].

The risk free rate

The first real parameter to estimate is the risk free rate. The risk free rate is quite frequently used in financial models, and is often taken for granted. This assignment is not to discuss in details the

[85] In real life a status quo leverage could change WACC level due to e.g. macro environment that changes risk appetite, hence interest rates on debt. Despite such impacts, WACC is as a standard a function of leverage.
[86] T. Koller, Valuation, Measuring and managing the value of companies , 2005

implication of the model, but simply to state some of the more obvious requirements. 1) there can be no dedault, 2) there can be no reinvestment risk[87]. The latter implications is the reason why there in some cases should be separate risk free rate for different cash flows at different maturities[88]. As private companies always have the risk of defaulting they can never achieve a risk free rate. Hence only government bonds can achieve a risk free status. But as they are issued in many currencies with separate maturities they all have different rates, which bring us back to the reinvestment risk and the demand for matching each cash flow with a new rate. The standardized approach to circumvent such troublesome modelling is to use one risk free rate that matches the duration of the cash flow you are valuing. In our case such risk free rate would then have to match the budget period described in the former chapter. When picking the actual risk free rate I will chose a German Treasury bond as the Danish kroner is pegged to the euro and also to keep the FX risk at a minimum (Bunds[89] are quoted in euro as well). Also the liquidity of German bonds are much better than Danish bonds why investors does not require a liquidity premium[90].

Estimating beta

As mentioned beta is a measure to adjust the riskiness of the assets in relation to the market. From an outset the market equals a beta of 1, whereas an asset with below-market risk has a beta value below 1 and an asset with above-market risk has a beta above 1. In other words, the risk compared to the market dictates what return we should expect from any given asset. Also, the beta value depends on leverage (as can be seen in Table 4) as interest increases volatility of earnings per share. To measure a company's beta (against the market) you do a regression to estimate the correlation between the market and the company(asset). As you might have figured out, beta is not a parameter measuring how much the company is moving up and down according to a steady-state market, but instead how much the company is moving together with the market. If volatility is less than the market you will get a value below 1, higher volatility will then give you a beta above 1. If beta is zero you have no risk, in other words the risk free rate has a beta equal to zero.

[87] The implications is that for a bond (or other) to be risk free expected and actual returns needs to be equal.
[88] A. Damodaran, Investment Valuation, 2002
[89] Bunds, is financial slang for German treasury bonds
[90] T. Koller et al, Valuation, Measuring and managing the value of companies , 2005

When doing the beta regression T. Koller et al. have 3 primary recommendation,

1) Use a data set of 60 periods
2) Use data of longer periods, such as months, as days easily provides data bias, and finally
3) Use as big as possible proxy for the market, as smaller exchanges often delivers one-sided data. E.g. Nokia used to be a very big part of the Finnish stock exchange in the hay-days.

Also it is recommended to do rolling beta's to make sure there are no systematic risks in the stocks beta[91]. Doing the regression you are left with the *raw beta*, which is influenced by whatever leverage ratio the company might have at that given point. The formula for raw beta is,

(Eq. 16) $$\beta = \frac{Cov_{i,m}}{\sigma_M^2}$$

where $Cov_{i,m}$ is the covariance between the company and market and σ^2_M is the variance of the market.

To undo the effect of leverage we need to calculate a beta excluding leverage. To do so, we again involve Modigliani and Miller who earlier in the thesis told us that the risk on the claims must equal the risk on the asset. Using this assessment we can equate risk with returns and hence use the following equation

(Eq. 17) $$\frac{V_u}{V_u+V_{txa}}\beta_u + \frac{V_{txa}}{V_u+V_{txa}}\beta_{txa} = \frac{D}{D+E}\beta_d + \frac{E}{D+E}\beta_e \ ,$$

where V_u is the value of the operating assets and V_{txa}, the value of the tax shield. On the right side you have β_x for risk on both equity (E) and debt (D). This equation can be simplified using the two general assumptions. 1) Debt is low-risk as it has priority over equity and is kept at a constant level, and 2) that the risk of the tax shield fluctuates with the risk of the assets, why β_{txa} will equal the β of the unlevered company. This leads us to the below simplified beta relation between the levered and unlevered company

[91] T. Koller et al, Valuation, Measuring and managing the value of companies , 2005

(Eq. 18) $\beta_l = \beta_u\left(1+\frac{D}{E}\right)$, hence $\beta_u = \frac{\beta_l}{\left(1+\frac{D}{E}\right)}$,

where β is the risk measure for the levered (*l*) and unlevered (*u*) company multiplied with the leverage. Re-levering the company, we wish to take into consideration the use of tax shield as well to estimate the levered beta, instead applying the formula

(Eq. 19) $\beta_l = \beta_u\left(1+(1+t)\right)\frac{D}{E}\Big)$, where t is the tax rate

We are now only lacking the final of the three parameters in the WACC formula, required return on debt.

5.4.3 Estimating the cost of debt

When financing a company there are multiple instruments that can be used to raise additional capital. Larger companies will often issue bonds whereas a smaller company will apply for credit at the local bank. As with everything else in finance, returns (/cost) follow risk, so the higher the risk on the debt, the higher the cost of borrowing. Risk increases due to two factors, a) high leverage and b) lack of collateral. In some cases existing debt can be made more risky simply by the company taken on new debt with e.g. collateral, pushing 'existing' debt further down the collateral 'latter'[92]. When companies issue debt as publicly traded bonds, the price of risk can easily be measured simply by turning to the traded bond and observe the price. When this is not the case, price and riskiness is assessed by using rating models that dictates a price on the debt. Such rating models is a mandatory tool of any bank, but also a tool that is not accessible to a wider audience as these are kept as a company secret. However as an alternative, rating agencies such as Moody's, Standard & Poors etc. have publicly available rating models, where quantitative and qualitative models are accessible[93].

Both T. Koller and A. Damodaran touch upon the subject of rating agencies and there approach. They both agree that the interest coverage ratio is of key importance, but also that company size is of importance to rating. As we need to have a practical approach to rating and cost of debt, it is not an

[92] An example of this is the 'world' famous LBO of TDC, see also; S. Kyhl et al., TDC case seen from corporate bond view, 2006

[93] Models are not a 100% public, but there is a general tendency to publicize the most common and important criteria

option to do a qualitative assessment, why I must do with quantitative modelling of the company's rating.

A. Damodaran has even gone so far as indicated a way to synthetically price the cost of debt using the coverage ratio. Using such an approach would make it possible to use in a dynamic model as the one developed in this thesis, why I will go with his setup[94].

1) Use the desired leverage ratio and company value to decide nominal debt level
2) Manually indicate an interest rate appropriate to the debt level
3) Find the appropriate EBITDA level and interest cost to calculate the coverage ratio
4) Use the coverage ratio to 'rate' the company and apply the appropriate interest rate
5) Use the interest rate calculated in step 4 in step 2
6) Repeat step 2-5 until rating and interest rate are aligned

The iterative process is a practical approach, where caution must be used. When calculating the coverage ratio, a ratio below 1, means that EBITDA is smaller than the interest due, hence the interest tax shield doesn't reach its full effect. As stated this is a practical approach very usable in a dynamic model as the one I have created in the extensive Excel modelling done for the case company.

Having given an approach for each of the parameters in the WACC equation, next step is to explain an approach to minimize WACC, hence optimizing the cash flow value/enterprise value.

5.4.4 Minimizing the cost of capital (WAACC)

Finding the optimum WACC is actually what the thesis is about. As the model is divided into two overall steps, the first part is to calculate the optimum WACC which equals minimum WACC in this case (as it doesn't take flexibility into account). In other words this section of the thesis is concerned with computing the lowest point on the WACC smile (see Graph 5).

[94] T. Koller et al, Valuation, Measuring and managing the value of companies , 2005 and
A. Damodaran, Investment Valuation, 2002

Setting up a step-by-step guide for estimating the minimum WACC is a practical exercise - using the input parameters earlier described in this chapter. As all parameter is a function of leverage, this will be the common input for all calculations. Following that we can estimate the cost of equity without regarding the risk on debt (as earlier defined the risk of debt to zero), following that we use an iterative process to compute the cost of debt and the essential 'use' of the interest tax shield. To approach the WACC computation I apply a step-by-step guide

1) Calculate the unlevered beta for the case company by doing a regression of monthly returns of target company and a market index
2) WACC terminology is based on market values, hence start by estimating the market value of the company,
3) Generate a table with smaller jumps in leverage as % to market value,
4) Calculate the nominal leverage level and levered beta for each leverage-level, then calculate the cost of equity by applying the CAPM formula

   (Eq. 15) $$r_E = r_f + \beta\left(\mathrm{E(R_{m)}} - \mathrm{r_f}\right)$$

5) Use the iterative process described earlier to compute rating, interest rate expenses and effective value of the tax shield
6) WACC is finally calculated using the weighted cost of equity and debt after tax

   Eq. 04) $$\mathrm{WACC} = r_E \frac{\mathrm{E}}{(\mathrm{E+D})} + r_D \frac{\mathrm{D}}{(\mathrm{E+D})}(1 - \mathrm{t_c})$$

   finally it is simply to locate the leverage at which the lowest WACC can be achieved

The leverage level that is found using this method is of course dependent on the amount of steps at which each leverage level is computed. To achieve higher accuracy one can simply use 1%-points steps instead of 10%-points steps in debt-to-enterprise value.

The leverage ratio and WACC value is the value that later will be used at the target capital structure for H+H International, and hence the value on which fluctuations could happen as an effect of e.g.

unfortunate economic environment - pushing leverage beyond the optimal point. For the full length of the base valuation model it is assumed that the leverage level is kept at this minimum level.

As this thesis argues that the minimum level, as just explained, is in fact not the most valuable to the company I will move onto explaining the methodology behind the alternative viewpoint. The real option valuation method is to value the 'slack' of an added leverage flexibility that is achieved by leveraging less than the optimal leverage point, leaving flexibility to endure uncertainties.

5.4.5 The expanded valuation setup (Real option)

In the previous section we described how to approach the basic valuation, but as we recall the job was to develop a valuation tool that included the value of flexibility in regards to leverage, the expanded Discounted Cash Flow model (eDCF). This section is to detail the latter part of that model.

As decided on earlier this flexibility is valued using the binominal model. Just as with the DCF model the estimation and the quality of the input-parameters are just as important for the output value. The major difference being that the inputs are restricted to fewer variables and are less concerned with the correct reformulation of annual reports. As explained (see Figure 9) the real option consists of two options subtracted from each other, $X_{ex.}$ and $X_{incl.}$, which is used to calculate the option on the underlying asset (*S*), which in our case is the leverage ratio. To explain the approach I will set up steps to implement the model. I will start with estimating the input parameters, later how to setup the lattice and calculate both option value and total eDCF value. The overall approach being,

- calculate the optimal leverage ratio which is to be used as the underlying asset (*S*) (see previous section)
- calculate the volatility on the underlying asset (*S*) using historical leverage figures as input
- setup the lattice for the underlying asset (*S*)
- setup lattices for calculating the strike with ($X_{incl.}$) and without ($X_{ex.}$) financial leverage room and calculate total leverage option value using equitation 13.

  (Eq. 13) $$Call_{lev..opt.} = Call_{X_{ex.}} - Call_{X_{incl.}}$$

When having done the following an integration of the DCF model end real option model is done, where after it is possible to solve the equation of where the true optimal leverage level is.

Leverage ratio – the underlying asset

In the theoretical ideal world any company would aim for a target capital structure that would minimize the company's WACC. When doing so they expose themselves to the risk of leverage increasing due to operations. The reason for the search of optimal leverage is of course to maximize the value gained from cash flows. This is, as we show, done through taking advantage of the interest tax shield. But as leverage tips over, the gains are lost. To estimate the value of this tipping point I use the binominal model to estimate the distance from the tipping point that is most valuable, taking volatility and leverage into account. To do so I use the optimal leverage ratio as the underlying asset in the asset lattice. Simply calculated as in the previous section, "5.4.4 Minimizing the cost of capital (WAACC)", using market values on both equity and debt to estimate the ratio.

It is worth mentioning that using the leverage ratio as the underlying asset is an original solution, and not previously mentioned in any relevant literature[95].

Volatility on underlying assets

In order to make use of option theory and the risk neutral probabilities we need to estimate a value for the volatility of the underlying assets. As we are interested in the movements of the leverage ratio, I simply go back in time and estimate the market value of debt and equity year by year.

The volatility is measured by the standard deviation (σ) or variance (σ^2), which is the driver behind the up and down motion in the lattice, along with time. The formula (Eq. 08 & 09) $u = e^{\sigma\sqrt{\Delta t}}$ then $d = 1/u$ tells us that volatility is adjusted by the fraction in which the year has been divided into[96].If we imagine the modelling to be done on a yearly basis we can shorten the equation to e^{σ} as $\sqrt{1} = 1$. If this is the case then we know that for a single period (year) the standard deviation should $e^{\sigma} = \sigma$.

[95] The statement is to emphasize two things, 1) the thesis is based on the authors own research and development in regards to the option part of the thesis, 2) it has not been possible for the author to locate any guiding articles or papers supporting the (or the opposite) option model developed in this thesis.

[96] As I am estimating the standard deviation on a year-by-year basis, delta time (Δt) equals the fraction of which the year has been split in the option modeling.

An equation with such properties can be found if using the natural logarithm function (LN) when calculating the volatility, since $e^{LN(X)} = X$, as long as X > 0. However this is no problem as leverage can never achieve a negative value[97]. In other words we should estimate the volatility using the LN^{th} value. The formula for the standard deviation for the leverage ratio can be written as

(Eq. 20) $$\sigma = \sqrt{\frac{1}{n-1}\left(\sum_{t=1}^{t=n} LN\left(lev._{ratio\ in\ \%} - avg.lev._{ratio\ in\ \%}\right)\right)^2}$$

The expression $lev._{ratio\ in\ \%}$ is leverage measured as percentage, $avg.\ lev._{ratio\ in\ \%}$ is the average leverage through the complete period of *n*. Notice that the estimate uses 1 degree of freedom; I might need to leave this out as we in cases of smaller data populations will experience large differences if using one degree of freedom (n-1).

The option value of leverage flexibility

The value of leverage flexibility has been defined as $Call_{lev..opt.} = Call_{X_{ex.}} - Call_{X_{incl.}}$, stating of course that the value is defined as the difference between a company without the flexibility ($Call_{X_{ex.}}$) and with flexibility ($Call_{X_{incl.}}$). The value is to be defined as a strike price of additional available capital that can keep the company from overshooting its target capital structure. Such capital could be either cash from operations, debt or equity.

When leverage increases and a company find it necessary to lower it by issuing additional equity, this of course is done with a risk premium. An alternative view to the trade-off between debt and equity proposed by Modigliani and Miller is the Pecking-order theory. This suggest a pecking order in financing that argues a company would finance itself from operations first, next with debt and finally with equity. In regards to equity the theory states that investors will interpret an equity issue as a sign of the stock being overvalued, as rational managers would not otherwise issue equity. This same viewpoint would hold for debt, but strongest for equity as debt is much less sensitive to a company's success.

[97] J.C. Hull, Options, Futures, and Other Derivatives, 2006

Despite the logical reasoning the long-term evidence doesn't back-up the theory as it would predict. However, T. Koller et al. argues the signalling effect for companies might be quite significant in regards to funding timing. In this thesis this case would support that I indeed should take into consideration the pecking order theory, as an issue of equity to lower leverage would fall under the category of bad timing[98]. In this light I disregard equity issue as a funding option to correct the leverage ratio. This is also supported by the equity issue done by H+H, which was forced upon them by their creditors, who otherwise would terminate the loan agreement[99].

I can now define the strike price (*X*) of the two options. The first strike ($X_{ex.}$) is used to price the option without flexibility. As this option is looking at the fully levered company the only funds available is the free cash flow (as defined in Figure 5). In order to align the nominal FCFF to the terminology used for the underlying asset (leverage ratio as a % of EV), we divide with enterprise value and get a %-value.

The second strike price ($X_{incl.}$) is equally defined as funds as % of enterprise value. As this strike price is to include the flexibility from decreasing leverage to below optimal. Making the additional funding equal the difference between current leverage and optimal leverage level.

Notice that if there is no additional funding $X_{ex.} – X_{incl.} = 0$, hence the value of the company equals the ordinary value calculated by the DCF model. If looking at Figure 9 that would result in the orange and green areas being exactly same height – hence exercising the same amount of options.

Developing the real option lattices

To make use of the inherent logic of the binominal model, a lattice is set up for each of the 3 steps. First we set up a lattice for the underlying asset (*S*) to be able to follow it up and down movements, following that we calculate the value for each of the two options.

[98] T. Koller et al, Valuation, Measuring and managing the value of companies , 2005
[99] M. Baker et al., Market Timing and Capital Structure, 2002 and M.C. Jensen, Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers, 1986

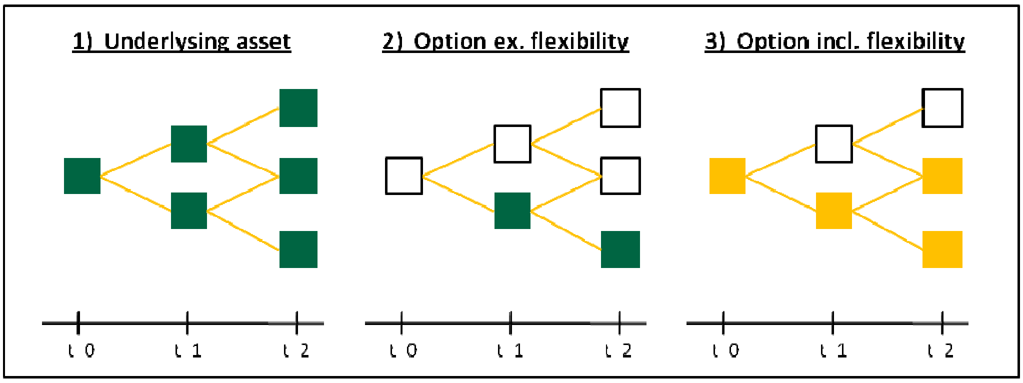


Figure 10 The 3 lattices

To calculate the first lattice we calculate from left to right, starting with optimal leverage ratio. Each node in the lattice is calculated using the formula for either an up- or down-movement.

(Eq. 08 & 09) $u = e^{\sigma\sqrt{\Delta t}}$ and $d = 1/u$. The process is continued node-to-node until we reach the end-node at time *t*=*n*. The end node is in this case the final year used in the DCF model (last year before the terminal value in budget). Notice that the down movement will continue to zero (or close) and the up movement will reach values above a 100% - in real terms meaning that debt exceeds enterprise value, and in effect the company is bankrupt. Both extreme movements are actually meaningful, as zero debt is an obvious conservative approach and on the other hand, the abnormal leverage ratio (>100%) is just a measure for the probability of default.

The next step is to calculate the two call values in lattice 2 and 3. As mentioned the value is calculated from right to left. The principle of each node is to choose the maximum value of the weighted discounted value from the two prior nodes or the current exercise value of exercising the option at current node. The end node is a special case where the alternative to present exercise is zero. The strike price used to calculate the option in both lattice 2 and 3 has been described above, the remaining task is simply to use the formulas previously defined,

(Eq. 11) $C_t = MAX(S_T - X; 0)$ which is the value of the call at the end node

(Eq. 12) $C_t = MAX(\frac{p*C_{t+1}^u+(1-p)*C_{t+1}^d}{e^{r_f\Delta t}}; S_t - X)$ which is the call value at all other nodes

As both option lattices have been calculated the two call option values are simply subtracted from each other, $Call_{lev..opt.} = Call_{X_{ex.}} - Call_{X_{incl.}}$, the value left is hence a % of enterprise value, more exactly the leverage ratio that the increased leverage flexibility could afford with the available funding.

5.4.6 Extracting total of the eDCF and the leverage option

In the initial phase the enterprise value of the company was computed as $\mathrm{EV} = \sum_{t=1}^{t=n} \frac{\text{CF to firm}_t}{(1+\text{WACC})^t}$ using the minimum WACC as discount rate. In order to prove the value of a leverage option we must apply the following equation $MAX = (DCF; eDCF)$. The value from the DCF model is pretty straight forward, but to transform the value from the leverage option into a nominal value some modelling must be done. As the $\mathrm{Call}_{lev.opt.}$ value is equivalent to a leverage ratio the nominal value of it is extracted as the delta value between the discounted cash flow using *"optimal leverage"* and *"optimal leverage - Call$_{lev.opt}$"*.. Hence the value is related to the difference in the discount rate used.

The total value calculated using the eDCF is then the present value of the cash flow using the discount rate modelled with the optimum leverage less the delta value of the call options, plus the present value of the difference between the optimal leverage scenario and the optimal leverage scenario added the call option delta value. To simplify the total value it is the sum of the 3 present value calculations. 1) EV_1 uses the optimal leverage minus the call option, 2) EV_2 uses the optimal leverage, and finally 3) EV_3 uses the optimal leverage plus the call option.

To understand the mathematics behind the complete model I have developed equation 21-24 to explain the mathematical logic. In respect of the reader, remember that a prerequisite to using the eDCF model is to calculate the optimal leverage point and WACC (*$WACC_{opt.}$*) along with the $Call_{lev..opt.} = Call_{X_{ex.}} - Call_{X_{incl.}}$. As this has been done we can now set up a formula for the eDCF, by defining the three calculation methods for three different WACC's used.

(Eq. 21) $$WACC_{opt.-} = r_E \frac{\mathrm{E}}{\mathrm{EV_1}} + r_D \frac{\mathrm{D_{opt.}} - \mathrm{call_{lev.opt.}}}{\mathrm{EV_1}} (1 - \mathrm{t_c}) \,,$$

(Eq. 22) $WACC_{opt.} = r_E \frac{\mathrm{E}}{\mathrm{EV_2}} + r_D \frac{\mathrm{D_{opt.}}}{\mathrm{EV_2}}(1 - \mathrm{t_c})$, and

(Eq. 23) $WACC_{\mathrm{opt.+}} = r_E \frac{\mathrm{E}}{\mathrm{EV_3}} + r_D \frac{\mathrm{D_{opt.}+call_{lev.opt.}}}{\mathrm{EV_3}}(1 - \mathrm{t_c})$, where $D_{opt.}$ is the optimal leverage point.

Using the WACC values above in the equation for the eDCF model, I can develop what is to maximise the value of the company by including the leverage option.

(Eq. 24) $$eDCF_{lev.opt.} = \underbrace{\sum_{t=1}^{t=n} \frac{\mathrm{CF\ to\ firm_t}}{(1+\mathrm{WACC_{opt.-}})^{\mathrm{t}}}}_{\mathrm{EV_1}} + \underbrace{\sum_{t=1}^{t=n} \frac{\mathrm{CF\ to\ firm_t}}{(1+\mathrm{WACC_{opt.}})^{\mathrm{t}}}}_{\mathrm{EV_2}} - \underbrace{\sum_{t=1}^{t=n} \frac{\mathrm{CF\ to\ firm_t}}{(1+\mathrm{WACC_{opt.+}})^{\mathrm{t}}}}_{\mathrm{EV_3}}$$

As to maximise the value of the company EV_1 - EV_2 must be smaller than EV_2 - EV_3. The logic behind that reasoning is that to gain flexibility the company must reduce its leverage from optimal. The cost of that equals exactly EV_1 - EV_2, whereas the gain is exactly EV_2 - EV_3. If $EV_1 - EV_2 = EV_2 - EV_3$ then the value of the leverage option is zero and the company should target a capital structure equal to $D_{opt.}$.

The eDCF model has now been fully developed, based on inspiration from A. Damodaran and his 'financial flexibility' model but mostly due to own research and testing into whether a 'leverage option' could be plausible. Next step is to test on a real life case, H+H International.

Part 6: H+H International A/S and the eDCF model

To test the own-developed eDCF model, to give the reader an insight in to its working and not least to find its pitfall the model will be applied to H+H International to test its applicability. The model is to highlight whether H+H from a value optimisation viewpoint should have chosen differently if applying the model. To carry out the analysis both the DCF model and the real option theory must be applied and merged. Both models require input from H+H historical performance as well as expectations for the future.

To start with I have made a reformulation of the annual accounts from 2004 to 2012 to get a financial indication of H+H hardship and the periods at which they were hit the hardest (see Appendix A) but also to get the feeling of the value drivers in the good times and the value destroyers in the bad times.

Key ratios	2004	2005	2006	2007	2008	2009	2010	2011	2012
EBIT	195.185	141.561	128.874	222.412	19.029	-205.290	-257.150	-53.063	-7.229
EBIT margin	14,2%	10,5%	7,8%	12,0%	1,3%	-19,2%	-21,7%	-4,1%	-0,5%
NOPLAT	145.257	95.820	84.947	170.477	14.896	-188.807	-248.687	-85.794	-48.938
NOPLAT / revenue	10,6%	7,1%	5,1%	9,2%	1,0%	-17,7%	-21,0%	-6,6%	-3,7%
Net operating assets	64.075	951.045	1.223.358	1.371.114	1.606.220	1.553.935	1.339.157	1.181.991	956.520
Asset turnover ratio[100]	2,04	1,75	1,51	1,05	0,66	0,76	0,98	1,12	N/A

Table 9 Key historical ratios og H+H International A/S

As numbers indicate, there is a rather big shift in the underlying performance in 2007, and again in 2008 as this was the first miserable year. 2008 should therefore not be included in the historical account but be part of the future accounts – in this way I can back test the result only using data provided from before the crucial years of 2008.

Therefore the present date at which the valuation has been carried out is 2006, using 2007 as the first future pro-forma year and 2013 as the last year pro-forma year before estimating the terminal period. In other words I use 7 future annual accounts before reaching a steady state on which the terminal period is based.

As space in the thesis is scarce the complete Excel analysis will for the most part only be available as extracted key-numbers, figures, tables and results within the thesis. However most of the numbers will be made available in the appendices. Further to this, all analysis and valuation modelling will be made available in the attached dynamic Excel analysis and valuation tool included on the CD-ROM attached to the thesis (see also the instruction manual in Table 10). Notice that only the historical

[100] The ratio has been calculated using next year's turnover as this years investments is seen as a prerequisite for revenue generated the coming years.

figures used in the modelling is attached in the appendices, the full analysis is only available on the CD-ROM.

Valuation tool to value the present value of H+H International A/S both excluding and including a leverage option		
Sheet	**Explanation**	**Instructions**
Accounts	Historical account from 2004 - 2012	No changes to be made
Equity statement	Historical equity statement or 2004-2012 incl. reformulation into Owner transactions and Total income	No changes to be made
Reformulation of accounts	Reformulating Historical to extract NOPLAT, FCFF etc. Also categorizing the balancesheet	No changes to be made
Key ratios & Value drivers	Key ratios for all historical years are calculated	No changes to be made
Assumptions	Simple assumtions incl. tax rate, risk free rate and market risk premium	No changes to be made
Beta calcuation	Calcuating beta for H+H using the a market index. The raw data is linked	No changes to be made. Data available here
Beta, industry alternatives	Alternative to company specific beta is indstry beta's	No changes to be here
Capital structure	Calcuating optimal leverage/minimum WACC for H+H	No changes to be made
Future Accounts	Setting up the Future Accounts(FA) for H+H, starting from 2007 + 10 years	Value drivers can be changed. Push button to adjust rates
DCF model	Setting up various DCF valuations to apply different WACC's. Uses input from FA	If future accounts is changed you must click button untill D/EV is alignned
Leverage ratio	Calculates the volatility of leverage and the average historical EBITDA	No changes to be made
Real Option Model	Completes the eDCF model by setting up and calcuating the binominal model	The solver function can be applied. Click Data→Solver (in analysis area)

Table 10 The Excel guidance made for the Excel eDCF valuation tool

6.1.1 Reformulating H+H International annual accounts for the DCF model

Having decided on the time period of the analysis 2004-2006 being the historical and 2007-2013 being the future I start my work[101]. I continue my work reformulating the income statement, the balance sheet and the equity statement (See Appendix A and Appendix B). This creates the platform for formulating the value drivers and the level at which they should be carried forward in good and bad times.

Also the reformulation of the equity statement brings out the dirty surplus of H+H, eliminating earnings and losses kept out of the income statement. In later years H+H has separated some of its non-future strategic locations from the remaining part of the income and balance sheet. As I consider this a 'bad excuse' for bad investments I kept the numbers in the analysis and made them part of core business. Also financial assets have been separated using a unique earnings driver.

[101] In volatility calculations of leverage ratio I use older historical figures to obtain a decent population.

6.1.2 Reformulating H+H International annual accounts for the Real Option model

Compared to the DCF model the binominal model only needs historical numbers to calculate future values. The yearly leverage ratio needs the market value of debt and equity. Leverage ratio is then calculated as *debt/equity + debt.* As to a have decent population for the calculation I have gathered data from 2000 until 2012. To calculate the market equity value I have used the share price of the final trading day multiplied with number of shares. As H+H debt is strictly bank financing (no publicly traded bonds) the only value accessible is the book value of debt which can be observed in the annual reports. Also I would argue (with some uncertainty) that H+H interest rate is a floating, meaning that rates can be adjusted annually (or so). Certainly it can be changed if covenants are broken. If this is the case then the market value of the debt would actually not change either, as the rate reflects the risk[102].

Calculating volatility we use equation 20 as defined earlier. As we can see from the equation it uses *n-1* degrees of freedom, which is the standard, but with such a small population it introduces additional/excess volatility. Therefore I use *1/n* instead.

(Eq.20) $$\sigma = \sqrt{\frac{1}{n-1}\left(\sum_{t=1}^{t=n} LN\left(lev._{ratio\ in\ \%} - avg.lev._{ratio\ in\ \%}\right)\right)^2}$$

in DKKt	Equity value	Debt	D/EV	ln(D/EV)	Shares outstanding	Stock price	Final trading day of the year
2000	900.876	282.685	23,9%	-1,43	1.000.973	900	*29-12-2000*
2001	754.000	291.103	27,9%	-1,28	1.160.000	650	*28-12-2001*
2002	777.200	362.356	31,8%	-1,15	1.160.000	670	*30-12-2002*
2003	1.473.200	262.223	15,1%	-1,89	1.160.000	1.270	*30-12-2003*
2004	1.363.000	233.331	14,6%	-1,92	1.160.000	1.175	*30-12-2004*
2005	1.571.800	123.356	7,3%	-2,62	1.160.000	1.355	*30-12-2005*
2006	2.134.400	352.926	14,2%	-1,95	1.160.000	1.840	*29-12-2006*
2007	1.579.920	380.773	19,4%	-1,64	1.160.000	1.362	*28-12-2007*
2008	327.000	863.040	72,5%	-0,32	1.090.000	300	*30-12-2008*
2009	637.650	595.774	48,3%	-0,73	9.810.000	65	*30-12-2009*
2010	519.930	613.605	54,1%	-0,61	9.810.000	53	*30-12-2010*
2011	415.944	628.540	60,2%	-0,51	9.810.000	42	*30-12-2011*
2012	255.060	538.638	67,9%	-0,39	9.810.000	26	*28-12-2012*

Table 11 Annual leverage ratio of H+H International A/S (market values)

[102] T. Koller et al., Valuation, Measuring and managing the value of companies , 2005

Calculating σ from 200-2012 we get σ=69% however as I decided to do the modelling from 2006 my numbers should be based on 2000-2006 figures. This results in σ=47%. Due to the later use of the dynamic Excel model I have also calculated a leverage ratio using book values.

in DKKt	Equity	D/EV on book value	ln(D/EV) book value
2000	421.623	40%	-0,91
2001	594.192	33%	-1,11
2002	574.510	39%	-0,95
2003	644.115	29%	-1,24
2004	755.981	24%	-1,44
2005	827.689	13%	-2,04
2006	870.432	29%	-1,24
2007	990.341	28%	-1,28
2008	743.180	54%	-0,62
2009	958.161	38%	-0,96
2010	725.552	46%	-0,78
2011	553.451	53%	-0,63
2012	417.882	56%	-0,57

Table 12 Annual leverage ratio of H+H International A/S (book values)

For the full population (2000-2012) σ=39% and for the reduced period (until 2006) σ=36%. Going forward I will use the volatility of calculated on book values for the reduced period[103].

6.1.3 Future accounts

To value H+H I use selected value drivers to forecast the income statement and balance sheet. On the basis of this a cash flow can be calculated and the capital structure can be extracted as a consequence of the cash flow. E.g. negative cash flow and dividend will increase leverage as it will increase debt. The future accounts are shown in Appendix E. The primary value drivers are revenue growth and EBITDA margin. Calculating production cost as a residual. Investments in tangible and intangible assets are then calculated as a % of revenue along with working capital. Net working capital and net investments is calculated and Free Cash From Firm (FCFF) is calculated. Adjustments to equity is simultaneously adjusted using dividends as function of leverage ratio and target leverage[104]. Further

[103] As the Excel model needs dynamics to be able to calculate the eDCF value, I have applied some restrictions in order to be able to make it work in practice. However, in the Excel model I have done market value calculation as a sanity test to the book value calculation.

[104] Target leverage is defined as lowest achievable WACC.

to this cost of debt is automatically calculated using a dynamic rating process as a function of leverage ratio (see for full table of future accounts and value drivers).

6.1.4 Calculating optimum leverage ratio

A vital part of the eDCF is the supposed optimal leverage as we know it from the standard corporate finance text book. As explained earlier calculating optimal WACC is a 6-step process (see *5.4.4 Minimizing the cost of capital (WAACC)*).

I start by calculating the unlevered beta by doing a regression of monthly returns of H+H and the market index represented by MSCI[105].

Calculating raw Beta		Calculating raw Beta	
From Jan. 2004 to Dec. 2008		*From Jan. 2008 to Dec. 2012*	
Obeservations	60	Obersevations	60
Variance	0,2022%	Variance	0,7006%
Covariance	0,1612%	Covariance	0,5563%
Beta	0,80	Beta	0,79
Calculating un-levered Beta		**Calculating un-levered Beta**	
From Jan. 2004 to Dec. 2008		*From Jan. 2008 to Dec. 2012*	
Levered beta	0,80	Levered beta	0,79
Tax rate	25%	Tax rate	25%
Number of shares	1.090.000	Number of shares	9.810.000
Price	300	Price	26
Equity, market value DKKt	327.000	Equity, market value DKKt	255.060
Debt, "Market" value	863.040	Debt, "Market" value	538.638
Un-levered beta	0,27	Un-levered beta	0,31
Source:	http://www.nasdaqomxnordic.com/aktier/Historiske_priser/?Instrument=CSE3284		
	MSCI World Index, Source: Bloomberg (MXWO)		

Table 13 Beta calculation for H+H International

T. Koller et al. suggest doing multiple beta calculations to check whether there are any systematic changes in beta. In Table 13 I have computed betas for two periods – before and during the crisis – both betas are almost identical in value, 0,27 and 0,31, but also remarkably low. Looking at the numbers I become critical of the very low beta value indicating a risk much below the market. Looking

[105] MSCI is a commonly used stock index originally developed by Morgan Stanley Capital International, an investment bank, but now a separate legal unit. It is constituted of approximately 1.600 stocks from wordwide.

closer at the data retrieved, it shows that H+H's daily trades and trading volume is very low. The median values being 19 and DKKt 780 respectively[106].

Industry Name	Unlevered Beta corrected for cash
Building Materials	0,88

Input for table calculations	
Risk free rate	2%
Un-levered beta*	0,88
Tax rate	0,25
Market risk premium	4,50%
Value of firm	1.554.637
EBITDA average	161.515

Table 14 Industry beta for 2007and table of value assumptions

The low volume indicates that H+H doesn't have sufficient liquidity for data to be applicable. Therefore I use industry beta for 2007 from A. Damodaran[107]. Using industry beta instead of company specific beta is also a recommend by T. Koller et al. as it improves the precision. Instead of using a single-company beta we use Damodaran's 0,88 for building materials, which is based on data from 48 companies (see Table 14). The unlevered beta is then re-levered as I model various WACC scenarios, and use it in equation 15, $r_E = r_f + \beta\left(\mathrm{E}(\mathrm{R_{m)}} - \mathrm{r_f}\right)$. The remaining input assumptions are highlighted above. The value of the firm is used to calculate the nominal debt level and corresponding interest and interest coverage ratio (see

Appendix D). The approx. 1.500.000 corresponds to the average book value of debt and market value of equity from 2000 until 2006. The EBITDA average number is the average EBITDA from the years 1992 until 2006, and is also used to estimate the coverage ratio, hence rating and interest rate on debt. Setting up a table as shown in

Appendix D I calculate WACC for small incremental changes in leverage in order to find the lowest WACC, hence optimal leverage ratio. Plotting the leverage against WACC shows the development as leverage increases. The orange column is the lowest calculated WACC value. It is worth noticing how little is gained from zero leverage to 50% and how much there is to lose when leverage passes the 50%.

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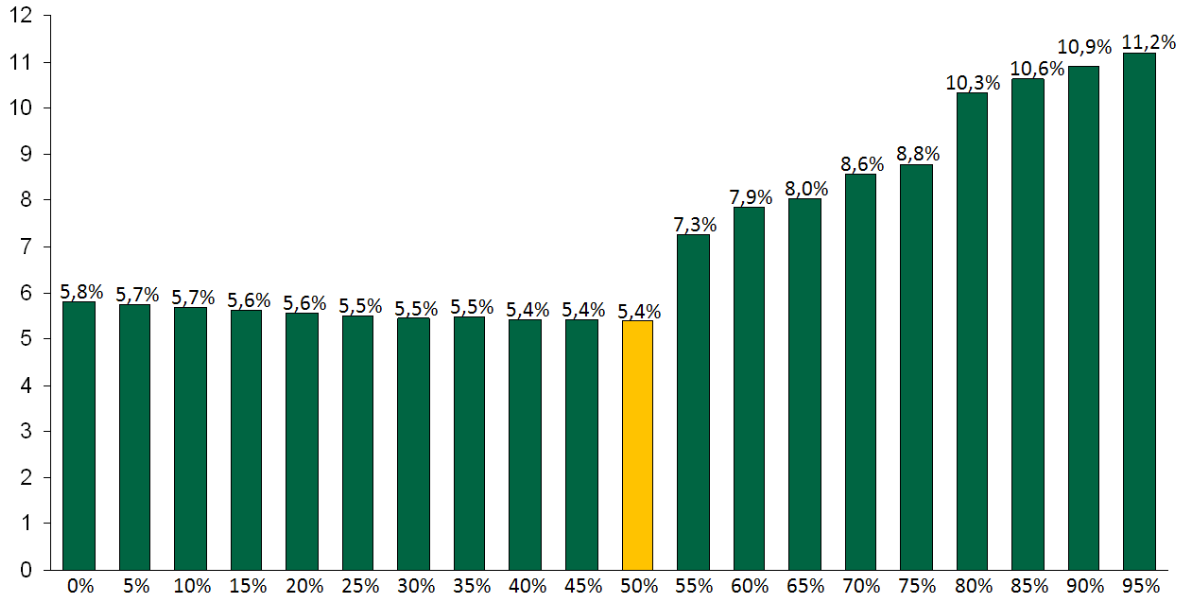
106 For a full set of data please see attached Excel sheet, sheet "Data, Beta" and "Beta, industry alternatives"

107 http://pages.stern.nyu.edu/~adamodar/



Graph 6 WACC plotted against leverage ratio

6.1.5 Valuation of H+H International using the DCF model

To calculate the value of H+H we make use of the standard DCF model. Using the future accounts to model the cash flow and the balance sheet movements. As the assignment is concentrated on developing a model to compute the value of the leverage option and hence not a strategic assessment of H+H, the value drivers should be seen as the writers subjective input loosely based on the development that actually took place prior to the crisis. Having given H+H a future direction NOPLAT is adjusted for investments and net working capital to get the free cash flow to firm (FCFF). Simultaneously the model adjusts the balance sheet in regards to debt. If leverage is below 50% equity is reduced by paying out dividends (80% of comprehensive income). When calculating the leverage ratio a trade-off has been made due to practicalities. The correct practice is to use market values calculated using the DCF model[108] thereafter using book value of debt to compute equity value. The practicality of the iterative process when calculating the market value would make it an extremely cumbersome job to make the pro forma budget why book value has been used (see Appendix E). To be able to value the book vs. market value trade-off I have made examples on

[108] T. Koller et al., Valuation, Measuring and managing the value of companies , 2005

calculation using both book value and market value so that the difference can be expressed using present value terms.

For both the book value example and the market value example the cash flow from the pro forma budget is used, in essence only making adjustments for leverage ratio, hence WACC. First I discount the cash flow using the yearly calibrated WACC on book values.

Dicounted Cash Flow valuation *(on book value)*	**2007e**	**2008e**	**2009e**	**2010e**	**2011e**	**2012e**	**2013e**	**Terminal**
FCFF	120.262	51.802	65.516	-920	15.657	18.616	119.055	110.174
Disount rate	0,94	0,89	0,84	0,80	0,75	0,71	0,67	0,67
Present value	113.535	46.244	55.259	-734	11.793	13.304	80.055	1.703.869
Enterprise Value	2.023.325							

Table 15 Enterprise value calculated on book values

Following that I calculate the Enterprise value with market values. Each future year the enterprise value of the future cash flow using the iterative process earlier described, has been applied, so that leverage ratio and WACC balances perfectly[109]. The calculations can be seen in Appendix F.

Dicounted Cash Flow valuation *(on dynamic WACC MV)*	**2007e**	**2008e**	**2009e**	**2010e**	**2011e**	**2012e**	**2013e**	**Terminal**
FCFF	120.262	51.802	65.516	-920	15.657	18.616	119.055	110.174
Disount rate	0,94	0,89	0,84	0,80	0,75	0,71	0,67	0,67
Present value	113.385	46.085	55.037	-732	11.790	13.292	80.356	1.716.804
Enterprise Value	2.036.016							

Table 16 Enterprise value calculated on market values

As cash flows in both calculations are exactly the same, the difference lies of course in the discount rate, WACC. As one can see the difference is in this case is very small. However as cash flow changes, so does enterprise value. Therefore changes in the difference between book- and market value can be very significant as stress tests will probably show.

	2007e	**2008e**	**2009e**	**2010e**	**2011e**	**2012e**	**2013e**	**Terminal**
WACC, book value	5,92%	5,84%	5,84%	5,84%	5,83%	5,76%	5,83%	5,84%
WACC, market value	6,07%	6,02%	5,98%	5,90%	5,84%	5,77%	5,78%	5,82%
Difference in %-points	-0,14%	-0,18%	-0,14%	-0,06%	-0,01%	-0,02%	0,06%	0,03%

Table 17 WACC difference in %-points

Next step is to merge the real option part of model with the DCF model. Doing this the model will make use of book values only, as the iterative process of optimising between the value of the real option and the alternative value of optimal leverage ratio (min. WACC) is not only cumbersome but

[109] In practice the process is cumbersome, why I have automated the process by using macro-coding that enables realignment of market values and WACC with a single push of a button.

involves so many calculation that Excel's Solver function must be applied. If adding a market value 'process' this would in practice not be doable without complex programming. Having calculated the effect of using book value it seems probable that the real option part will be fairly accurate despite using book values.

6.1.6 Real Option valuation of optimal leverage ratio

As the base of the valuation, the DCF model is now in place I move on to the next step – the binominal model. By default I start by modelling the underlying asset which is the optimal leverage ratio (the previous calculated 50%) using the volatility of the historical leverage ratio, equal to a standard deviation of 36%[110]. The time to expiration of the option equals the budget period used in the DCF model – 2007 until 2013. By default the option is then only available until the steady state (terminal period) of H+H. Following these assumptions the binominal tree for the underlying asset can be calculated using equation 8 and 9 for an up and down motion, $u = e^{\sigma\sqrt{\Delta t}} \rightarrow u = e^{0,36\sqrt{1}} = 1{,}43$ and $d = \frac{1}{u} \rightarrow d = \frac{1}{1{,}43} = 0{,}70$. The underlying asset will then follow a path as shown in Figure 11.

Development in Leverage ratio (D/EV)						
2007e	**2008e**	**2009e**	**2010e**	**2011e**	**2012e**	**2013e**
						421%
					295%	
				207%		207%
			145%		145%	
		102%		102%		102%
	71%		71%		71%	
50%		50%		50%		50%
	35%		35%		35%	
		25%		25%		25%
			17%		17%	
				12%		12%
					8%	
						6%
t=1	*t=2*	*t=3*	*t=4*	*t=5*	*t=6*	*t=7*

Figure 11 Path of underlying asset - optimal leverage ratio

As earlier explained the value of the leverage is the delta between two call options, $Call_{lev..opt.} = Call_{X_{ex.}} - Call_{X_{incl.}}$. The first strike price, $Call_{X_{ex.}}$, is defined as available funds without taking

110 The standard deviation in the period from 2000-2006 equals 36% whereas the period from 2000-2012 equals 39%. In other words, the volatility is rather constant.

additional funds into consideration and can be defined as (FCFF-interest on debt)/Enterprise value. As the call option is to calculate the option to 'defend'the optimal leverage ratio from sudden jumps above the 50% leverage point, the strike is only considering Free cash flow to Firm (FCFF) less interest on debt. To eliminate negative numbers I have used the average FCFF-r_D/EV.

Strike value (X_{ex})	**2007e**	**2008e**	**2009e**	**2010e**	**2011e**	**2012e**	**2013e**
Strike, average CF/EV	3%	3%	3%	3%	3%	3%	3%
(book value)							
D/EV max	50%	50%	50%	50%	50%	50%	50%
FCFF less interest	113.664	49.409	55.635	-3.258	833	-1.193	100.147
Enterprise value *(Book value)*	1.199.560	1.250.839	1.290.685	1.398.446	1.484.626	1.582.765	1.598.817
Average FCFF-r_D/EV	3%						

Figure 12 Strike price calculation without leverage room

The value of the option can be calculated using equation 11 and 12, discounting the strike value from right to left, always continuing with the larger value. As we can see from Figure 13 every node is exercised, as the leverage ratio for every node is above 3% (see Figure 11).

Call value, without additional D/EV capacity						
2007e	**2008e**	**2009e**	**2010e**	**2011e**	**2012e**	**2013e**
						418%
					292%	
				204%		204%
			142%		142%	
		99%		99%		99%
	68%		68%		68%	
47%		47%		47%		47%
	32%		32%		32%	
		22%		21%		21%
			14%		14%	
				9%		9%
					5%	
						3%
t=1	*t=2*	*t=3*	*t=4*	*t=5*	*t=6*	*t=7*

Figure 13 The call price without leverage room

Next to be calculated is the strike price including leverage room. Leverage room is the level of funds that is available to H+H to prevent the leverage ratio to increase beyond the optimal leverage level of 50%.

As explained earlier in the assignment, additional leverage room is the difference between $Call_{X_{ex.}}$ and $Call_{X_{incl.}}$ and can be defined as the additional funds from debt until leverage ratio reaches 50%. Hence if no additional funds from debt is available $Call_{X_{ex.}} - Call_{X_{incl.}} = 0$, and the option therefore has no value. As a result H+H needs to have additional debt available if the option is to have any value – the available leverage can be defined as the leverage less the 50%. However if this is to make sense from a value optimization view point the value of the lesser leveraged H+H must increase the value beyond what is achievable with the optimal levered H+H[111]. The equation we need to solve is therefore; maximize the value of the eDCF model, compare it to the standard DCF model using the 50% leverage ratio and pick the greater value of the two. The equation that needs to be solved is hence $MAX = (DCF; eDCF)$ where DCF equals equation 3 and eDCF equals equation 24.

6.2.1 Maximizing the value of H+H International using the leverage option

Using the binominal tree for the underlying asset and the strike price *excluding* leverage room I can start the quest for the call *including* leverage room, hence maximizing the value of H+H. The variables for calculating the asset lattice and the two call options are listed below in Table 18.

Assumption	
Risk free rate	1,85%
Years	7
Lenght of period (Δt)	1
S	50%
Leverage ratio, Standard deviation (σ)	36%
Un-levered beta	0,88
Market risk premium	4,50%
growth in terminal period (g)	1,50%

Real option calculation	
Volatility (σ^2)	0,13
u	1,43
d	0,70
p	0,44
1-p	0,56
$e^{rf\,\Delta t}$	1,02

Table 18 Assumptions and Real Option input calculation input

Calculating the maximum enterprise value I apply the assumptions above, but as I need to apply Excels solver function to solve the equation, $MAX = (DCF; eDCF)$, I most apply some mathematical limits to the dimension to keep Excel searching within the logical values that maximises H+H's value.

[111] The optimal levered company is in this case defined as H+H having leverage ratio of 50%.

To start with I will assume that an alternative leverage ratio should be below the 50% and above 0%, thereafter I set up three different DCF calculations to compute the Enterprise values defined in equation 24

(Eq. 24) $$eDCF_{lev.opt.} = \underbrace{\sum_{t=1}^{t=n} \frac{\text{CF to firm}_t}{(1+\text{WACC}_{\text{opt.}-})^t}}_{\text{EV}_1} + \underbrace{\sum_{t=1}^{t=n} \frac{\text{CF to firm}_t}{(1+\text{WACC}_{\text{opt.}})^t}}_{\text{EV}_2} - \underbrace{\sum_{t=1}^{t=n} \frac{\text{CF to firm}_t}{(1+\text{WACC}_{\text{opt.}+})^t}}_{\text{EV}_3}$$

I setup a table to calculate EV_2 using optimal leverage level (the default 50%), and a table to calculate EV_3 which uses the optimal leverage (50%) plus the value of $Call_{lev..opt.} = Call_{X_{ex.}} - Call_{X_{incl.}}$ as this is the delta value of the of the leverage ratio that can be mitigated using all available funds. Following the DCF computations, I subtract EV_3 from EV_2, as this delta value represents the value of being able to mitigate the value loss if leverage ratio was to increase above the 50% ratio by the same ratio as the freed up funds allows H+H to mitigate leverage ratio swings. Finally I calculate the DCF value for EV_1 using the 50% leverage ratio exactly offsetting (subtracting) it by the $Call_{lev.opt.}$ value.

Having set up the interconnected network of calculations, the maximum value of H+H can be decided by changing the strike price of $Call_{X_{incl.}}$. As leverage changes so does the strike price of $Call_{X_{incl.}}$, defined as the leverage gap from 50% plus FCFF-r_D (see Table 19)

Strike value ($X_{incl.}$)	2007e	2008e	2009e	2010e	2011e	2012e	2013e
Strike, CF incl. D/EV capacity	25,7%	25,7%	25,7%	25,7%	25,7%	25,7%	25,7%
D/EV max	50,0%	50,0%	50,0%	50,0%	50,0%	50,0%	50,0%
D/EV optimal	27,5%	27,5%	27,5%	27,5%	27,5%	27,5%	27,5%

Table 19 Strike price calculation without leverage room

Just as the previous strike (without leverage room) we set up a binominal tree where each node is calculated from right to left. Notice that 3 of the end nodes no longer is exercised (see Table 20).

Call value, with additional D/EV capacity						
2007e	2008e	2009e	2010e	2011e	2012e	2013e
						396%
					270%	
				182%		181%
			121%		120%	
		78%		77%		76%
	49%		47%		46%	
30%		28%		26%		24%
	16%		13%		10%	
		7%		4%		0%
			2%		0%	
				0%		0%
					0%	
						0%
t=1	*t=2*	*t=3*	*t=4*	*t=5*	*t=6*	*t=7*

Table 20 The call price with leverage room

To find the maximum value of H+H International I apply Excel's Solver function[112]. First I set the target cell to *Total enterprise value*, by changing *Optimal leverage ratio (See* Table 21*)*. Further I apply the min. and max. Leverage so that Excel only searches for logical leverage values.

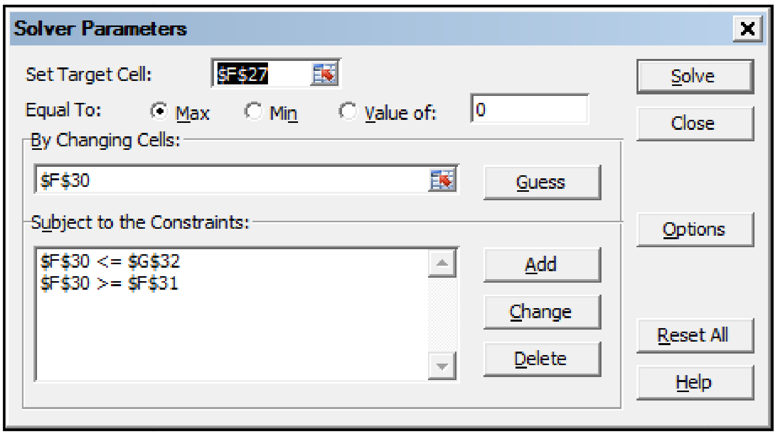


Figure 14 Excels Solver function in action

As Excels solver function uses linear modelling there is a tendency that it searches for local optimal values why I have searched manually in steps of 5%, e.g. plugging in a value of 20% in the *Optimal leverage level.*

[112] I suggest the reader to try out the function as well. Open the Excel sheet "Real Option Model", click Data->Analysis->Solver. Simply click solve in the pop-up window. Notice that Excel needs the Solver function to be installed, which it's not by default .

Leverage	
Optimal leverage level	27,5%
Max model leverage	50%
Min leverage	1%

Total value of de-leverage	
Call (without D/EV capacity	47,1%
Call (with D/EV capacity)	29,6%
Net Call value (oppurtunity cost)	17,5%
De-leverage opputunity gain	1.095.818
Enterprise value	2.221.856
Total enterprise value	**3.317.673**

Table 21 Calculation results from Solver function

The total value calculated by the eDCF can be split into two types of value adds, 1) In the model, compared to the valuations done in Table 15 and Table 16, we see that the Enterprise value(without the option value) has risen from DKKm ~2.020 to DKKm ~2.220. This is simply due the "on average" more optimal leverage. If H+H increased its leverage to the ideal 50% the value would increase further to DKKm ~2.270. in other words simply having a target capital structure adds value. 2) a considerable amount is added from having the leverage option to fend off unforeseen events DKKm ~1.090. The opportunity cost of having the lower leverage level (27,5%) is the value of the difference between discounting the cash flow with a 50% leverage and the 27,5% leverage. The gain however is the difference from the 50% leverage and the 50% plus the leverage room (50%-27,5%) which is much more worth to the company. This can also be seen if we look back at Graph 6, where the cost of capital increases far more on the right side of the optimal leverage point than on the left side.

I have now shown the value of having a leverage option. The option is certainly no exact measure, but it provides a valuable insight into some of the thinking that probably should be part of any financial manager's decision making – the fact that leverage is under nobody's full control. In the following sections I will highlight some of the pitfalls that I see, and areas with could/should be looked further into. Also I will of course conclude on my initial problem statement.

Part 7: Reflections and perspective

Having developed a model without any matching theoretical foundation to base it on there, are plenty of reflections to be made and criticism of the approach – of that I am sure.

The eDCF consist of two known models; the DCF model being used in its traditional way, why I will neglect further reflections on this part but leave it to the general and plentiful corporate finance literature. The second model is the binominal model, used in an untraditional way, why I will reflect upon the special case of the leverage option as it is described and used in this thesis.

Variables and assumptions

As already mentioned the model uses market value as input, this is of course not correct, but as it was mandatory to create a functioning model, a practical approach was needed. When that is said there are other more subtle issues and concerns with other model variables.

When calculating the WACC we use automated rating model that spits out an interest rate based on the coverage ratio. As mentioned a rating consists of a multitude of factors that in no way can be reflected in a single ratio. Further to that an interest rate is not only sensible to company specifics but also to external environment, country, competition etc.. Further to this, both interest rates and the industry beta value used are both based on American data from bigger companies.

In regards to the underlying asset of the real option, I use the book value for the leverage ratio and the volatility. First of all, leverage is very much a catch-all variable of many of the manager decisions, e.g. doing additional investments, stock buy-backs, dividends payouts etc., These all impact leverage but is not associated with external forces that should be mitigated. Such swings are of course included in the volatility calculation increasing the value of the option even though they might not be relevant. Alternatively you could argue that if a firm's leverage target is set, dividends and buybacks would only be used to adjust leverage if earnings allowed it, limiting the 'swing', not the opposite.

If market value was used, alternative issues would probably arise as well. In a crisis situation the market value of both equity and debt would decrease, actually reducing the leverage ratio and hence the risk. In the case of H+H I actually deselected using the market value of equity due to huge volatility. In some aspects such volatility could be translated into swings in debt (leverage), when it in fact is due to the share price. Especially in cases as of small-cap companies like H+H where liquidity and depth of the market can influence the share price tremendously.

The value of the option

When calculating the option value in the H+H case, the value of the option reached approximately 50% of the DCF valuation. The value seems very high compared to the standard DCF model valuation. Dissecting the option value components there is some logic to it. The approx DKKbn 1.000 value that is added corresponds to the value that would have been destroyed if H+H passed the 50% leverage ratio point with the same percentage-points that it now subtracts from the 50% leverage ratio point instead. In other words the value added to the DCF valuation is the value that would have otherwise been destroyed by increased cost of capital due to excess leverage in a crisis situation. Looking at the free falling stock price from 2007 to 2008, reversing that incident could support this point, as a less levered company probably would have maintained much of the lost value in such a scenario[113]. Further tests and theoretical debate would probably bring much light to the issue of the large option value. Stress testing would have been valuable, but was simply not possible due to space restraints. I can however mention that the model is very sensible to changes in the budget.

The thesis wishes to address whether the standard approach to optimal leverage ratio really is optimal. Other models have looked at similar issues but from a different angle. A. Damodaran[114] developed a model that values the option of financial flexibility – doing investments in the future, P. Crsobie et Al.[115] developed a model valuing default risk using Black-Scholes which to some extent addresses capital structure issues as well. Both models have a very different approach than the eDCF model, but they both address relevant questions to capital structure questions.

Part 8: Conclusion

The main subject of the thesis was whether a model could be developed, to value the option on leverage that H+H International had. To examine the question and find a logical and practical

[113] We must remember that the value of the company is a function of both a numerator and a denominator. Cost of capital is only one part of that equation.
[114] A. Damodaran, The Promise and Peril of Real Options, 2005
[115] P. Crosbie et Al. Modeling Default Risk, Moody's|KMV, 2003

approach, a series of sub questions was asked to highlight central parts of the thesis and to guide it towards a practical solution with a focus on real options.

H+H ***How is real options best applied to add value to a valuation analysis with regards to financial gearing?***

As it is stated all managers are faced with options that concern the future. Often these options are associated with great uncertainties. In a standard valuation process a cash flow model is most often the choice, in such a case the uncertainty is reflected in a discount factor. Bringing real options into account the manager's option is directly targeted. The option valued in this thesis being about leverage, a method for valuing this has been applied. To target the issue of the leverage option I have valued the precision of a narrow approach focusing on few but somewhat simple parameters. As a result of this approach I found the Binominal model the most practical in its use as it reflects both the uncertainties of the option (decision) and the value of that decision development through time. The approach of two strikes prices, where the delta value is used to calculate the value of additional funds, is somewhat intuitive despite its originality.

In my research I discarded the use of the Black-Scholes model, despite the fact that A. Damodaran used the Black-Sholes model in his article on a slightly similar issue; however I argue that the Binominal model is much more applicable which seems to be supported by the Excel model I developed. Overall it must be mentioned that the majority of choices I made throughout the thesis is based solely on own development, as a leverage option using the leverage ratio as the underlying asset so far is unseen in corporate finance or other related literature[116].

H+H ***Would the usage of an Expanded DCF Model have shown that H+H was destroying value simply by its leverage target?***

Reading H+H's 2007 annual report, they stated a solidity ratio of minimum 30% (equity/total assets). This ratio is calculated on book value. But as you, the reader, might remember so was our example

[116] This viewpoint can by default only be my own viewpoint, but the fact remains that I have not stumbled upon a model that highlighted anything similar to the approach and underlying asset setup used in this thesis.

due to practical reasons. In H+H's annual report for 2012 the wording on capital structure is different, this time net debt should not exceed 2x EBITDA by 2014. Concluding on the future using hindsight is of course not fair, but if standing ultimo 2006 looking forward, even the standard DCF model and the optimal leverage ratio (50%) used in the thesis would show an appropriate leverage level above the 30% solidity target. If also applying the eDCF model, including the value of the leverage option, the leverage target was way above a value-creating level[117].

If we look beyond the valuation results and look closer at the 2007 leverage target versus the 2012 leverage target (stipulated in the annual reports) and compare to the model calculations the results are striking. Using simplified calculations the 2007 target equals 30% = 450/1.500 (E/EV)[118] equalling a leverage ratio of 70%. In 2012 target was set to 2xEBITDA in 2014, resulting in a leverage of approx. 400/1500 = 27%[119]. If comparing these targets to the eDCF model; the leverage ratio without the leverage option equalled 50%, but if we included the 'recommendation' from the leverage option you get a suggested optimal leverage ratio of 27,5% (see Table 21). If we assume that H+H's 2012 leverage ratio target is based on 5 years of hardship, a steep learning curve and a gifted new management then I assume that the new target of 2xEBITDA is a reasonable level that reflects the learning's of the crisis. If this is the case then I would, simply looking at the results, conclude that (Yes) the eDCF model could not only highlight value destruction but also propose a very qualified alternative leverage ratio.

H+H ***Could the model have successfully been applied to other industries in the construction sector?***

As I went through the construction sector I clearly highlighted that some industries was suitable for leverage, where others weren't. If applying this selection then I would conclude that I see no obstacle in applying the model with other building material producers or Hardware stores/DIY shops. To both it most of course be highlighted that any company analysed must be of a certain size, otherwise

[117] As mentioned in the discussion the value of the leverage option seems high compared to the regular DCF value.
[118] I use the correlation of Equity/Total Assets = Equity/Enterprise value on book values.
[119] The logic behind the calculations is the following) Targets for 2012; EBITDA target min. 13%. Revenue in 2014 equals DKKm 1500, then debt equals 2xEBITDA=2*13%*1.500= 390=~400. If using the same asset pool as in 2007 we get a leverage ratio of 400/1500=27%.

general consistency in numbers would be too small. Despite the model being applied to H+H, it is not to be seen as a company specific framework but a general applicable solution that could be widely used. The issue is that the model is the first of its kind, and has therefore not been tested elsewhere in either theory or practice. Anyone applying the model elsewhere should keep this in mind.

Could a valuation model be developed to address the complications of the leverage option?

In the thesis I have developed a model based on two commonly known valuation frameworks, the DCF model and the Binominal model. The DCF model and its application is a common framework with commonly known drawbacks and pitfalls. The theoretical framework of the real option setup is also well known, but as I have made a new setup, especially using the leverage ratio as the underlying asset some doubts is of course reasonable and further research, discussion and stress-testing should be carried out. When that is said, the result of the eDCF valuation looks promising and it seems that the setup has some intuitive reasoning while also providing some concrete and useable results, when addressing the leverage option.

Part 9: Further research

I definitely believe that real option theory is an appropriate model to value the leverage option, but as the model is original and only have been described in the latter 80 pages, plenty of issues have remained unsaid and unexplained. Therefore I see a huge need for doing 1) stress testing and 2) a further separation of the leverage decision and the operational risk.

Stress testing

The H+H case has not undergone any structured stress testing in its development. To highlight the triggers and pitfalls some practical testing is often a good approach. Therefore I see a need to do stress testing on additional companies, preferably from different industries, as my primary interest is how the model would apply to industries/companies with a different WACC smile. Also it would be of interest to see how the model would react if different inputs for the volatility factor was used, e.g. swings in FCFF or EBITDA, which to a larger extent would reflect a stress scenario instead of using volatility in the leverage ratio which is a catch-all variable of both internal decisions and operational influences.

Separation of the leverage decision and operation

The model is concerned with highlighting the risk associated with the liability decision, and the option value of such a decision. Valuing a company is of course impossible without measuring the value created from the assets, however I believe that further research to separate the liability option from decisions made on the asset side would benefit both a further development of this model but also the general understanding of liability decisions.

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Appendix A

Reformulation of annual accounts

Reformulation of income statement	2004	2005	2006	2007	2008	2009	2010	2011	2012*
Revenue	1.370.865	1.354.436	1.662.392	1.850.233	1.439.460	1.067.957	1.185.468	1.309.753	1.322.274
Production cost	-802.584	-825.539	-1.180.718	-1.248.858	-1.002.179	-820.277	-947.883	-1.027.451	-1.051.390
- hereof non-realised write-downs (no CF effect)	-	-	*1.231*	*2.053*	*3.606*	*3.156*	*4.675*	*-5.935*	*4.291*
Other external expenses	-293.312	-305.263	-247.185	-243.070	-305.890	-230.897	-234.818	-194.954	-196.090
Other operating income and expenses	115	5.543	71	-11.200	4.109	-15.820	-7.590	4.107	11.239
Profit for the year from discontinued operations	-	-	-	-	-	-	-11.718	-42.580	-22.711
EBITDA	**275.084**	**229.177**	**235.791**	**349.158**	**139.106**	**4.119**	**-11.866**	**42.940**	**67.613**
Depreciation	-79.899	-87.616	-105.686	-116.557	-116.471	-121.505	-118.912	-101.938	-102.878
Impairment losses	-	-	-	-8.136	-	-84.748	-121.697	-	32.327
- hereof non-realised write-downs (no CF effect)	-	-	-1.231	-2.053	-3.606	-3.156	-4.675	5.935	-4.291
EBIT	**195.185**	**141.561**	**128.874**	**222.412**	**19.029**	**-205.290**	**-257.150**	**-53.063**	**-7.229**
Tax on year result	48.366	47.484	39.773	47.595	-280	-31.046	-11.571	16.094	30.570
Tax from discontinued operations	-	-	-	-	-	-	-4.156	6.057	-
Tax effect from financial expenses	1.562	-1.743	4.154	4.340	4.413	14.563	7.264	10.580	11.139
Total tax effect	**49.928**	**45.741**	**43.927**	**51.935**	**4.133**	**-16.483**	**-8.463**	**32.731**	**41.709**
NOPLAT	**145.257**	**95.820**	**84.947**	**170.477**	**14.896**	**-188.807**	**-248.687**	**-85.794**	**-48.938**
Foreign exchange adjustementts, foregin companies	-5.262	12.595	5.046	-12.780	-115.233	7.554	41.057	-56.602	39.178
Value adjustments (incl gain/losses on pension plans)	-	-	-2.660	6.605	-3.247	-	-	-	-14.249
Value adjustments transferred to financial expenses	-	-	-	-	-2.033	1.844	-	-	-
Expenses in connection with share issue	-	-	-	-	-	-35.976	-311	-	-
Total dirty surplus	**-5.262**	**12.595**	**2.386**	**-6.175**	**-120.513**	**-26.578**	**40.746**	**-56.602**	**24.929**
Comprehensive income from operations	**139.995**	**108.415**	**87.333**	**164.302**	**-105.617**	**-215.385**	**-207.941**	**-142.396**	**-24.009**
Interest income	2.706	1.608	416	77	576	209	109	192	105
Other exchange rate adjustments	239	8.788	40	620	9.684	1.707	13.909	301	588
Other financial income	273	34	158	127	128	227	963	867	886
Finacial income	**3.218**	**10.430**	**614**	**824**	**10.388**	**2.143**	**14.981**	**1.360**	**1.579**
Interest expenses	-8.302	-3.721	-14.472	-16.637	-21.858	-53.003	-34.653	-34.487	-32.033
Fair value adjustments transferred from equity relating to hedg	-	-	-	-	-	-1.844	-	-	-
Other exchange rate adjustments	-83	-387	-274	-1.373	-4.835	-2.084	-2.319	-2.545	-1.461
Foreign exchange losses on derivatives	-	-	-	-	-686	-127	-	-81	-
Financial expenses relating to pension plans*	-	-	-	-	-	-	-	-	-7.754
Other financial expenses	-39	-96	-703	-175	-662	-3.338	-7.064	-6.567	-4.888
Finacial expenses*	**-8.424**	**-4.204**	**-15.449**	**-18.185**	**-28.041**	**-60.396**	**-44.036**	**-43.680**	**-46.136**
Net financial costs	**-5.206**	**6.226**	**-14.835**	**-17.361**	**-17.653**	**-58.253**	**-29.055**	**-42.320**	**-44.557**
Tax effect from financial expenses	1.562	-1.743	4.154	4.340	4.413	14.563	7.264	10.580	11.139
Net financial costs after tax	**-3.644**	**4.483**	**-10.681**	**-13.021**	**-13.240**	**-43.690**	**-21.791**	**-31.740**	**-33.418**
Total comprehensive income	**136.351**	**112.898**	**76.652**	**151.281**	**-118.857**	**-259.075**	**-229.732**	**-174.136**	**-57.427**
Profit attributable to non-controlling interests	0	18	364	-2	-1	1	0	0	0
Total comprehensive income after non-controlling	**136.351**	**112.916**	**77.016**	**151.279**	**-118.858**	**-259.074**	**-229.732**	**-174.136**	**-57.427**

Reformulation of balancesheet	2004	2005	2006	2007	2008	2009	2010	2011	2012*
Goodwill	28.194	70.483	90.079	94.071	85.691	85.902	88.388	81.773	59.062
Other intangible assets	-	2.980	12.972	13.810	31.767	23.830	28.207	13.337	11.835
Land and buildings	262.606	332.256	433.069	463.613	418.089	469.815	467.789	398.202	345.557
Plant and machinery	446.093	507.877	565.627	508.510	390.576	673.843	560.231	507.637	445.099
Fixtures and fittings, tools and equipment	35.288	38.890	79.392	78.703	80.970	182.529	137.187	123.504	154.690
Property, plant and equipment under construction	62.217	75.648	42.343	182.921	529.317	15.098	22.183	8.358	15.608
Deferred tax assets*	25.934	18.369	24.729	20.036	22.472	44.348	55.183	40.350	17.092
Inventories	124.705	141.171	172.449	189.637	212.039	209.913	181.779	190.991	194.213
Trade receivables	105.678	118.418	184.557	150.741	94.945	107.838	78.275	87.821	22.695
Tax receiveables	-	-	1.808	28.992	9.216	1.630	599	386	495
Other receivables	7.405	22.926	20.417	13.727	34.434	14.738	12.180	11.684	16.024
Assets held for sale	-	-	-	-	-	-	-	91.597	87.667
Prepayments	2.336	4.855	4.839	26.765	5.562	7.877	9.039	5.207	7.280
Total operating assets	**1.100.456**	**1.333.873**	**1.632.281**	**1.771.526**	**1.915.078**	**1.837.361**	**1.641.040**	**1.560.847**	**1.377.317**
Pension obligation*	88.018	91.682	94.322	87.191	68.775	74.078	80.585	65.457	167.401
Provisions (incl. Other non-current liabilities)**	137.898	17.375	16.243	28.085	19.922	17.076	20.137	7.725	6.940
Deferred tax liabilities*	37.934	51.367	68.345	63.596	56.997	46.282	32.085	34.428	21.397
Trade payables	83.424	97.429	122.332	99.418	72.802	56.242	72.193	130.867	107.097
Income tax	23.246	13.915	8.296	16.930	2.162	2.014	12.876	710	750
Other payables	65.861	111.060	99.385	105.192	88.200	87.734	84.007	74.159	65.000
Liabilities relating to assets held for sale	-	-	-	-	-	-	-	65.510	52.212
Total operating liabilities	**436.381**	**382.828**	**408.923**	**400.412**	**308.858**	**283.426**	**301.883**	**378.856**	**420.797**
Net operating assets	**664.075**	**951.045**	**1.223.358**	**1.371.114**	**1.606.220**	**1.553.935**	**1.339.157**	**1.181.991**	**956.520**
Cash and cash equivalents (securities)	189.196	85.672	5.878	12.206	7.741	17.625	13.062	19.855	15.474
Total financial assets	**189.196**	**85.672**	**5.878**	**12.206**	**7.741**	**17.625**	**13.062**	**19.855**	**15.474**
Credit institutions	-	164	2.017	1.133	869.979	612.190	626.174	648.307	554.112
Credit institutions	107.986	208.864	356.787	391.846	802	1.209	493	88	-
Total financial liabilities	**-107.986**	**-209.028**	**-358.804**	**-392.979**	**-870.781**	**-613.399**	**-626.667**	**-648.395**	**-554.112**
Net financial liabilities	**81.210**	**-123.356**	**-352.926**	**-380.773**	**-863.040**	**-595.774**	**-613.605**	**-628.540**	**-538.638**
Total equity	**745.285**	**827.689**	**870.432**	**990.341**	**743.180**	**958.161**	**725.552**	**553.451**	**417.882**
Non-controlling interests	0	208	19	21	22	21	0	0	0
Total equity ex. Non-controlling interests	**745.285**	**827.481**	**870.413**	**990.320**	**743.158**	**958.140**	**725.552**	**553.451**	**417.882**

Appendix B

Reformulation of Equity statement

Reformulation of Equity Statement	2004	2005	2006	2007	2008	2009	2010	2011	2012*
Equity at 1.1.	**612.537**	**745.285**	**827.481**	**870.413**	**990.320**	**743.158**	**958.140**	**725.552**	**553.451**
*Changes in accounting policies**	-	-	-	-	-	-	-	-	*-80.779*
Tax on changes in equity	328	1.274	2.686	-2.524	1.147	1.945	-3.365	1.228	2.423
Dividend paid	-34.800	-40.600	-40.600	-23.200	-34.800	-	-	-	-
Reduction of share capital	-	-	-	-	-92.164	-	-	-	-
Capital increase / Buyback of non-controlling interests	-	-	-364	-	-	470.880	-	-	-
Sale of treasury shares	29.267	6.915	6.112	945	-	848	-	-	-
Buyback of treasury shares	-	-	-3.487	-9.250	-7.677	-	-	-	-
Dividend, treasury shares	1.002	678	361	306	2.715	-	-	-	-
Total owner transactions (O)	**-4.203**	**-31.733**	**-35.292**	**-33.723**	**-130.779**	**473.673**	**-3.365**	**1.228**	**2.423**
Foreign exchange adjustementts, foregin companies	-5.262	12.595	5.046	-12.780	-115.233	7.554	41.057	-56.602	39.178
Value adjustments (incl gain/losses on pension plans)	-	-	-2.660	6.605	-3.247	-	-	-	-14.249
Value adjustments transferred to financial expenses	-	-	-	-	-2.033	1.844	-	-	-
Expenses in connection with share issue	-	-	-	-	-	-35.976	-311	-	-
Profit for the year	141.613	100.321	74.630	157.454	1.655	-232.496	-270.478	-117.534	-82.356
Total comprehensive income (T)	**136.351**	**112.916**	**77.016**	**151.279**	**-118.858**	**-259.074**	**-229.732**	**-174.136**	**-57.427**
Share-based payment	600	1.013	1.208	2.351	2.475	383	509	807	214
Total Equity, post non-controlling interest	**745.285**	**827.481**	**870.413**	**990.320**	**743.158**	**958.140**	**725.552**	**553.451**	**498.661**
Non-controlling interest 1.1.	-	-	208	19	21	22	21	-	-
Profit attributable to non-controlling interests	-	18	364	-2	-1	1	-	-	-
Changes in non-controlling interests	-	208	-189	2	1	-1	-21	-	-
Total Equity at 31.12	**745.285**	**827.689**	**870.432**	**990.341**	**743.180**	**958.161**	**725.552**	**553.451**	**417.882**

Appendix C

Key Ratios and Value Drivers

Key ratios and value drivers

Income statement	2004	2005	2006	2007	2008	2009	2010	2011	2012
Revenue	1.370.865	1.354.436	1.662.392	1.850.233	1.439.460	1.067.957	1.185.468	1.309.753	1.322.274
Revenue growth	N/A	-1,2%	22,7%	11,3%	-22,2%	-25,8%	11,0%	10,5%	1,0%
EBITDA	275.084	229.177	235.791	349.158	139.106	4.119	-11.866	42.940	67.613
EBITDA margin	20,1%	16,9%	14,2%	18,9%	9,7%	0,4%	-1,0%	3,3%	5,1%
Depreciation	-79.899	-87.616	-106.917	-118.610	-120.077	-124.661	-123.587	-96.003	-107.169
Depreciation / Revenue	5,8%	6,5%	6,4%	6,4%	8,3%	11,7%	10,4%	7,3%	8,1%
Impairments	-	-	-	-8.136	-	-84.748	-121.697	-	32.327
Impairments / Revenue	0,0%	0,0%	0,0%	0,4%	0,0%	7,9%	10,3%	0,0%	-2,4%
EBIT	195.185	141.561	128.874	222.412	19.029	-205.290	-257.150	-53.063	-7.229
EBIT margin	14,2%	10,5%	7,8%	12,0%	1,3%	-19,2%	-21,7%	-4,1%	-0,5%
NOPLAT	145.257	95.820	84.947	170.477	14.896	-188.807	-248.687	-85.794	-48.938
NOPLAT / revenue	10,6%	7,1%	5,1%	9,2%	1,0%	-17,7%	-21,0%	-6,6%	-3,7%
Tax on year result + discontinued operations	48.366	47.484	39.773	47.595	-280	-31.046	-15.727	22.151	30.570
Effective tax rate - tax on total results	-24,8%	-33,5%	-30,9%	-21,4%	1,5%	-15,1%	-6,1%	41,7%	422,9%

Total operating assets	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total property, plant & equipment (incl. assets for sales	806.204	954.671	1.120.431	1.233.747	1.418.952	1.341.285	1.187.390	1.129.298	1.048.621
Investments / revenue	58,8%	70,5%	67,4%	66,7%	98,6%	125,6%	100,2%	86,2%	79,3%
Inventories	124.705	141.171	172.449	189.637	212.039	209.913	181.779	190.991	194.213
Inventories / Revenue	9,1%	10,4%	10,4%	10,2%	14,7%	19,7%	15,3%	14,6%	14,7%
Trade receivables	105.678	118.418	184.557	150.741	94.945	107.838	78.275	87.821	22.695
Trade receivables / revenue	7,7%	8,7%	11,1%	8,1%	6,6%	10,1%	6,6%	6,7%	1,7%
Other receivables	7.405	22.926	20.417	13.727	34.434	14.738	12.180	11.684	16.024
Other receivables / revenue	0,5%	1,7%	1,2%	0,7%	2,4%	1,4%	1,0%	0,9%	1,2%
Deferred tax assets*	25.934	18.369	24.729	20.036	22.472	44.348	55.183	40.350	17.092
Deferred tax assets / revenue	1,9%	1,4%	1,5%	1,1%	1,6%	4,2%	4,7%	3,1%	1,3%
Total intangible assets	28.194	73.463	103.051	107.881	117.458	109.732	116.595	95.110	70.897
Total intangible assets / revenue	2,1%	5,4%	6,2%	5,8%	8,2%	10,3%	9,8%	7,3%	5,4%
Tax receiveables	-	-	1.808	28.992	9.216	1.630	599	386	495
Tax receiveables / revenue	0,0%	0,0%	0,1%	1,6%	0,6%	0,2%	0,1%	0,0%	0,0%
Prepayments	2.336	4.855	4.839	26.765	5.562	7.877	9.039	5.207	7.280
Prepayments / Revenue	0,2%	0,4%	0,3%	1,4%	0,4%	0,7%	0,8%	0,4%	0,6%
Check	-	-	-	-	-	-	-	-	-

Total operating liabilities	2004	2005	2006	2007	2008	2009	2010	2011	2012
Pension obligation*	88.018	91.682	94.322	87.191	68.775	74.078	80.585	65.457	167.401
Pension obligation / revenue	6,4%	6,8%	5,7%	4,7%	4,8%	6,9%	6,8%	5,0%	12,7%
Provisions (incl. Liabilities realiting to assets held for sal	137.898	17.375	16.243	28.085	19.922	17.076	20.137	73.235	59.152
Provisions / revenue	10,1%	1,3%	1,0%	1,5%	1,4%	1,6%	1,7%	5,6%	4,5%
Deferred tax liabilities*	37.934	51.367	68.345	63.596	56.997	46.282	32.085	34.428	21.397
Deferred tax liabilities / revenue	2,8%	3,8%	4,1%	3,4%	4,0%	4,3%	2,7%	2,6%	1,6%
Trade payables	83.424	97.429	122.332	99.418	72.802	56.242	72.193	130.867	107.097
Trade payables / revenue	6,1%	7,2%	7,4%	5,4%	5,1%	5,3%	6,1%	10,0%	8,1%
Income tax	23.246	13.915	8.296	16.930	2.162	2.014	12.876	710	750
Income tax / revenue *(effective tax rate)*	1,70%	1,03%	0,50%	0,92%	0,15%	0,19%	1,09%	0,05%	0,06%
Other payables	65.861	111.060	99.385	105.192	88.200	87.734	84.007	74.159	65.000
Other payables / revenue	4,8%	8,2%	6,0%	5,7%	6,1%	8,2%	7,1%	5,7%	4,9%

Balance sheet, other assets	2004	2005	2006	2007	2008	2009	2010	2011	2012
Net operating assets	664.075	951.045	1.223.358	1.371.114	1.606.220	1.553.935	1.339.157	1.181.991	956.520
Asset turnover ratio	2,04	1,75	1,51	1,05	0,66	0,76	0,98	1,12	N/A
Total financial assets	189.196	85.672	5.878	12.206	7.741	17.625	13.062	19.855	15.474
Total financial assets / revenue	13,8%	6,3%	0,4%	0,7%	0,5%	1,7%	1,1%	1,5%	1,2%

Balance sheet, other liabilities	2004	2005	2006	2007	2008	2009	2010	2011	2012
Equity	745.285	827.689	870.432	990.341	743.180	958.161	725.552	553.451	417.882
Net debt / equity	-10,9%	14,9%	40,5%	38,4%	116,1%	62,2%	84,6%	113,6%	128,9%
Net operating assets /equity	89,1%	114,9%	140,5%	138,4%	216,1%	162,2%	184,6%	213,6%	228,9%
- Check	*1,0*	*1,0*	*1,0*	*1,0*	*1,0*	*1,0*	*1,0*	*1,0*	*1,0*
Credit institutions (debt)**	107.986	209.028	358.804	392.979	870.781	613.399	626.667	648.395	554.112
Debt / net operating assets	16,3%	22,0%	29,3%	28,7%	54,2%	39,5%	46,8%	54,9%	57,9%
Net debt	-81.210	123.356	352.926	380.773	863.040	595.774	613.605	628.540	538.638
Net debt / net operating assets	-12,2%	13,0%	28,8%	27,8%	53,7%	38,3%	45,8%	53,2%	56,3%

*** including Other non-current liabilities in 2008*

Profitability	2004	2005	2006	2007	2008	2009	2010	2011	2012
Interest cost	8.302	3.721	14.472	16.637	21.858	53.003	34.653	34.487	32.033
Interest on debt	N/A	3,4%	6,9%	4,6%	5,6%	6,1%	5,6%	5,5%	4,9%
Interest on financial assets	N/A	0,8%	0,5%	1,3%	4,7%	2,7%	0,6%	1,5%	0,5%
Interest on total debt	N/A	-2,6%	11,4%	4,7%	5,6%	6,1%	5,8%	5,6%	5,1%
ROIC	21,87%	10,08%	6,94%	12,43%	0,93%	-12,15%	-18,57%	-7,26%	-5,12%
ROIC spread (ROIC-r)	N/A	9,23%	6,46%	11,12%	-3,79%	-14,85%	-19,19%	-8,73%	-5,65%
ROE	N/A	11,45%	9,56%	16,71%	-3,48%	-21,38%	-34,80%	-17,17%	-12,39%

Key ratios and value drivers									
	2004	2005	2006	2007	2008	2009	2010	2011	2012
EBIT	195.185	141.561	128.874	222.412	19.029	-205.290	-257.150	-53.063	-7.229
EBIT margin	14,2%	10,5%	7,8%	12,0%	1,3%	-19,2%	-21,7%	-4,1%	-0,5%
NOPLAT	145.257	95.820	84.947	170.477	14.896	-188.807	-248.687	-85.794	-48.938
NOPLAT / revenue	10,6%	7,1%	5,1%	9,2%	1,0%	-17,7%	-21,0%	-6,6%	-3,7%
Net operating assets	664.075	951.045	1.223.358	1.371.114	1.606.220	1.553.935	1.339.157	1.181.991	956.520
Asset turnover ratio	2,04	1,75	1,51	1,05	0,66	0,76	0,98	1,12	N/A

Appendix D

Optimal capital structure

Calculating raw Beta	
From Jan. 2004 to Dec. 2008	
Obersevations	60
Variance	0,2022%
Covariance	0,1612%
Beta	0,80

Calculating raw Beta	
From Jan. 2008 to Dec. 2012	
Obersevations	60
Variance	0,7006%
Covariance	0,5563%
Beta	0,79

Calculating un-levered Beta	
From Jan. 2004 to Dec. 2008	
Levered beta	0,80
Tax rate	25%
Number of shares	1.090.000
Price	300
Equity, market value DKKt	327.000
Debt, "Market" value	863.040
Un-levered beta	0,27

Calculating un-levered Beta	
From Jan. 2008 to Dec. 2012	
Levered beta	0,79
Tax rate	25%
Number of shares	9.810.000
Price	26
Equity, market value DKKt	255.060
Debt, "Market" value	538.638
Un-levered beta	0,31

Source: http://www.nasdaqomxnordic.com/aktier/Historiske_priser/?Instrument=CSE3284
MSCI World Index, Source: Bloomberg (MXWO)

Industry Name	Unlevered Beta corrected for cash
Building Materials	0,88

D/EV ratio	Levered beta	r_E	Debt	Interest cost	Coverage ratio	Rating	Look up, r_{FK}	r_{FK}	*Check*	Effective Tax	After tax, r_{FK}
0%	0,88	5,8%	0	-	∞	N/A	0,0%	0,0%	OK	25,0%	0,0%
5%	0,91	6,0%	77.732	1.749	92,50	AAA	2,3%	2,3%	OK	25,0%	1,7%
10%	0,95	6,1%	155.464	3.498	46,00	AAA	2,3%	2,3%	OK	25,0%	1,7%
15%	0,99	6,3%	233.196	5.247	31,00	AAA	2,3%	2,3%	OK	25,0%	1,7%
20%	1,04	6,5%	310.927	6.996	23,00	AAA	2,3%	2,3%	OK	25,0%	1,7%
25%	1,10	6,8%	388.659	8.745	18,50	AAA	2,3%	2,3%	OK	25,0%	1,7%
30%	1,16	7,1%	466.391	10.494	15,50	AAA	2,3%	2,3%	OK	25,0%	1,7%
35%	1,23	7,4%	544.123	13.875	11,50	AA	2,6%	2,6%	OK	25,0%	1,9%
40%	1,32	7,8%	621.855	15.857	10,00	AA	2,6%	2,6%	OK	25,0%	1,9%
45%	1,42	8,2%	699.587	18.889	8,50	A+	2,7%	2,7%	OK	25,0%	2,0%
50%	1,54	8,8%	777.319	20.988	7,50	A+	2,7%	2,7%	OK	25,0%	2,0%
55%	1,68	9,4%	855.050	62.846	2,50	B+	7,4%	7,4%	OK	25,0%	5,5%
60%	1,86	10,2%	932.782	77.887	2,00	B	8,4%	8,4%	OK	25,0%	6,3%
65%	2,10	11,3%	1.010.514	84.378	2,00	B	8,4%	8,4%	OK	25,0%	6,3%
70%	2,41	12,7%	1.088.246	99.030	1,50	B-	9,1%	9,1%	OK	25,0%	6,8%
75%	2,85	14,7%	1.165.978	106.104	1,50	B-	9,1%	9,1%	OK	25,0%	6,8%
80%	3,51	17,6%	1.243.710	141.161	1,00	CC	11,4%	11,4%	OK	25,0%	8,5%
85%	4,61	22,6%	1.321.441	149.984	1,00	CC	11,4%	11,4%	OK	25,0%	8,5%
90%	6,80	32,4%	1.399.173	158.806	1,00	CC	11,4%	11,4%	OK	25,0%	8,5%
95%	13,38	62,1%	1.476.905	167.629	1,00	CC	11,4%	11,4%		24,1%	8,6%

Damodarans "synthetic" rating spreads

Coverage ratio, greater than	*Rating*	*Spread*	*r_{FK}*
-100000	D	12,0%	13,9%
0,50	C	10,5%	12,4%
0,80	CC	9,5%	11,4%
1,25	CCC	8,8%	10,6%
1,50	B-	7,3%	9,1%
2,00	B	6,5%	8,4%
2,50	B+	5,5%	7,4%
3,00	BB	4,0%	5,9%
3,50	BB+	3,0%	4,9%
4,00	BBB	2,0%	3,9%
4,50	A-	1,3%	3,2%
6,00	A	1,0%	2,9%
7,50	A+	0,9%	2,7%
9,50	AA	0,7%	2,6%
12,50	AAA	0,4%	2,3%

in DKKm	EBITDA
1992	71.778
1993	111.595
1994	155.101
1995	129.730
1996	126.780
1997	187.407
1998	182.495
1999	253.577
2000	233.816
2001	12.253
2002	50.306
2003	167.830
2004	275.084
2005	229.177
2006	235.791

Input for table calculations	
Risk free rate	2%
Un-levered beta*	0,88
Tax rate	0,25
Market risk premium	4,50%
Value of firm	1.554.637
EBITDA average	161.515

D/EV ratio	Levered beta	r_E	After tax, rFK	WACC
0%	0,88	5,8%	0,0%	5,798%
5%	0,91	6,0%	1,7%	5,741%
10%	0,95	6,1%	1,7%	5,683%
15%	0,99	6,3%	1,7%	5,626%
20%	1,04	6,5%	1,7%	5,568%
25%	1,10	6,8%	1,7%	5,511%
30%	1,16	7,1%	1,7%	5,453%
35%	1,23	7,4%	1,9%	5,475%
40%	1,32	7,8%	1,9%	5,429%
45%	1,42	8,2%	2,0%	5,433%
50%	1,54	8,8%	2,0%	5,392%
55%	1,68	9,4%	5,5%	7,270%
60%	1,86	10,2%	6,3%	7,854%
65%	2,10	11,3%	6,3%	8,025%
70%	2,41	12,7%	6,8%	8,590%
75%	2,85	14,7%	6,8%	8,789%
80%	3,51	17,6%	8,5%	10,339%
85%	4,61	22,6%	8,5%	10,622%
90%	6,80	32,4%	8,5%	10,906%
95%	13,38	62,1%	8,6%	11,288%
			D/EV ratio	WACC
		Min. WACC	50%	5,4%

Appendix E

Future accounts

Income statement	2004	2005	2006	2007e	2008e	2009e	2010e	2011e	2012e	2013e
Revenue	1.370.865	1.354.436	1.662.392	1.246.794	1.309.134	1.374.590	1.388.336	1.402.220	1.416.242	1.430.404
Production cost and Other operating income and expenses	-1.095.781	-1.125.259	-1.426.601	-1.122.115	-1.178.220	-1.237.131	-1.249.503	-1.261.998	-1.260.455	-1.258.756
EBITDA	**275.084**	**229.177**	**235.791**	**124.679**	**130.913**	**137.459**	**138.834**	**140.222**	**155.787**	**171.649**
Depreciation	-79.899	-87.616	-106.917	-45.749	-47.810	-50.535	-52.738	-54.799	-57.100	-58.521
Impairment losses	-	-	-	-	-	-	-	-	-	-
EBIT	**195.185**	**141.561**	**128.874**	**78.930**	**83.104**	**86.924**	**86.096**	**85.423**	**98.687**	**113.128**
Tax on year result	48.366	47.484	39.773	-19.733	-20.776	-21.731	-21.524	-21.356	-24.672	-28.282
Tax effect from financial expenses	1.562	-1.743	4.154	2.199	798	3.293	779	4.941	6.603	6.303
Total tax effect	**49.928**	**45.741**	**43.927**	**-17.533**	**-19.978**	**-18.438**	**-20.745**	**-16.414**	**-18.069**	**-21.979**
NOPLAT	**145.257**	**95.820**	**84.947**	**96.463**	**103.082**	**105.362**	**106.840**	**101.837**	**116.756**	**135.107**
Total dirty surplus	-5.262	12.595	2.386	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000
Comprehensive income from operations	**139.995**	**108.415**	**87.333**	**91.463**	**98.082**	**100.362**	**101.840**	**96.837**	**111.756**	**130.107**
Interest income	2.706	1.608	416	77	388	190	140	225	112	99
Other financial income	512	8.822	198	747	9.812	1.934	14.872	1.168	1.474	-
Finacial income	**3.218**	**10.430**	**614**	**824**	**10.200**	**2.124**	**15.012**	**1.393**	**1.586**	**99**
Interest expenses	-8.302	-3.721	-14.472	-8.073	-7.208	-7.905	-8.746	-11.965	-13.896	-15.811
Other financial expenses	-122	-483	-977	-1.548	-6.183	-7.393	-9.383	-9.193	-14.103	-9.500
Finacial expenses*	**-8.424**	**-4.204**	**-15.449**	**-9.621**	**-13.391**	**-15.298**	**-18.129**	**-21.158**	**-27.999**	**-25.311**
Net financial costs	**-5.206**	**6.226**	**-14.835**	**-8.797**	**-3.191**	**-13.174**	**-3.117**	**-19.765**	**-26.413**	**-25.211**
Tax effect from financial expenses	1.562	-1.743	4.154	2.199	798	3.293	779	4.941	6.603	6.303
Net financial costs after tax	**-3.644**	**4.483**	**-10.681**	**-6.598**	**-2.394**	**-9.880**	**-2.338**	**-14.824**	**-19.810**	**-18.908**
Total comprehensive income	**136.351**	**112.898**	**76.652**	**84.866**	**95.688**	**90.482**	**99.503**	**82.013**	**91.946**	**111.198**
Profit attributable to non-controlling interests	-	18	364	-	-	-	-	-	-	-
Total comprehensive income after non-controlling	**136.351**	**112.916**	**77.016**	**84.866**	**95.688**	**90.482**	**99.503**	**82.013**	**91.946**	**111.198**
Dividend	-	-	-	67.893	76.550	72.385	79.602	65.611	73.557	88.959

Cash flow analsys	2004	2005	2006	2007e	2008e	2009e	2010e	2011e	2012e	2013e
NOPLAT	**145.257**	**95.820**	**84.947**	**96.463**	**103.082**	**105.362**	**106.840**	**101.837**	**116.756**	**135.107**
WC - assets	*N/A*	*-39.681*	*-103.060*	*123.949*	*-363*	*-19.088*	*-3.389*	*2.040*	*-5.223*	*-3.816*
WC - liabilities	*N/A*	*-53.553*	*26.095*	*-83.510*	*17.408*	*50.982*	*-34.323*	*-17.470*	*-21.459*	*31.328*
Working capital	N/A	-93.234	-76.965	40.440	17.045	31.894	-37.712	-15.430	-26.682	27.512
Investments - tangible	N/A	-227.321	-261.985	-103.514	-108.486	-114.211	-116.881	-119.430	-122.202	-95.581
Investments - intangible	N/A	-54.031	-40.280	41.124	-7.649	-8.064	-5.906	-6.119	-6.355	-6.504
Depreciations & Impairments	79.899	87.616	106.917	45.749	47.810	50.535	52.738	54.799	57.100	58.521
FCFF	**N/A**	**-191.150**	**-187.366**	**120.262**	**51.802**	**65.516**	**-920**	**15.657**	**18.616**	**119.055**
Net financial costs	-3.644	4.483	-10.681	-6.598	-2.394	-9.880	-2.338	-14.824	-19.810	-18.908
Total dirty surplus	-5.262	12.595	2.386	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000	-5.000
Dividend	N/A	N/A	N/A	-67.893	-76.550	-72.385	-79.602	-65.611	-73.557	-88.959
Changes in Liquidity	N/A	103.524	79.794	-2.347	1.185	-15.645	7.388	-5.959	4.683	839
Changes in Non-controlling interest	-	208	-189	2	1	-1	-21	-		
Changes in Equity	-3.603	-30.720	-34.084	-	-	-	-	-	-	-
Cash flow from finance	N/A	90.090	37.226	-81.835	-82.758	-102.912	-79.573	-91.394	-93.683	-112.028
Change in Debt	**N/A**	**-101.060**	**-150.140**	**38.426**	**-30.956**	**-37.396**	**-80.493**	**-75.737**	**-75.067**	**7.027**

Appendix F

Discounted cash flow model w. various WACC

WACC calculation *(on book value)*	2007e	2008e	2009e	2010e	2011e	2012e	2013e	Terminal
WACC	5,92%	5,84%	5,84%	5,84%	5,83%	5,76%	5,83%	5,84%
Leverage ratio, book value (D/EV)	25,0%	30,0%	30,0%	30,0%	35,0%	40,0%	35,0%	35,0%
Interest rate, after tax	1,7%	1,7%	1,7%	1,7%	1,9%	1,9%	1,9%	1,9%
r_E	7,34%	7,62%	7,62%	7,62%	7,94%	8,32%	7,94%	7,96%
Tax rate	25,0%	25,0%	25,0%	25,0%	25,0%	25,0%	25,0%	24,5%
Levered beta	1,22	1,28	1,28	1,28	1,35	1,44	1,35	1,36

Dicounted Cash Flow valuation *(on book value)*	2007e	2008e	2009e	2010e	2011e	2012e	2013e	Terminal
FCFF	120.262	51.802	65.516	-920	15.657	18.616	119.055	110.174
Disount rate	0,94	0,89	0,84	0,80	0,75	0,71	0,67	0,67
Present value	113.535	46.244	55.259	-734	11.793	13.304	80.055	1.703.869
Enterprise Value	2.023.325							
Equity value	1.670.399							
Number of shares	1.090.000							
Price per share	1532							

Dicounted Cash Flow valuation *(on dynamic WACC MV)*	2007e	2008e	2009e	2010e	2011e	2012e	2013e	Terminal
FCFF	120.262	51.802	65.516	-920	15.657	18.616	119.055	110.174
Disount rate	0,94	0,89	0,84	0,80	0,75	0,71	0,67	0,67
Present value	113.385	46.085	55.037	-732	11.790	13.292	80.356	1.716.804
Enterprise Value	2.036.016							

Dynamic WACC calculation *(on market value - MV)*	2007e	2008e	2009e	2010e	2011e	2012e	2013e	Terminal
WACC	6,07%	6,02%	5,98%	5,90%	5,84%	5,77%	5,78%	5,82%
Leverage ratio, MV (D/EV)	16,7%	19,3%	21,7%	26,4%	30,1%	33,8%	33,7%	36,8%
Interest rate, after tax	1,7%	1,7%	1,7%	1,7%	1,7%	1,7%	1,7%	1,9%
rE	6,94%	7,06%	7,17%	7,41%	7,62%	7,86%	7,86%	8,08%
Tax rate	25,0%	25,0%	25,0%	25,0%	25,0%	25,0%	25,0%	24,5%
Levered beta	1,13	1,16	1,18	1,24	1,28	1,34	1,33	1,39

Dicounted Cash Flow valuation *(on dynamic WACC MV)*	2007e	2008e	2009e	2010e	2011e	2012e	2013e	Terminal	Market EV	BV debt	MV Equity	Market D/EV	Market D/EV	d
From 2007 to Terminal	113.385	46.047	54.907	-727	11.664	13.075	78.837	1.598.017	**1.915.205**	**320.378**	**1.594.827**	17%	17%	*OK*
From 2008 to Terminal		46.085	54.974	-728	11.688	13.107	79.063	1.617.996	**1.822.186**	**351.333**	**1.470.852**	19%	19%	*OK*
From 2009 to Terminal			55.037	-730	11.710	13.137	79.274	1.636.915	**1.795.344**	**388.730**	**1.406.615**	22%	22%	*OK*
From 2010 to Terminal				-732	11.755	13.197	79.696	1.675.610	**1.779.526**	**469.223**	**1.310.303**	26%	26%	*OK*
From 2011 to Terminal					11.790	13.244	80.029	1.707.056	**1.812.119**	**544.959**	**1.267.159**	30%	30%	*OK*
From 2012 to Terminal						13.292	80.367	1.739.808	**1.833.467**	**620.027**	**1.213.441**	34%	34%	*OK*
From 2013 to Terminal							80.356	1.738.749	**1.819.105**	**612.999**	**1.206.105**	34%	34%	*OK*
Terminal-period								1.716.804	**1.716.804**	**631.164**	**1.085.640**	37%	37%	*OK*

Appendix G

Historical leverage ratios and volatility

in DKKt	Equity value	Debt	D/EV	ln(D/EV)	Shares outstanding	Stock price	Final trading day of the year	Equity	D/EV on book value	ln(D/EV) book value
2000	900.876	282.685	23,9%	-1,43	1.000.973	900	*29-12-2000*	421.623	40%	-0,913
2001	754.000	291.103	27,9%	-1,28	1.160.000	650	*28-12-2001*	594.192	33%	-1,112
2002	777.200	362.356	31,8%	-1,15	1.160.000	670	*30-12-2002*	574.510	39%	-0,950
2003	1.473.200	262.223	15,1%	-1,89	1.160.000	1.270	*30-12-2003*	644.115	29%	-1,240
2004	1.363.000	233.331	14,6%	-1,92	1.160.000	1.175	*30-12-2004*	755.981	24%	-1,445
2005	1.571.800	123.356	7,3%	-2,62	1.160.000	1.355	*30-12-2005*	827.689	13%	-2,042
2006	2.134.400	352.926	14,2%	-1,95	1.160.000	1.840	*29-12-2006*	870.432	29%	-1,243
2007	1.579.920	380.773	19,4%	-1,64	1.160.000	1.362	*28-12-2007*	990.341	28%	-1,281
2008	327.000	863.040	72,5%	-0,32	1.090.000	300	*30-12-2008*	743.180	54%	-0,621
2009	637.650	595.774	48,3%	-0,73	9.810.000	65	*30-12-2009*	958.161	38%	-0,959
2010	519.930	613.605	54,1%	-0,61	9.810.000	53	*30-12-2010*	725.552	46%	-0,780
2011	415.944	628.540	60,2%	-0,51	9.810.000	42	*30-12-2011*	553.451	53%	-0,632
2012	255.060	538.638	67,9%	-0,39	9.810.000	26	*28-12-2012*	417.882	56%	-0,574
Standard deviation (σ)				69%		Standard deviation (σ), 2000-2012				39%
Standard deviation (σ), 2000-2006				47%		Standard deviation (σ), 2000-2006				36%
Average			35,2%			Average			37,0%	

in DKKm	EBITDA	Enterprise value, MV	Running average
1992	71.778	1.183.561	1.183.561
1993	111.595	1.045.103	1.114.332
1994	155.101	1.139.556	1.122.740
1995	129.730	1.735.423	1.275.911
1996	126.780	1.596.331	1.339.995
1997	187.407	1.695.156	1.399.188
1998	182.495	2.487.326	**1.554.637**
1999	253.577	1.960.693	1.605.394
2000	233.816	1.190.040	1.559.243
2001	12.253	1.233.424	1.526.661
2002	50.306	1.133.535	1.490.923
2003	167.830	1.044.484	1.453.719
2004	275.084	793.698	**1.402.948**
2005	229.177		
2006	235.791		
2007	349.158		
2008	139.106		
2009	4.119		
2010	-11.866		
2011	42.940		
2012	67.613		

Appendix H

Real Option model and leverage optimization

Real option calculation	
Volatility (σ^2)	0,13
u	1,43
d	0,70
p	0,44
1-p	0,56
$e^{rf\,\Delta t}$	1,02

Assumption	
Risk free rate	1,85%
Years	7
Lenght of period (Δt)	1
S	50%
Leverage ratio, Standard deviation (σ)	36%
Un-levered beta	0,88
Market risk premium	4,50%
growth in terminal period (g)	1,50%

Leverage	
Optimal leverage level	27,5%
Max model leverage	50%
Min leverage	1%

Total value of de-leverage	
Call (without D/EV capacity	47,1%
Call (with D/EV capacity)	29,6%
Net Call value (oppurtunity cost)	17,5%
De-leverage opputunity gain	1.095.818
Enterprise value	2.221.856
Total enterprise value	**3.317.673**

Development in Leverage ratio (D/EV)

2007e	2008e	2009e	2010e	2011e	2012e	2013e
						421%
					295%	
				207%		207%
			145%		145%	
		102%		102%		102%
	71%		71%		71%	
50%		50%		50%		50%
	35%		35%		35%	
		25%		25%		25%
			17%		17%	
				12%		12%
					8%	
						6%
t=1	*t=2*	*t=3*	*t=4*	*t=5*	*t=6*	*t=7*

Call value, without additional D/EV capacity						
2007e	**2008e**	**2009e**	**2010e**	**2011e**	**2012e**	**2013e**
						418%
					292%	
				204%		204%
			142%		142%	
		99%		99%		99%
	68%		68%		68%	
47%		47%		47%		47%
	32%		32%		32%	
		22%		21%		21%
			14%		14%	
				9%		9%
					5%	
						3%
t=1	*t=2*	*t=3*	*t=4*	*t=5*	*t=6*	*t=7*

Strike value (X_{ex})	**2007e**	**2008e**	**2009e**	**2010e**	**2011e**	**2012e**	**2013e**
Strike, average CF/EV	3%	3%	3%	3%	3%	3%	3%
(book value)							
D/EV max	50%	50%	50%	50%	50%	50%	50%
FCFF less interest	113.664	49.409	55.635	-3.258	833	-1.193	100.147
Enterprise value *(Book value)*	1.199.560	1.250.839	1.290.685	1.398.446	1.484.626	1.582.765	1.598.817
Average FCFF-r_D/EV	3%						

DCF value	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**Terminal**
FCFF	120.262	51.802	65.516	-920	15.657	18.616	119.055	110.174
Present value	114.011	46.557	55.822	-744	11.990	13.515	81.937	1.898.767
Enterprise value	2.221.856							

Calculation of WACC	2007	2008	2009	2010	2011	2012	2013	Terminal
WACC	5,48%	5,48%	5,48%	5,48%	5,48%	5,48%	5,48%	5,49%
Gearing (D/EV)	27,5%	27,5%	27,5%	27,5%	27,5%	27,5%	27,5%	27,5%
Interest on debt after tax	1,7%	1,7%	1,7%	1,7%	1,7%	1,7%	1,7%	1,7%
r_E	6,9%	6,9%	6,9%	6,9%	6,9%	6,9%	6,9%	6,9%
Tax rate	25,0%	25,0%	25,0%	25,0%	25,0%	25,0%	25,0%	24,5%
Levered beta	1,13	1,13	1,13	1,13	1,13	1,13	1,13	1,13
Interest on debt	2,3%	2,3%	2,3%	2,3%	2,3%	2,3%	2,3%	2,3%

Call value, with additional D/EV capacity

2007e	2008e	2009e	2010e	2011e	2012e	2013e
						396%
					270%	
				182%		181%
			121%		120%	
		78%		77%		76%
	49%		47%		46%	
30%		28%		26%		24%
	16%		13%		10%	
		7%		4%		0%
			2%		0%	
				0%		0%
					0%	
						0%
t=1	*t=2*	*t=3*	*t=4*	*t=5*	*t=6*	*t=7*

Strike value ($X_{incl.}$)	2007e	2008e	2009e	2010e	2011e	2012e	2013e
Strike, CF incl. D/EV capacity	25,7%	25,7%	25,7%	25,7%	25,7%	25,7%	25,7%
D/EV max	50,0%	50,0%	50,0%	50,0%	50,0%	50,0%	50,0%
D/EV optimal	27,5%	27,5%	27,5%	27,5%	27,5%	27,5%	27,5%

DCF value	2007	2008	2009	2010	2011	2012	2013	Terminal
FCFF	120.262	51.802	65.516	-920	15.657	18.616	119.055	110.174
Present value	110.850	44.012	51.307	-664	10.418	11.417	67.300	882.866
Enterprise value	1.177.504							

Calculation of WACC	2007	2008	2009	2010	2011	2012	2013	Terminal
WACC	8,49%	8,49%	8,49%	8,49%	8,49%	8,49%	8,49%	8,53%
Gearing (D/EV)	67,5%	67,5%	67,5%	67,5%	67,5%	67,5%	67,5%	67,5%
Interest on debt after tax	6,8%	6,8%	6,8%	6,8%	6,8%	6,8%	6,8%	6,9%
r_E	11,9%	11,9%	11,9%	11,9%	11,9%	11,9%	11,9%	12,0%
Tax rate	25,0%	25,0%	25,0%	25,0%	25,0%	25,0%	25,0%	24,5%
Levered beta	2,24	2,24	2,24	2,24	2,24	2,24	2,24	2,25
Interest on debt	9,1%	9,1%	9,1%	9,1%	9,1%	9,1%	9,1%	9,1%

EV using MAX LEVERAGE *(on book value)*	2007	2008	2009	2010	2011	2012	2013	Terminal
FCFF	120.262	51.802	65.516	-920	15.657	18.616	119.055	110.174
Disount rate	0,95	0,90	0,85	0,81	0,77	0,73	0,69	0,69
Present value	114.109	46.637	55.965	-746	12.041	13.584	82.430	1.949.301
Enterprise Value	2.273.322							

WACC using MAX LEVERAGE *(on book value)*	2007	2008	2009	2010	2011	2012	2013	Terminal
WACC	5,39%	5,39%	5,39%	5,39%	5,39%	5,39%	5,39%	5,41%
Leverage (D/EV), book value	50,0%	50,0%	50,0%	50,0%	50,0%	50,0%	50,0%	50,0%
Interest rate, after tax	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%	2,0%
rE	8,8%	8,8%	8,8%	8,8%	8,8%	8,8%	8,8%	8,8%
Tax rate	25,0%	25,0%	25,0%	25,0%	25,0%	25,0%	25,0%	24,5%
Levered beta	1,54	1,54	1,54	1,54	1,54	1,54	1,54	1,54