CATÓLICA LISBON
BUSINESS & ECONOMICS

Celgene Corporation & Juno Therapeutics

M&A in the biopharmaceutical industry

Richard Krieg

Dissertation written under the supervision of
António Borges de Assunção

Dissertation submitted in partial fulfilment of requirements for the MSc in Finance Program at the Universidade Católica Portuguesa, June 2018.

Abstract

Celgene & Juno Therapeutics

M&A in the biopharmaceutical industry

On the 22nd January 2018, the US American biopharmaceutical company Celgene Corporation announced the signing of a definitive merger agreement with their research partner Juno Therapeutics. Both companies have already spent three years working on the development of CAR-T cancer therapies which hold the potential to treat life threatening diseases that cannot be fully cured, yet.

The industry both companies operate in is shaped by intensive regulation, cut throat competition but also immense pricing power for suppliers. Various competitors have already engaged in CAR-T research, fuelling a race for the best-in-class drug. Celgene has shown industry superior growth in the last years at a high dependency on their blockbuster drug REVLIMID®. They have intensified R&D spending to build a highly specialized knowledge base for future product development. Juno is a young, research driven biotechnology company that has been working on specialized CAR-T research with Celgene. However, most of their drug candidates are in early development stages, resulting in massive losses and cash burns.

Prior to the acquisition, Celgene has been priced almost fairly with a slight upside potential. Their stand-alone valuation arrives at a top-range share price of $106.60 whilst they traded at $102.65 as of 19th January 2018. Juno, on the other hand, traded at a value of $56.50 at the same day, whilst their valuation yielded a share price of $48.02 Synergies of up to $10bn have been identified, justifying the 29% premium with the promise to bring additional strategic value to Celgene's extensive research network.

Candidate: Richard Krieg

Lisbon 29th May 2018

Keywords: mergers, acquisitions, USA, CAR-T, cancer, biopharmaceuticals, pharmaceuticals, biotechnology, research, development

Abstracto

Celgene & Juno Therapeutics

M&A in the biopharmaceutical industry

No passado dia 22 de Janeiro de 2018, a biofarmacêutica norte-americana Celgene Corporation anunciou uma decisão de fusão com a sua parceira de pesquisa, a Juno Therapeutics. A parceria começou em 2015, no desenvolvimento de terapias CAR-T para tratamento de cancros, que têm o potencial para curar doenças fatais ainda não-tratáveis.

A indústria de ambas é caracterizada por forte regulação e competição intensa, mas também um elevado poder negocial para as fornecedoras. Vários competidores já iniciaram pesquisas de terapias CAR-T, promovendo uma autêntica batalha para obter o melhor produto no mercado. A Celgene demonstrou um crescimento superior à média no passado recente, maioritariamente devido ao seu "medicamento estrela" REVLIMID®. A empresa tem intensificado o investimento em I&D para criar uma base de conhecimentos para desenvolvimento de produtos, altamente especializada. A Juno é uma jovem biotecnológica especializada em pesquisa, que tem vindo desenvolver pesquisas em terapias CAR-T especializadas com a Celgene. Muitos dos produtos candidatos estão ainda numa fase inicial, o que se traduz em perdas significativas.

Antes da aquisição, a Celgene estava avaliada quase a preço justo, com potencial positivo. Estava avaliada em $106.60 por acção, no segmento mais elevado, estando a ser negociada a $102.65 no dia 19 de Janeiro de 2018. Por outro lado, a Juno estava a ser negociada a $56.50, enquanto que a sua avaliação era de $48.02 por acção. Foram identificadas sinergias até $10 biliões, justificando o prémio de 29% e a promessa de trazer valor estratégico adicional para a rede de pesquisa da Celgene.

Candidato: Richard Krieg
Lisboa 29 de Maio 2018

Palavres des chaves: fusões, aquisições, estados unidos, CAR-T, Câncer, biofarmacêuticos, farmacêuticos, biotecnologia, pesquisa, desenvolvimento

Acknowledgements

First and Foremost, I would like to express my sincere gratitude to my thesis advisor António Borges de Assunção. He has always been available to share his extensive knowledge and give crucial advice. Additionally, he has used his academic experience and personal intuition to guide my work throughout all phases of the dissertation process.

Moreover, I want to thank my family for their support over the last two years. I feel very fortunate to have made the experiences that I have made. None of this would have been possible without you.

I am grateful to the staff of Católica Lisbon School of Business and Economics for their dedication to help and support the students of this institution. I found the Master of Science in Finance program to be a challenging journey on which I was lucky enough to meet fellow students who never came short of supporting me. I eventually became personal friends with a variety of colleagues at this institution for which I wish nothing but the best.

Table of contents

List of Tables

List of Figures

1. Introduction

After years of collaborative research and development, Celgene Corporation (in the following: Celgene) announced the signing of a definitive merger agreement with Juno Therapeutics (in the following: Juno) on the 22nd January 2018 (2018g). Celgene agreed to buy the remaining 90.30% of the company's equity at a price of $87 per share, paying a total of $9bn in cash. The deal values Juno at an equity value of approximately $9.9bn, giving them a premium of about 29% compared to the previous day's market price.

Celgene justified the deal as an enhancement to their exhaustive biopharmaceutical research platform and the potential to add significant long-term revenue growth drivers to their product portfolio. The deal follows a wave of technical advancements related to the development of CAR-T cancer treatment systems. CAR-T is a technology that holds the potential to treat a variety of oncological diseases that cannot be fully cured, yet. From a financial perspective, the transaction promises to bring a highly innovative product to a market on which suppliers can gain almost monopolistic pricing power, protected by strong, long-term intellectual protection rights. On the other hand, the industry is known for a cut-throat competition between small research driven biotech specialists and large pharmaceutical conglomerates, which have previously engaged in related fields of research.

In chapter two, the following paper will give an overview of common equity valuation techniques and the general characteristics of Mergers & Acquisitions (in the following: M&A). Chapter three is going to analyze Celgene, Juno and the biopharmaceutical industry in which both companies operate. Chapter four will give valuation estimates for both company on a stand-alone basis prior to the transaction and as a merged firm after the acquisition. The main question of research will be whether and, if yes, how the merger is adding value to Celgene and whether the deals synergies justify the acquisition premium paid. The last chapter intends to sum up the thesis' results and give a final opinion on the deal and its implications for the merged firm.

2. Literature Review

2.1 Valuation Techniques

2.1.1 Absolute Valuation Techniques

"An absolute valuation model is a model that specifies an asset's intrinsic value. Such models are used to produce an estimate of value that can be compared with the asset's market price" (Pinto *et al.*, 2010). Two of the most important absolute valuation categories are the discounted cash flow models and the asset-based valuation model. Asset-based valuation models either obtain a disposal value (liquidation value) or replacement costs for a specific asset. They are mostly used for accounting purposes or in bankruptcy scenarios. Both models estimate an asset's value based on some sort of cash flow forecast and/or the market value of comparable assets. Therefore, they cannot be strictly distinguished from the discounted cash flow and relative valuation models. Literature partly suggests in practice, they can be used as the lower bound to a firm valuation, since they tend to evaluate an entity's assets independently without accounting for the potential value generation and growth that a company can accomplish by combining a variety of assets. Although, an asset-based valuation may yield the same values as other valuation techniques if the firm has no growth assets and the market assessments of value reflect expected cash flows (Damodaran, 2002).

Damodaran refers to discounted cash flow (in the following: DCF) models as "the foundation on which all other valuation approaches are built" (2002). In fact, the first applications of DCF calculations seem to date back as far as 1800-1600 BC (cited in Shrieves and Wachowicz, 2001). DCF models are intrinsic valuation models which derive an asset's value from its ability to generate future cash flows in relation to the time and risk involved. In a broad sense, all discounted cash flow valuation models rely on two main input factors:

- (Projected) future cash flows
- Discount rate

There are various methods to conduct a DCF valuation. Explaining all of them would extent the content of this paper by far. As a consequence, no technical details are explained at this point. DCF valuation methods might differ in the type of cash flow used and in the applied discount rate, but they should all yield the same outcome (when applied correctly). According to Fernández, the differences between them result from calculating the present value of the tax shields (2007).

Comparing different valuation techniques, Kaplan et. al. found "evidence that discounted cash flow valuation methods produce reliable estimates of market value" and that highly leveraged transactions were valued most accurately by using a compressed APV technique rather than other DCF techniques

(1996). Luehrman also argues, that APV is more reliable in situation where WACC discounting does not provide trust worthy results whilst providing more explanatory power to the management by dismantling financial side effects on firm value (1997). In fact, authors of corporate finance papers and text books seem to feel obligated to choose between the APV and the WACC side. Inselbag and Kaufold reveal, once again, that both techniques should lead to the same results, regardless of capital structure decisions. Although they add that the APV technique might be more convenient when firms aim to change their debt/ equity ratio, whereas WACC calculations are more practical when the capital structure is expected to remain relatively constant (1997).

Any analysis, however, is only as accurate as the forecasts it relies on (Goedhart, Koller and Wessels, 2005). The process of projecting future cash flows is therefore one of the major challenges in the equity valuation process. Cash flow projections in a DCF model can usually be divided into two categories. At first, explicit financial projections are made for a period of approximately five or ten years. These projections should be modeled by identifying key business drivers and their underlying factors. When the firm is expected to be in a steady state, the residual value of cash flows after the explicit period must be calculated. There are two main methods to do so: one of them is the Gordon Growth perpetuity model, which assumes that the cash flows will grow at a constant rate in perpetuity. The other one is the exit multiple approach, which basically simulates the company's disposal at a multiple of one of their financial performance measures at the end of the explicitly forecasted period (Janiszewski, 2011). The discounted value of the explicitly projected future cash flows and the discounted residual value added up together are the result of the valuation.

2.1.2 Relative Valuation Techniques

"Relative valuation models estimate an asset's value relative to that of another asset". The underlying idea is, that similar assets should be traded at similar prices (Pinto *et al.*, 2010). Relative valuation models are usually based on financial data from precedent transactions or comparable companies. They can either compute a firm's equity or enterprise value. The process of computing firm or equity values on a multiple basis can be broken down into the following four steps (Brito, 2017):

1) select a sample of comparable companies
2) choose and compute a multiple for those peer companies/ precedent transactions
3) aggregate those multiples into a single figure using a central statistics, such as the mean, the median, the harmonic mean or the geometric mean
4) apply the aggregated multiple of peers/ transactions to the corresponding value of the firm/ equity under analysis in order to estimate its value

Step four is rather a mechanical part of the multiple calculation process. Controversial issues in multiple valuations mostly lie in the selection of peer companies/ precedent transactions, the selection of a central statistic measure and in the identification of the most appropriate multiple(s) for the target firm. Answers for all of these questions can be found in the relevant literature:

Precedent transactions should be transactions that happened in recent times within the same industry. Mostly the number of transaction to choose from will be rather small, which turns their selection into a rather straight-forward process. The selection of peer companies turns out to be harder, since there is a larger range to choose from. Alford recommends to choose peers from the same industry defined by the three digit SIC code (1992). Later, Bhojraj and Lee tested statistical approaches to peer selection (e.g. cluster analysis, regression models) and found that results sharpen drastically, especially for the so called new economy stocks (2002). Regarding the number of comparable companies, Cooper and Cordeiro find, that "Using ten closely comparable firms is as accurate on average as using the entire cross-section of firms in an industry.", that "it is generally better to use a small number rather than all firms in an industry with a large number of members" and that it is better to use a smaller industry sample with similar growth rates (Cooper *et al.*, 2008).

In line with Liu, Nissim and Thomas (2002), Brito found that the harmonic mean performs best out of all central statistics for all multiples and clustering procedures (Brito, 2017). Various papers have been searching for the most reliable multiple or the most reliable combination of multiples. Liu, Nissim and Thomas found, that "multiples based on forward earnings explain stock prices reasonably well (…). In terms of relative performance, our results show historical earnings measures are ranked second after forward earnings measures, cash flow measures and book value are tied for third, and sales performs the worst" (2002). Schreiner also finds, that equity value multiples outperform entity/ enterprise multiples. He also finds, that the two-year forward P/E ranks first and the one-year forward P/EBT ranks second for US companies (2007).

Regarding the role of multiples in an equity valuation, most authors agree that they cannot replace a DCF model and are not as accurate as them, but that they are an enhancement to the DCF model. As an example, a study by Kaplan & Ruback finds, that the method of comparable company multiples reports the least accurate valuation results and that the comparable transactions approach worked much better. Nevertheless, they found that the most reliable estimates were found by using the DCF and the comparable methods combined (1996).

2.1.3 Contingent Claim Valuation Techniques

"A contingent claim or option pays off only under certain contingencies - if the value of the underlying asset exceeds a pre-specified value for a call option or is less than a pre-specified value for a put option. Much work has been done in the last twenty years in developing models that value options, and these option pricing models can be used to value any assets that have option-like features". An asset can be valued by modeling its payoff as a call option if the asset's payoff depends on the asset exceeding a pre – specified level. It has put option - like features if its value increases as the value of the underlying asset drops below a specific level (Damodaran, 2002).

Amongst other assets, this payoff character can be found in undeveloped natural reserves or licenses and patents. The most common option pricing schemes are the Black-Scholes Model and the Binomial Model. According to the Black-Scholes Model (Black and Scholes, 1973), an undeveloped field of natural reserves could be priced as:

$$C = S_0 N(d1) - Xe^{-rT} N(d2)$$

with

$$d1 = \frac{\ln(\frac{S}{X}) + \left(r + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}}$$

and

$$d2 = d1 - \sigma\sqrt{T}$$

Whereas

C = Value of field

S = Value of the commodity

X = Exploration cost

r = Risk free rate

σ = Volatility of the commodity's market price

T = Exploration time[1]

As time increases, the mine's proven reserves and therefore the mine's value decreases. This can be modeled by using the Black approximation for dividend yields or by using separate annual options.

An application of the binomial Model can be found in Kellog, Charnes and Demirer (2000). They calculate the expected net present value of a drug development project as:

$$ENPV = \sum_{i=1}^{7} \rho_i \sum_{t=1}^{T} \frac{DCF_{it}}{(1+r_d)^t} + \rho_7 \sum_{j=1}^{5} q_j \sum_{t=1}^{T} \frac{CCF_{jt}}{(1+r_c)^t}$$

i (1,…,7) = seven stages from discovery through post drug approval[2]

ρ_i = probability that stage i is the end stage for the drug

[1] e.g. maturity of the mining license

[2] The drug approval process in the USA is divided into seven stages.

T = time at which all future cash flows become zero

DCF_{it} = expected development stage cash flow at time t given that stage i is the end stage

Whereas

r_d = discount rate for development cash flows

j (1,…,5) = index of quality for the drug

q_j = probability that the drug is of quality j

CCF_{jt}= expected commercialization cash flow at time t for a drug of quality j

r_c = is the discount rate for commercialization cash flows

A graphical representation of this process can be found in the Appendix 1. The intuition behind this calculation is that there is a probability of failure for all seven stages of the drug approval process. For a failure, the expectation value will be zero. The expected net present value of the development project therefore depends (amongst others) on the likelihood of approval throughout all given stages and the expected cash flows for each stag. Kellog, Charnes and Demirer extent this basic model to incorporate growth options in later stages.

2.2 Mergers & Acquisitions

2.2.1 Classification

Mergers and Acquisitions (from now on M&A) are financial transactions. Reed, Lajoux and Nesvold distinguish between them by defining a merger as a process in which "one corporation is combined with and disappears into another corporation" whereas they describe an acquisition as the change of ownership of assets or stock (2007). Other authors draw the line between these two transaction types by defining a merger as a transaction between similar sized companies, whereas an acquisition scenario is defined by having a considerably larger buyer than seller (DeChesare, 2016).

Damodaran proposes a classification that distinguishes between acquisitions lead by the company's own management (Buyouts) and acquisitions lead by other firms. A short summary of his M&A categorization can be found in Appendix 2.

2.2.2 Deal structure

Once the decision for an acquisition has been made, the deal needs to be structured. The deal structuring process involves the search for an acquisition vehicle, the form of payment, the form of acquisition, accounting- and tax considerations. Goals of the deal structuring process lie in the

minimization of tax payments and risk, whilst not giving away too much earning potential and fulfilling all legal requirements (DePamphilis, 2014).

The forms of payment include stock, cash, debt, assets or a mix of those (DePamphilis, 2014). Acquirers may use cash if the firm has significant borrowing capacity, substantial excess cash reserves, and undervalued shares and wishes to maintain control. This cash can either come from own cash reserves or from debt, to add leverage to the structure. The acquirer may choose to use stock if it is believed to be overvalued and has limited borrowing capacity and excess cash balances. Acquirer shares might be especially attractive to the seller if their growth prospects are strong. Furthermore, they can be used to split risk between the partners. Other forms of noncash payment include real property, rights to intellectual property, royalties, earnouts, and contingent payments.

A study of payment choices in European Mergers & Acquisitons between 1997 and 2000 has found that the choice of payment foremost depends on the tradeoff between corporate governance concerns and debt financing constraints. They also found that incentives to choose cash are strong, when a bidder's controlling shareholder has an intermediate level of voting power and when the voting control of their dominant share- holders is threatened. When the owner of the bidder and target is the same, indicating that when the target is under bidder control, they see that stock financing of the M&A deal is more likely. They also observe that stock financing is less likely for unlisted targets and corporate subsidiaries, which supports bidder aversion to creating a new block holder.

2.2.3 Reasons and Drivers

There are various reasons to engage in M&A activities. In financial terms, buyside M&A activity should increase earnings per share for the buyer's shareholders. A transaction that increases earnings per share for the buyer is called an accretive transaction. A transaction that does not increase earnings per share for the buyer's shareholders is called a dilutive transaction.

In practice, M&A activity can be driven by various factors. Some of them are (Roberts, Wallace and Moles, 2016), (DePamphilis, 2014):

- **Strategic rationale:** M&A to reach strategic objectives (e.g. market entry)
- **Cross selling potential:** increase revenues by offering related products to existing customers
- **Cost savings:** improve merged firm's cost structure
- **Diversification:** buying firms beyond a company's current lines of business to achieve higher growth rates and a reduction in cost of capital
- **National and international business consolidation:** two companies combine assets to improve their position in the market
- **Integration:** horizontal or vertical

- **Resource acquisition:** M&A to gain access to specific assets and skills
- **Tax considerations:** target's losses may be used to offset future profits of the merged firm

Some M&A drivers have brought more, others less success to the company's shareholders. In many cases, the drivers of M&A activity have been used to identify potential synergies and to therefore justify the engagement in M&A activities.

2.2.4 Synergies

"Synergy is the additional value that is generated by combining two firms, creating opportunities that would not been available to these firms operating independently" (Damodaran, 2015). Damodaran further distinguishes synergies in operating and financial synergies.

Operating synergies are synergies that lead to an increase in operating income. They do so by increasing income from existing assets and/or increase growth. The four types of operating synergies, according to Damodaran, are: economies of scale, greater pricing power, combination of different functional strengths and higher growth in new or existing markets. These synergies affect margins, returns and return growth. In terms of valuation, they are usually expressed in higher cash flows (Damodaran, 2015). Dividing the potential for operating synergies into increased cash inflows and reduced cash outflows, the latter one is often perceived as more realistic. Studying the 50 largest US mergers between 1979 and 1983, Healy, Palepu and Rubak indeed find improvements in sample firm's cash flows returns mainly as a result of increased asset productivity but also as a result of reduced labor costs (Healy *et al.*, 1990).

Financial Synergies do not affect the operating income. Examples for financial Synergies are Tax Benefits, an increase in debt capacity, the avoidance of underfunding and risk diversification. In terms of valuation, they usually lead to a decrease in capital costs (Damodaran, 2015). Leland examined the existence of purely financial synergies and their effect on firm value through the separation and isolation of non-synergetic operations. He found that "In many cases, examples calibrated to empirical data suggest that financial synergies are insufficient to justify mergers by themselves, but they can become important in specialized circumstances" (2005). The Synergy valuation process is done after the value of the combined firm without synergies was computed.

2.2.5 Value Creation

There is a vivid discussion on whether M&A creates value, and if yes, for whom. Bruner criticizes that "the conventional wisdom is poorly grounded in the scientific evidence on the subject. The fashionable view seems to be that M&A is a loser's game" (2005). In fact, Eccles et. al. claim that M&A pays poorly for the buyer and cites studies measuring M&A performance in the 70s and in the

90s. He also illustrates that a fair acquisition value differs between potential acquirers for the same target. The buyer has to make sure that there are enough synergies to justify the premium paid above the intrinsic value (1999). Devos et. al. analyzed 264 large mergers and found, that the average gains in firm value through synergies lies at about 10% of the combined company's firm value (2009).

The drivers for a successful, value creating merger are specific to each transaction. Although an evaluation of literature and data on the topic of M&A value creation by Bruner has brought forward 18 conditions under which M&A tends to perform well and 18 characteristics under which it tends to perform badly. They are summarized in Appendix 3.

3. Company and Industry Profile

3.1 Industry and Market Dynamics

3.1.1 Industry Introduction

Celgene describes itself as a global biopharmaceutical company (Celgene Corporation, 2018h). In the past two decades, this industry has created almost $1.7 trillion in shareholder value over the S&P 500 ($1 trillion from pharma and $0.7 trillion from biotech) (Backer and Ruby, 2017). Being described as large, diversified and global, they are sometimes referred to as some of the most critical and competitive sectors in the economy (International Trade Administration, 2016). Biotechnological/ pharmaceutical products tend to have long development lead times, high risk of failure and usually undergo exhaustive regulation. On the other hand, drug producers can hold tremendous pricing power, offering lifesaving innovation in highly profitable markets. Companies in these industries need to plan far ahead to avoid revenue holes. Their valuations fluctuate with their research prospects and the commercialization of their intellectual property. On top of that, the industries constantly find themselves morally challenged between ethical issues and commercial obligations. The industries' products can be categorized by the following three criteria:

1.) **Accessibility:** over the counter drugs vs. prescribed drugs
2.) **Intellectual protection:** generic drugs vs. innovative drugs
3.) **Production:** chemically derived vs. biologically derived

Celgene is a producer of prescribed drugs. Their products cannot be accessed without a physician's written consent (prescription). They are focused on the development and production of innovative drugs. This term refers to drugs that can claim an intellectual protection status (patent and/ or exclusivity), which forbids competitors to copy the product or the underlying intellectual property for many years. Other criteria to categorize drugs can be the production process. Pharmaceutical goods can be derived from chemicals or from biological processes. This line marks the main difference between pharmaceutical and biotechnological goods/ companies. Also, the production scope for the biotechnology sector is much broader than for the pharmaceutical sector. Aside drug production and development, companies in the biotechnological industry might produce goods for the agricultural sector, research sources for alternative fuels or produce ecologically sustainable plastics instead of drugs.

Pharmaceutical companies can be large multinational drug producers with various research projects over a large spectrum of diseases, or small companies that specialize on a narrow field of medical conditions. Biotechnology companies are mostly small, research driven companies which tend to be unprofitable for many years. They hardly ever issue dividends, so investors usually supply liquidity

with prospects to capitalize on the disposal of intellectual property (e.g. royalties) or through an external acquisition some time in the future.

For Celgene, the acquisition of Juno can be interpreted as a strategic decision to diversify their product pipeline over the mid- and long-term future by internalizing cutting edge research that they have financed and supported for many years. This soon-to-be company is going to sell its products in a highly competitive market. The following paragraphs are going to give an overview over the biotech/ pharma industry. It is going to evaluate Celgene's products and relevant markets, their dynamics and the competitive environment that they have to operate in.

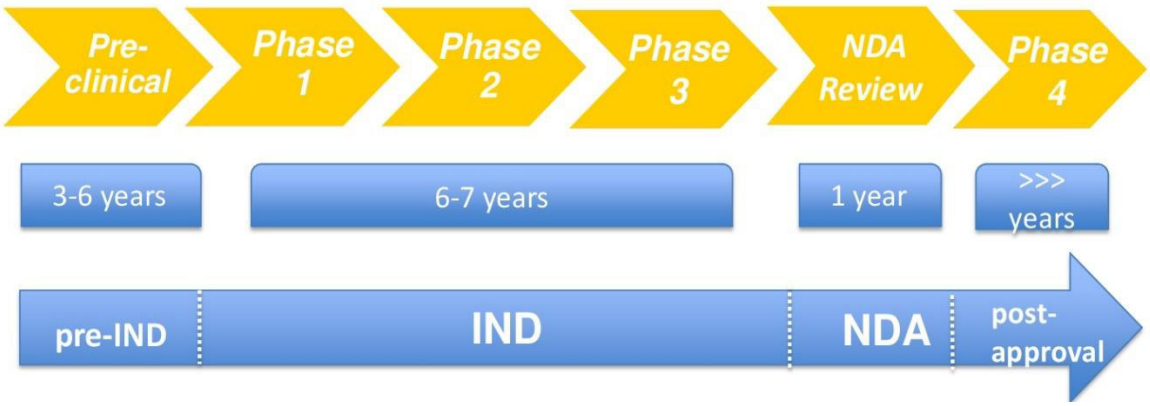
3.1.2 The U.S. Drug Approval Process

Celgene's goods need to be approved by the Food and Drug Administration (In the following: FDA) to be commercialized in the US American pharmaceutical market. Over the last 150 years, the FDA has evolved from a small division of the U.S. Patent Office to one of the largest consumer protection agencies in the world. Its mission is to ensure that new medical treatments reach the public as quickly as possible, while simultaneously ensuring that they are both safe and effective (Van Norman, 2016a and Van Norman, 2016b). If a drug is not considered safe and/or does not provide benefits over existing treatments, the FDA will not give their approval and the drug must not be sold in the USA.

Figure I

The FDA Drug Approval Process

(Source: Lolic, 2017)



The Drug approval and review process starts when a company has developed a new drug compound. In a pre-clinical testing stage, the drug is tested for toxicity on animals. If it passes the toxicity tests, the drug is entering the three phases of clinical testing. Phase I is focused on safety, phase II is focused on effectiveness and phase III investigates both criteria in experiments with different dosages and populations. The number of participants increases from a few dozen to thousands of people in phase

III trials. If the NDA review has been successful, the product may be sold to the public. At this point, the phase IV (post-clinical review) begins. During that stage, the drug manufacturer needs to submit periodic safety updates to the FDA (U.S. Food & Drug Administration (FDA), 2018b). The process might vary under special circumstances (e.g. Orphan Act for very rare diseases or fast track approval process). The whole process of bringing a drug from the laboratory to the market takes an average time of 12 years (Van Norman, 2016b) and can cost billions of dollars. Once approved, a patent or market exclusivity is granted. Patents and exclusivity work in a similar fashion but are distinct from one another and governed by different statutes. For example, patents are property rights that normally last for 20 years, whilst exclusivity refers to certain delays and prohibitions on approval of competitor drugs, which can last for up to seven years (U.S. Food & Drug Administration (FDA), 2018a). Both statuses help to protect products from being copied and therefore tends to reward innovative products with high market shares and additional pricing power.

The FDA approval process is interpreted as one of the world's most supportive domestic environments for the development and commercialization of pharmaceuticals with minimal market barriers (International Trade Administration, 2016). Regulatory hurdles in international markets are going to differ from US law and might require additional efforts.

3.1.3 Products and Markets

Celgene produces a variety of medical goods that can be applied to a variety of different diseases. Each product needs to receive a separate FDA approval for every potential medical condition that it could be prescribed for. Celgene's products are used to cure the following diseases:

- **Hematology/ blood disorders:** Multiple Myeloma, Myelodysplastic Syndromes, Acute Myeloid Leukemia, Lymphoma, Chronic Lymphocytic Leukemia, Mantle Cell Lymphoma, Beta Thalassemia
- **Oncology:** Myelofibrosis, Solid Tumors
- **Inflammations and Immunological diseases**

Often, Celgene products are first approved for a certain disease and are later redeveloped for further therapeutic applications. REVLIMID®, for example, was approved for the treatment of Myelodysplastic Syndromes in 2005, for relapsed/ refractory Multiple Myeloma in 2006 and for newly diagnosed transplant ineligible Multiple Myeloma in 2016. These sicknesses can be summarized under the category "Hematology" (blood cancer). In the US, a new person is diagnosed with blood cancer every three minutes (approximately 170,000 new incidents per year). Every nine minutes, a patient dies from blood cancer (Leukemia and Lymphomia Society (LLS), 2017).

The overall oncology market is expected to grow at a CAGR of 7.1% and reach a value of about $112bn in 2020 (Tatkare, 2015). With REVLIMID® contributing for more than half of Celgene's revenue, the market for hematologic cancer therapies is clearly the most important one for Celgene, at this time.

Celgene is currently developing a variety of innovative drugs. Two examples are the bb2121/ bb21217 and JCAR017. Both drug candidates are based on the CAR-T technology. Bb2121 is a phase I drug candidate addressed to treat patients suffering from Multiple Myeloma. In march 2018, Celgene has engaged into a strategic long-term agreement to co-develop, manufacture and commercialize the product with bluebird bio (Celgene Corporation, 2018a) after receiving breakthrough therapy designation by the FDA. This status is given when preliminary clinical evidence demonstrates substantial improvement over available therapy in at least one clinically significant criteria (Celgene Corporation, 2017b). JCAR017 has received this status in 2017 (Celgene Corporation, 2018f). It is a drug candidate in phase I-II trials aimed to cure Non-Hodgkin Lymphoma, but the company believes, that the underlying technology can be applied to a broader variety of medical conditions (2018). The JCAR research & development series started as a strategic project with Juno, which Celgene has fully acquired in March 2018. According to analyst estimates, the product is expected to provide first revenues as early as 2019.

An overview over Celgene's products, their pipeline and therapeutic applications is given in Appendix 4. JP Morgan has valued Celgene's pipeline at a stand-alone value of about $20bn in March 2018 (Kasimov, 2018).

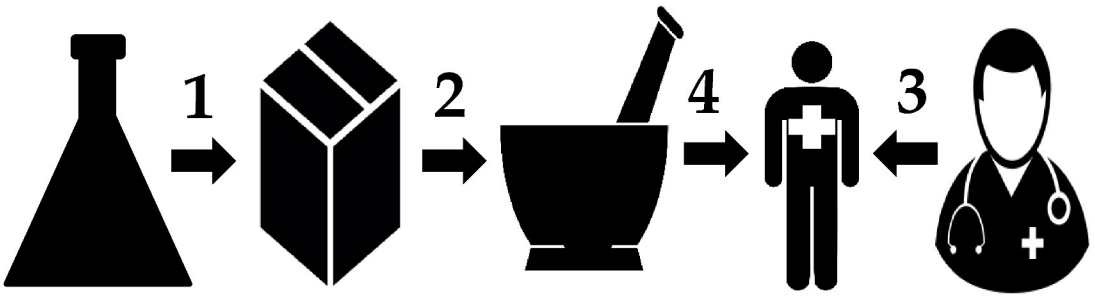
3.1.4 Retail and Consumption Process

Celgene develops a variety of pharmaceutical products to treat cancer and inflammatory diseases. With a revenue contribution of about 75% in 2017, Celgene's most important market is the US market. On this market, the company primarily sells their drugs to wholesale distributors (1). Wholesale distributors sell their drugs to pharmacies or specialized pharmaceutical retail stores (2) (f.e. CVS Health Corporation, 2018). These drugs can be picked up by the patient in these pharmacies or specialized stores (4) if they have been previously prescribed to him by a physician as part of a medical therapy (3), as visualized in Figure II.

Figure II

Drug Retail and Consumption Chain for Prescriptive Drugs in the USA

Figure II shows the Retail and Consumption process for Celgene's pharmaceutical products in the United States of America from Celgene (test tube), to the wholesale distributor (parcel) to the pharmacy/ specialized retailer (bowl and mortar) to the patient (human body) who has previously received prescription from a physician (figure on the right). (Source: Own graphic)



Celgene's products cannot be consumed if they have not been previously prescribed by a physician. Therefore, step 3 (the prescription process) is crucial for the commercial success of Celgene's products. In step 3, a physician prescribes a drug to the patient. The prescription of a specific drug is determined by many factors. The most important drug prescription determinants are the following ones:

- **Type of disease:** The prescribed drug is first and foremost specific to the patient's indication.
- **Patient specific conditions:** Patient's with similar medical conditions might receive different medication due to their specific physiology and (f.e.) other simultaneous medical treatments.
- **FDA approval:** The therapy must be authorized and approved by the FDA for the patient's specific medical condition.
- **Drug quality:** Physicians prefer to describe drugs that have shown superior characteristics in effectiveness and/or have less harmful side effects for the patient ("best-in-class")[3].
- **Third party reimbursement and insurance regulation:** Prescribed drugs are usually paid by the patient's insurance company. For most publicly insured US citizens, the coverage of prescription drugs depends on their specific Medicare Part D prescription drug plan. For this plan, patients need to decide on specific drugs that they are going to be reimbursed for by their insurance company and drugs that are not going to be covered for a specific diagnosis when entering into the insurance system. If a specific drug is not covered by the patient's health insurance, he/ she must either pay for the drug themselves or the physician might need to prescribe another drug. On top of that, approaches to cost and risk control like the "fail first requirement" might force the physician to prescribe the most cost-efficient therapy until it fails, before switching to more advanced treatments. Private health insurance can be provided by the patient's employer or contracted through an individual plan. Health insurance coverage from private insurers differs according to individual contract details.

[3] Some diseases may only be treated by one specific drug. This drug is then called the "first-in-class" drug and practically holds a monopoly on the market until competitor products are successfully commercialized.

The pharma industry is known for their efforts to influence physician's prescription preferences through their marketing efforts. These can be gifts, free drug samples or invitations to prestigious events. A study conducted in the District of Columbia suggests that gifts from pharmaceutical companies are associated with more prescriptions per patient, more costly prescriptions, and a higher proportion of branded prescriptions. Gifts of any size had an effect and larger gifts elicited a larger impact on prescribing behaviors. Their study proves that pharmaceutical companies have the capability and potential to increase sales volume through such marketing channels and that drug prescription in the US is not solely conducted on medical rationale. On a macroeconomic level, the authors argue, that "Industry gifts influence prescribing behavior, may have adverse public health implications, and should be banned" (Wood *et al.*, 2017).

The retail and prescription process for prescribed drugs differs in markets outside the USA. Celgene's customers in other countries are mostly clinics, hospitals and retail chains, many of which are government owned. The retail and prescription process might therefore vary, but should be similar by nature.

3.1.5 Prescription Drug Pricing in the United States of America

The pricing process for prescriptive drugs differs from most other markets. In many countries, state authorities are the only major customer for medical goods. In this case, both parties must agree on prices for pharmaceutical products from a position of similar bargaining leeway, because there might be only one seller and one customer which both have strong incentives to agree on common terms.

In the US, the process is different because the government can legally not negotiate prices directly with drug producers. Instead, drug producers set prices independently and give discounts to major customers like private insurers or wholesale distributors. Drug providers tend to find themselves in a position of strong negotiation power because there might not be sufficient substitutes due to strong intellectual protection rights.

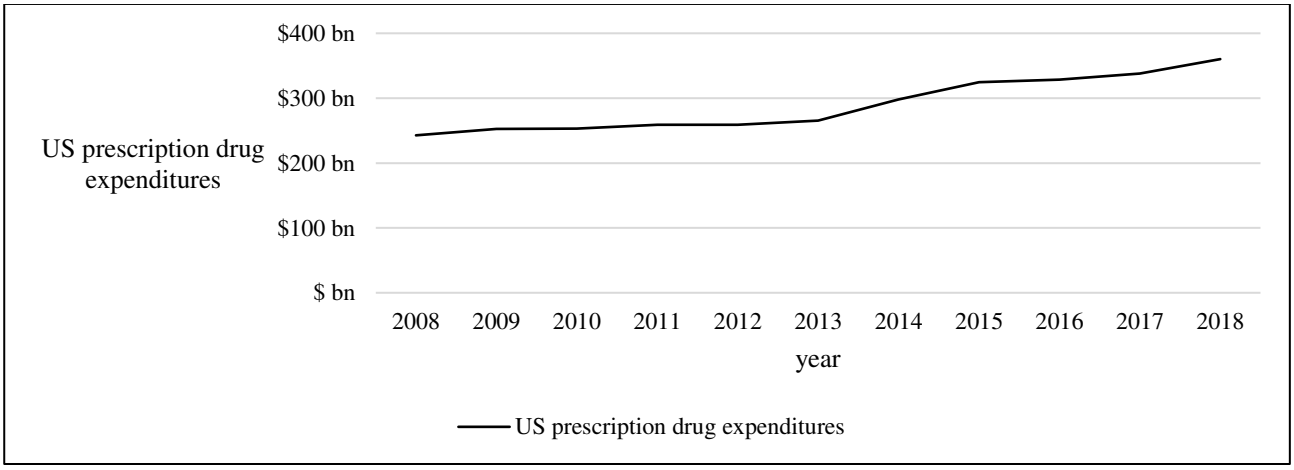
There are situations in which pharmaceutical companies have monopolist-like pricing power. This is the case, if the current practice of medicine is changed by his product through a "first-in-class" or "best-in-class" discovery. A first-in-class drug is a highly innovative drug that uses a new unique mechanism of action for treating a medical condition. These drugs can possibly be the first and only solution to treat certain diseases. A best-in-class drug is a drug that succeeds over all other competitor products in all or most relevant medication criteria. That can be a drug that is more efficient and, at the same time, safer to use than all competitor products. After some time, these products usually have to compete with generic products because their exclusivity rights have expired. If the market is very

small, however, competition might not view the market as attractive enough and does not choose to compete against the first-/ or best-in-class product (f.e. many orphan drug markets). In this case, manufacturers of pharmaceutical goods can possibly increase prices heavily without facing declines in sales volume.

Figure III

US Prescription Drug Expenditures

Figure III shows the annual expenditures for prescription drugs in the USA from 2008 to 2018. (Source: Statista, 2018a).



All in all, prescription drug expenditures in the USA have risen by 4.8% on average over the last 10 years. Although, drug prices have been growing above inflation, the increase in total expenditures for prescribed drugs can not only be attributed to the pharmaceutical industry's pricing power. Other factors are, for example, changes in the population's general health conditions and changes in healthcare consumption patterns.

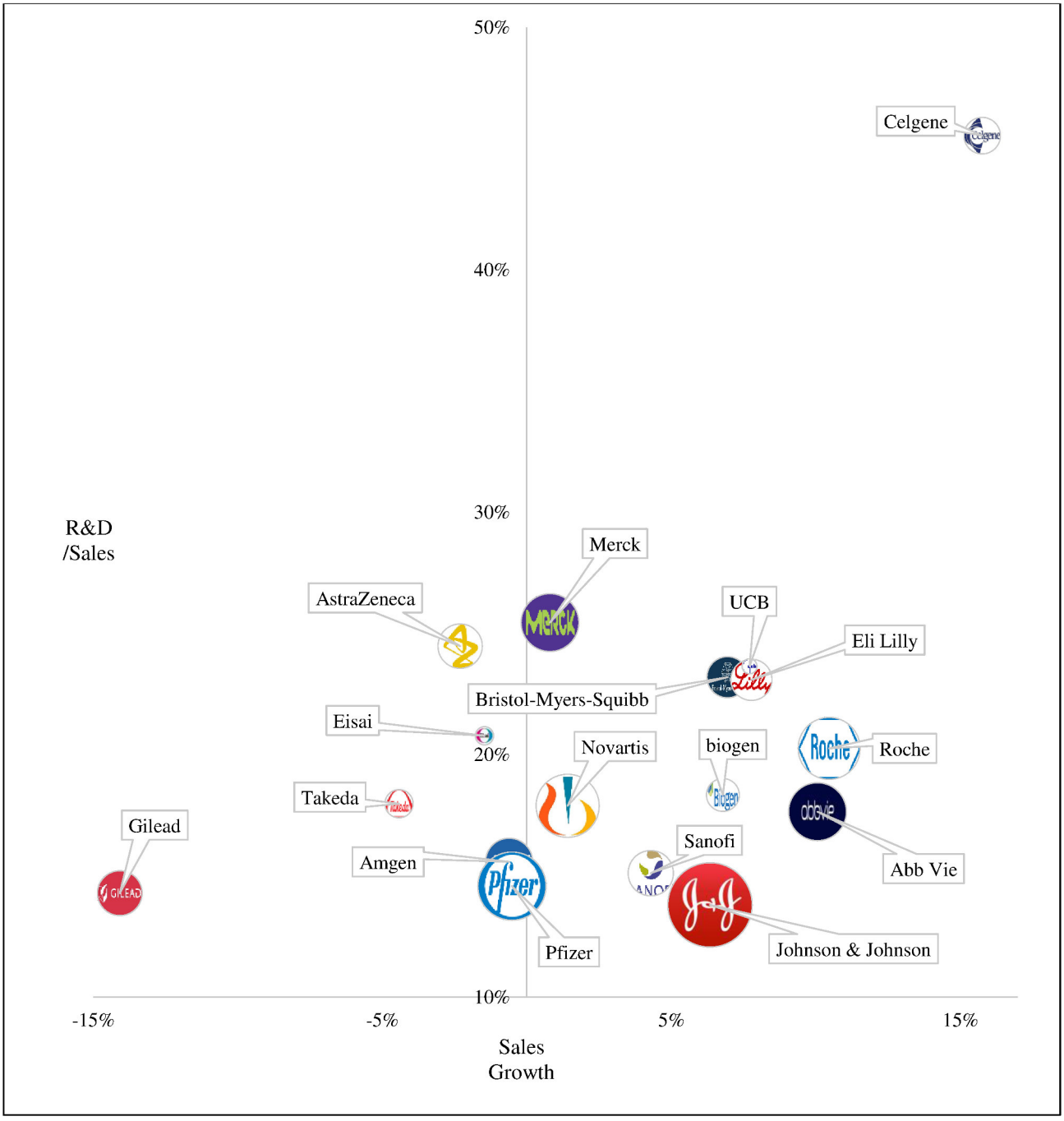
3.1.6 Competition & Rivalry

The pharmaceutical and biotechnology industries, in which Celgene operates, are highly competitive and subject to rapid and significant technological change (Celgene Corporation, 2018f). Their current products and product candidates face competition from other innovative drugs and, in some cases, generic drugs. Among other factors, Celgene names product efficacy, safety, reliability, availability, price, third-party reimbursement, sales and promotional activities as factors that determine the degree of competition in their relevant markets (2018f).

Figure IV

Competitive Landscape

Figure IV plots Celgene's competitors according to their R&D intensity (proxy: R&D/sales) and their sales growth from 2016 to 2017. The size of the bubble is relative to the companies' enterprise value. (Source: Celgene, Yahoo Finance)



Celgene's competitive landscape consists of a variety of pharmaceutical and biotechnological companies. On the one hand, they compete against large multinational drug manufacturer like Pfizer or Johnson & Johnson whose enterprise value is up to five times as big as Celgene's enterprise value.

On the other hand, they face competition from small, specialized biopharmaceutical research companies like UCB. Their competition includes cell-based and non-cell-based treatments.

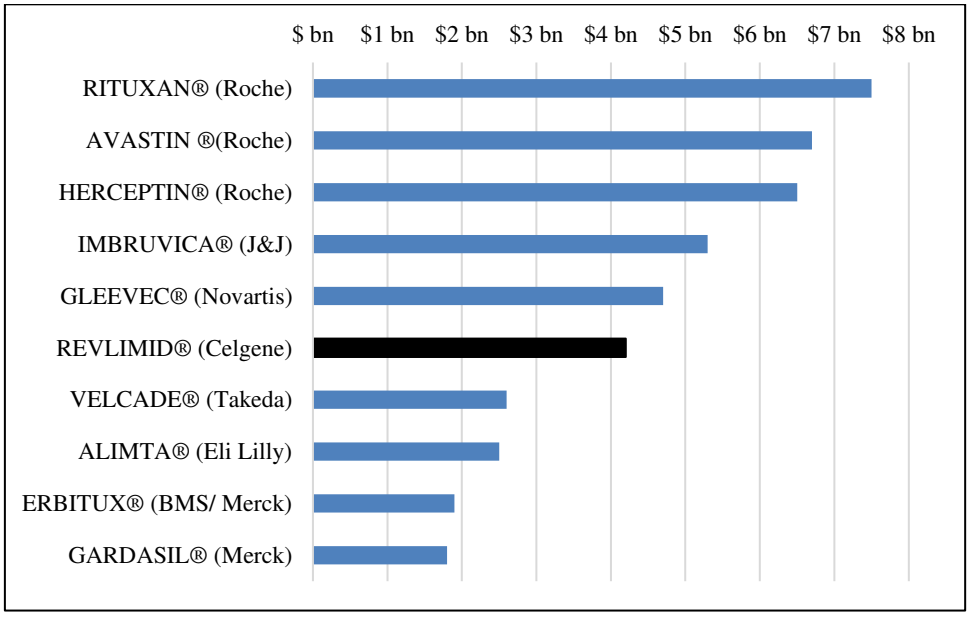
Celgene has had the highest revenue growth and the highest R&D expenditures relative to sales in comparison to its competitors. On the one hand, this can be interpreted as a focus on growth through internally developed products, on the other hand it could also be interpreted as a lack of efficiency. Competitors might also pursue different strategies in the development of their products (f.e. M&A or options on external R&D projects that have not been accounted for in their R&D expenditure section). Celgene's growth in sales must also be viewed highly positive but was largely driven by REVLIMID® revenue growth and is therefore dependent on the performance of one single product which is expected to reach peak sales in 2021.

According to Celgene's annual report 2017, all companies in Figure IV compete with Celgene in one or multiple markets. Even though, the competitor's overall product portfolio may vary a lot from Celgene's product portfolio. For example, a competitor might offer drugs to treat Lymphoma, Lung Cancer and HIV, but may not sell drugs to treat Myeloma. In the same manner, the prescription spectrum might differ between drugs that compete for the application in one specific medical condition, exposing them to a variety of competition in a variety of highly specialized sub markets.

Figure V

Cancer Drugs

Figure V ranks the top 10 cancer drugs across all cancer types by revenue for the year 2016 worldwide. The drug manufacturer is given in brackets behind the drug title. (Source: Statista, 2018b)



With regard to revenue figures for cancer drugs, Roche has been selling the three most successful products in 2016. Global revenue for RITUXAN® has been at about $7.5bn. The drug is a direct competitor for REVLIMID® used for the treatment for common forms of blood cancer but it is also used for the treatment of rheumatoid arthritis and certain types of vasculitis (Statista, 2018b) and is therefore prescribed across a greater variety of medical conditions.

The industry's degree of rivalry can be analyzed using Porter's five forces analyses. Despite low threat of entrants, power of suppliers and power of buyers, the competitive rivalry in the industry is very high. Details on the industry's five forces analysis can be found in Appendix 5.

The biopharmaceutical industry attracts investors due to the promise of high profit margins for successfully commercialized research projects. As a consequence, CAR-T research has accelerated since Novartis' Tisagenlecleucel has been approved as a first-in-class drug for B-cell Leukemia in the fall of 2017 (U.S. Food & Drug Administration (FDA), 2017). Research is conducted by various companies in several regions of the world. Sometimes, even key industry players lack information on competition. According to a Financial Times article from April 2018, significant research milestones have been overcome by Chinese drug researcher Nanjing Legend. Their CAR-T trial reports at the annual meeting of the American Society of Clinical Oncology have left competitors astonished, with a reported patient response rate of 94%, superior to all trials conducted by US companies (Crow, Hancock and Xueqiao, 2018). Shortly after, Johnson & Johnson has agreed to engage into a $350mn agreement to partner up with them. Moreover, the merger market for CAR-T research has been hot in recent months. One of the most notable deals, asides the Juno acquisition, has been the acquisition of Kite Pharma by Gilead Sciences for $11.9bn in August 2017 (Gilead Sciences Inc., 2017b). Many companies have put significant time and capital into the development of a best-in-class CAR-T therapy system. The situation seems to develop more and more into a winner-takes-it-all scenario and the competition is becoming more fierce and incomprehensible over time.

3.2 Company Profile: Celgene Corporation

Celgene is an integrated, global biopharmaceuticals company. Together with its subsidiaries, it is engaged in the discovery, development and commercialization of therapies for the treatment of cancer and inflammatory diseases. Celgene was originally founded in 1980 as a Celanese business unit, incorporated in in the State of Delaware (USA) in 1986 and spun off as an independent, public company in 1987 (Celgene Corporation, 2018c).

The company has about 7500 full-time employees and mainly operates in the United States. Likewise, more than 75% of their revenues came from the US market (Celgene Corporation, 2018f). General Celgene company information is summarized in Appendix 6.

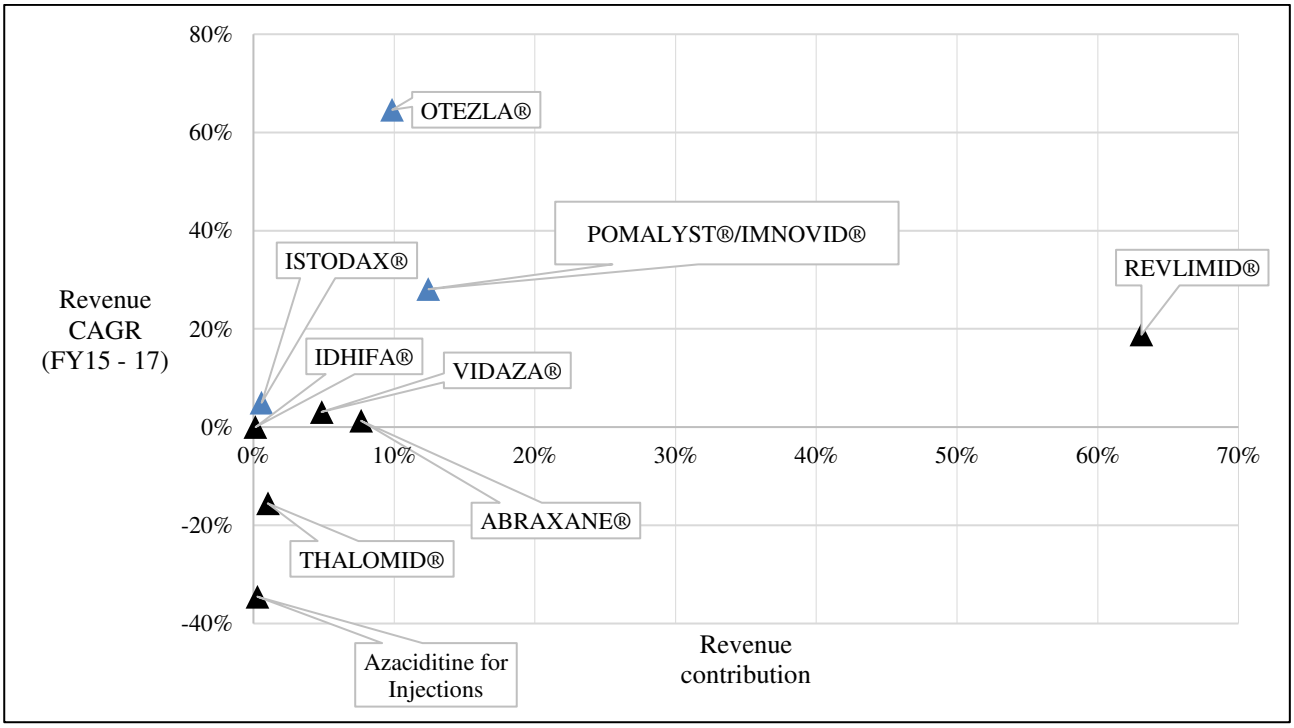
Celgene's products are developed through research in protein homeostasis, immuno-oncology, epigenetics, immunology and neuro-inflammation procedures. This drug development process is complex, consisting of many interrelated business activities and functional constituents. On a regulatory level, all their products must go through the FDA drug approval process to be commercialized in the US. Some of their products had to go through the process several times to be used for multiple therapy purposes. Celgene's products are then governed by patent/ market exclusivity status.

However, drugs tend to become medically outdated/ copied by generics which leads towards revenue degeneration as time progresses after their FDA approval.

Figure VI

Celgene Product Portfolio

Figure VI plots Celgene's product portfolio by the product's relative revenue contribution for the fiscal year 2017 on the x axis and the annual CAGR (2015 – 2017) on the Y axis. Products that have been first approved by the FDA after 2012 are marked blue, older products have been marked black. (Source: (Celgene Corporation, 2018f)



The information can be used to split Celgene's product portfolio into three groups:

Table I

Juno Revenue Contribution

Group 1: ***The Bestseller***		REVLIMID® is mainly used to treat multiple myeloma (blood cancer) and myelodysplastic syndromes (bone marrow diseases). In 2017, it accounted for more than 60% of Celgene's revenue. In their annual report, they note that "A significant decline in REVLIMID®'s net revenue, in the absence of offsetting increases in revenue from our other marketed products, would have a material adverse effect on our results of operations, cash flows and financial condition" (2018f). REVLIMID®'s revenues have been growing at about 20% on average in the last years and its last patent is expected to expire only in 2027 (USA) according to company information (2018f) but the product is expected to face first generic competition after 2021. Being first approved by the FDA in 2006, the product has been approved for various other therapies in the following 10 years. REVLIMID® is expected to remain Celgene's most important product in the near future, since peak sales may not be reached, yet.
Group 2: ***Growth Prospects***		POMALYST®/IMNOVID®, OTEZLA® and IDHIFA® have been approved by the FDA no later than 2013, with IDHIFA® being approved by the FDA in the 3rd quarter of 2017. Together, they accounted for about 22% of Celgene's revenue in 2017. From all currently marketed Celgene products, this group can be expected to grow the most, since they have just entered the market.
Group 3: ***Degenerating Products***		ABRAXANE®, VIDAZA®, azacitidine for injection, THALOMID® and ISTODAX® have been approved before 2013. Together they make up for about 14% of Celgene's revenue. Their CAGR has been slightly positive or negative. Patents and exclusivity are running out/ have been running out. Some of these products might become technically obsolete and/ or going to be copied by generics in the next years. Their contribution to Celgene's revenue streams is expected to keep decreasing.

Companies in the biotech/ pharma industry put significant efforts in their R&D pipeline to prevent future revenue gaps. The outcome of these projects has a strong impact on Celgene's value. Amongst others, Celgene is currently engaged in various research and drug development projects in the areas of Immune-Inflammatory diseases, Myeloid Diseases, Epigenetics Protein Homeostasis and Immuno-Oncology. JP Morgan estimates that about one third of the company's firm value will result from Celgene's current R&D pipeline (2018). An overview of Celgene's product pipeline and its progression level is given in Appendix 4.

Pharmaceutical drugs and therapies are highly heterogeneous goods. Their prescription depends (amongst other factors) on the patient's characteristics and the progression level of the specific illness[4]. The level of competition might therefore differ between specific products and even within medical conditions which they have been approved for.

Table II

Celgene Performance

(in mn)		FY15		FY16		FY17	CAGR
Revenue	$	9,256	$	11,229	$	13,003	19%
Gross Profit	$	8,836	$	10,791	$	12,542	19%
EBIT	$	2,255	$	3,166	$	4,707	44%
Net income	$	1,602	$	1,999	$	2,940	35%

There have been solid double digit average growth rates for revenue, gross profit, EBIT and net income over the last three years. In absolute numbers, Celgene's revenue growth was the highest across the whole industry, according to Bloomberg (Goonewardene and Rye, 2018). Most of Celgene's costs lie in the operating expenses section (R&D expenses). Cost of goods sold are almost neglectable, enabling them to have a 96% gross profit margin in 2017. A significant amount of the cash inflow from operations has been used for investing activities (about $3bn) and share repurchases (about $4bn).

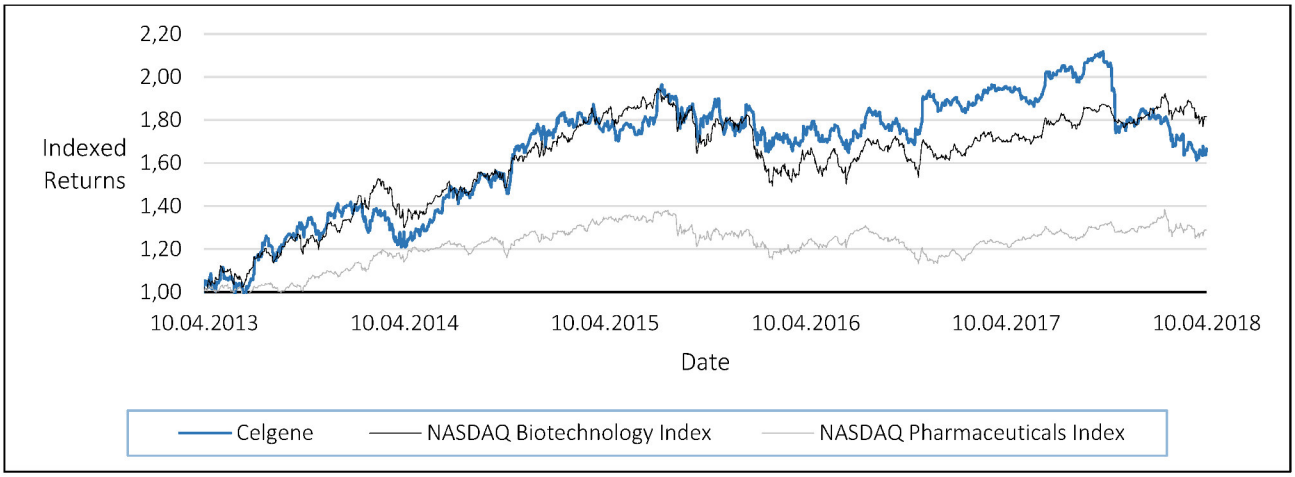
Despite that, Celgene's liquidity situation is still superb with more than $12bn held in cash, cash equivalents or marketable securities (about 40% of total assets). Their debt to total capital ratio lies slightly above 50%. Shareholder's equity on the other hand makes up about 23% of total capital.

[4] Please see 3.1.4 for more information on the drug prescription process.

Figure VII

Celgene vs. NASDAQ Biotechnology and Pharmaceuticals Index

Figure VII shows indexed returns for Celgene shares, the NASDAQ Biotechnology Index and the Nasdaq Pharmaceutical Index over the period of five years from April 2013 until April 2018. (Source: Yahoo Finance)



Celgene's shares are listed on the NASDAQ stock exchange. They closed at a price of $89.44 on the 10th April 2018, giving them a market capitalization of about $66bn US dollar. Over the last three years, Celgene's share price decreased about 12%, whilst the NASDAQ Biotechnology Index increased 2% and the NASDAQ Pharmaceuticals Index decreased 7% in value.

Table III

Celgene Summary Statistics

Table III gives summary statistics for Celgene share returns in comparison to the NASDAQ Biotechnology Index and the NASDAQ Pharmaceuticals Index from 10th April 2017 until 10th April 2018. (Source: Yahoo Finance)

	Celgene	NASDAQ Biotechnology Index	NASDAQ Pharmaceuticals Index
Min	-16.37%	-4.39%	-4.55%
Max	5.24%	4.05%	2.38%
Mean	-0.11%	0.04%	0.01%
Volatility	31.40%	17.97%	12.31%
Skewness	-3.18	-0.24	-1.26
Kurtosis	22.08	1.79	5.75
Percentile (2.5%)	-4.18%	-2.35%	-1.55%
Percentile (97.5%)	2.96%	2.36%	1.28%

After solid growth from 2013 until the middle of 2017, Celgene suffered the biggest share price loss in the history of the company at the 26th October 2017, after Celgene CEO Mark Alles reduced their

2020 sales guidance from $21bn to $19bn. One reason for this was that clinical trials for Mongersen had to be terminated (Kim, 2018). Since then, investors have been concerned whether Celgene's pipeline is sufficient to fuel long term growth for the company. The downward trend has continued and their shares have been falling 29% from 10th April 2017 until 10th April 2018 at an annualized volatility of about 30%. The acquisition of Juno was announced on the 22nd January 2018. On that day, Celgene's share price increased by 0.25%.

The company recently made significant investments in the development of CAR-T based cell immunotherapy systems by acquiring Juno and engaging into a co-development agreement with bluebird bio (Celgene Corporation, 2018a). The purpose of this strategy is to accelerate revenue diversification with meaningful growth drivers from 2020 and beyond (Celgene Corporation, 2018d) to be less reliant on revenues derived from their bestseller and to compensate for revenue holes caused by degenerating products in the middle- and long-term future. Celgene's CEO Mark Alles comments the transaction as follows: "Our colleagues at Juno are developing some of the most promising approaches to treating cancer, and we are excited to add their pioneering work to Celgene's leading hematology and oncology research and commercial platform. Together, we expect to expand our opportunities to discover and develop new therapies that will improve and extend the lives of patients worldwide" (2018a).

3.3 Company Profile: Juno Therapeutics

Juno is a biopharmaceutical company, which is focused on the development of cellular immunotherapies for the treatment of cancer (mainly CAR and TCR technology). The company was founded in 2013 through a collaboration of the Fred Hutchinson Cancer Research Center, Memorial Sloan-Kettering Cancer Center and pediatrics partner Seattle Children's Research Institute after one of their lymphoma patients first experienced significant responses from a CAR-T treatment in 2010 (Kochenderfer *et al.*, 2010). Since then, they have received funding from various research organizations and private sources until going public in 2014[5].

In June 2015, they entered into a ten-year master research and collaboration agreement with Celgene, pursuant to which Juno and Celgene are to research, develop and commercialize novel cellular therapy product candidates and other immuno-oncology and immunology therapeutics, including, in particular, CAR and TCR product candidates (Juno Therapeutics Inc., 2015). Both partners had initially agreed to conduct independent products, whereas each party had certain options to obtain either an exclusive license to develop and commercialize specified product candidates or the right to participate in the co-development and co-commercialization of them (Juno Therapeutics Inc., 2018). On January 2018, they entered into a merger agreement with Celgene pursuant to which Juno will survive as a wholly-owned subsidiary in the Celgene group.

As such, Juno is expected to continue research on T cells with the goal to develop best-in-class CAR and TCR cancer therapy systems. While both systems differ in certain biotechnological aspects, the therapy process for them can be summarized in five steps:

1.) Patient's white blood cells are artificially harvested (Leukaphersis)
2.) Ex vivo (out of body) selection & activation of patient's T cells
3.) CAR/ TCR gene sequences are transferred into the T cell to help it detect and destroy cancer proteins
4.) Patient's T cells are expanded until they reach the desired dose
5.) Reinfusion of T cells into the patient's body[6]

Juno's current research is mainly focused on optimizing certain cell characteristics, the T cell protein composition and the composition of chemotherapeutic agents used after Leukaphersis to increase the tumor's vulnerability to the reinjected T cells. They believe, that their further research may provide greater consistency across patients and give them a competitive advantage over competitor's products to have their products reach a best-in-class status. The most advanced research amongst both systems is currently targeted towards certain types of Lymphoma, but Juno believes that it is possible to

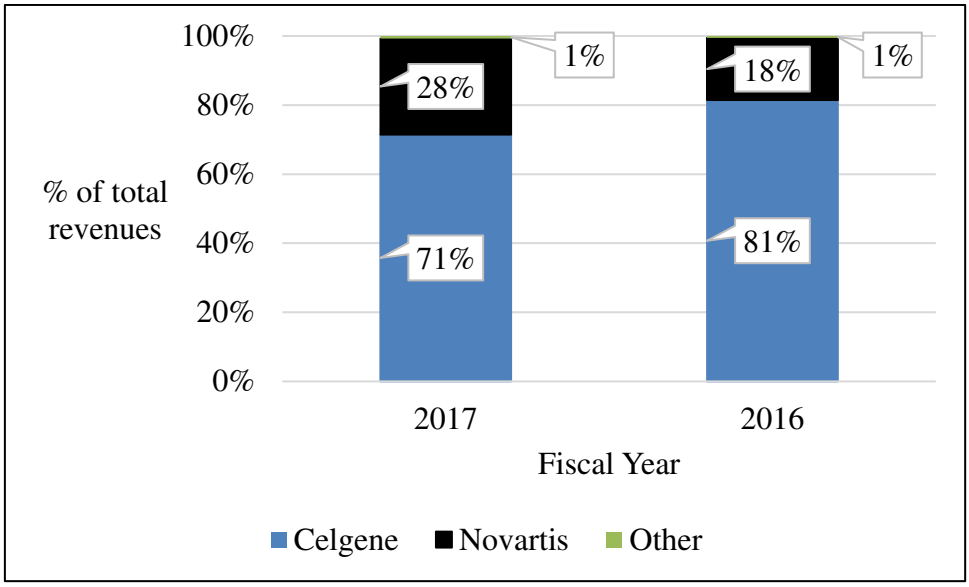
[5] General information about Juno is summarized in Appendix 7.
[6] A graphic overview is given in Appendix 8.

develop immunotherapies targeting a broad array of cancer-associated proteins, including solid organ cancers (Juno Therapeutics Inc., 2018).

Figure VIII

Juno Revenue Contribution

Figure VIII shows Juno's revenue contribution by contract partners in the fiscal years 2016 and 2017. (Source:(Juno Therapeutics Inc., 2018))



Juno generated $112mn of revenue in 2017, primarily through research collaborations and licensing agreements. These contracts allow Juno's Partners to commercialize products based on their intellectual property or to participate in Juno's research operations and can be dependent on the on-time accomplishment of certain mile stones or the contractor's product sales. In their annual report, they acknowledge that most of their revenues have primarily been generated from their collaboration with Celgene. Another significant partner is Novartis, from which Juno receives upfront, milestone and royalty revenues as part of a sublicense agreement from previous research projects (2018).

Table IV

Juno Cash Flow

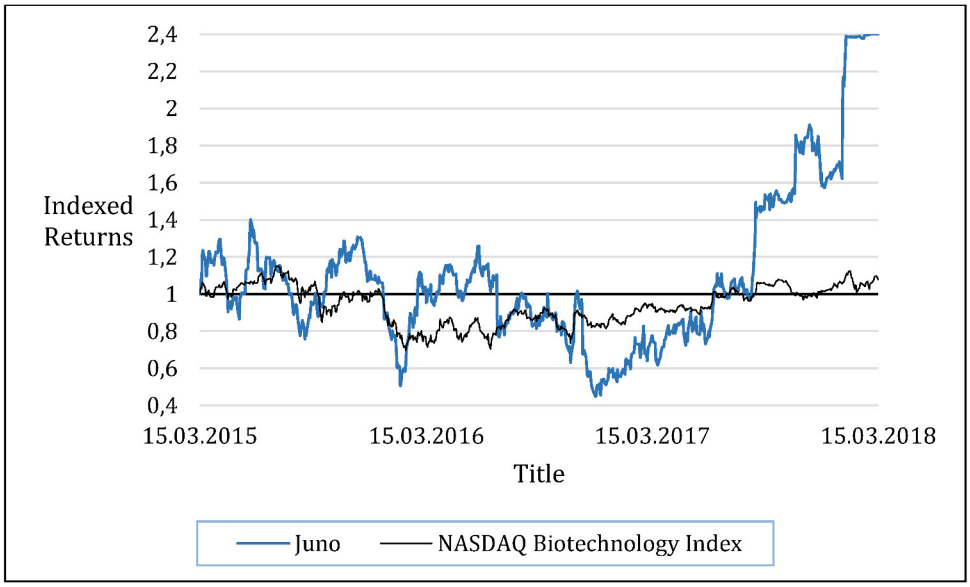
(in mn)	FY15	FY16	FY17
CFO	$ 7	$ -190	$ -225
CFF	$ 851	$ 37	$ 338
CFI	$ -962	$ 89	$ -68
Cash Flow	$ -104	$ -65	$ 45

Juno's cost structure is similar to other early stage, research driven biotechnology companies. They do not report any Cost of Goods Sold. This is due to the fact, that they do not produce any goods that would require material or manufacturing costs of any sort. Their primary cost sources are Research & Development. In the past years, these costs alone exceeded Juno's revenues by far. As a consequence, the company has reported a net loss of about $437mn in 2017 (about four times revenue). Previous annual results have been similar. Since the company does almost not have any debt (Debt/ Total Capital < 1%), most of the proceeds from financing activities come from common stock disposals or increases in their capital stock (shareholders' equity and additional paid-in-stock). Again, Celgene is mentioned as one of their main long-term investors (Juno Therapeutics Inc., 2018).

Figure IX

Juno vs. NASDAQ Biotechnology Index

Figure IX shows indexed returns for Juno shares and the NASDAQ Biotechnology Index over the period of three years from March 2015 until March 2018. (Source: Yahoo Finance)



Juno's shares have been listed on the NASDAQ stock exchange from the end of 2014 until the beginning of 2018. Their share price has been considerably volatile with an annualized volatility of 86%, correlated to the progress and status of their research projects. Setbacks in the development of their products have had a highly negative impact on their share price in the past years. As an example, Juno's share price plunged as much as 35% after two of their patients died, undergoing clinical trials for one of their leukemia therapies (Fortune, 2015). Further deaths in summer 2016 have caused the FDA to place a clinical hold on some of the company's trials. As a reaction, Juno's share prices decreased even further (Hey and Kesselheim, 2016).

Table V

Juno Summary Statistics

Table V shows summary statistics for Juno share returns in comparison to the NASDAQ Biotechnology Index from 15th March 2017 until 15th March 2018. (Source: Yahoo Finance)

	Juno	NASDAQ Biotechnology Index
Min	-14.34%	-4.39%
Max	51.86%	4.05%
Mean	0.64%	0.06%
Volatility	85.98%	17.91%
Skewness	4.25	-0.24
Kurtosis	35.37	1.85
Percentile 2.5%	-8.00%	-2.29%
Percentile 97.5%	8.15 %	2.35%

From spring 2017 until 2018 their share price has almost quadrupled due to more favorable results in their research pipeline and the initiating acquisition by Celgene. Juno's acquisition by Celgene was officially announced by Celgene on the 22nd January 2018 (2018g). Juno shares increased by 52% in price on the 17th January and by another 27% on the 22nd, pushing Juno's shares close to the tender offer price of $87. All in all, the deal was conducted at a 29% premium (Celgene Corporation, 2018b), valuing the company at about $9.9bn (Messer, 2018) before delisting Juno from the NASDAQ in the middle of March 2018.

Most recently, Juno's co-founder and former CEO Hans Bishop was elected to Celgene's Board of Directors (Celgene Corporation, 2018e). Celgene CEO Mark Alles referred to this step as following: "The changes announced today strengthen corporate governance by refreshing our Board of Directors and improving strategic insights provided to management in areas critical to our future success. Hans is a pioneer in the field of cellular immunotherapy whose expertise will help Celgene lead in this extremely promising area of science." (2018b).

4. Valuation

4.1 Juno

4.1.1 Relative Valuation

The diverse nature of business models, the relative newness of the companies, the lack of many tangible assets and the limited financial history available are difficulties to overcome when valuing a biotechnology company. The high degree of uncertainty, the long development times required to produce marketable assets and the development of competitor's research are further hurdles when forecasting revenues for the industry. As a consequence, Keegan concludes, that there is no obvious or accepted way of applying valuation in this field (2008).

The market for CAR-T companies has been hot in recent quarters. There have been various partnering agreements, IPOs and early financing rounds for investors to participate in the race to commercialize novel cancer therapies. The two most similar transactions to Celgene's acquisition of Juno in terms of geographical, industry specific and financial characteristics are the acquisitions of Kite Pharma by Gilead Sciences and the acquisition of Bioverativ Inc. by Sanofi SA. Just like Juno, Kite is engaged in CAR-T research with therapies for relapsed or refractory aggressive non-Hodgkin lymphoma currently under review by the FDA. According to company information, the acquisition has been completed in October 2017 through a 29% premium tender offer, valuing Kite Pharma's equity at $11.9bn (Gilead Sciences Inc., 2017a). Bioverativ is a US company mainly engaged into the research for hemophilia and related blood order diseases by non-gene-based therapy methods. The acquisition company has been acquired in March 2018 with a 64% premium at an equity price of $11.6bn (Sanofi Corporation, 2018).

Table VI

Juno Precedent Transactions

Table VI estimates implied equity prices for Juno based on precedent transaction multiples. Peer comparison based on Juno transaction values. (Sources: Bloomberg, Thomson Reuters)

Metric	Average Multiplier	Median Multiplier	Juno Equity Value (Average)	Juno Equity Value (Median)	Discount/ Premium to peers (Average)	Discount/ Premium to peers (Median)
EV/ Revenue	114x	114x	**$12.53bn**	**$12.58bn**	27%	27%
EV/ R&D Exp.	18x	16x	**$7.86bn**	**$7.10bn**	-21%	-28%
EV/ Book Value	5x	5x	**$7.57bn**	**$7.37bn**	-23%	-26%
EV (mn)/ Employee	19x	20x	**$12.68bn**	**$13.24bn**	28%	34%

Since Juno did not generate profits, equity value multiples based on (f.e.) profit, EBIT or EBITDA cannot be applied. Instead, more cash flow unrelated multiples had to be used. The multiples

calculation is based on FY2017 data. Juno was acquired on a discount between 39% and 113% compared to the average of the two most similar industry transactions in the recent past, based on the given multiples. Although, it must be mentioned, that the multiples used are

Table VII

Juno Peer Group

Table VII estimates implied equity valuations for Juno based on peer group multiples (FY2017 data). Peer comparison based on Juno's transaction value. (Sources: Bloomberg, Thomson Reuters)

Metric	Average Multiplier	Median Multiplier	Juno Equity Value (Average)	Juno Equity Value (Median)	Discount/ Premium to peers (Average)	Discount/ Premium to peers (Median)
EV/ Revenue	114x	114x	**$12.53bn**	**$12.58bn**	27%	27%
EV/ R&D Exp.	18x	16x	**$7.86bn**	**$7.10bn**	-21%	-28%
EV/ Book Value	5x	5x	**$7.57bn**	**$7.37bn**	-23%	-26%
EV (mn)/ Employe	19x	20x	**$12.68bn**	**$13.24bn**	28%	34%

Juno mentions a diverse variety of almost 40 competitors in their annual report 2017 (2018). A lot of them are privately held companies. Analyzing the remaining companies for cluster, Bluebird Bio Inc., Incyte Corp. and Ziopharm Oncology Inc. are identified as Juno's nearest neighbors. Cluster Analysis results can be found in Appendix 9. Applying their average and median multiples to Juno gives an equity valuation range between $7.37bn and $13.24bn, diverging about 30% in both directions compared to the actual transaction value. Again, it must be mentioned that the accuracy of these valuation results need to be analyzed with caution because the applied multiples are not closely related to cash flow. Forward multiples have not been applied because Juno and (many of) its peers are not expected to generate profits/ positive cash flows in the next years.

4.1.2 Discounted Cash Flow Valuation

A common proverb in Finance, claims that cash is king. This is one of the reasons why a profound DCF analysis should be at the heart of every equity valuation. The basic idea is that an asset is worth the cash it generates in the future discounted by time and risk. However, Keegan argues, that cash is irrelevant in valuing ongoing biotechnology businesses because the likelihood of management giving it back to the investors is very remote due to the immense cash burn required to build the company (2008).

Value can rather be derived from the commercial potential of the company's R&D pipeline relative to their success probabilities. Other potential value drivers like interest tax shields, working capital/

cost efficiency etc. can practically be neglected due to the company's business model and financing structure.

Keegan therefore introduces a DCF related, probability weighted net present value approach for all pipeline assets advancing Phase I trials without explicitly taking into account the cash required to develop it. Originally, he does not consider any drug candidates in Phase I or below because their profile is not considered sufficiently recognizable, yet. Though, the majority of Juno's assets are early stage projects. The valuation would lack the majority of its base without considering them. Therefore, Phase I projects have been considered in Juno's valuation. Preclinical candidates have not been considered in the valuation. The company's equity value is computed by multiplying the estimated sum of profit by a pharma specific P/E factor, implying the company is maturing towards a traditional pharmaceutical company.

The model's strengths lie in the focus on industry specific value drivers and their impact on the company's asset value:

1.) **Development risk:** The drug's probability to successfully enter the market
2.) **Revenue potential/ commercialization risk:** The revenue a drug can generate depending on the indication's epidemiology, therapy prices and realizable market shares

Weaknesses lie in the high degree of subjectivity inherited in probability/ market estimations. A thorough analysis requires credible data and the evaluation of different possible scenarios. Furthermore, development costs are practically neglected and only Peak Sales are reflected in the analysis. The model is not robust in financial theory but it gives valuable indications to how and where the value of the company is derived from and how current or future events might affect its value.

Table VIII

Juno pNPV Valuation Results

Table VIII gives valuation results for the pNPV valuation on Juno as of January 2018. (Sources: Bloomberg, Countryeconomy.com (2018), Global Data (2017), Global Market Insights (2017), Grand View Research (2016), Grand View Research (2018), Jadhav (2018), Myers and Howe (1997), Persistent Market Research (2017), Reuters, Rohan (2018), Rohan (2018a), Statista (2018), The World Bank (2016), Visiongain Ltd., (2017))

pNPV JCAR017	$499mn
pNPV Phase I/II Candidates	$778mn
pNPV Phase I Candidates	$3.416mn
Enterprise Value	**$4.692mn**
Long term debt	$10mn
Excess cash	-
Equity Value	**$4,68bn**
Shares outstanding	116,11mn
Share price	$42,33

Juno's pipeline has been split up into 14 separately valued assets. One of them Is JCAR017, which is originally part of the CD19 research series. It is currently undergoing an accelerated approval process with Celgene and is expected to reach the market in 2019 (Source: Thomson Reuters). Its value for Juno lies at about $500mn. Only four other assets have reached Phase I/II trials. Their overall probability weighted NPV lies at about $778mn. Another $3.4bn pNPV is derived from Phase I drug candidates. Excess cash is assumed to be zero because the company is expected to use its cash reservoirs to finance their research.

All in all, Juno is valued at an equity value of $4.68bn, stand-alone, dated back to January 2018. However, this result is a purely asset-based valuation which neglects 8 of Juno's early stage research projects. Peak Sales estimates are based on overall market forecasts and Juno's projected market share for 2022. It is assumed that markets continue to grow at projected rates and that Juno's partners can sustain its projected 2022 market share. Product cannibalization for Juno products that treat the same diseases have been taken into account.

One of the main value drivers is Juno's Lewis Y candidate, since the drug is expected to treat solid tumors on a market that is expected to have a size of $220bn in 2032 (Simoes, 2014). The discount rate used in the valuation was 10%. Though, industry WACC rates would be significantly higher due to equity heavy capital structures and highly volatile stock return patterns. The reason for using such a low rate, is that the main business risk of the company is already captured in the drug development's

success probabilities. The remaining 10% are based on practitioner's recommendations to capture remaining risk factors, such as the commercialization and operating risk (Keegan, 2008).

However, the valuation results are highly sensitive to the applied discount rate and other factors. All in all, the implied equity value of $4.68bn is rather optimistic due to market growth and size assumptions. Valuation details and analysis can be found in Appendix 10, 11 and 12.

4.1.3 Contingent Claim Valuation

The value of a biotechnology company can be modeled as a decision tree, leading to probability weighted cash flows depending on the company's future decisions. This concept introduces flexibility that cannot be captured using traditional DCF models. A DCF model must assume that a drug under development will reach the market or apply a probability of failure as seen in 4.1.2. Using a traditional DCF, the risk of failure must be captured in the company's overall discount rate (f.e. WACC/ APV).

A contingent claim model, in contrast, portrays the company as a series of options. It includes the possibility to save on investment costs related to the next step of the drug development process by eliminating negative NPV projects. The model works by computing each year's project cash flow relative to the probability of occurrence. The cash flow consists of drug development costs, operating costs and potential revenue inflows. Revenues are modelled using a five scenario setting with individualized peak sales and revenue growth patterns (Myers and Howe, 1997). The revenues are probability weighted for each scenario and therefore represent expectation values. The probability rated cash flow is discounted back to the current year.

Table IX

Juno Binomial Tree Valuation Results

Table IX gives valuation results for the Contingent Claim valuation on Juno as of January 2018 without any acquisition effects. (Sources: Bloomberg, Countryeconomy.com (2018), Global Data (2017), Global Market Insights (2017), Grand View Research (2016), Grand View Research (2018), Jadhav (2018), Myers and Howe (1997), Persistent Market Research (2017), Reuters, Rohan (2018), Rohan (2018a), Statista (2018), The World Bank (2016), Visiongain Ltd., (2017))

NPV JCAR017	$339mn
NPV Phase I/II Candidates	$855mn
NPV Phase I Candidates	$5.284mn
Enterprise Value	**$6.478mn**
Long term debt	$10mn
Excess cash	-
Equity Value	**$6,47bn**
Shares outstanding	116,11mn
Share price	$57,72

The model gives an overview over each project's equity value contribution and identifies potentially unsuccessful projects. In the model, Juno's enterprise value would increase about $8mn by cancelling their WT-1 research for Mesothelioma because the relevant market and the probability of success are too small to justify the research costs. All in all, the company's equity is estimated at about $6.47bn, as of January 2018 (prior to the acquisition). Again, market estimates have been rather optimistic by applying mid-term market growth rates over a long-term period and keeping Juno's market share at a forecasted 2022 value. More detailed information on Juno's binomial tree valuation is given in Appendix 13, 14, 15, 16 and 17.

4.2 Celgene

4.2.1 Relative Valuation

Celgene names a variety of competitors with cell related and non-cell related product backgrounds in their annual report 2017 (2018f). According to cluster analysis, their closest peers are AbbVie Inc, Johnson & Johnson and Novartis AG. Like Celgene, Johnson & Johnson and Novartis AG shares have both lost in value over the last twelve months. AbbVie has seen moderate increases in share price.

Table X

Celgene Peer Group

Table X estimates implied equity valuations for Juno based on peer group multiples (FY2017 data) (Sources: Bloomberg, Thomson Reuters)

Metric	Average Multiplier	Median Multiplier 4.47	Celgene Equity Value (Average)	Celgene Equity Value (Median)	Discount/ Premium to Peers (Average)	Discount/ Premium to Peers (Median)
EV/ EBITDA	14x	15x	**55.50**	**57.44**	-28.82%	-26.34%
EV/ EBIT	19x	18x	**65.68**	**62.19**	-15.77%	-20.24%
Price/ EPS	21x	22x	**66.97**	**71.21**	-14.11%	-8.67%
Price/ BV	17x	5x	**116.18**	**37.58**	49.00%	-51.80%

Celgene was traded at a price of $102.65 on the 19th January 2018, representing a market capitalization of approximately $78bn. Peer group comparison reveals that they have been traded at a premium of up to 49% for most given multiple metrics. Whilst Novartis AG is traded on an EBITDA multiple of about 15, Celgene is traded on an EBITDA multiple of about 20. A possible explanation of this is Celgene's outstanding operating growth in the last years and the reflected future growth expectations. Cluster analysis results and peer group data can be found in Appendix 18.

4.2.2 Discounted Cash Flow Valuation

Celgene's Gross Profit margin lay between 95% and 96% in the last fiscal years. Their outstanding debt has been issued at interest rates as low as just above 2%. Like Juno, the company's main value drivers lie in the successful development of their R&D pipeline and the commercialization of existing products. The Celgene DCF model is based on revenue estimations for the five different product and candidate categories given in the Celgene company profile and on revenue estimations for products that have not entered the market, yet. The five categories are:

- Bestseller
- Degenerating Products
- Growth Prospects
- Late Stage Candidates
- Early Stage Candidates

Revenue forecasts for Celgene's existing product are forecasted in line with patent expirations and pending approval requests for alternative indications. As a result, the bestseller REVLIMID® reaches its peak sales before patent expiry in 2021. Thereafter, sales from pending REVLIMID® FDA requests are expected to buffer revenue degeneration. In a similar fashion, degenerating products are modeled to lose close to 8% in revenue per year over the forecasted period. Growth prospects are expected to reach peak sales in 2024 and grow at an average of 1.88% per year between 2018 and 2030.

The revenue estimation for drug candidates was conducted in a different fashion. Late stage candidates are expected to reach the market from 2019 onwards. Revenue estimates are based on specialist reports, analyst estimates and company information. The product group is expected to reach peak sales in 2026. The average growth in revenue lies at about 10%. Early stage candidates include a variety of Phase I/ early stage II candidates. Similar to the pNPV approach for Juno, their revenues have been probability weighted to cover the additional risk that is not represented in Celgene's overall WACC. Those 15 candidates are expected to generate fast growing revenues from 2024 onwards and do not reach peak sales in the forecasted period until 2030. As a result, Celgene's revenues are expected to increase in the next years with a revenue growth gap between 2021 and 2024.

Revenue forecasts for Bestseller and Degenerating Products can be considered moderately accurate because these products have already been on the market for a considerable time. Expected forecast accuracy naturally decreases for the remaining product groups due to development and commercialization hurdles that have to be passed over the forecasted period

from 2018 to 2030. As a result, the valuation's degree of uncertainty decreases with increasing revenue components. Appendix 19 shows data on Celgene's revenue estimates.

Operational margins have been kept at past year averages, since there is no information that would indicate significant changes. The capital structure is held constant throughout the valuation. Celgene has conducted share repurchases in the past. This model was changed into a dividend payout model since forecasting share repurchases would require a variety of practically unpredictable variables (f.e. timing and share price development). Assets and working capital grow relative to revenues. The cost of equity has been derived as an average of historical and peer group implicated rates. The US 30-year-treasury yield has been used as the risk-free rate. More detailed information about Celgene's DCF valuation can be found in Appendix 20 to Appendix 26.

Figure X

Celgene Discounted Cash Flow Valuation Results

Figure X gives results for Celgene's DCF valuation as of January 2018. The graph breaks down Celgene's share price contribution into five product- and candidate types according to their degree of maturity. (Sources: Bloomberg, Campbell (2017), Countryeconomy.com (2018), Global Data (2016), Global Data (2017), Global Market Insights (2017), Grand View Research (2016), Grand View Research (2018), Jadhav (2018), Kolaczkowski (2017), Lawrennce (2016), MacKay and Zheng (2017), Myers and Howe (1997), Persistent Market Research (2017), Reuters, Rohan (2018), Rohan (2018a), Staines (2018), Statista (2018), Supid (2015), The World Bank (2016), Visiongain Ltd., (2017), Wood (2018))

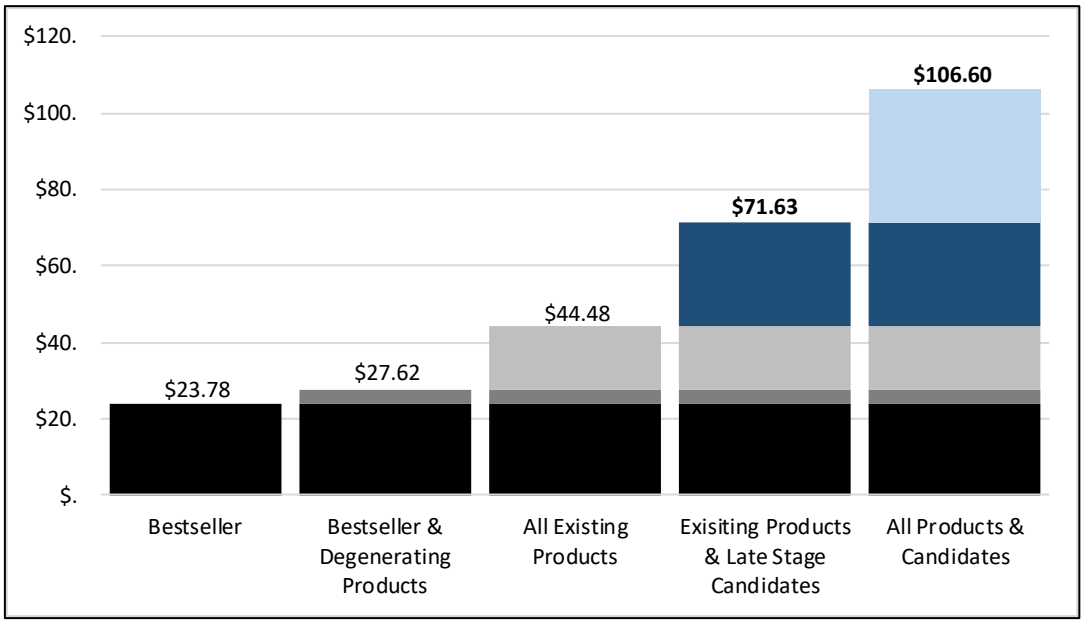


Figure X shows Celgene's share price development under different revenue scenarios. In a scenario where all revenues solely consist of REVLIMID®, their share would be worth $23.78. Revenues from Degenerating products and Growth Prospects add a value of $20.70 per share, lifting them

to a price of $44.48. The valuation yields additional $27.15 per share for Late Stage Candidates and $34.97 for Early Stage Candidates.

Celgene's shares should have therefore been worth $106.60 in a top scenario including all products and candidates at given revenue estimations, as of 19th January 2018.

4.3 Synergies and Merged Firm

Synergies are found where the value of both firms' added value is increased through the transaction. Using discounted cash flow valuation logic, Devos et. al. express this mathematically as follows (2009):

$$Total\ Synergies = PV(CCF)_{postmerger,A+T} - PV(CCF)_{premerger,A} - PV(CCF)_{premerger,T}$$

The total value of synergies is equal to the value of the merged firm minus the independent present value of both firms before the merger. There are different approaches to categorize the sources of synergy. The following five categories are one possible way to do so (Eccles, Lanes and Wilson, 1999):

- Cost savings
- Revenue enhancements
- Process improvements
- Financial engineering
- Tax benefits

The valuation can be conducted based on value line forecasts, using forward looking financial statements to arrive at the calculation as seen above. However, previous chapters have argued that the best way to break down Juno's value is to estimate revenue generation potential using probability weighted cash flows or real options approaches on their intangible asset base, instead of traditional DCF valuation. This approach has already summarized the value of Juno's operations on a product level. Following this logic, the operational synergy valuation process (Costs, Revenues and Process improvement synergies) should start at Juno's asset values as a stand-alone company and compare it to the value that could be generated from these assets as part of the Celgene group. In other words: how does Juno's asset value increase, using Celgene's business infrastructure?

Juno is a company that does not possess any capacities to manufacture and commercialize pharmaceutical goods. They capitalize on their assets by letting external partners produce goods based on their research efforts. In this way, Juno is just receiving a royalty contribution on the drugs overall profit. As part of Celgene, all revenues related to Juno products can be internalized at Celgene's profit scheme. These additional revenues make up the majority of synergies. Since Juno is expected to

continue their operations as an independent Celgene subsidiary, major cost cuttings or process changes cannot be expected.

Celgene and Juno already engaged in a contract that allows Celgene to market Juno's CD19 and CD22 line exclusively. As a result, cash flows related to CD22 and CD19 product candidates have been with the companies prior to the merger. The contract contains a profit split, milestone payments, upfront payments and other payment schemes. The actual split between both companies should therefore be close to a common market rate of 15% revenue, which was used in the previous chapters to calculate company revenues. It follows that synergies for CD19 and CD22 drug candidates should practically be zero. In fact, the synergy calculation yields negative synergies for these research modules. The reason for this is that pNPV and binomial valuation makes use of common biotechnology profit ratios that differ from Celgene's profit structure. Also, the calculations behind those valuation schemes might factor in abandoning options or differ in the probability valuation/ discounting process. Mathematically, the calculations therefore yield different results.

Juno's equity value is the average of pNPV and binomial valuation on candidate and firm level. The premerger equity value for the acquirer represents royalties that Celgene would derive from Juno through existing contracts. The calculated synergies mainly emerged through the internalization of revenues from prior licensing partners. In some cases, Juno has agreed to pay revenue royalties to their licensee partners. One example for this is the Fred Hutchinson Cancer Research Center that has been supporting Juno in their WT-1 research module development. Those cash outflows have been considered, as far as they were public and foreseeable.

$$Total\ Operating\ Synergies = \$18{,}033\ mn - \$2{,}421\ mn - \$5{,}464\ mn = \mathbf{\$10,147\ mn}$$

As a result, about $10.1bn in operating synergies are derived from the merger. The synergies are calculated on rather optimistic market forecasts. As mentioned before, revenue estimations have been made upon a variety of optimistic assumptions. Therefore, the given synergies should be at the estimation range's top end. More detailed information on operational synergies can be found in Appendix 27.

Financial Synergies can be found when the merged firms WACC decreases through an increase in leverage and risk diversification or through the possibility to refinance the target's existing debt at the acquirer's lower debt refinancing rate without increasing the merged companies cost of debt. However, Juno is almost solely equity financed and there are no reasons to expect the company's overall WACC to decrease. Finally, tax synergies might emerge by deducting Juno's losses carried

forward from Celgene's earnings before taxes. Under the premise, that all of Juno's accumulated losses may be carried forward and may be fully deducted from EBT in 2018 at Celgene's tax rate and discounted by their Cost of debt. Tax synergies are calculated as follows:

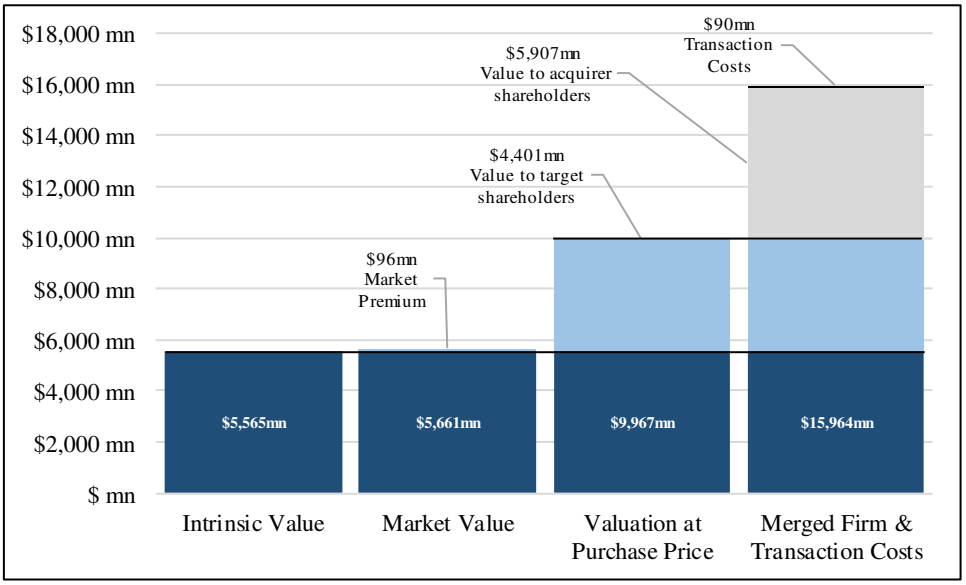
$$Total\ Tax\ Benefits\ = \frac{Juno's\ accumulated\ losses * Celgene's\ tax\ rate\ 2018}{1 + Celgene's\ Cost\ of\ Debt}$$

Under the reasonable assumption, that Celgene's EBT will extend Juno's accumulated losses, the merger's tax benefits are a discounted cash flow value of about $251mn. Total Synergies therefore amount to $10.398mn for 100% of the firm's equity, excluding transaction costs.

Figure XI

Premium Analysis and Synergies

Figure XI provides a premium and synergy analysis for Celgene and Juno.

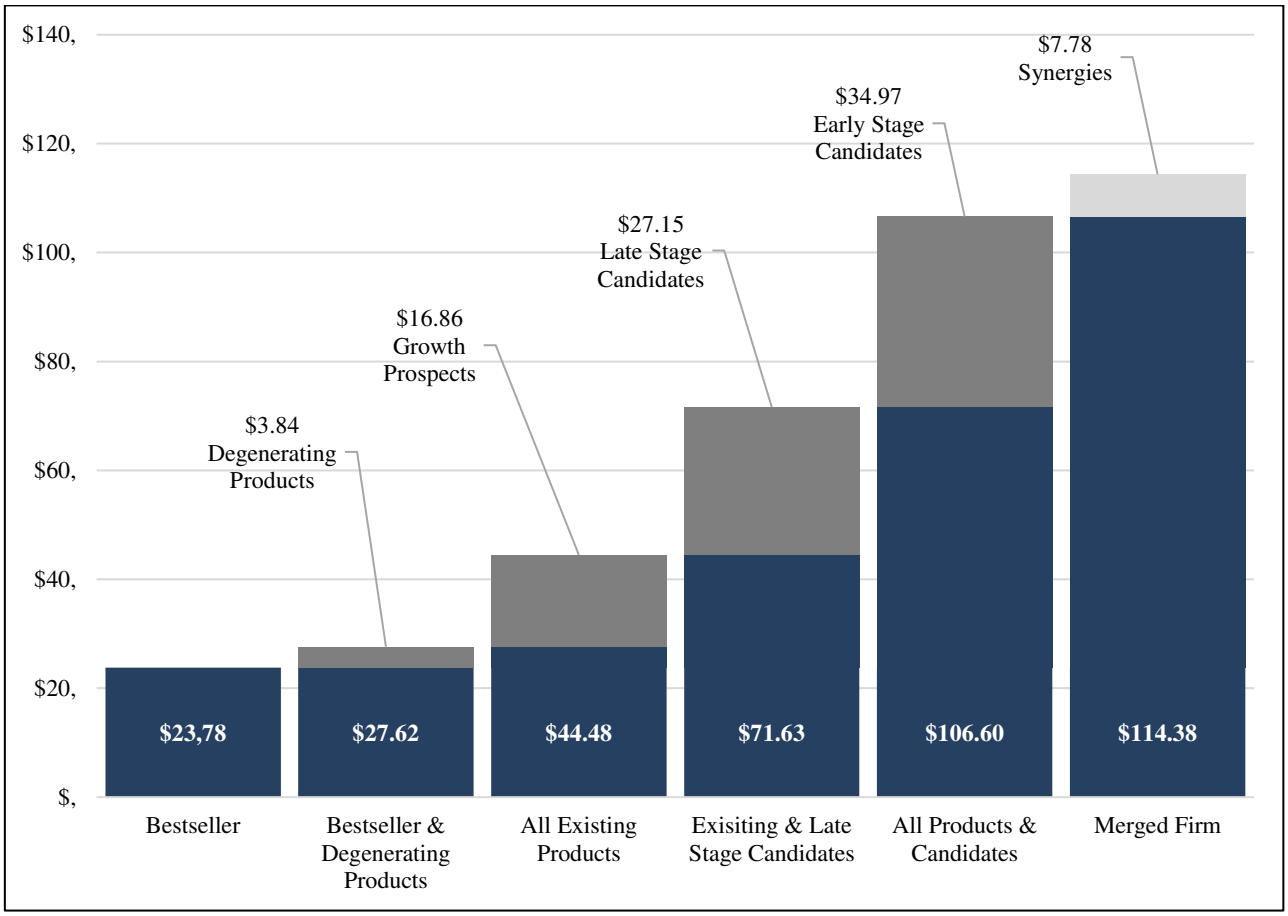


Assuming transaction costs at 1% of the purchase price ($90mn), the transaction added a value of $4,401mn to the target's shareholders and a value of $5,907mn to the acquirer's shareholders for the whole firm. The acquisition was conducted using cash, only. Therefore, their share price can now be portrayed as follows:

Figure XII

Merged Firm

Figure XII provides the merged firm's share price contribution from products, candidates and synergies.



Synergies from the Celgene acquisition add a total of $7.78 in synergies to Celgene's share price. The merged firm's overall value lies at a top range valuation of $114.38 per share.

5. Conclusion: Celgene – a biopharmaceutical research network

Biopharmaceutical acquisitions are risky by nature. An early stage, research oriented, company in this industry usually does not provide positive cash flows as far as 5 or 10 years in the future, if ever. Their commercial value depends not only on the capability to successfully expand the borders of medicine as we know it today, but also to be the first and/or the best to do so. Evaluating this ability requires a high degree of scientific know how and market knowledge. Who else is pursuing similar research projects? What is there current state of development? How many incidents will be diagnosed for relevant medical conditions? How are prescriptions going to be affected? Is reimbursement going to change on a legislative level? What price can be negotiated with customers in regards of demand, competition and pricing power?

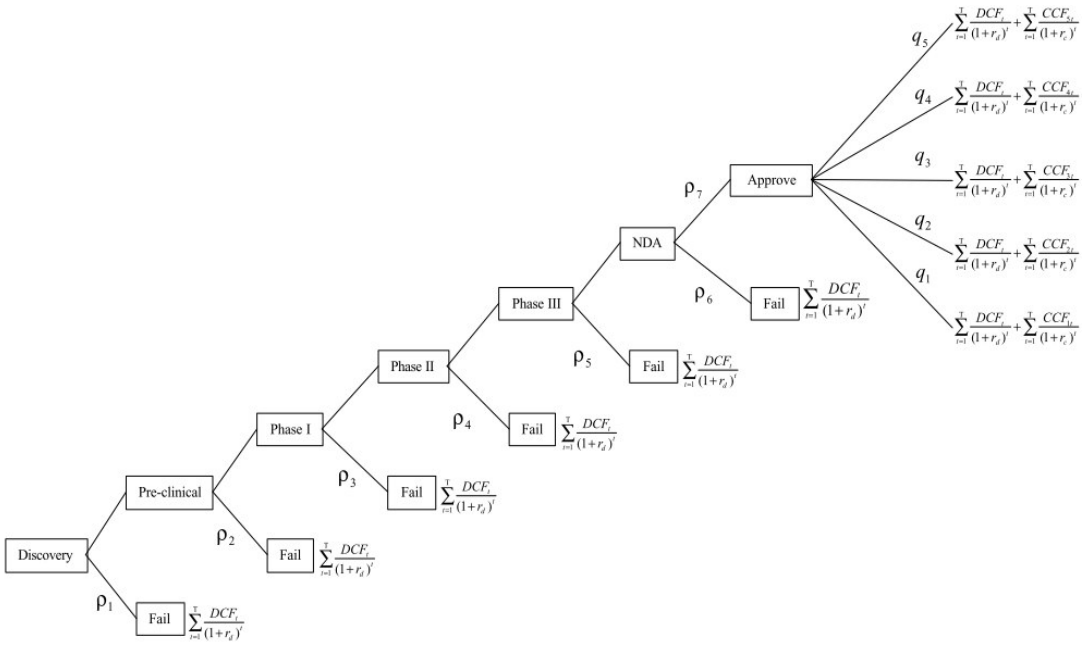
As a consequence, traditional DCF models lose their power. They are too stagnant and the information required lies too far ahead in the future compared to the companies' short history and the variety of possible scenarios. The given thesis has therefore brought forward arguments to conduct a rather asset based valuation on Juno and to frame the acquisition as an asset enhancement.

The valuation of both companies has shown that Celgene was almost fairly priced by the market with a slight upside potential. Their actual share price of $102.65 only diverges 3.8% from the price found in a stand-alone DCF valuation. Juno's stand-alone equity value was estimated at about $5.6bn, or a share price of approximately $48.02, diverging around 18% from the actual pre acquisition market price. However, this is likely going to be related to the looming merger with Celgene. The acquisition's synergies have are estimated at a value of just above $10bn, pushing Celgene's share price potential up to a value of $114.38.

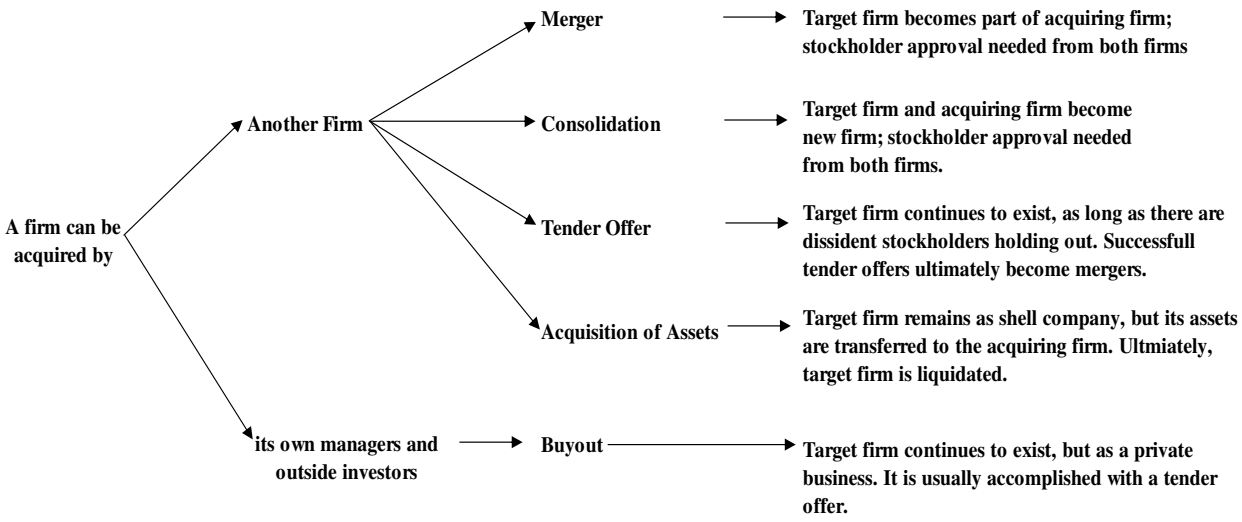
Celgene's vivid engagement into a broad variety of research and development collaborations can be seen as a risk diversification strategy. The company reserves itself the option to continue promising research and commercialize successful candidates while others can be divested at any given time. Successful candidates then take advantage on Celgene's commercial network and manufacturing capabilities. This strategy is based on the notion that profits from one successful research candidate can possibly make up for sunken costs in a dozen of failed projects. In that sense, Celgene accumulates know-how from a variety of directions and decides which part of it to extend and which part of it to abandon. As fully owned subsidiary of Celgene, Juno's research efforts can know be coordinated and channeled by Celgene and their results can be combined with the outcome of other research projects. Perhaps, the establishment of such an interdependent research network can be interpreted as the true synergy value that Juno is providing for Celgene.

6. Appendix

Appendix 1: Decision Tree for Pharmaceutical Development (Kellogg, Charnes and Demirer, 2000)



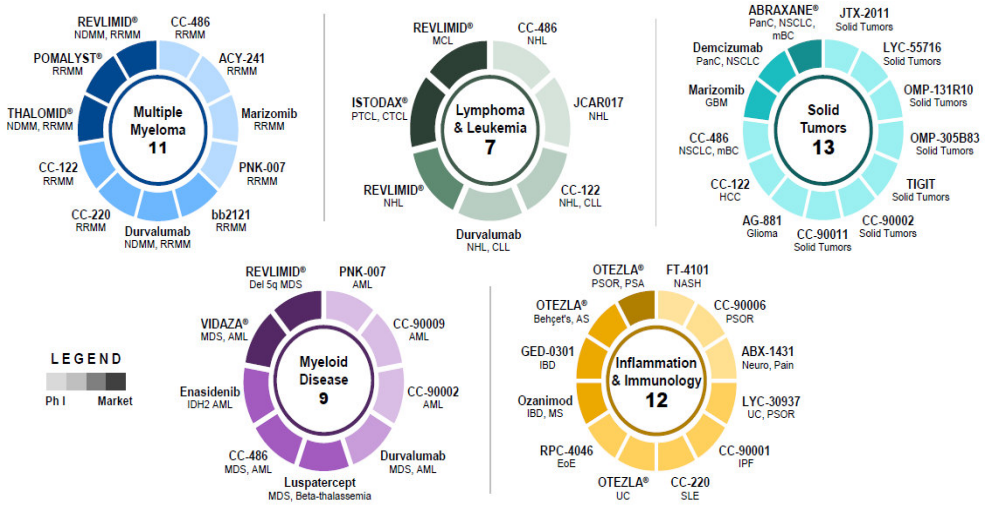
Appendix 2: M&A classification (Damodaran, 2015)



Appendix 3: Success and failure characteristics in M&A (Bruner, 2005)

Returns to buyers likely will be higher if:	**Returns to buyers likely will be lower if:**
1. Strategic Motivation	1. Opportunistic motivation
2. Value acquiring	2. Momentum growth/ glamour acquiring
3. Focused/ related acquiring	3. Lack of focus/ unrelated diversification
4. Credible Synergies	4. Incredible Synergies
5. To use excess cash profitably	5. Just to use excess cash
6. Negotiated purchases of private firms	6. Auctions of public firms
7. Cross Border for special advantage	7. Cross border naively
8. Go hostile	8. Negotiate with resistant target
9. Buy during cold M&A markets	9. Buy during hot M&A markets
10. Pay with cash	10. Pay with stock
11. High tax benefits to buyer	11. Low tax benefits to buyer
12. Finance with debt judiciously	12. Over-lever
13. Stage the payments (earnouts)	13. Pay full up-front
14. Mergers of equals	14. Not a merger of equals
15. Managers have significant stake	15. Managers have low or no stake
16. Shareholder-oriented management	16. Entrenched management
17. Active investors	17. Passive investors
18. Big good deals	18. Big bad deals

Appendix 4: Celgene Product Pipeline (Celgene Corporation, 2017a)



Appendix 5: Porter's five forces analysis for the biopharmaceutical industry

1.) Threat of new Entrants:		Entering the market for cancer related drugs requires a high degree of specialized knowledge. On top of that, significant funding is required to finance exhaustive periods of research and development.	**LOW**
2.) Power of Suppliers		Pharmaceutical companies usually require basic chemical compounds to produce their goods, which are provided by a variety of suppliers. Biotechnological companies do often not manufacture any tangible products at all. Their supply consists of highly specialized research equipment. The market for such goods is usually balanced because supply and demand are equally concentrated.	**LOW**
3.) Power of Buyers:		As a producer of pharmaceutical goods, consumers do only have very little pricing power due to (amongst other reasons) intellectual protection rights, as explained in chapter 3.1.5.	**LOW**
4.) Availability of Substitutes		The availability of substitutes depends on the drug's performance and market timing compared to other treatment options. "first-in-class" and "best-in-class" face a very low substitution risk until a more innovative drug is discovered or until generic products enter the market.	**MEDIUM**
5.) Competitive Rivalry:		High dependence on intellectual property leads to a cut throat competition in research and development. Especially in the biotechnology sector, dozens of companies might research similar therapy systems with only a few of them successfully commercializing a novel drug.	**VERY HIGH**

Appendix 6: Celgene company information (Sources: Thomson Reuters, Celgene Corporation, 2018f)

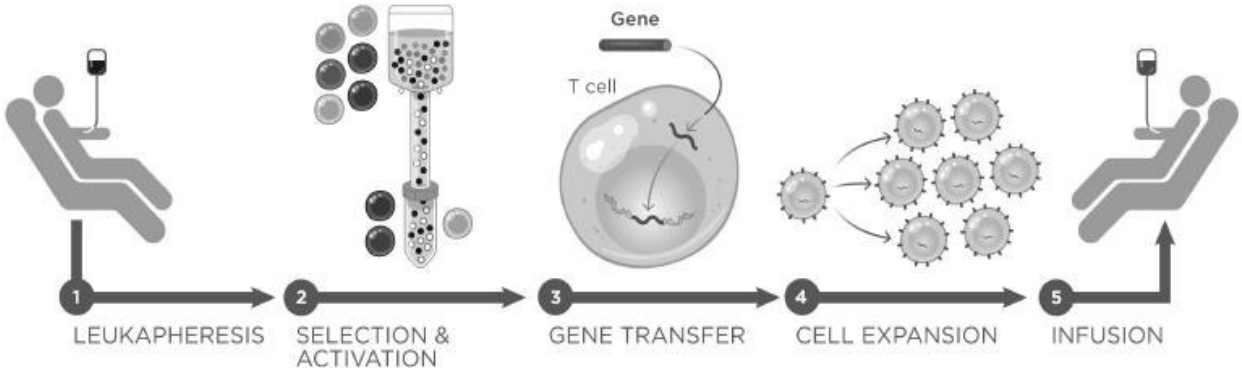
Name:		Celgene Corporation
Incorporation:		1986
Industry:		Biopharmaceuticals
Stock listing:		NASDAQ
Products:		Drugs for the treatments for medical conditions in the areas of Hematology/ blood disorders, Oncology, Inflammations and Immunological diseases
Locations:		Headquarters in Summit, New Jersey (USA). Manufacturing facilities in Phoenix, Arizona (USA) and Switzerland. Variety of offices in other parts of the USA.
Headcount:		About 7500 employees
Size:		Enterprise value at about $70bn[7]
Assets:		Book value of assets at about $30bn. Therein cash, cash equivalent securities and marketable securities for sale at about $12bn and intangible assets at about $8bn.
Capital:		Total shareholders' equity at a book value of about $7bn (Market capitalization ca. $66bn). Long term debt is accounted for at about $16bn, net of discount with a par value of ca. $20bn. Almost all of Celgene's debt was issued in bond tranches with maturities between 2019 and 2048.

Appendix 7: Juno company information (Sources: Thomson Reuters, Juno Therapeutics)

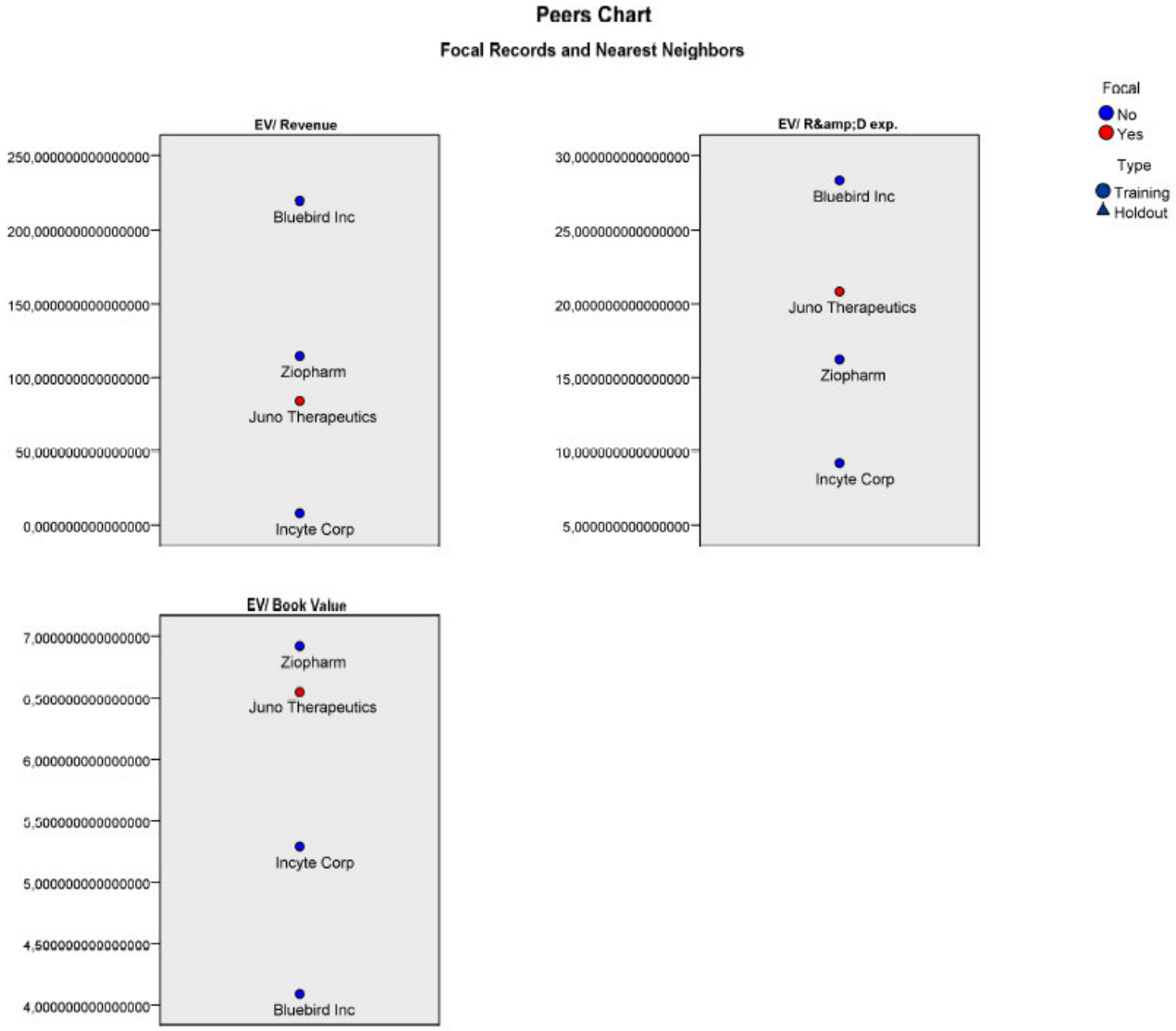
Name:		Juno Therapeutics, Inc.
Incorporation:		2013
Industry:		Biotechnology/ Biopharmaceuticals
Stock listing:		NASDAQ
Products:		Licenses and patents used in drug development processes.
Locations:		Headquarters in Seattle, Washington (USA), administrative facilities in Germany and a small variety of offices in other parts of the USA.
Headcount:		About 660 employees
Size:		Acquired by Celgene at an Equity Value of about $10bn.
Assets:		Book value of assets at about $1.5bn. Therein cash, cash equivalent securities and marketable securities at about $730mn.
Capital:		Total shareholders' equity at a book value of about $1bn with an additional $2.3bn paid-in-capital and accumulated losses of $2.3bn. Long term debt is accounted for at about $9mn.

[7] As of 2nd May 2018.

Appendix 8: CAR and TCR System (Juno Therapeutics Inc., 2018)



Appendix 9: Juno cluster analysis and peer group data



Company	Ticker	EV/ Revenue	EV/ R&D exp.	EV/ Book Value	Employees	EV	#Employees	R&D exp.	Assets	Revenue
Bluebird Inc	BLUE.O	219.46	28.32	4.09	22.21	$7,774,818,037	350	$274,567,000	$1,900,567,000	$35,427,000
Incyte Corp	INCY.O	7.93	9.18	5.29	20.30	$12,179,713,278	600	$1,326,361,000	$2,302,582,000	$1,536,216,000
Ziopharm Onc. Inc	ZIOP.O	114.40	16.21	6.92	15.89	$730,929,084	46	$45,084,000	$105,606,000	$6,389,000

Appendix 10: Juno pNPV assumptions

Universal		Phase I/II		Phase I	
Years to Peak Sales	5	**Estimated Launch Phase I/II pipeline Success rates for Phase I/II**	8	**Estimated Launch Phase I pipeline Success rates for Phase I**	9
Royalty Rate	15%		23% Average		17% Average
Profitability	60%		*20% Keegan*		*15% Keegan*
Discount rate	10%		*30% Abrantes-Metz*		*26% Abrantes-Metz*
Pharma PE	17		*10% CMR*		*14% CMR*
Royalty Rate FHCRC	5%		*22% DiMasi*		*7% DiMasi*
			32% MBC		*22% MBC*

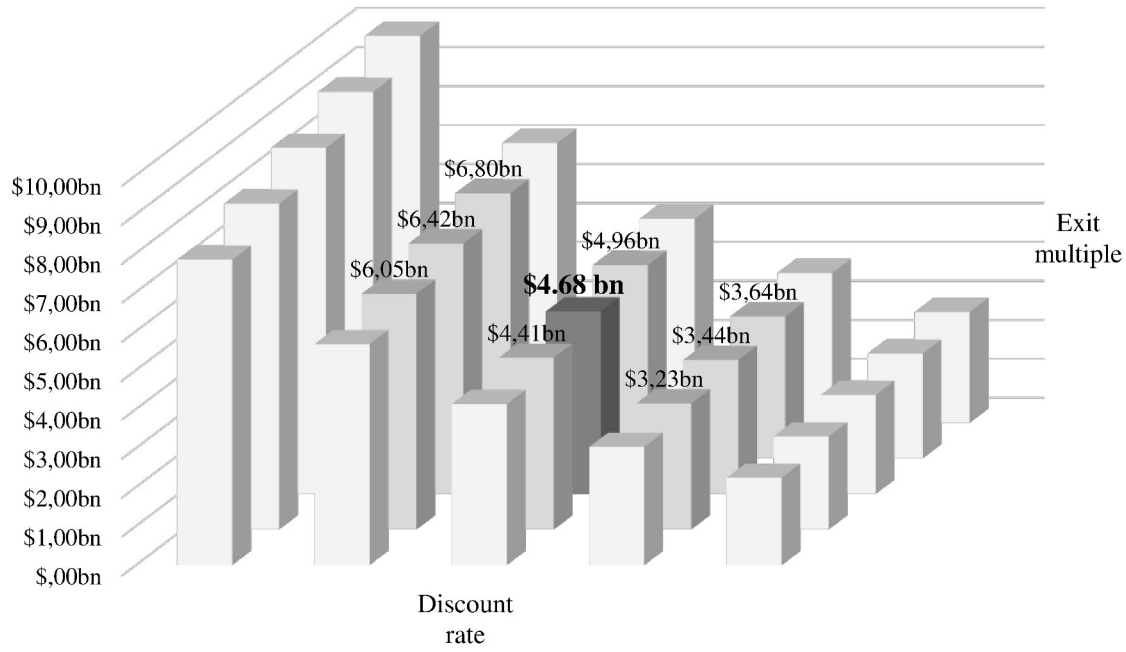
Appendix 11: Juno pNPV candidate results

Drug Candidates	Indication	Status	Years to Launch	Years to Peak Sales	Success Probability	Peak Sales	Probability weighted Peak Sales	Royalty Rate	Profitability	Probability Weighted Peak Profit	Discount Factor	pNPV (No Canblztn.)	pNPV (Canblztn.)
CD19: JCAR017	Non-Hodgkins Lymphoma & Lymphoma	Fast Track	8	13	75%	$3,000 mn	$2,250 mn	15%	60%	202.50	3.45	**$997 mn**	
CD19: Liso-cel	Chronic Lymphocytic Leukemia	Phase I/II	8	13	23%	$2,311 mn	$523 mn	15%	60%	47.10	3.45	**$232 mn**	**$232 mn**
WT-1: JTCR016	Acute Myeloid Leukemia	Phase I/II	8	13	23%	$7,061 mn	$1,599 mn	10%	60%	95.95	3.45	**$473 mn**	**$473 mn**
WT-1: JTCR016	Non-Small Cell Lung Cancer	Phase I/II	8	13	23%	$1,022 mn	$232 mn	10%	60%	13.89	3.45	**$68 mn**	**$68 mn**
WT-1: JTCR016	Mesothelioma	Phase I/II	8	13	23%	$77 mn	$17 mn	10%	60%	1.05	3.45	**$5 mn**	**$5 mn**
CD19: Liso-cel	Non-Hodgkins Lymphoma	Phase I	9	14	17%	$1,262 mn	$212 mn	15%	60%	19.09	3.80	**$85 mn**	**$85 mn**
CD19: JCAR014 with Durvalumab	Non-hodgkin Lymphoma	Phase I	9	14	17%	$1,262 mn	$212 mn	15%	60%	19.09	3.80	**$85 mn**	
CD22: JCAR018 Fully-Human scFv	Non-hodgkin Lymphoma	Phase I	9	14	17%	$1,262 mn	$212 mn	15%	60%	19.09	3.80	**$85 mn**	
BCMA: JCARH125	Multiple Myeloma	Phase I	9	14	17%	$3,342 mn	$561 mn	15%	60%	50.53	3.80	**$226 mn**	**$226 mn**
BCMA: MCARH171 & FCARH143	Multiple Myeloma	Phase I	9	14	17%	$3,342 mn	$561 mn	15%	60%	50.53	3.80	**$226 mn**	
L1CAM: JCAR023	Pediatric Neuroblastoma	Phase I	9	14	17%	$7,926 mn	$1,332 mn	15%	60%	119.84	3.80	**$536 mn**	**$536 mn**
MUC16 & IL-12: JCAR020 "Armored" CAR	Ovarian	Phase I	9	14	17%	$9,751 mn	$1,638 mn	15%	60%	147.44	3.80	**$660 mn**	**$660 mn**
ROR1: JCAR024	Non-small cell lung cancer/ breast cancer	Phase I	9	14	17%	$5,622 mn	$945 mn	15%	60%	85.01	3.80	**$381 mn**	**$381 mn**
Lewis Y	Solid Tumors	Phase I	9	14	17%	$19,626 mn	$3,297 mn	15%	60%	296.75	3.80	**$1,328 mn**	**$1,328 mn**
											TOTAL EVs:	**$5,389 mn**	**$3,995 mn**

Appendix 12: Juno pNPV sensitivity analysis

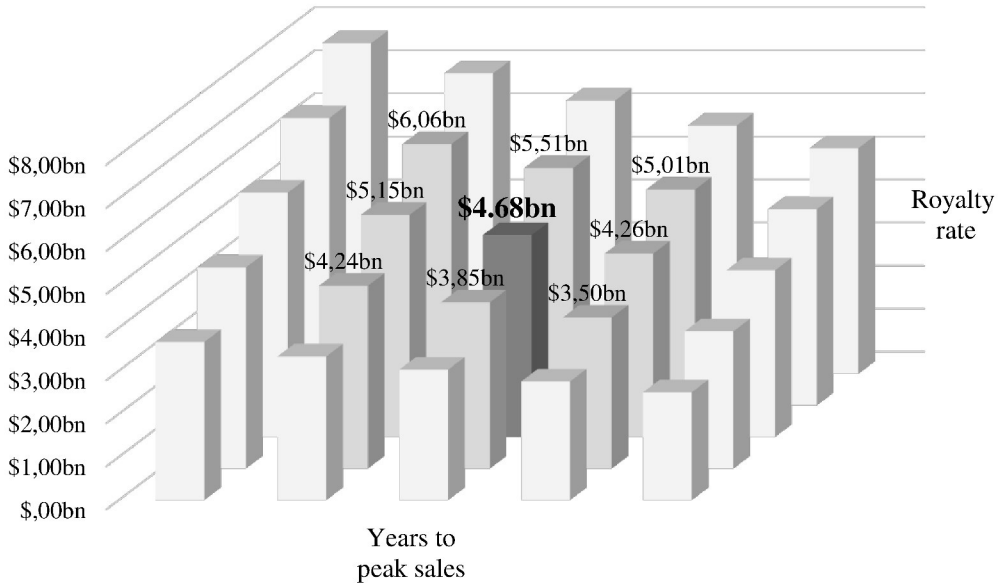
Discount rate & Exit multiple

		Discount Rate				
		5%	**7.50%**	**10%**	**12.50%**	**15%**
Exit multiple	**15x**	$7.83bn	$5.67bn	$4.13bn	$3.03bn	$2.24bn
	16x	$8.36bn	$6.05bn	$4.41bn	$3.23bn	$2.39bn
	17x	$8.88bn	$6.42bn	**$4.68bn**	$3.44bn	$2.54bn
	18x	$9.40bn	$6.80bn	$4.96bn	$3.64bn	$2.69bn
	19x	$9.92bn	$7.18bn	$5.23bn	$3.84bn	$2.84bn



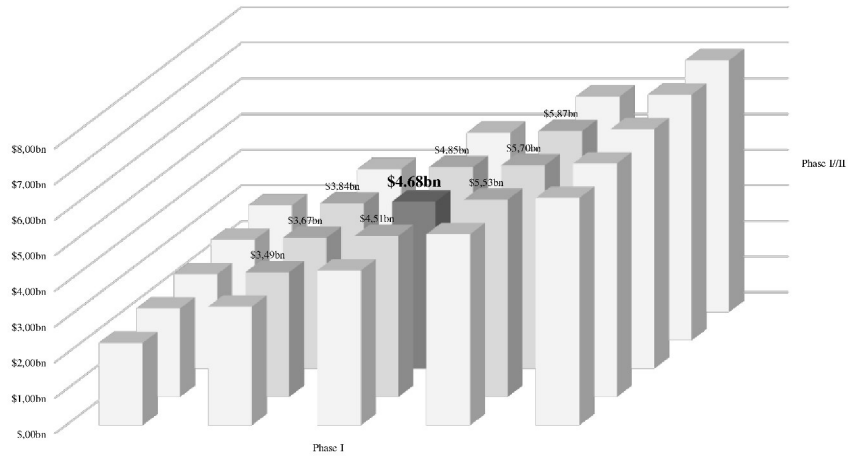
Years to peak sales & Royalty rate

		Years to peak sales				
		3	4	5	6	7
Royalty rate	10.00%	$3.67bn	$3.33bn	$3.03bn	$2.75bn	$2.50bn
	12.50%	$4.67bn	$4.24bn	$3.85bn	$3.50bn	$3.18bn
	15.00%	$5.67bn	$5.15bn	**$4.68bn**	$4.26bn	$3.87bn
	17.50%	$6.67bn	$6.06bn	$5.51bn	$5.01bn	$4.55bn
	20.00%	$7.67bn	$6.97bn	$6.34bn	$5.76bn	$5.24bn



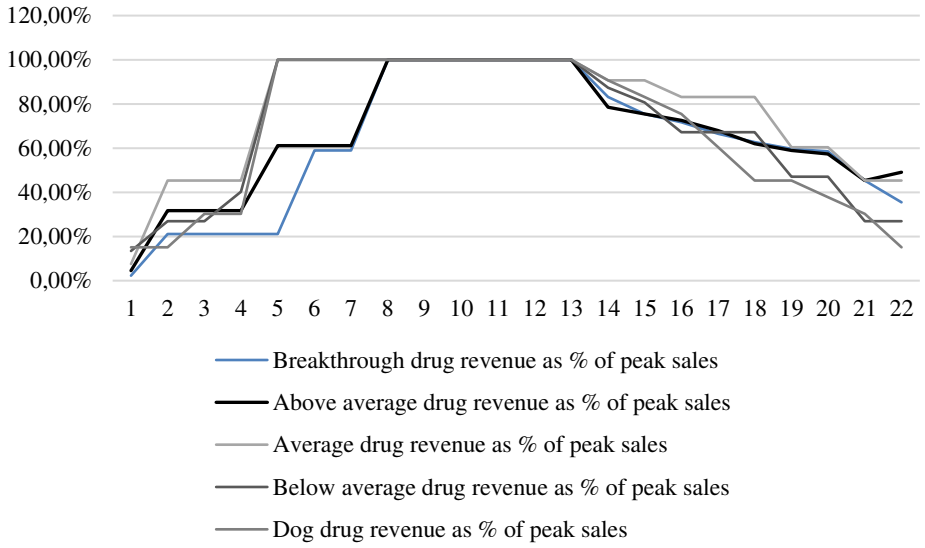
Success Probabilities

		Phase I				
		6.80%	**11.80%**	**16.80%**	**21.80%**	**26.80%**
Phase I/II	**12.65%**	$2.31bn	$3.32bn	$4.34bn	$5.36bn	$6.37bn
	17.65%	$2.48bn	$3.49bn	$4.51bn	$5.53bn	$6.54bn
	22.65%	$2.65bn	$3.67bn	**$4.68bn**	$5.70bn	$6.72bn
	27.65%	$2.82bn	$3.84bn	$4.85bn	$5.87bn	$6.89bn
	32.65%	$2.99bn	$4.01bn	$5.03bn	$6.04bn	$7.06bn



Appendix 13: Drug revenue distribution relative to peak sales (Myers and Howe, 1997)

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Breakthrough	2.27%	21.15%	21.15%	21.15%	21.15%	58.92%	58.92%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	83.09%	75.53%	71.76%	66.47%	62.69%	59.67%	58.54%	45.32%	35.50%
Above Average	4.53%	31.72%	31.72%	31.72%	61.18%	61.18%	61.18%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	78.55%	75.53%	72.51%	67.98%	61.94%	58.92%	57.41%	45.32%	49.10%
Average	7.55%	45.32%	45.32%	45.32%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	90.63%	90.63%	83.08%	83.08%	83.08%	60.42%	60.42%	45.32%	45.32%
Below Average	13.44%	26.88%	26.88%	40.32%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	87.37%	80.65%	67.20%	67.20%	67.20%	47.04%	47.04%	26.88%	26.88%
Dog	15.11%	15.11%	30.21%	30.21%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	90.63%	83.08%	75.53%	60.42%	45.32%	45.32%	37.76%	30.21%	15.11%



Appendix 14: Juno binomial tree assumptions

Stage	Years in Stage	Total Cost in Stage	Success Probability (p)	Discount rate (rd)
Discovery	1	$2.20 mn	60%	10%
Pre-clinical	3	$13.80 mn	90%	
Phase I	1	$2.80 mn	75%	
Phase II	2	$6.40 mn	50%	
Phase III	3	$18.10 mn	85%	
FDA Filing	3	$3.30 mn	75%	
Post-Approval	9	$31.20 mn	100%	

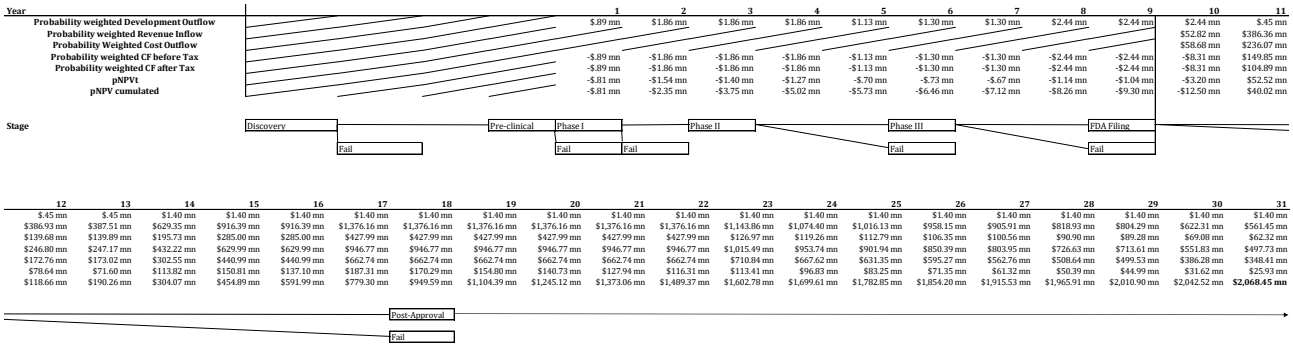
Stage	t in years	Cost per year	Discounted Cost per year
Discovery	1	$2.20 mn	-$2.00 tn
Pre-clinical	2	$4.60 mn	-$3.80 tn
Pre-clinical	3	$4.60 mn	-$3.46 tn
Pre-clinical	4	$4.60 mn	-$3.14 tn
Phase I	5	$2.80 mn	-$1.74 tn
Phase II	6	$3.20 mn	-$1.81 tn
Phase II	7	$3.20 mn	-$1.64 tn
Phase III	8	$6.03 mn	-$2.81 tn
Phase III	9	$6.03 mn	-$2.56 tn
Phase III	10	$6.03 mn	-$2.33 tn
FDA Filing	11	$1.10 mn	-$.39 tn
FDA Filing	12	$1.10 mn	-$.35 tn
FDA Filing	13	$1.10 mn	-$.32 tn
Post-Approval	14	$3.47 mn	-$.91 tn
Post-Approval	15	$3.47 mn	-$.83 tn
Post-Approval	16	$3.47 mn	-$.75 tn
Post-Approval	17	$3.47 mn	-$.69 tn
Post-Approval	18	$3.47 mn	-$.62 tn
Post-Approval	19	$3.47 mn	-$.57 tn
Post-Approval	20	$3.47 mn	-$.52 tn
Post-Approval	21	$3.47 mn	-$.47 tn
Post-Approval	22	$3.47 mn	-$.43 tn

Scenario	Probability	Peak Sales as a multiplier of average scenario	Tax rate	Royalty rate
Breakthrough	10%	20.00x	30%	15%
Above Average	10%	10.00x		
Average	60%	1.00x		
Below Average	10%	.11x		
Dog	10%	.10x		

Cost as % of revenue

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
COGS	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Marketing Expenses	100%	50%	25%	25%	20%	20%	20%	20%	20%	20%	20%	20%	20%	0%	0%	0%	0%	0%	0%	0%	0%	0%
G&A	11.10%	11.10%	11.10%	11.10%	11.10%	11.10%	11.10%	11.10%	11.10%	11.10%	11.10%	11.10%	11.10%	11.10%	11.10%	11.10%	11.10%	11.10%	11.10%	11.10%	11.10%	11.10%

Appendix 15: Juno binomial tree drug candidate example (Lewis Y)



Year	1	2	3	4	5	6	7	8	9	10	11
Probability weighted Development Outflow	$.89 mn	$1.86 mn	$1.86 mn	$1.86 mn	$1.13 mn	$1.30 mn	$1.30 mn	$2.44 mn	$2.44 mn	$2.44 mn	$.45 mn
Probability weighted Revenue Inflow										$52.82 mn	$386.36 mn
Probability Weighted Cost Outflow										$58.68 mn	$236.07 mn
Probability weighted CF before Tax	-$.89 mn	-$1.86 mn	-$1.86 mn	-$1.86 mn	-$1.13 mn	-$1.30 mn	-$1.30 mn	-$2.44 mn	-$2.44 mn	-$8.31 mn	$149.85 mn
Probability weighted CF after Tax	-$.89 mn	-$1.86 mn	-$1.86 mn	-$1.86 mn	-$1.13 mn	-$1.30 mn	-$1.30 mn	-$2.44 mn	-$2.44 mn	-$8.31 mn	$104.89 mn
pNPVt	-$.81 mn	-$1.54 mn	-$1.40 mn	-$1.27 mn	-$.70 mn	-$.73 mn	-$.67 mn	-$1.14 mn	-$1.04 mn	-$3.20 mn	$52.52 mn
pNPV cumulated	-$.81 mn	-$2.35 mn	-$3.75 mn	-$5.02 mn	-$5.73 mn	-$6.46 mn	-$7.12 mn	-$8.26 mn	-$9.30 mn	-$12.50 mn	$40.02 mn

Year	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Probability weighted Development Outflow	$.45 mn	$.45 mn	$1.40 mn	$1.40 mn	$1.40 mn	$1.40 mn	$1.40 mn	$1.40 mn	$1.40 mn	$1.40 mn	$1.40 mn	$1.40 mn	$1.40 mn	$1.40 mn	$1.40 mn	$1.40 mn	$1.40 mn	$1.40 mn	$1.40 mn	$1.40 mn
Probability weighted Revenue Inflow	$386.93 mn	$387.51 mn	$629.35 mn	$916.39 mn	$916.39 mn	$1,376.16 mn	$1,376.16 mn	$1,376.16 mn	$1,376.16 mn	$1,376.16 mn	$1,376.16 mn	$1,143.86 mn	$1,074.40 mn	$1,016.13 mn	$958.15 mn	$905.91 mn	$818.93 mn	$804.29 mn	$622.31 mn	$561.45 mn
Probability Weighted Cost Outflow	$139.68 mn	$139.89 mn	$195.73 mn	$285.00 mn	$285.00 mn	$427.99 mn	$427.99 mn	$427.99 mn	$427.99 mn	$427.99 mn	$427.99 mn	$126.97 mn	$119.26 mn	$112.79 mn	$106.35 mn	$100.56 mn	$90.90 mn	$89.28 mn	$69.08 mn	$62.32 mn
Probability weighted CF before Tax	$246.80 mn	$247.17 mn	$432.22 mn	$629.99 mn	$629.99 mn	$946.77 mn	$946.77 mn	$946.77 mn	$946.77 mn	$946.77 mn	$946.77 mn	$1,015.49 mn	$953.74 mn	$901.94 mn	$850.39 mn	$803.95 mn	$726.63 mn	$713.61 mn	$551.83 mn	$497.73 mn
Probability weighted CF after Tax	$172.76 mn	$173.02 mn	$302.55 mn	$440.99 mn	$440.99 mn	$662.74 mn	$662.74 mn	$662.74 mn	$662.74 mn	$662.74 mn	$662.74 mn	$710.84 mn	$667.62 mn	$631.35 mn	$595.27 mn	$562.76 mn	$508.64 mn	$499.53 mn	$386.28 mn	$348.41 mn
pNPVt	$78.64 mn	$71.60 mn	$113.82 mn	$150.81 mn	$137.10 mn	$187.31 mn	$170.29 mn	$154.80 mn	$140.73 mn	$127.94 mn	$116.31 mn	$113.41 mn	$96.83 mn	$83.25 mn	$71.35 mn	$61.32 mn	$50.39 mn	$44.99 mn	$31.62 mn	$25.93 mn
pNPV cumulated	$118.66 mn	$190.26 mn	$304.07 mn	$454.89 mn	$591.99 mn	$779.30 mn	$949.59 mn	$1,104.39 mn	$1,245.12 mn	$1,373.06 mn	$1,489.37 mn	$1,602.78 mn	$1,699.61 mn	$1,782.85 mn	$1,854.20 mn	$1,915.53 mn	$1,965.91 mn	$2,010.90 mn	$2,042.52 mn	**$2,068.45 mn**

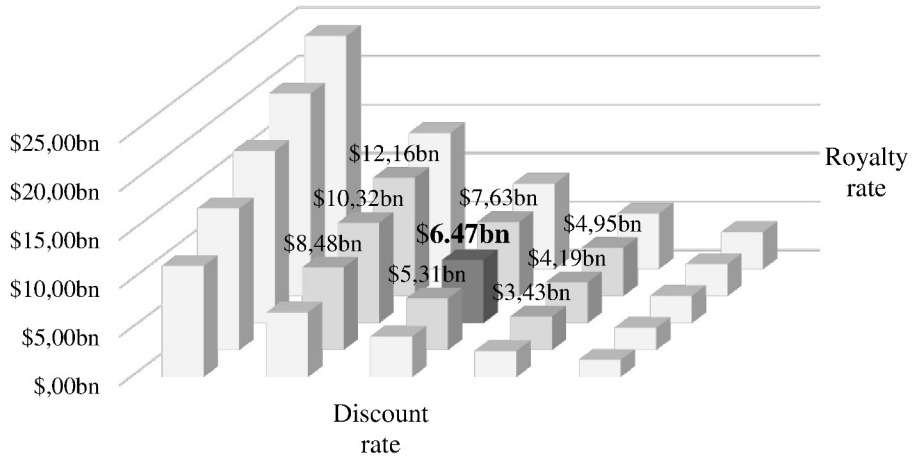
Appendix 16: Juno binomial tree candidate results

Drug Candidates	Indication	Status	pNPV (No Canblztn.)	pNPV (Canblztn.)
CD19: JCAR017 (pNPV valuated + Analyst recomendations)	Non-Hodgkins Lymphoma & B Cell Lymphoma	Fast Track	**$679 mn**	
CD19: Liso-cel	Chronic Lymphocytic Leukemia	Phase I/II	**$258 mn**	**$258 mn**
WT-1: JTCR016	Acute Myeloid Leukemia	Phase I/II	**$539 mn**	**$539 mn**
WT-1: JTCR016	Non-Small Cell Lung Cancer	Phase I/II	**$66 mn**	**$66 mn**
WT-1: JTCR016	Mesothelioma	Phase I/II	**-$8 mn**	**-$8 mn**
CD19: Liso-cel	Non-Hodgkins Lymphoma	Phase I	**$121 mn**	**$121 mn**
CD19: JCAR014 with Durvalumab	Non-hodgkin Lymphoma	Phase I	**$121 mn**	
CD22: JCAR018 Fully-Human scFv	Non-hodgkin Lymphoma	Phase I	**$121 mn**	
BCMA: JCARH125	Multiple Myeloma	Phase I	**$343 mn**	**$343 mn**
BCMA: MCARH171 & FCARH143	Multiple Myeloma	Phase I	**$343 mn**	
L1CAM: JCAR023	Pediatric Neuroblastoma	Phase I	**$832 mn**	**$832 mn**
MUC16 & IL-12: JCAR020 "Armored" CAR	Ovarian	Phase I	**$1,027 mn**	**$1,027 mn**
ROR1: JCAR024	Non-small cell lung cancer/ breast cancer	Phase I	**$586 mn**	**$586 mn**
Lewis Y	Solid Tumors	Phase I	**$2,082 mn**	**$2,082 mn**
		TOTAL EVs:	**$7,110 mn**	**$5,847 mn**

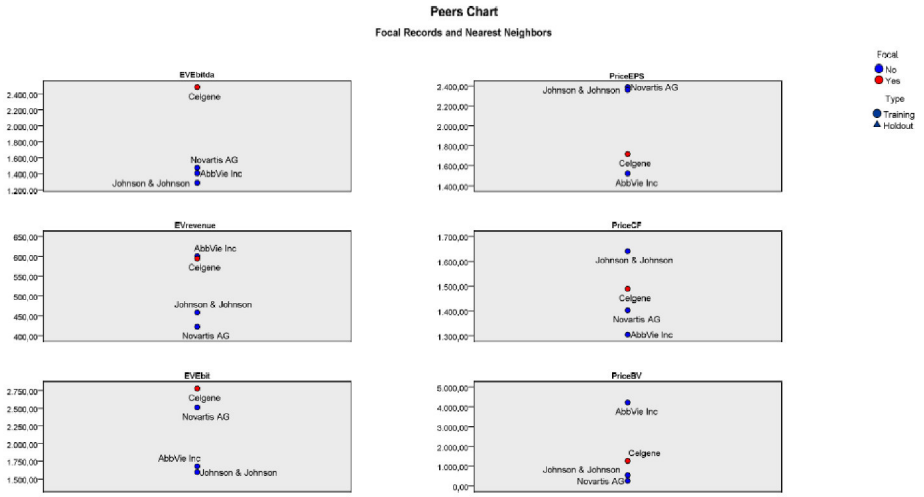
Appendix 17: Juno binomial sensitivity analysis

Discount Rate & Royalty Rate

		Discount rate				
		5%	**7.50%**	**10%**	**12.50%**	**15%**
	10.00%	$11.43bn	$6.64bn	$4.15bn	$2.68bn	$1.76bn
	12.50%	$14.57bn	$8.48bn	$5.31bn	$3.43bn	$2.27bn
Royalty rate	**15.00%**	$17.72bn	$10.32bn	**$6.47bn**	$4.19bn	$2.78bn
	17.50%	$20.86bn	$12.16bn	$7.63bn	$4.95bn	$3.29bn
	20.00%	$24.00bn	$14.00bn	$8.79bn	$5.71bn	$3.80bn



Appendix 18: Celgene cluster analysis and peer group data



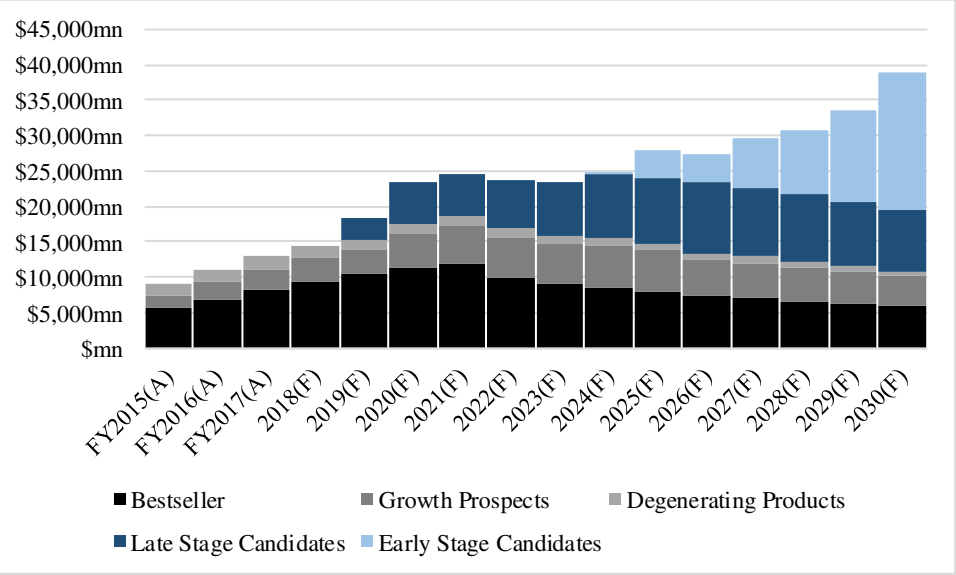
Cluster Analysis Peer Group

	EV/ REVENUE	EV/ EBITDA	EV/ EBIT	Price/ EPS	Price/ CF	Price/ BV
AbbVie Inc	6.66	15.69	17.97	17.09	15.37	42.27
Johnson & Johnson	4.47	12.47	15.69	22.38	15.86	5.43
Novartis AG	4.26	14.78	23.10	23.67	15.14	2.66

Appendix 19: Celgene revenue estimations

	FY2015(A)	FY2016(A)	FY2017(A)	2018(F)	2019(F)	2020(F)	2021(F)	2022(F)	2023(F)	2024(F)	2025(F)	2026(F)	2027(F)	2028(F)	2029(F)	2030(F)
Bestseller	$5,801mn	$6,974mn	$8,187mn	$9,365mn	$10,432mn	$11,308mn	$11,918mn	$9,902mn	$9,002mn	$8,552mn	$7,922mn	$7,472mn	$7,112mn	$6,688mn	$6,321mn	$5,978mn
Growth Prospects	$1,455mn	$2,328mn	$2,913mn	$3,336mn	$3,380mn	$4,834mn	$5,445mn	$5,646mn	$5,646mn	$5,822mn	$5,822mn	$4,997mn	$4,890mn	$4,724mn	$4,563mn	$4,173mn
Degenerating Products	$1,896mn	$1,879mn	$1,864mn	$1,730mn	$1,503mn	$1,432mn	$1,372mn	$1,282mn	$1,192mn	$1,123mn	$1,043mn	$970mn	$910mn	$852mn	$779mn	$725mn
Late Stage Candidates	$mn	$mn	$mn	$mn	$3,046mn	$5,954mn	$5,963mn	$6,831mn	$7,559mn	$9,140mn	$9,140mn	$10,005mn	$9,627mn	$9,439mn	$8,927mn	$8,627mn
Early Stage Candidates										$78mn	$3,926mn	$3,982mn	$7,189mn	$8,955mn	$12,944mn	$19,321mn

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
REVLIMID®	$5,801mn	$6,974mn	$8,187mn	$9,365mn	$10,432mn	$11,308mn	$11,918mn	$9,902mn	$9,002mn	$8,552mn	$7,922mn	$7,472mn	$7,112mn	$6,688mn	$6,321mn	$5,978mn
POMALYST®/IMNOVID®	$983mn	$1,311mn	$1,614mn	$1,614mn	$1,614mn	$2,638mn	$2,638mn	$2,638mn	$2,638mn	$2,638mn	$2,638mn	$2,072mn	$1,993mn	$1,913mn	$1,793mn	$1,634mn
OTEZLA®	$472mn	$1,017mn	$1,279mn	$1,279mn	$1,279mn	$1,685mn	$1,685mn	$1,685mn	$1,685mn	$1,685mn	$1,685mn	$1,425mn	$1,398mn	$1,312mn	$1,271mn	$1,214mn
IDHIFA®			$20mn	$443mn	$487mn	$511mn	$1,123mn	$1,323mn	$1,323mn	$1,499mn	$1,499mn	$1,499mn	$1,499mn	$1,499mn	$1,499mn	$1,325mn
ABRAXANE®	$967mn	$973mn	$992mn	$992mn	$779mn	$749mn	$719mn	$674mn	$614mn	$584mn	$545mn	$508mn	$477mn	$446mn	$417mn	$390mn
VIDAZA®	$591mn	$608mn	$628mn	$493mn	$474mn	$455mn	$427mn	$389mn	$370mn	$345mn	$322mn	$302mn	$282mn	$264mn	$247mn	$231mn
azacitidine for injection	$84mn	$66mn	$36mn	$33mn	$33mn	$30mn	$30mn	$30mn	$22mn	$20mn	$17mn	$15mn	$13mn	$11mn	$9mn	$8mn
THALOMID®	$185mn	$152mn	$132mn	$132mn	$132mn	$112mn	$110mn	$103mn	$100mn	$95mn	$80mn	$74mn	$67mn	$59mn	$54mn	$48mn
ISTODAX®	$69mn	$80mn	$76mn	$80mn	$85mn	$86mn	$86mn	$86mn	$86mn	$78mn	$78mn	$72mn	$72mn	$72mn	$52mn	$47mn
BB2121								$862mn	$1,464mn	$1,464mn	$1,464mn	$1,464mn	$1,464mn	$1,464mn	$1,216mn	$1,105mn
CC-486					$17mn	$92mn	$101mn	$107mn	$234mn	$276mn	$276mn	$312mn	$329mn	$405mn	$414mn	$419mn
JCAR017					$50mn	$548mn	$548mn	$548mn	$548mn	$1,528mn	$1,528mn	$2,593mn	$2,593mn	$2,593mn	$2,593mn	$2,593mn
LUSPATERCEPT					$34mn	$313mn	$313mn	$313mn	$313mn	$873mn	$873mn	$1,482mn	$1,482mn	$1,482mn	$1,482mn	$1,482mn
OZANIMOD					$2,946mn	$5,000mn	$5,000mn	$5,000mn	$5,000mn	$5,000mn	$5,000mn	$4,154mn	$3,777mn	$3,588mn	$3,323mn	$3,135mn
CC-90006											$2mn	$7mn	$37mn	$109mn	$244mn	$518mn
JTX - 2011											$223mn	$425mn	$557mn	$591mn	$1,252mn	$1,252mn
LYC-55716											$804mn	$804mn	$1,533mn	$2,011mn	$2,133mn	$4,520mn
LYC-30937										$33mn	$63mn	$83mn	$88mn	$186mn	$186mn	$186mn
ACY-241											$239mn	$161mn	$307mn	$403mn	$427mn	$905mn
OMP-131R10											$1,406mn	$396mn	$1,804mn	$2,366mn	$2,509mn	$5,317mn
ABX-1431											$201mn	$136mn	$258mn	$339mn	$360mn	$762mn
Cereblon Modulator: CC-220										$12mn	$23mn	$30mn	$32mn	$68mn	$68mn	$68mn
GED-0301										$33mn	$63mn	$83mn	$88mn	$186mn	$186mn	$186mn
BET Inhibitor: CC-90010											$21mn	$40mn	$53mn	$56mn	$118mn	$118mn
PAN-IDH Inhibitor: AG-881											-$66mn	$8mn	$10mn	$11mn	$23mn	$23mn
LSD1 Inhibitor: CC-90011											$946mn	$1,804mn	$2,366mn	$2,509mn	$5,317mn	$5,317mn
CD19 series without JCAR017												$6mn	$52mn	$95mn	$95mn	$124mn
CD22-JCAR018													$3mn	$25mn	$25mn	$25mn



Appendix 20: Celgene DCF discount factors

Peer Name	Levered Beta	Debt	Market Cap	Tax Rate	Unlevered Beta
AbbVie Inc	1.62	32,499	153,975	35%	1.42
Johnson & Johnson	0.74	32,299	374,802	35%	0.70
Novartis AG	1.06	23,224	195,996	35%	0.98
Asset Beta	1.04				
D/E Target Ratio	20%				
Corporate Tax rate (Tc)	35%				
Equity Beta (Peer Group)	**1.17**				
Equity Beta (Historical)	**1.46**				
risk free rate (rf)	3.13%				
Market risk premium	5.50%				
Cost of Equity Peer Group (CoEQp)	**9.57%**				
Cost of Equity Historical (CoEQh)	**11.16%**				
Cost of Equity (Average)	**10.37%**				
Interest Expenses on Debt	3.52%				
Tax rate	20%				
After-tax Cost of Debt	**2.80%**				
Shares outstanding	759				
Share price	104.36				
Total Equity (Market Cap)	79,241				
Total Debt (Book Value)	15,838				
Total Capital	95,079				
%Equity	**83%**				
%Debt	**17%**				
WACC	**9.11%**				
Terminal Growth Rate (g)	**2.00%**				
Exit Multiple	**17x**				

Appendix 21: Celgene DCF forecast assumptions

	2015(A)	2016(A)	2017(A)	2018(F)	2019(F)	2020(F)	2021(F)	2022(F)	2023(F)	2024(F)	2025(F)	2026(F)	2027(F)	2028(F)	2029(F)	2030(F)
Operations																
COGS/ Revenue	4.5%	3.9%	3.5%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%	4.0%
SG&A/ Revenue	24.9%	23.7%	20.2%	22.9%	22.9%	22.9%	22.9%	22.9%	22.9%	22.9%	22.9%	22.9%	22.9%	22.9%	22.9%	22.9%
R&D/ Revenue	39.9%	39.8%	45.5%	41.7%	41.7%	41.7%	41.7%	41.7%	41.7%	41.7%	41.7%	41.7%	41.7%	41.7%	41.7%	41.7%
Other operating/ Revenue	2.84%	3.46%	-7.61%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%	-0.4%
Working Capital																
DSO (Receivables)	56	61	59	59	59	59	59	59	59	59	59	59	59	59	59	59
DIO (Inventory)	385	415	428	409	409	409	409	409	409	409	409	409	409	409	409	409
Prepaid Expenses/ Revenue	0.00%	0.35%	0.32%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Other Current Assets/ Revenue	10.64%	4.31%	1.26%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%	5.4%
DPO (Accounts Payable)	209	206	241	219	219	219	219	219	219	219	219	219	219	219	219	219
Accrued Expenses/ SG&A	71.3%	79.6%	92.2%	81.0%	81.0%	81.0%	81.0%	81.0%	81.0%	81.0%	81.0%	81.0%	81.0%	81.0%	81.0%	81.0%
Other Current Liabilities/ Revenue	0.9%	0.9%	2.0%	1.26%	1.26%	1.26%	1.26%	1.26%	1.26%	1.26%	1.26%	1.26%	1.26%	1.26%	1.26%	1.26%
Long Term Assets																
Depreciation/ PPE FY-1		14.88%	14.41%	14.64%	14.64%	14.64%	14.64%	14.64%	14.64%	14.64%	14.64%	14.64%	14.64%	14.64%	14.64%	14.64%
Amortization/ Intangible Assets FY-1		3.53%	3.24%	3.39%	3.39%	3.39%	3.39%	3.39%	3.39%	3.39%	3.39%	3.39%	3.39%	3.39%	3.39%	3.39%
CAPEX long term assets/ Revenue	3.09%	2.10%	2.15%	2.45%	2.45%	2.45%	2.45%	2.45%	2.45%	2.45%	2.45%	2.45%	2.45%	2.45%	2.45%	2.45%
Capital & Financing																
Cash/ Revenue	70.8%	71.0%	92.6%	78.12%	78.12%	78.12%	78.12%	78.12%	78.12%	78.12%	78.12%	78.12%	78.12%	78.12%	78.12%	78.12%
Tax/ EBIT	18.41%	13.25%	29.47%	20.38%	20.38%	20.38%	20.38%	20.38%	20.38%	20.38%	20.38%	20.38%	20.38%	20.38%	20.38%	20.38%
Tax/ EBT	20.85%	15.73%	31.85%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%	21.00%
Interest Expenses/ Long Term Debt	2.6%	4.0%	3.5%	3.36%	3.36%	3.36%	3.36%	3.36%	3.36%	3.36%	3.36%	3.36%	3.36%	3.36%	3.36%	3.36%
Dividends payout ratio				90.00%	90.00%	90.00%	90.00%	90.00%	90.00%	90.00%	90.00%	90.00%	90.00%	90.00%	90.00%	90.00%
Interest Income/ Cash + Sht. Inv.	1.22%	1.42%	1.27%	1.30%	1.30%	1.30%	1.30%	1.30%	1.30%	1.30%	1.30%	1.30%	1.30%	1.30%	1.30%	1.30%
Other ratios																
Other non-operating income/ revenue	0.25%	-0.11%	0.43%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%	0.19%
Other investing cash flow items/ revenue	64.53%	6.82%	20.09%	30.48%	30.48%	30.48%	30.48%	30.48%	30.48%	30.48%	30.48%	30.48%	30.48%	30.48%	30.48%	30.48%
Financing Cash Flow Items/ Revenue	3.15%	1.32%	0.00%	1.49%	1.49%	1.49%	1.49%	1.49%	1.49%	1.49%	1.49%	1.49%	1.49%	1.49%	1.49%	1.49%

Appendix 22: Celgene DCF income statement

	2015(A)	2016(A)	2017(A)	2018(F)	2019(F)	2020(F)	2021(F)	2022(F)	2023(F)	2024(F)	2025(F)	2026(F)	2027(F)	2028(F)	2029(F)	2030(F)
Revenue (All Products & Candidates)	**9,256**	**11,229**	**13,003**	**14,431**	**18,361**	**23,529**	**24,698**	**23,661**	**23,399**	**24,715**	**27,852**	**27,426**	**29,729**	**30,657**	**33,534**	**38,825**
Cost of Goods Sold	420	438	461	576	733	940	987	945	935	987	1,113	1,096	1,188	1,225	1,340	1,551
Gross Profit	**8,836**	**10,791**	**12,542**	**13,855**	**17,628**	**22,589**	**23,712**	**22,716**	**22,464**	**23,728**	**26,740**	**26,330**	**28,541**	**29,432**	**32,194**	**37,274**
Selling, General & Administration	2,305	2,658	2,626	3,308	4,209	5,393	5,662	5,424	5,364	5,665	6,385	6,287	6,815	7,027	7,687	8,900
Research & Development	3,697	4,470	5,915	6,024	7,665	9,822	10,311	9,878	9,768	10,318	11,627	11,449	12,411	12,798	13,999	16,208
Depreciation & Amortization	279	459	329	157	185	224	276	324	361	392	423	461	492	526	559	597
Other/ Unusual Operating Expenses/ (Income)	263	388	-990	-63	-81	-103	-108	-104	-103	-108	-122	-120	-130	-135	-147	-170
Total Operating Expenses	**6,544**	**7,975**	**7,880**	**9,426**	**11,979**	**15,337**	**16,139**	**15,521**	**15,390**	**16,267**	**18,313**	**18,077**	**19,587**	**20,217**	**22,098**	**25,535**
EBIT	**2,292**	**2,816**	**4,662**	**4,429**	**5,649**	**7,252**	**7,572**	**7,195**	**7,074**	**7,461**	**8,427**	**8,254**	**8,954**	**9,215**	**10,096**	**11,739**
Interest Expenses	371	545	557	533	526	629	765	790	752	735	760	834	809	858	869	932
Interest Income	80	113	153	157	147	187	240	251	241	238	252	284	279	303	312	341
Net Interest Expenses/ (Income)	291	432	404	376	379	442	525	538	511	497	508	551	530	556	557	590
Other non operating Income/ (Expenses)	23	-12	56	28	35	45	47	45	45	47	53	52	57	58	64	74
EBT	**2,024**	**2,372**	**4,314**	**4,081**	**5,305**	**6,855**	**7,094**	**6,701**	**6,607**	**7,012**	**7,971**	**7,755**	**8,481**	**8,718**	**9,604**	**11,223**
Taxes	422	373	1,374	930	1,186	1,523	1,590	1,511	1,486	1,567	1,770	1,733	1,880	1,935	2,120	2,465
Net income	**1,602**	**1,999**	**2,940**	**3,151**	**4,119**	**5,332**	**5,504**	**5,191**	**5,122**	**5,445**	**6,202**	**6,022**	**6,601**	**6,782**	**7,483**	**8,758**

Appendix 23: Celgene DCF assets

	2015(A)	2016(A)	2017(A)	2018(F)	2019(F)	2020(F)	2021(F)	2022(F)	2023(F)	2024(F)	2025(F)	2026(F)	2027(F)	2028(F)	2029(F)	2030(F)
Cash and Short Term Investments	6,552	7,970	12,042	11,274	14,344	18,381	19,295	18,485	18,280	19,308	21,759	21,426	23,225	23,950	26,198	30,332
Receivables	1,421	1,878	2,103	2,321	2,953	3,784	3,972	3,805	3,763	3,975	4,480	4,411	4,781	4,931	5,393	6,244
Inventory	443	498	541	647	823	1,054	1,107	1,060	1,048	1,107	1,248	1,229	1,332	1,374	1,503	1,740
Prepaid Expenses		39	42	32	41	53	55	53	52	55	62	61	66	68	75	87
Other Current Assets	985	484	164	780	992	1,272	1,335	1,279	1,265	1,336	1,505	1,482	1,607	1,657	1,812	2,098
Current Assets	**9,401**	**10,869**	**14,892**	**15,022**	**19,113**	**24,492**	**25,709**	**24,629**	**24,357**	**25,727**	**28,992**	**28,548**	**30,945**	**31,912**	**34,906**	**40,414**
Total PPE	814	930	1,070	1,267	1,530	1,882	2,211	2,466	2,678	2,891	3,149	3,359	3,595	3,819	4,080	4,433
Goodwill	4,879	4,866	4,866	4,866	4,866	4,866	4,866	4,866	4,866	4,866	4,866	4,866	4,866	4,866	4,866	4,866
Intangibles	10,858	10,392	8,436	8,436	8,436	8,436	8,436	8,436	8,436	8,436	8,436	8,436	8,436	8,436	8,436	8,436
Other Long Term Assets	1,012	1,031	877	877	877	877	877	877	877	877	877	877	877	877	877	877
Long Term Assets	**17,563**	**17,219**	**15,249**	**15,446**	**15,709**	**16,061**	**16,390**	**16,645**	**16,857**	**17,070**	**17,328**	**17,538**	**17,774**	**17,998**	**18,259**	**18,612**
Total Assets	**26,964**	**28,088**	**30,141**	**30,467**	**34,822**	**40,553**	**42,099**	**41,275**	**41,214**	**42,796**	**46,320**	**46,087**	**48,719**	**49,909**	**53,166**	**59,026**

Appendix 24: Celgene DCF capital

	2015(A)	2016(A)	2017(A)	2018(F)	2019(F)	2020(F)	2021(F)	2022(F)	2023(F)	2024(F)	2025(F)	2026(F)	2027(F)	2028(F)	2029(F)	2030(F)
Accounts Payable	241	247	305	346	440	564	592	567	561	592	667	657	712	734	803	930
Accrued Expenses	1,643	2,115	2,422	2,680	3,410	4,370	4,587	4,395	4,346	4,591	5,173	5,094	5,522	5,694	6,229	7,211
Current Port. Of LT Debt/ Capital Leases		501														
Other Current Liabilities	85	97	260	182	231	297	311	298	295	312	351	346	375	386	423	489
Current Liabilities	**1,969**	**2,960**	**2,987**	**3,208**	**4,082**	**5,230**	**5,491**	**5,260**	**5,202**	**5,494**	**6,192**	**6,097**	**6,609**	**6,815**	**7,455**	**8,631**
Long Term Debt	14,161	13,789	15,838	15,628	18,697	22,746	23,482	22,369	21,854	22,600	24,806	24,065	25,526	25,831	27,700	31,508
Deferred Income Tax	2,519		1,327	1,327	1,327	1,327	1,327	1,327	1,327	1,327	1,327	1,327	1,327	1,327	1,327	1,327
Other Liabilities	2,396	4,739	3,068	3,068	3,068	3,068	3,068	3,068	3,068	3,068	3,068	3,068	3,068	3,068	3,068	3,068
Long Term Liabilities	**19,076**	**18,528**	**20,233**	**20,023**	**23,092**	**27,141**	**27,877**	**26,764**	**26,249**	**26,995**	**29,201**	**28,460**	**29,921**	**30,226**	**32,095**	**35,903**
Total Liabilities	**21,045**	**21,488**	**23,220**	**23,231**	**27,174**	**32,372**	**33,368**	**32,024**	**31,451**	**32,489**	**35,393**	**34,557**	**36,530**	**37,041**	**39,550**	**44,534**
Common Stock	9	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Additional Paid in Capital	11,119	12,378	13,806	13,806	13,806	13,806	13,806	13,806	13,806	13,806	13,806	13,806	13,806	13,806	13,806	13,806
Retained Earnings	8,074	10,074	13,061	13,376	13,788	14,321	14,872	15,391	15,903	16,447	17,067	17,670	18,330	19,008	19,756	20,632
Common Treasury Stock	-14,052	-16,821	-20,243	-20,243	-20,243	-20,243	-20,243	-20,243	-20,243	-20,243	-20,243	-20,243	-20,243	-20,243	-20,243	-20,243
accumulated other comprehensive income	768	419	287	287	287	287	287	287	287	287	287	287	287	287	287	287
Total Equity	**5,918**	**6,060**	**6,921**	**7,236**	**7,648**	**8,181**	**8,732**	**9,251**	**9,763**	**10,307**	**10,927**	**11,530**	**12,190**	**12,868**	**13,616**	**14,492**
Total Liabilities & Equity	**26,963**	**27,548**	**30,141**	**30,467**	**34,822**	**40,553**	**42,099**	**41,275**	**41,214**	**42,796**	**46,320**	**46,087**	**48,719**	**49,909**	**53,166**	**59,026**

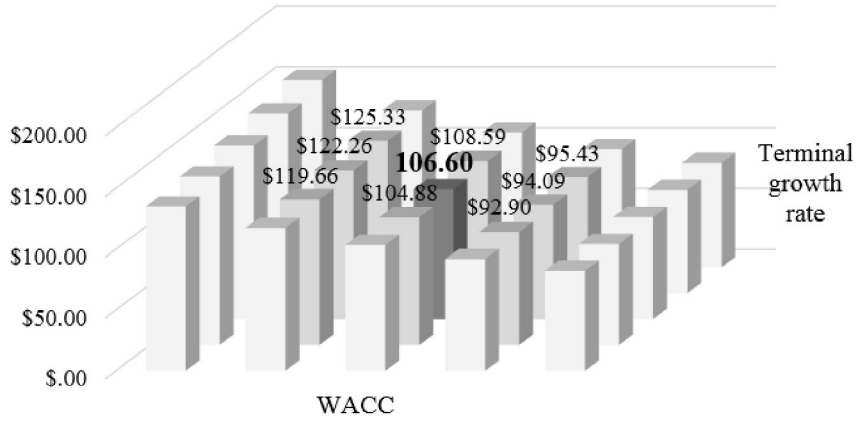
Appendix 25: Celgene DCF free cash flow to firm

	2015(A)	2016(A)	2017(A)	2018(F)	2019(F)	2020(F)	2021(F)	2022(F)	2023(F)	2024(F)	2025(F)	2026(F)	2027(F)	2028(F)	2029(F)	2030(F)
Revenue (All Products & Candidates)	**9,256**	**11,229**	**13,003**	**14,431**	**18,361**	**23,529**	**24,698**	**23,661**	**23,399**	**24,715**	**27,852**	**27,426**	**29,729**	**30,657**	**33,534**	**38,825**
EBIT	2,292	2,816	4,662	4,429	5,649	7,252	7,572	7,195	7,074	7,461	8,427	8,254	8,954	9,215	10,096	11,739
Tax rate on EBIT	18.41%	13.25%	29.47%	20.38%	20.38%	20.38%	20.38%	20.38%	20.38%	20.38%	20.38%	20.38%	20.38%	20.38%	20.38%	20.38%
Tax on EBIT	422	373	1374	902	1151	1478	1543	1466	1441	1520	1717	1682	1825	1878	2057	2392
EBIAT/ NOPLAT	**1,870**	**2,443**	**3,288**	**3,526**	**4,498**	**5,774**	**6,029**	**5,729**	**5,633**	**5,941**	**6,710**	**6,572**	**7,130**	**7,337**	**8,039**	**9,347**
(+) D&A	409	505	471	157	185	224	276	324	361	392	423	461	492	526	559	597
(-) CAPEX	286	236	279	353	449	576	604	579	573	605	682	671	728	750	821	950
Inc. Receivable	-995	457	225	218	632	831	188	-167	-42	212	505	-69	370	149	463	851
Inc. Inventory	50	55	43	106	176	232	52	-46	-12	59	141	-19	103	42	129	237
Inc. Prepaid Expenses		39	3	-10	9	12	3	-2	-1	3	7	-1	5	2	6	12
Inc. Other current Assets		-501	-320	616	212	279	63	-56	-14	71	170	-23	124	50	155	286
Inc. Accounts Payable	43	6	58	41	94	124	28	-25	-6	32	75	-10	55	22	69	127
Inc Accrued Expenses		472	307	258	730	960	217	-193	-49	244	583	-79	428	172	534	983
Inc. Other Current Liabilities		12	163	-78	50	65	15	-13	-3	17	40	-5	29	12	36	67
(-) Increase in Operating Working Capital	-988	-440	-577	709	156	205	46	-41	-10	52	124	-17	91	37	114	210
FCFF from Operations	**2,981**	**3,152**	**4,057**	**2,621**	**4,078**	**5,218**	**5,654**	**5,514**	**5,431**	**5,676**	**6,327**	**6,379**	**6,803**	**7,076**	**7,663**	**8,785**
FCFF from non operating activities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FCFF	**2,981**	**3,152**	**4,057**	**2,621**	**4,078**	**5,218**	**5,654**	**5,514**	**5,431**	**5,676**	**6,327**	**6,379**	**6,803**	**7,076**	**7,663**	**8,785**
WACC				9.11%	9.11%	9.11%	9.11%	9.11%	9.11%	9.11%	9.11%	9.11%	9.11%	9.11%	9.11%	9.11%
Discounted FCFF				**2,402**	**3,426**	**4,018**	**3,990**	**3,567**	**3,220**	**3,084**	**3,151**	**2,911**	**2,846**	**2,713**	**2,693**	**2,830**
Discounted Perpetuity Value																**39,823**
P/E Exit Multiple																**47,956**

Appendix 26: Celgene DCF sensitivity analysis

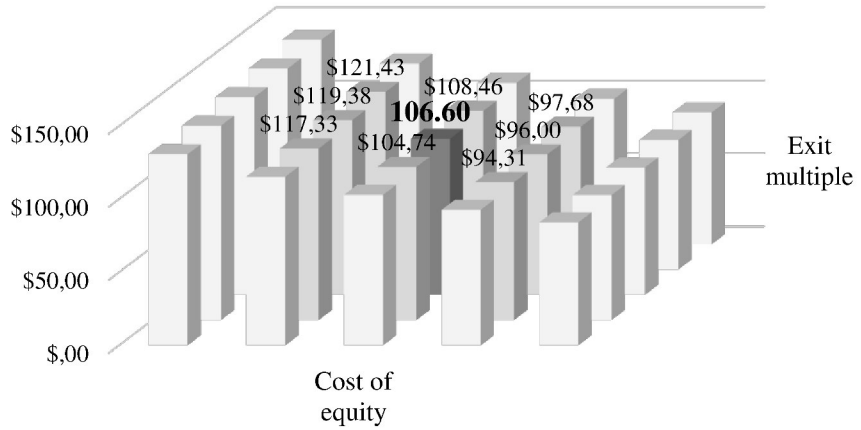
WACC & Terminal growth rate

		WACC				
		7.11%	8.105500%	9.11%	10.11%	11.11%
Terminal growth rate	1.0%	$135.05	$117.42	$103.37	$91.85	$82.21
	1.5%	$138.51	$119.66	$104.88	$92.90	$82.97
	2.0%	$142.65	$122.26	**$106.60**	$94.09	$83.81
	2.5%	$147.69	$125.33	$108.59	$95.43	$84.75
	3.0%	$153.96	$129.00	$110.90	$96.96	$85.81



Cost of equity & Exit multiple

		Cost of equity				
		8.37%	9.37%	10.37%	11.37%	12.37%
Exit multiple	15x	$130.65	$115.27	$102.88	$92.63	$83.98
	16x	$132.92	$117.33	$104.74	$94.31	$85.50
	17x	$135.19	$119.38	**$106.60**	$96.00	$87.03
	18x	$137.46	$121.43	$108.46	$97.68	$88.55
	19x	$139.73	$123.48	$110.32	$99.36	$90.08



Appendix 27: Operational Synergies

	pNPV	Binomial Tree	Juno premerger	Celgene Premerger	Post Merger	Operational Synergies
CD19: JCAR017	$997 mn	$679 mn	$838 mn	$2,247 mn	$2,643 mn	-$441 mn
CD19: Liso-cel (Chronic Lymphocytic Leukemia)	$232 mn	$258 mn	$245 mn	$650 mn	$738 mn	-$157 mn
WT-1: JTCR016 (Acute Myeloid Leukemia)	$473 mn	$539 mn	$506 mn		$1,018 mn	$512 mn
WT-1: JTCR016 (Non-Small Cell Lung Cancer)	$68 mn	$66 mn	$67 mn		$196 mn	$129 mn
WT-1: JTCR016 (Mesothelioma)	$5 mn	-$8 mn	-$1 mn		$16 mn	$17 mn
CD19: Liso-cel (Non-Hodgkins Lymphoma)	$85 mn	$121 mn	$103 mn	$321 mn	$367 mn	-$58 mn
CD19: JCAR014 with Durvalumab (Non-hodgkin Lymphoma)	$85 mn	$121 mn	$103 mn	$333 mn	$381 mn	-$56 mn
CD22: JCAR018 Fully-Human scFv (Non-hodgkin Lymphoma)	$85 mn	$121 mn	$103 mn	$321 mn	$367 mn	-$58 mn
BCMA: JCARH125 (Multiple Myeloma)	$226 mn	$343 mn	$285 mn		$1,009 mn	$724 mn
BCMA: MCARH171 & FCARH143 (Multiple Myeloma)	$226 mn	$343 mn	$285 mn		$1,009 mn	$724 mn
L1CAM: JCAR023 (Pediatric Neuroblastoma)	$536 mn	$832 mn	$684 mn		$2,380 mn	$1,696 mn
MUC16 & IL-12: JCAR020 "Armored" CAR (Ovarian)	$660 mn	$1,027 mn	$844 mn		$2,932 mn	$2,088 mn
ROR1: JCAR024 (Non-small cell lung cancer/ breast cancer)	$381 mn	$586 mn	$483 mn		$1,684 mn	$1,200 mn
Lewis Y (Solid Tumors)	$1,328 mn	$2,082 mn	$1,705 mn		$5,915 mn	$4,210 mn
TOTAL without product cannibalization:	**$4,392 mn**	**$6,431 mn**	**$6,250 mn**	**$3,872 mn**	**$20,653 mn**	**$10,532 mn**
TOTAL with product cannibalization:	**$3,805 mn**	**$5,554 mn**	**$4,679 mn**	**$971 mn**	**$15,412 mn**	**$9,762 mn**
TOTAL	**$4,099 mn**	**$5,993 mn**	**$5,464 mn**	**$2,421 mn**	**$18,033 mn**	**$10,147 mn**

7. References

Alford, A. W. (1992) 'The Effect of the Set of Comparable Firms on the Accuracy of the Price-Earnings Valuation Method', *Journal of Accounting Research*, 30(1), pp. 94–108.

Alles, M. (2018a) *Celgene Completes Acquisition of Juno Therapeutics , Inc ., Advancing Global Leadership in Cellular Immunotherapy*.

Alles, M. (2018b) *Celgene Corporation Announces Changes to Its Board of Directors*.

Backer, R. De and Ruby, T. (2017) 'Biopharma valuations — onward and upward?', (Exhibit 1), pp. 1–11.

Bhojraj, S. and Lee, C. M. C. (2002) 'Who is my peer? A valuation-based approach to the selection of comparable firms', *Journal of Accounting Research*, 40(2), pp. 407–439. doi: 10.1111/1475-679X.00055.

Black, F. and Scholes, M. (1973) 'The Pricing of Options and Corporate Liabilities', *Journal of Political Economy*, 81(3), pp. 637–654. doi: 10.1086/260062.

Brito, P. (2017) *The Method of Market Multiples on the Valuation of Companies : A Multivariate Approach*, *FEP Working Papers*.

Bruner, R. F. (2005) 'Where M & A Strays and Where it Pays', *Wiley and Sons*, (January), pp. 1–54.

Campbell, T. (2017) *Can This Tiny Biotech Stock Pay Off Big for Celgene?* Available at: https://www.fool.com/investing/2017/11/17/can-this-tiny-biotech-stock-pay-off-big-for-celgen.aspx (Accessed: 20 May 2018).

Celgene Corporation (2017a) *Celgene Company Presentation at the 37th Annual Cowen Health Care Conference*. Boston. Available at: http://files.shareholder.com/downloads/AMDA-262QUJ/6284057589x0x932199/AC036424-C2E6-460D-8270-7CA69D414313/Celgene_Cowen_03_08_17_FINAL_without_notes.pdf.

Celgene Corporation (2017b) *Celgene Corporation and bluebird bio Announce bb2121 Anti-BCMA CAR-T Cell Therapy Has Been Granted Breakthrough Therapy Designation from FDA and Prime Eligibility from EMA for Relapsed and Refractory Multiple Myeloma (NASDAQ:CELG)*, *Celgene*. Summit, New Jersey. Available at: http://ir.celgene.com/releasedetail.cfm?releaseid=1049014.

Celgene Corporation (2018a) *Bluebird Bio and Celgene Corporation Enter into Agreement to Co-Develop and Co-Promote Anti-BCMA CAR T Cell Therapy bb2121 in the United States*. Summit, New Jersey.

Celgene Corporation (2018b) *Celgene Announces Expiration of Cash Tender Offer for Shares of*. Summit, New Jersey. Available at: http://ir.celgene.com/releasedetail.cfm?releaseid=1059597.

Celgene Corporation (2018c) *Celgene Company History*. Available at: https://www.celgene.com/about/history/.

Celgene Corporation (2018d) *Celgene Completes Acquisition of Juno Therapeutics , Inc ., Advancing Global Leadership in Cellular Immunotherapy*.

Celgene Corporation (2018e) *Celgene Corporation Announces Changes to Its Board of Directors*. Summit, New Jersey. Available at: http://ir.celgene.com/releasedetail.cfm?ReleaseID=1064316.

Celgene Corporation (2018f) *Celgene Corporation Form 10-K (annual report 2017)*. Delaware: United States securities and exchange commission.

Celgene Corporation (2018g) *Celgene Corporation to Acquire Juno Therapeutics, Inc., Advancing Global Leadership in Cellular Immunotherapy*. Summit, New Jersey.

Celgene Corporation (2018h) *Celgene Landing Page*. Available at: http://www.celgene.com/ (Accessed: 22 April 2018).

Cooper, I. a. *et al.* (2008) 'Optimal Equity Valuation Using Multiples: The Number of Comparable Firms', *Working paper*, pp. 1–31. doi: 10.2139/ssrn.1272349.

Countryeconomy.com (2018) *G8 Major Economies*. Available at: https://countryeconomy.com/countries/groups/g8 (Accessed: 1 May 2018).

Crow, D., Hancock, T. and Xueqiao, W. (2018) 'Healthcare: Cancer breakthrough leads China's biotech boom', *Financial Times*, pp. 1–9. Available at: https://www.ft.com/content/30b5a944-3b57-11e8-b9f9-de94fa33a81e.

CVS Health Corporation (2018) *CVS Health 2017 Annual Report*. Woonsocket. doi: 10.1080/10598650.2007.11510575.

Damodaran, A. (2002) *Investment Valuation*. second edi. New Jersey: John Wiley & Sons, Inc.

Damodaran, A. (2015) 'The Value of Synergy', *Damodaran on Valuation*, (October), pp. 541–574. doi: 10.1002/9781119201786.ch15.

DeChesare, B. (2016) *Breaking into Wall street - Merger Model Guide*.

DePamphilis, D. M. (2014) *Mergers, Acquisitions, and other Restructuring Activities*. Seventh Ed. San Diego: Elsevier Inc. doi: 10.1016/B978-0-12-385487-2.00019-2.

Devos, E., Kadapakkam, P. R. and Krishnamurthy, S. (2009) 'How do mergers create value? A comparison of taxes, market power, and efficiency improvements as explanations for synergies', *Review of Financial Studies*, 22(3), pp. 1179–1211. doi: 10.1093/rfs/hhn019.

Eccles, R. G., Lanes, K. L. and Wilson, T. C. (1999) 'Are you paying too much for that acquistion?', *Hbr*, (July-August), pp. 136–146.

Fernández, P. (2007) 'Valuing companies by cash flow discounting: ten methods and nine theories', *Managerial Finance*, 33(11), pp. 853–876. doi: 10.1108/03074350710823827.

Fortune (2015) *Juno Therapeutics â€™ Shares Sink After 2 More Deaths in Leukemia Drug Trial*. Available at: http://fortune.com/2016/11/23/juno-therapeutics-leukemia-drug/.

Gilead Sciences Inc. (2017a) *Gilead Sciences Completes Acquisition of Kite Pharma, Inc.*

Gilead Sciences Inc. (2017b) *Gilead Sciences to acquire Kite Pharma for $11.9 billion*. Available at: http://www.gilead.com/news/press-releases/2017/8/gilead-sciences-to-acquire-kite-pharma-for-119-billion.

Global Data (2016) *Glioblastoma Treatment Market: $3.3 Billion by 2024*. Available at: https://www.pharmpro.com/news/2016/01/glioblastoma-treatment-market-33-billion-2024.

Global Data (2017) *Report: Ovarian Cancer Market Expected to Quadruple to $5.2B*. Available at:

https://www.pharmpro.com/news/2017/04/report-ovarian-cancer-market-expected-quadruple-52b (Accessed: 1 May 2018).

Global Market Insights (2017) *Breast Cancer Therapeutics Market Size By Product*. Available at: https://www.gminsights.com/industry-analysis/breast-cancer-therapeutics-market (Accessed: 1 May 2018).

Goedhart, M., Koller, T. and Wessels, D. (2005) 'The right Role for Multiples in Valuation', *McKinsey on Finance*, 15, pp. 7–11.

Goonewardene, A. and Rye, B. (2018) *Bloomberg Intelligence Global Biotech 2018 Outlook*.

Grand View Research (2016) *Multiple Myeloma Therapeutics Market To Be Worth $37.5 Billion By 2024*. Available at: https://www.grandviewresearch.com/press-release/global-multiple-myeloma-therapeutics-market (Accessed: 1 May 2018).

Grand View Research (2018) *Pediatric Vaccines Market Analysis By Type (Monovalent, Multivalent), By Technology (Live Attenuated, Inactivated, Subunit, Toxoid, Conjugate), By Application (Infectious Diseases, Cancer, Allergy), By Region, And Segment Forecasts, 2018 - 2025*. Available at: https://www.grandviewresearch.com/industry-analysis/pediatric-vaccine-market (Accessed: 1 May 2018).

Healy, P. M. *et al.* (1990) 'Does Corporate Performance Improve After Mergers?', *National Bureau of Economic Research*.

Hey, S. P. and Kesselheim, A. S. (2016) *The FDA, Juno Therapeutics, and the ethical imperative of transparency*, *BMJ (Clinical research ed.)*. doi: 10.1136/bmj.i4435.

Inselbag, I. and Kaufold, H. (1997) 'Two DCF Approaches for Valuing Companies Under Alternative Financing Strategies (and How to Choose Between Them)', *Journal of Applied Corporate Finance*, 10(1), pp. 114–122. doi: 10.1111/j.1745-6622.1997.tb00132.x.

International Trade Administration (2016) 'Top Markets Report Pharmaceuticals Overview and Key Findings', *Top Markets Report pharmaceuticals*, pp. 1–10. Available at: http://trade.gov/topmarkets/pdf/Pharmaceuticals_Executive_Summary.pdf.

Jadhav, R. (2018) *Global Non-Hodgkin Lymphoma Therapeutics Market 2018-2023*. Available at: https://thetechnicalprogress.com/2018/05/global-non-hodgkin-lymphoma-therapeutics-market-2018-2023/ (Accessed: 11 May 2018).

Janiszewski, S. (2011) 'How to Perform Discounted Cash Flow Valuation?', *Foundations of Management*, 3(1), pp. 81–96. doi: 10.2478/v10238-012-0037-4.

Juno Therapeutics Inc. (2015) *Celgene and Juno Announce Ten-Year Collaboration to Advance Potentially Groundbreaking Immunotherapies for Patients with Cancer and Autoimmune Diseases*. Available at: http://ir.junotherapeutics.com/news-releases/news-release-details/celgene-and-juno-announce-ten-year-collaboration-advance.

Juno Therapeutics Inc. (2018) *Juno Therapeutics , Inc . Form 10-K (annual report 2017)*. Delaware: United States securities and exchange commission.

Kaplan, S. and Ruback, R. (1996) 'The market pricing of cash flow forecasts: Discounted cash flow vs. the method of "comparables', *Journal of Applied Corporate Finance*, 8, p. 45. doi: 10.1111/j.1745-6622.1996.tb00682.x.

Kasimov, C. (2018) *Celgene Overweight Previous: Not Rated CELG, CELG US Moving to an OW Rating and a $110 Price Target from Not Rated*. JP Morgan Equity Research.

Keegan, K. D. (2008) *Biotechnology Valuation-An Introductory Guide*. Chichester: John Wiley & Sons Ltd. doi: 10.1002/9781118673508.

Kellogg, D., Charnes, J. M. and Demirer, R. (2000) 'Valuation of a Biotechnology Firm: An Application of Real-Options Methodologies', *Financial Analysts Journal*, 56(3), pp. 76–84.

Kim, T. (2018) *Celgene plunges 18% after biotech company slashes 2020 guidance; worst drop in 17 years*. Available at: https://www.cnbc.com/2017/10/26/celgene-plunges-after-the-biotech-company-slashes-2020-guidance.html (Accessed: 17 April 2018).

Kochenderfer, J. N. *et al.* (2010) 'Eradication of B-lineage cells and regression of lymphoma in a patient treated with autologous T cells genetically engineered to recognize Brief report Eradication of B-lineage cells and regression of lymphoma in a patient treated with autologous T cells', *American Society of Hematology*, 116(20), pp. 4099–4102. doi: 10.1182/blood-2010-04-281931.

Kolaczkowski, L. (2017) *A Look Inside MS Marketplace Projections*. Available at: https://multiplesclerosisnewstoday.com/2017/09/28/ms-therapies-look-inside-market-research-report/.

Lawrence, S. (2016) *Jounce nabs first big deal in $2.6B I/O tie-up with Celgene*. Available at: https://www.fiercebiotech.com/biotech/jounce-nabs-first-big-deal-2-6b-i-o-tie-up-celgene.

Leland, H. (2005) 'On Purely Financial Synergies : Implications for Mergers and Structured Finance Presentation to the Q-Group'.

Leukemia and Lymphomia Society (LLS) (2017) *Facts and Statistics*. Available at: https://www.lls.org/http%3A/llsorg.prod.acquia-sites.com/facts-and-statistics/facts-and-statistics-overview/facts-and-statistics (Accessed: 18 May 2018).

Liu, J., Nissim, D. and Thomas, J. (2002) 'Equity valuation using multiples', *Journal of Accounting Research*, 40(1), pp. 135–172. doi: 10.1111/1475-679X.00042.

Lolic, M. (2017) 'NDA at the FDA', *U.S. Food & Drug Administration*.

Luehrman, T. A. (1997) 'Using APV: A Better Tool for Valuing Operations', *Harvard Business Review*, May-June(May-June 1997).

MacKay, K. and Zheng, H. (2017) *RBC - Luspatercept is a De-Risked Blockbuster, but St Agrees: Initiating at Sector Perform*. Available at: https://www.investorvillage.com/smbd.asp?mb=341&mn=212593&pt=msg&mid=17527100 (Accessed: 10 May 2018).

Messer, C. (2018) *Juno Therapeutics, Inc. (JUNO) Celgene Takeover Announced at $87/share. Downgrading to Neutral*. Needham & Company Equity Research.

Myers, S. and Howe, C. (1997) 'A Life-Cycle Financial Model of Pharmaceutical R&D', *Program on the Pharmaceutical Industry, MIT*.

Van Norman, G. A. (2016a) 'Drugs, Devices, and the FDA: Part 1: An Overview of Approval Processes for Drugs', *JACC: Basic to Translational Science*. Elsevier, 1(3), pp. 170–179. doi: 10.1016/j.jacbts.2016.03.002.

Van Norman, G. A. (2016b) 'Drugs, Devices, and the FDA: Part 2', *JACC: Basic to Translational Science*. Elsevier, 1(4), pp. 277–287. doi: 10.1016/j.jacbts.2016.03.009.

Persistent Market Research (2017) *Global Market Study on Malignant Mesothelioma: Cisplatin and Combination Segment Projected to be the Second Most Lucrative Segment by Drug Type*. Available at: https://www.persistencemarketresearch.com/market-research/malignant-mesothelioma-market.asp (Accessed: 1 May 2018).

Pinto, J. *et al.* (2010) *Equity Asset Valuation*. second edi. Hoboken, New Jersey: John Wiley & Sons, Inc.

Reed, S. F., Lajoux, A. R. and Nesvold, H. P. (2007) *The Art of M&A, Fourth Edition: A Merger Acquisition Buyout Guide*. doi: 10.1036/0071403027.

Roberts, A., Wallace, W. and Moles, P. (2016) 'Mergers and Acquisitions', *Edinburgh Business School*, 2016(1020), p. 29. doi: 10.1108/eb039093.

Rohan, S. (2018a) *MarketsandMarkets: Acute Myeloid Leukemia Therapeutics Market in G8 Countries worth $1.67 Billion by 2020*. Available at: https://www.marketsandmarkets.com/PressReleases/acute-myeloid-leukemia-therapeutics.asp (Accessed: 1 May 2018).

Rohan, S. (2018b) *MarketsandMarkets: Chronic Lymphocytic Leukemia Therapeutics Market worth $2.2 Billion by 2020*. Available at: https://www.marketsandmarkets.com/PressReleases/chronic-lymphocytic.asp (Accessed: 1 May 2018).

Sanofi Corporation (2018) *Sanofi Completes Acquisition of Bioverativ Inc.* Paris.

Schreiner, A. (2007) *Equity valuation using multiples: An empirical investigation*. University of St. Gallen. doi: 10.1007/978-3-8350-9531-1.

Shrieves, R. E. and Wachowicz, J. M. (2001) 'Free cash flow (FCF), economic value added (EVA™), and net present value (NPV): A reconciliation of variations of discounted-cash-flow (DCF) valuation', *Engineering Economist*, 46(1), pp. 33–52.

Simoes, S. (2014) *Bluepharma - we are a partner that cares*. Available at: https://www.bio.org/sites/default/files/Sept 10 - Company Presentation - 14h45 - BluePharma.pdf (Accessed: 5 May 2018).

Staines, R. (2018) *Bluebird bio details plans to file three blockbusters*. Available at: https://pharmaphorum.com/news/bluebird-bio-aims/ (Accessed: 5 May 2018).

Statista (2018a) *Prescription drug expenditure in the United States from 1960 to 2018 (in billion U.S. dollars)*. Available at: https://www.statista.com/statistics/184914/prescription-drug-expenditures-in-the-us-since-1960/.

Statista (2018b) *Top 10 cancer drugs worldwide by revenue in 2016 (in billion U.S. dollars)*. Available at: https://www.statista.com/statistics/288538/top-cancer-drugs-based-on-revenue/ (Accessed: 1 May 2018).

Statista (2018c) *Top 10 pharmaceutical companies based on global oncology market share in 2016 and 2022*. Available at: https://www.statista.com/statistics/309711/oncology-market-share-of-top-ten-pharmaceutical-companies-worldwide/.

Supid, S. (2015) *Increasing Incidences of Glioblastoma Multiforme Propels the Growth of Global Glioblastoma Treatment Market, Expected to Reach USD 0.91 Billion in 2022*. Available at: https://www.transparencymarketresearch.com/pressrelease/global-glioblastoma-treatment-market.htm.

Tatkare, D. (2015) *Oncology/Cancer Drugs Market by Therapeutic Modalities (Chemotherapy, Targeted Therapy, Immunotherapy, Hormonal), Cancer Types (Blood, Breast, Gastrointestinal , Prostate, Skin, Respiratory/Lung Cancer) - Global Opportunity Analysis and Industry Forecast,*. Allied Market Research. Available at: https://www.alliedmarketresearch.com/oncology-cancer-drugs-market.

The World Bank (2016) *Population growth (annual %)*. Available at: https://data.worldbank.org/indicator/SP.POP.GROW (Accessed: 1 May 2018).

U.S. Food & Drug Administration (FDA) (2017) 'Tisagenlecleucel BLA Approval'. United States of America: U.S. Food & Drug Administration. Available at: www.fda.gov.

U.S. Food & Drug Administration (FDA) (2018a) *Frequently Asked Questions on Patents and Exclusivity*. Available at: https://www.fda.gov/Drugs/DevelopmentApprovalProcess/ucm079031.htm.

U.S. Food & Drug Administration (FDA) (2018b) *The FDA Drug Approval Process (Infographic)*. Available at: https://www.fda.gov/downloads/drugs/resourcesforyou/consumers/ucm284393.pdf.

Visiongain Ltd. (2017) *Non-Small Cell Lung Cancer (NSCLC) Drugs Market Forecast 2017-2027*. Available at: https://www.prnewswire.com/news-releases/non-small-cell-lung-cancer-nsclc-drugs-market-forecast-2017-2027-635385943.html.

Wood, L. (2018) *Systemic Lupus Erythematosus Market Report 2018: Insights, Epidemiology and Forecasts to 2027*. Available at: https://www.businesswire.com/news/home/20180222006552/en/Systemic-Lupus-Erythematosus-Market-Report-2018-Insight.

Wood, S. F. *et al.* (2017) 'Influence of pharmaceutical marketing on Medicare prescriptions in the District of Columbia', *PLOS one*, pp. 1–13. Available at: https://doi.org/%0A10.1371/journal.pone.0186060.