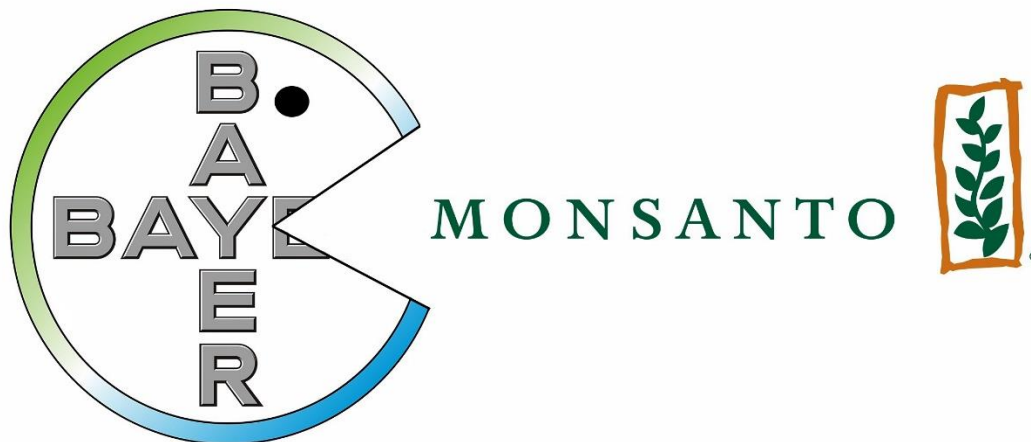


Case Study: The Bayer-Monsanto Acquisition Deal



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ABSTRACT

The acquisition of Bayer-Monsanto was one of the largest M&A deals of the past decade. In this study, I document the motives of this transaction and the timeline of events that took place, from the initial rumors until Bayer's milestone settlement of Monsanto's "Roundup" litigation in mid-2020. Fundamental valuations of the two individual companies and their officially disclosed synergies reveal that the premium paid over Monsanto's overvalued share price was not justified, as is commonly observed in the M&A ecosystem. Multiple approaches to the calculation of the discount factor reach the same conclusion. Averaging across multiple costs of capital, shows that the combined intrinsic value with synergy of roughly \$177bn was some \$2.12bn higher than the sum of parts, suggesting a rather profitable investment opportunity. However, Bayer, did overpay by 18.08% to reap these benefits. Disclosed synergies seem in accord to a relevant study that examines the average Synergy/Deal Value ratio across multiple mergers but are based on the author's conservative assumptions about terminal synergy cash flows, that could have as well been fairly inflated under management's expectations. Finally, event studies are conducted to unravel the economic impact of certain developments along the road, to the main players as well as their competitors, customers and suppliers. Deal announcement effects on the bidder and the target are in line with contemporary scientific literature, meaning that Bayer suffered market cap loss, but Monsanto's price soared. Litigation clashes had a pummeling effect on Bayer. Impact on competitors, customers and suppliers was not sizeable, but suggests that the first did not welcome events that could solidify the merger in the long run, while the latter two, desired to maintain business but also negotiating power with the life-sciences conglomerate. It becomes evident that this was eventually one of the most value-destructive transactions ever experienced, as almost 2 years after the closing of the deal, Bayer's market value had dropped by the whole amount originally paid to secure the assets of the U.S. agricultural giant.

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1. Introduction: The two players and the state of the agriculture industry

Bayer AG is a life science company and one of the largest pharmaceutical companies in the world, headquartered in Leverkusen, Germany. Bayer's first and best-known product was the aspirin. In 1898 Bayer trademarked the name heroin for the drug diacetylmorphine and marketed it as a cough suppressant and non-addictive substitute for morphine until 1910. Bayer also introduced phenobarbital; prontosil, the first widely used antibiotic and the subject of the 1939 Nobel Prize in Medicine; the antibiotic Cipro (ciprofloxacin); and Yaz (drospirenone) birth control pills. **(Bayer AG, 2020)** “In the year 2017, the Bayer Group consisted of 237 consolidated companies in 79 countries globally. The company also provides a reliable supply of high-quality food-, feed-, and plant-based raw materials” **(Kumar, 2019)**. “The company's segments are Pharmaceuticals, Consumer Health, Crop Science and Animal Health. The Pharmaceuticals segment focuses on researching, developing and marketing prescription products and specialty therapeutics especially in the areas of cardiology, oncology, gynecology, hematology and ophthalmology, as well as radiopharmacology and others. The Consumer Health segment develops, produces and markets nonprescription over-the-counter products in the dermatology, dietary supplement, analgesic, gastrointestinal, cold, allergy, sinus and flu, foot care and sun protection categories, among others. The Crop Science segment researches, develops and markets crop protection solutions and seeds. The Animal Health segment is engaged in the development, production and marketing of prescription and nonprescription veterinary products.” **(Refinitiv Eikon, 2020a)**

The Monsanto Company was an American agrochemical and agricultural biotechnology corporation founded in 1901 and was headquartered in Missouri, United States. “Monsanto’s seeds biotechnology trait products, herbicides, and digital agriculture products provide farmers with solutions that help improve the productivity and reduce the cost of farming” **(Kumar, 2019)**. Monsanto developed Roundup, a glyphosate-based herbicide, in the 1970s, and became a major producer of genetically engineered crops.

The company reports two main segments in its financial statements: Seeds and Genomics and Agricultural Productivity. “The Seeds and genomics segment produces leading seed brands which include DEKALB, Asgrow, Deltapine, Seminis, and De Ruiter. Monsanto develops biotechnology traits which help farmers in controlling insects and weeds and digital agricultural products to assist farmers in decision-making. Agricultural productivity segment manufactures Roundup brand herbicides and other herbicides and provides lawn and garden herbicide products for the residential market” **(Kumar, 2019)**.

Monsanto was one of the first companies to introduce genes into plants in 1983 **(Plant Biotech News, 2013)**, and was among the first to conduct field trials of genetically modified crops in 1987. It was one of the top ten U.S. chemical companies until it divested most of its chemical businesses between 1997 and 2002, through a process of mergers and spin-offs that focused the company on biotechnology. Monsanto was one of the first companies to apply the biotechnology industry business model to agriculture, using techniques developed by biotech drug companies **(Leonard-Barton & Pisano, 1990)**. In this business model, companies recoup R&D expenses by exploiting biological patents **(Moschini, 2010)**, **(Schneider, 1990)**, **(Burrone, 2006)**, **(Fernandez-Cornejo, 2004)**. Monsanto's role in agricultural changes, biotechnology products, lobbying of government agencies, and roots as a chemical company, resulted in controversies. The company once manufactured controversial products such as the insecticide DDT, PCBs,

Agent Orange, and recombinant bovine growth hormone. Its seed patenting model was criticized as biopiracy and a threat to biodiversity (Parsai, 2012) (Vidal, 2000) as invasive species (Paull, 2018).

Agriculture supply industry has been markedly consolidated after three major mergers, with the Bayer-Monsanto merger being the largest. The other two mergers were Dow-DuPont and Syngenta–ChemChina (2017). Now, “approximately 61% of the global seeds and pesticide production is concentrated in these three enormous entities”. (Kumar, 2019).

The merger was also motivated by the fact that it took approximately ten years for a company to develop and get approval for a new herbicide. Similarly it took the same time to make a seed trait that responded to the new chemical. The merger would facilitate Bayer and Monsanto’s combined resources to develop the paired products in a shorter timeframe. Monsanto had partnerships and joint ventures with other companies to develop innovative products which in turn resulted in profit sharing. The consolidated new company would be in a better position to develop in house innovative products which didn’t require a revenue sharing partnership (Kumar, 2019; Varinsky, 2018).

For Monsanto, data acquisition was the key motive for the deal. In 2013, Monsanto purchased The Climate Corp., a data company which provided farmers with weather data and predictions for approximately \$1bn. By 2014, more than one third of all US farmland was using this technology. Monsanto’s “farm-to-fork” data platform called Climate FieldView was a strategic growth driver for the company. This platform used tractors fitted with sensors and GPS, algorithms, and data drones to monitor field conditions and advise farmers in real time. The merger gave a “first-mover” advantage for Bayer and Monsanto to create the biggest platform to facilitate control of the food value chain in terms of which pesticides would be used and which seeds would be planted (Kumar, 2019; Varinsky, 2018).

There has been concern though that one of the primary incentives for this merger could have been the desire to gain control over a very large proportion of the world’s agriculture supply with the sole purpose of increasing prices for farmers globally, thus spiraling profits substantially (Varinsky, 2018).

2. Timeline

To thoroughly understand the background and dynamics of the deal, I have compiled a detailed timeline, covering the time-frame from the initial negotiations in May 2016, to the infamous “Roundup” litigations and their eventual resolution in June 2020. The information comes either from Bayer investor handouts, (retrieved from investor.bayer.com), SEC filings (U.S. Securities and Exchange Commission, retrieved from www.sec.gov), or articles from the Wall Street Journal (WSJ), all referenced at the final section of this paper. A detailed overview of the timeline can also be found in **Table 1** of the Appendix.

2.1 The path to the deal announcement

The first recorded contact between Bayer and Monsanto happened in March 2016, when strangely enough Monsanto was the one to approach Bayer for a potential deal. Reuters had reported that Monsanto approached Bayer with a proposition valued at more than \$30bn. Bloomberg had also reported that Monsanto was interested in Bayer's CropScience, saying the companies discussed possible asset purchases or joint ventures. Global seed and pesticide companies were under pressure to explore deals and partnerships after China National Chemical Corp. clinched a deal to buy Syngenta AG for \$43bn late 2015. Monsanto itself had gone after Syngenta, only to be rebuffed and later outbid by ChemChina (**Divac, 2016**). Dow Chemical Co. and DuPont Co. also struck a merger deal last December (**Eyk Henning et al., 2016**).

On 12th May 2016, reports surfaced claiming that Bayer AG and BASF SE had taken their turn to offer own bids in a private meeting with Monsanto (**WSJ Staff, 2016**). The discussions were preliminary, held internally with advisors. In response to media coverage, Monsanto disclosed on 19/05 they had received a proposal from Bayer and Bayer confirmed the press release (**Bayer AG, 2016c**), while almost two weeks later, on the 23rd May, Bayer officially disclosed the contents of its private proposal: an offer of \$122/share (\$62bn enterprise value, including net debt), all-cash payment (**Bayer AG, 2016d**). In this investor call, Bayer boasted about the creation of a global leader in agriculture. The offer price included a substantial premium of 37% to Monsanto's share price of \$89.03 on May 9th (a day prior to the initially undisclosed meeting) and the proposed valuation made up for a last twelve months (LTM) EBITDA multiple of 15.8x (as of Feb 2016). The transaction was planned to be financed using a mix of debt and equity, with the equity portion expected to represent 25% of the enterprise value. Up to this point, the Bank of America, Merrill Lynch and Credit Suisse had agreed on providing bridge financing. Bayer also advocated full commitment to single "A" credit rating category in the long term, thus retaining investment grade status.

Despite the sheer size of such deal, Bayer exclaimed confident of obtaining regulatory approval. Bayer attempted to embellish this "unique and compelling opportunity" to its shareholders through a variety of points (**Bayer AG, 2016d**): It would "reinforce Bayer as a Life Science company with leadership positions in its core business segments, targeting an attractive long-term growth industry, with highly innovative biotech that would address unmet scientific need". The merger would ensure an industry leader with integrated offering of Seeds & Traits, Crop Protection as well as Biologics and Digital Farming (high predictability of yield and input, customized advice and service, best in-class data analytics, modelling and reporting). Broad product portfolio and combined R&D pipeline (breeding, traits, chemistry, biologics, seed treatment and digital farming) would deliver superior solutions to farmers. Bayer had also officially disclosed an estimate of \$1.5bn synergies after year three, plus additional integrated benefits over future years. It was also pointed out that Monsanto was owner of industry leading margins and thus highly profitable, reducing the investment risk in the eyes of shareholders. It is important to note though, that a shareowners' vote was not required on Bayer's side. This was not the case with Monsanto however, since shareholders would have to submit their votes on the proposal (**S.E.C, 2016b**).

Bayer (**Bayer AG, 2016d**) proceeded with projected key metrics. Life science sales were projected to increase to €47.1bn in a combined company setting, from Bayer's standalone €34.3bn, and the crop science segment would now account for 49% of overall business. A prospective deal was also supposed to address fundamental global challenges. Population was projected to reach the 10bn mark by 2050, thus increasing

the per capita protein intake by 16%. Agriculture market size was estimated at €120bn by 2025. Climate change shocks were projected to reduce crop yields by 17% by 2050. All this, results in a projected required productivity increase of 60% in order to adequately feed the planet by 2050. A combination of Bayer and Monsanto would optimize crop yield given the environmental conditions by taking the right decisions on genetics and agronomic practices. It would ensure sustainability by optimizing input factors (e.g fertilizers, crop protection) in order to preserve natural resources. Finally, it would also be much more efficient in managing agronomic volatility and mitigating risks, such as the weather and commodity prices. Obviously, a thorough investigation into these issues (and measures to counter them) would later on provide substantial argument support in the deliberations with regulatory bodies regarding a potential deal approval, despite Bayer asserting itself confident in achieving this goal. A summary of prior proven track record through successful M&A deals was also presented during the investor call, to further assuage any concerns.

The \$1.5bn synergies (and integrated benefits) were classified into “cost synergies” and “sales synergies” (**Bayer AG, 2016d**). The first referred to optimizing product supply chains, marketing & sales and R&D teams, as well as overhead cost reduction. The second referred to sophisticated customized product combinations and integrated solutions that would now cover a much larger geographic scale.

In general, Bayer emphasized that the leading position of a combined company as the world’s largest seed and crop-chemical supplier would translate in a highly value-accretive transaction ex-post.

Despite outlining the benefits of such move to Monsanto shareholders (substantial premium to the share price, attractive multiple, benefits of integrated business model), the target company rejected the offer on 24th May as too low (**Bunge, 2016a**). Monsanto Chief Executive and Chairman Hugh Grant had said there could be "substantial benefits" to a deal, but the offer "significantly undervalues" the company and doesn't address certain risks related to a deal, including potential financing and regulatory hurdles.

In an effort to bring Monsanto to the negotiating table (**Bunge & Eyk Henning, 2016a**), Bayer sent the company a letter saying it had lined up financing for the deal and was confident any regulatory obstacles could be overcome, according to sources of the Wall Street Journal (WSJ). It sought access to detailed business information (due diligence) which Bayer said could lead to a higher offer. Bayer didn't increase its bid. Monsanto considered the proposal little changed and responded by refusing to grant such access until Bayer raises its bid. Monsanto also told the German company that in addition to more money, it needs clarity on other matters including regulatory risks before agreeing to a deal.

Late June, Monsanto admitted it had been discussing deals with other prospective bidders as well, adding that there is value in the "right combination" (**Bunge, 2016b**).

Bayer then made a new offer of \$125/share verbally on July 1st 2016, and officially July 9th (**Eyk Henning et al., 2016**). The new proposal was again quickly rejected by Monsanto as undervalued. It was viewed as "financially inadequate" and "insufficient to ensure deal certainty". The board unanimously rejected the offer but did not rule out further negotiations (**Bunge & Eyk Henning, 2016b**).

As Monsanto proved hard to bargain with, Bayer was once again forced to increase the offer to \$127.5/share, which valued Monsanto at over \$65bn, including debt (**Bunge, 2016c**). Shortly after the

announcement, German chemicals group BASF SE was reported to be monitoring antitrust concerns regarding potential acquisitions in the general agrochemical sector (**WSJ, 2016**).

On 14th September 2016, Bayer and Monsanto pledge to “Create a Global Leader in Agriculture” (**Bayer AG, 2016e**). The offer consists of \$128/share, or \$66bn total value at the time (\$57bn of planned to be equity value, the remaining to be covered through issuance of corporate bonds), all-cash payment. This translates into a premium of 44% over Monsanto’s share price one day prior to the privately held meeting in May, LTM EBITDA multiple of 18.6x as of May 31, 2016 and FY2017 EBITDA multiple of 16.5x. The transaction was unanimously approved by Monsanto’s Board of Directors, Bayer’s Board of Management and Bayer’s Supervisory Board. Dividend payout ratio of 30-40% was to be maintained. Notable is Bayer’s commitment to pay \$2bn in case the deal was hindered by regulators (**Bunge & Alessi, 2016**).

This time, the roughly \$1.5bn synergies were more concretely classified (**Bayer AG, 2016e**) as 80% cost synergies and 20% sales synergies, but unfortunately the additional integrated benefits after year three were not quantified once again (noteworthy is a graph handed out to investors that seemed to imply that total long-term synergies would roughly amount to \$2.5bn. See Graph 1 in the Appendix). 70% of cost synergies would stem from SG&A savings and the remaining 30% from R&D synergies and COGS synergies (e.g. from overlap in the supply chain management and procurement expenses).

It is important to note that the announcement (**Bayer AG, 2016e**) also came with disclosures on the financing aspect of the deal. Bayer had secured bridge financing for \$57bn committed by the Bank of America, Merrill Lynch, Credit Suisse, Goldman Sachs, HSBC and JP Morgan. The combined company once again targeted investment grade credit rating, post deal closing.

Global Seeds & Traits and North American commercial headquarters would be located in Monsanto’s prior headquarters in St. Louis, Missouri, while Global Crop Protection and overall Crop Science headquarters would be located in Monheim, Germany.

The stage was set and final steps in the path to completion were the Monsanto shareholders vote by the end of 2016, submission of regulatory filings and the expected regulatory approval. Closing was anticipated by the end of 2017.

2.2 From the deal announcement to deal closing

The day after the deal announcement, WSJ (**Bunge, 2016d**) reported concerns about intense upcoming regulatory scrutiny. The agriculture industry had become increasingly concentrated with the merger of Dow Chemical and DuPont and the acquisition of Syngenta by China National Chemical Corp. So even though Monsanto's seed business didn't vastly overlap with Bayer's pesticide agricultural franchise, the combination of two of the largest suppliers in the sector was posed to cause turmoil among farmers and politicians.

A month later (**S.E.C, 2016a**), Bayer successfully closed the syndication of the \$57bn facility – an agreement between Bayer and prominent financial institutions that was disclosed the day of the deal announcement. Pricing and terms were strictly confidential though.

In November 2016, Monsanto's shareholders voted "for" or "against" the planned merger (**S.E.C, 2016b**) while shortly thereafter, Bayer issued the first €4bn of the equity component of the transaction, in the form of mandatory convertible notes (**S.E.C, 2016c**). The Monsanto shareholder meeting concluded a month later with a resounding approval (**Salter, 2016; Bayer AG, 2017a**) giving a strong mandate to executive management to move forward with all required proceedings.

With the introduction of 2017, "Bayer pledged to add U.S. jobs and investment after meeting with President-elect Donald Trump, the latest in a string of public displays from companies looking to head off criticism from the incoming administration about job losses. Bayer would implement "research investments and create several thousand new high-tech positions" (**Bunge & Alessi, 2017**). This was a move that arguably also aimed at gaining the favor of regulatory bodies, as jobs creation would provide further support for the establishment of the merger.

By the end of August 2017, it was reported that the European Commission viewed the deal as an additional burden on farmers who already faced difficulties due to low crop prices. The regulator had gone through an opening inspection, but it was clear it needed more time to finish its work, playing spoiler into the companies' attempt to finalize the deal by end of 2017, as was initially estimated (**Drozdiak & Bunge, 2017**).

Two months later, Bayer agrees to sell off selected crop science segments to BASF for €5.9bn, in an effort "to assuage regulators" (**Shevlin & Drozdiak, 2017**) while also securing significant proceeds that would partially fund the purchase of Monsanto.

Bayer's endeavours to appeal to the regulators seemed to pay off on December 2017, when the Committee on Foreign Investment in the United States (CFIUS) "completed its review of the proposed merger, and concluded that there are no unresolved national security concerns with respect to the transaction" (**Bayer AG, 2017b**).

As Bayer was trying to persuade antitrust authorities (having already divested certain segments to BASF), preparations to sell more assets were announced in the first quarter of 2018, namely the entire vegetable-seed business (**Turner & Drozdiak, 2018**).

Three weeks later, Bayer managed to obtain the conditional approval of the European Commission (**Bayer AG, 2018a**): "The conditions cover in particular the divestment of certain Bayer businesses, including the global field crop seeds business such as canola, cotton, and soybean (with minor exceptions restricted to the Asia region), the R&D platform for hybrid wheat, the global vegetable seeds business, the global glufosinate ammonium business as well as certain glyphosate-based herbicides in Europe, predominantly for industrial use. In addition, Monsanto's global business with the nematicide NemaStrike must be divested. The conditions also stipulate the transfer of three Bayer research projects in the area of non-selective herbicides and the granting of a license to Bayer's digital farming portfolio. BASF is the intended purchaser of these assets".

In early April 2018, The U.S. Justice Department decides to allow the multibillion dollar deal, after the companies pledged to divest additional assets (**Kendall & Bunge, 2018**), leading Monsanto's price to a 6.2% rise (**Banerji & Gold, 2018**). In response, Bayer signs agreement three weeks later to sell further

Crop Science businesses to BASF for up to €1.7bn (**Bayer AG, 2018b**), thus steering the Justice Department to a more concrete and official approval three days later, conditional to Bayer eventually selling off a total of \$9bn of assets to BASF (the largest divestiture for purposes of a U.S. merger approval), in order to preserve competition (**Kendall, 2018**) This was its second major merger resolution under the newly established Trump administration, a surprising move considering that last November it challenged AT&T Inc.'s acquisition of Time Warner Inc. In May 2018, it was also disclosed that Monsanto Co. Chief Executive Hugh Grant would leave the company after deal closing. “Chief Financial Officer Pierre Courduroux and a number of other top executives, such as the general counsel and chief technology officer, were also leaving after the deal would be completed. Monsanto Chief Operating Officer and President Brett Begemann -- along with some other Monsanto executives -- would become part of Bayer's crop-science executive-leadership team when the deal would be completed” (**WSJ, 2018a**).

With most of the regulatory hurdle now out of the way, Bayer announces on June 4th, 2018 (**Bayer AG, 2018c**) the closing of the acquisition deal, which finally comes into fruition three days later, for the price of \$128 per share, as originally announced back in September 2016 (**Bayer AG, 2018d**). Two weeks later, Bayer issues corporate bonds of total worth \$20bn “to pay down portions of the syndicated credit facility used as bridge financing for the acquisition of Monsanto” (**Bayer AG, 2018f, 2018e**).

2.3 “Roundup” – the product that nearly nihilated a \$63bn deal

When Bayer purchased Monsanto, it assimilated all its assets and liabilities. “Roundup”, Monsanto’s primary weed killer had accumulated a series of lawsuits in the past. Apparently, Bayer believed that even if they went to trial, a not too costly settlement would be a feasible solution. However, on August 10th 2018 (just two months after the deal closing), “a jury had ordered Monsanto Co. to pay \$289.2 million in a landmark lawsuit over whether exposure to two of its powerful weed killers caused cancer. The jury verdict, in San Francisco Superior Court, was the latest setback for Monsanto, now part of Bayer, as its flagship weed killer Roundup came under increased scrutiny following the 2015 determination from the World Health Organization that glyphosate, the active ingredient in Roundup herbicides, is probably carcinogenic. In the first of thousands of lawsuits to go to trial, the jury unanimously found that the company's Ranger Pro and Roundup products presented a "substantial danger" to consumers, and that Monsanto knew or should have known of potential risks and failed to warn consumers like Dewayne "Lee" Johnson. Mr. Johnson had worked as a groundskeeper for the Benicia Unified School District in the San Francisco Bay-area and was diagnosed with non-Hodgkin lymphoma. The jury awarded him \$39.2 million in compensatory damages and \$250 million in punitive damages.” (**Armental, 2018**). Bayer’s share price dropped by 10% after the decision was notified (**Shevlin, 2018**).

It is notable though that “there was overwhelming scientific evidence that glyphosate did not cause cancer. One comprehensive study, published last November in the Journal of the National Cancer Institute, investigated cancer incidence among nearly 45,000 licensed pesticide applicators who had been exposed to glyphosate. The study found "no evidence of an association between glyphosate use and risk of any solid tumors or lymphoid malignancies" -- including non-Hodgkin lymphoma. Even the Environmental

Protection Agency, far from a corporate shill, has likewise concluded that glyphosate is safe” (WSJ, 2018b). Citing such scientific studies, Monsanto said it would appeal the verdict (Armental, 2018).

A month later, Bayer revealed that “the number of plaintiffs alleging its recently acquired weed killers cause cancer, had risen sharply, adding to concerns about potentially lengthy and costly litigation”. The number had risen to some 8,700 plaintiffs up from 5,200 a few months earlier (Bender, 2018a).

A few days later, Bayer hit five-year low share prices (-21% since the verdict), thus stepped up its legal defense: the company asked a California state court judge to overturn the jury's verdict, order a new trial or reduce damages, according to a court filing (Bunge & Bender, 2018).

Mid October 2018, a California judge issued a tentative ruling for a new trial on the \$250mln in punitive damages awarded to a groundskeeper (Bunge, 2018), which was finalized almost two weeks later, reducing the damages imposed by \$200mln (Randazzo & Bunge, 2018). Judge Suzanne Ramos Bolanos said “the \$250 million in punitive damages awarded by the jury must be slimmed down to match the \$39.25 million in compensatory damages.”

The 8,700 plaintiffs quickly jumped to 9,300 according to a Bayer report in November '18, but Bayer emphasized its strong belief in its “meritorious defenses” that draw upon scientific studies. Good news was the substantial increase in Q3 2018 sales (23%) compared to Q3 2017, due to the Monsanto acquisition. Net profit however fell compared to Q3 2017, because back then Bayer had dismissed a lot of its assets to BASF (Bender, 2018b). By end of November, Bayer had lost some \$30 billion in market capitalization (Bender, 2018c).

While early 2017 Bayer pledged to create jobs, the ongoing developments forced it to “cut 12,000 jobs and sell its animal-health business, Coppertone sunscreens and Dr. Scholl's foot-care products in an effort to win back investors' trust after a string of setbacks and a sharp fall in its share price” (Bender, 2018d).

Early 2019 and Bayer scores its first litigation victory against a new plaintiff, Edwin Hardeman, a California resident who developed non-Hodgkin lymphoma and alleges his illness to supposedly cancerous Monsanto weed killers. “U.S. District Judge Vince Chhabria granted a request from Bayer to stagger the submission of evidence. The judge's approval essentially splits the trial into two phases. Now lawyers for the plaintiff in the first case must demonstrate that the chemical glyphosate in the weed killers caused his cancer before they can present evidence that manufacturer Monsanto acted with malice” (Bender & Mancini, 2019).

However, mid-January, “a French court revoked approval for one of Bayer’s Roundup glyphosate-based products because it might cause cancer. The administrative court in Lyon, France, said that despite European Union approval of glyphosate, scientific studies and animal testing showed Bayer's Roundup Pro 360 weed killer was potentially carcinogenic to humans and likely to be harmful to human reproduction and aquatic organisms. It said the ban was effective immediately” (Bender, 2019a).

By the end of February 2019, Edwin Hardeman’s first of two trials against Bayer had begun. Unlike the first trial that resulted in a loss for Monsanto, “jurors in this trial would first hear evidence solely on whether Roundup and its active ingredient glyphosate caused Mr. Hardeman's cancer. Only if jurors sided with the

plaintiff would they then hear evidence of alleged misconduct by the company”. Bayer’s lawyers defended the company citing scientific studies that glyphosate is not carcinogenic. Bayer’s share price had dropped some 30% to this point, since the first negative litigation verdict back in August 2018 (**Randazzo & Bender, 2019a**). Interestingly, at the same time Bayer announced attainment of operational targets for FY2018, namely +4.5% in group sales (€39.6bn), with crop science specific sales substantially higher due to the acquisition, +2.5% EBITDA of €9.55bn and net income of €1.7bn (**Bayer AG, 2019**).

The second phase of the trial took place a month later, with the jury resolving against Bayer, despite analysts and investors seeing the company at an advantage, since the first phase “focused solely on whether Roundup and its active ingredient, glyphosate, are carcinogenic”. The number of plaintiffs indicting the company had now exploded to 11,200 (**Randazzo & Bender, 2019b**). The next day Bayer’s share price plummeted by another 9.6% (**Bender, 2019b**). Interesting to note is the fact that farmers continued to stand by Bayer’s Roundup herbicide despite adverse rulings from two juries (**Bunge, 2019**). The jury had awarded Edwin Hardeman \$80.3mln in damages, by the end of March 2019 (**Bender & Randazzo, 2019**).

So far Bayer had undergone two trials both of which lost, with a notable victory reducing the damages of the first by \$200mln. However, the downturn was bound to carry on. “A jury in May 2019 awarded \$2.055bn to a California couple who blamed Bayer’s Roundup weed killer for causing their cancer, the largest such verdict to date and one that added significant pressure to the company. The money awarded included \$2bn in punitive damages and \$55mln in compensatory damages to the couple.”. This series of events has caused the shareholders to revolt and the plaintiffs alleging carcinogenic traits to Roundup to rise up to 13,400 (**Randazzo & Bender, 2019c**).

“The German company seemed stuck at what could be one of its darkest hours. Plaintiffs claiming Roundup caused their cancer had won in three jury trials, lawsuits had multiplied and damage awards so far exceed \$2bn. Bayer was worth less than the \$63bn it paid for Monsanto roughly a year ago. Several major shareholders withdrew their support for Bayer management at last month’s general meeting -- an unprecedented move in German corporate history” (**Bender, 2019c**).

A month later, Bayer announced plans to invest €5bn (\$5.64bn) on developing new ways (products) to combat weeds over the next decade, most likely in an attempt to regain trust in its business after the accumulation of a horde of lawsuits alleging its Roundup herbicide causes cancer (**Bender & Bunge, 2019**).

With developments proving formidable enough for Bayer to handle, investors pushed for the enlistment of additional legal expertise. A special committee of eight supervisory board members was tasked to consult with management on legal strategies. It also brought in an expert lawyer on mass tort and product litigation, to advise the board on all Roundup legal issues, including trial tactics and mediation (**Bender & Dummett, 2019**).

Following the ban of Roundup in France mentioned earlier, now Austria banned the chemical glyphosate, the main ingredient in Roundup, dealing another severe blow to Bayer (**Bender, 2019d**).

A federal judge cut by \$55mln the verdict from Bayer’s second trial in January’19 (plaintiff Edwin Hardeman, who won a more than \$80mln in damages). “U.S. District Judge Vince Chhabria said the \$75 million in punitive damages awarded to Mr. Hardeman by the six-person jury was excessive compared with

the \$5.3mln in other damages. The judge said \$20mln in punitive damages, or roughly four times the compensatory damages, was more appropriate” (**Randazzo, 2019a**). Ten days later, Bayer achieved another enormous cut: “A California state court judge in Alameda County, trimmed a more than \$2 bn award to \$86.7mln in the case of a local husband and wife who each blamed non-Hodgkin lymphoma diagnoses on Bayer's product” (**Randazzo, 2019b**), thus giving the company a sigh of relief and hope for a potential settlement regarding the outstanding cases.

Bayer sold in August its animal-health business to rival Elanco Animal Health Inc. for \$7.60bn (\$5.3bn in cash and a stake in Elanco valued at \$2.3bn, which planned to exit over time). The move would provide significant cash injection needed during the negative Roundup litigation developments, while it would also signal to nervous investors a restructuring focused on strengthening other core businesses (e.g. pharmaceuticals) (**Bender, 2019e**). By now, 18,400 plaintiffs had filed lawsuits and “shares had dropped roughly 30% since the deal closed, making it one of the worst corporate deals by lost share value. Its market capitalization was now close to what the company paid for Monsanto, meaning the value of one entire company had almost entirely evaporated. With three verdicts issued against Bayer so far, analysts' estimates of its total Roundup liability varied between €5bn and €25bn (\$5.5bn and \$27.7 bn)” (**Bender, 2019f**).

“Bayer’s efforts to fend off thousands of lawsuits against its Roundup herbicide were dealt a symbolic blow in September, when Germany, the company's home country, said it would ban the product's key ingredient, the glyphosate. The move was still unlikely to directly affect the chemicals and pharmaceuticals group's bottom line because Germany is a negligibly small market for Roundup. The decision was motivated by environmental considerations rather than glyphosate's alleged potential to cause cancer, which is at the center of the lawsuits” (**Bender, 2019g**).

In October, “Bayer appointed a prominent U.S. agriculture expert to its board in the company's latest effort to convince investors that it has its troubled crop-science business under control. Large Bayer shareholders had expressed concern about a lack of expertise among the company's nonexecutive directors in assessing the difficulties faced since acquiring Monsanto Co. As tension rose between shareholders and management, culminating in a rare no-confidence vote at that year's general meeting, investors pushed the company to beef up its legal expertise earlier in June, and bring in more people to oversee an agriculture business that now accounted for nearly half of group sales” (**Bender, 2019h**). The number of plaintiffs had more than doubled to 42,700 in the past three months, adding even greater pressure. On the bright side of things, Bayer’s stock rose 2% after the company posted better-than-expected sales and profit for Q3 2019 (**Bender, 2019i**).

Three weeks later “Monsanto had agreed to pay \$10.2mln in fines and plead guilty to spraying a banned pesticide in Hawaii”, further diminishing Bayer’s profile to the public (**WSJ, 2019**).

The end of 2019 would hold a pleasant surprise for Bayer. The Trump administration backed the company in its high-stakes Roundup litigation. “The Environmental Protection Agency, working with the Justice Department, filed court papers supporting Bayer's argument that glyphosate, the active ingredient in the company's Roundup herbicide, poses no cancer risk. The filing backs Bayer's appeal in federal court of a \$25mln verdict in the case of a California man who blamed Roundup for causing his non-Hodgkin lymphoma. Lawyers for both government agencies argued the verdict should be overturned because it

would have been illegal for Bayer to print cancer-risk warnings on Roundup labels. They said Congress granted the EPA the sole authority over safety labels on chemical products, and the agency wouldn't have approved a cancer warning for Roundup” (**Bunge & Puko, 2019**).

In February 2020, it was reported that “Bayer and plaintiff lawyers were approaching a deal in which Bayer would pay a total of roughly \$10bn for current and future plaintiffs who alleged the company's Roundup herbicide causes cancer” (**Bender, 2020a**). This would be a significant development for the company, especially considering that analysts were speculating such settlement could cost up to \$25bn. “Expectations that the company could soon find a reasonable way out of its legal morass have helped pull Bayer's shares up roughly 50% since they hit a seven-year low of roughly €52, or \$57, last June.”

Bayer also said “its scientists had discovered the building block for a new herbicide as the company's existing weed killers faced legal and regulatory challenges. The conglomerate said it identified a chemical molecule that proved effective against grasses that had evolved to survive other herbicides, including Bayer's Roundup, the world's top-selling weed killer. Roundup had for years been losing effectiveness against a rising number of weed species” (**Bunge, 2020**). This was a direct result of the company's €5bn investment announcement back in June 2019, in an attempt to win back investor confidence. Bayer also said “it would strengthen external oversight of its due diligence in deal making and allow an independent expert to review its rules for scrutinizing major deals. It also agreed to a new review of how it evaluated risks in its \$63bn purchase of Monsanto, which shareholders had criticized as overly risky after the acquisition plunged the company into a legal battle. The move highlighted Bayer's efforts to appease investors ahead of its shareholder meeting in April” (**Bender, 2020b**).

In April, the coronavirus pandemic had officially hit, with increased Q1 2020 profit for Bayer as “customers of the German company's farming and drugs businesses stocked up amid the coronavirus pandemic. Sales increased 4.8% to €12.85bn (\$13.91bn). Net profit rose to €1.49bn from €1.24bn a year earlier. But Bayer also said the pandemic also slowed progress on resolving its high-stakes legal battle” (**Bender, 2020c**).

What seemed to be the beginning of the final chapter in the Roundup litigation clash, was the announcement Bayer made in mid-June 2020. The life sciences giant said “it would pay more than \$10bn to settle the tens of thousands of lawsuits with U.S. plaintiffs alleging the company's Roundup herbicide causes cancer, a milestone in the German company's legal battle that has been weighing down its share price for nearly two years” (**Bender et al., 2020**), a move that brought long-sought clarity to investors on how much these legal proceedings would actually cost Bayer, following its 2018 purchase of U.S. agricultural giant Monsanto Co. Bayer still insisted that glyphosate, the active ingredient in Roundup, is safe and doesn't cause cancer. It did not admit to any wrongdoing as part of the settlement and continued to defend its decision to purchase Monsanto. The company would continue to sell Roundup, without any cancer warning labels, leaving speculation for additional lawsuits in the future.

“As part of the deal, Bayer said it has set aside between \$8.8bn and \$9.6bn to settle claims brought by lawyers representing some 95,000 plaintiffs, as well as some 30,000 more claims that hadn't yet agreed to a settlement. The company said it would set aside an additional \$1.25bn to work toward a resolution of future claims, including funding a panel to evaluate whether the product causes cancer. The findings from

that panel would help shape the outcome of litigation going forward and would be reported to U.S. District Judge Vince Chhabria in San Francisco. A conclusion that the product doesn't cause cancer would essentially shut future cases. If the panel found a link between Roundup and cancer, Bayer would have to fight plaintiff-by-plaintiff to prove the individuals' cancer wasn't caused by the product”, leaving investor confidence still quite tentative (**Bender et al., 2020**).

Bayer confirmed it would continue appealing the three cases it had lost in jury trials in the past two years, highlighting the importance of scientific evidence in favor of glyphosate that categorically dismissed any potential carcinogenic effects assigned to the infamous herbicide ingredient.

3. Data and Methodology

In the upcoming sections, a quantitative analysis of the deal follows. First, I conduct fundamental valuations of Bayer and Monsanto, using the most contemporary information from quarterly financial reports (see references) leading up to the date of the first private meeting between the two companies, in order to ensure exclusion of any material operational changes that would stem from the announcement and subsequent negotiations. The first contact was on 10.05.2016 and as such, Bayer is valued on 31.03.2016 (Q1 FY16) and Monsanto is valued on 31.05.2016 (Q3 FY16), since it is considerably closer to the announcement date than Q2 FY16 in February. A slight trade-off is expected (up to date operating and financing information, for a potential stock price effect from the announcement), but any differences should be minimal.

Moreover, I value separately the disclosed synergies, combined company without synergy and combined company with synergy. From the financial reports, I extract figures such as sales, costs of goods sold, depreciation, capital expenditures, debt levels and equity components, current assets, current liabilities, cash and cash equivalents, short-term and long-term debt etc. Share prices, shares outstanding, equity indices, market indices and market values of equity are retrieved from Thomson Reuters Datastream (**Thomson Reuters, 2020**). Sales and dividends forecasts are retrieved from the Wharton Research Data Services (**WRDS, 2020a, 2020b**). For said valuations I employ the Discounted Cash Flow Model.

Finally, I employ the standard event study methodology (**Campbell et al., 1997**) to unravel the financial impact of certain key proceedings of the deal timeline on the share price (and therefore value) of the two companies and their competitors, customers and suppliers. Events of interest are outlined later in the paper. The companies that comprise these groups were retrieved from Thomson Reuters Eikon (**Refinitiv Eikon, 2020b**). Competitors for Bayer were chosen from within the industry classification “GICS - Health Care/Pharmaceuticals, Biotechnology & Life Sciences”. Competitors for Monsanto were chosen from within the industry classification “Agricultural Chemicals”. Customers and Suppliers were retrieved from the “Value Chains” section within Eikon. Prices for companies and their respective indices were retrieved from Thomson Reuters Datastream (**Thomson Reuters, 2020**).

4. Fundamental Valuations

4.1 Firm Free Cash Flows

The first step is to construct the planning period firm free cash flows of the two companies that will be used in their respective valuations. The formula is given as follows (Titman & Martin, 2016, p.25-26, 40):

$$\text{FFCF} = \text{EBIT}(1-t) + \text{DA} - \text{CAPEX} - \Delta\text{NWC}$$

where:

FFCF: Firm Free Cash Flow

EBIT: Earnings before Interest and Taxes

t: Effective tax rate

DA: Depreciation and Amortization

CAPEX: Capital Expenditures

ΔNWC : Change in Net Working Capital

$$\text{NWC} = (\text{Current assets} - \text{Cash and Marketable Securities}) - (\text{Current Liabilities} - \text{Current Portion of Interest-Bearing Debt/Notes})$$

$$\Delta\text{NWC} = \text{Net Working Capital}_t - \text{Net Working Capital}_{t-1}$$

$$\text{Effective tax rate} = \frac{\text{Income taxes}}{\text{Income before income taxes}}$$

“The reason we leave cash out of the working capital computation is that we view cash, for the most part, to be a non-wasting asset, insofar as firms earn a fair rate of return on the cash. Put another way, cash that is invested in commercial paper or treasury bills is no longer a wasting asset and should not be considered part of working capital” (Damodaran, 2015, p.169). Please note that I apply the following general rule of thumb for the remaining of the paper (Ang, 2018):

Non-operating cash = Reported cash – 2% of quarterly revenue

Depreciation and Amortization and Capital Expenditures are retrieved by the Cash Flow Statement. EBIT for Bayer is directly retrieved from the Income Statement, while for Monsanto, it is calculated as:

$$EBIT = Revenues - COGS - OPEX \text{ (including DA)}$$

Note that EBIT is taking into account the reclassification of operating leases as debt (detailed explanation follows in the chapter for the Capital Structure). Current Assets and Current Liabilities are retrieved from the Balance Sheet. Cash and Marketable Securities are proxied by Cash and Cash Equivalents + Assets Held for Sale (when applicable) for Bayer and by Cash and Cash Equivalents + Short-Term Investments for Monsanto, both found under the Balance Sheet. Marketable securities have only been detected in Monsanto's annual financial statements, so for purposes of computing quarterly free cash flows, I use annually reported marketable securities, equally divided across quarters. Current Portion of Interest-Bearing Debt/Notes is proxied by Current Financial Liabilities for Bayer and Short-Term Debt (including current portion of long-term debt) for Monsanto, both located in the Balance Sheet.

The process is as follows: Quarterly free cash flows are computed back to 2014 for both companies (**Tables 2 and 3** in the Appendix). Then I compute the ratio of these cash flows relative to quarterly revenues. Using these historical ratios, I extract the average (historical) ratio of free cash flow over quarterly revenue (10.51% for Bayer, 21.27% for Monsanto). Then I multiply this ratio by WRDS (**WRDS, 2020a**) quarterly revenue forecasts (**Table 4**), thus obtaining the planning period firm free cash flows (**Table 5**). In other words, the planning period free cash flows are a function of historical and forecast information.

This method was chosen because it proved particularly difficult to obtain forecasts for the all the components of the free cash flow formula dating back to 2016. Most financial databases that I had access to, such as Thomson Reuters Eikon or Yahoo! Finance, would mainly report sales and go back to 2017 at most, while others would charge to provide access to forecasts prior to 2019 or so. Eikon specifically reports historical estimates as they dynamically changed over time, meaning that a FY17 sales forecast that was first reported in June 2017, would only show its updated value just a while prior to disclosure of the actual figure (e.g. start of December 2017 in this case). As such, tying the FFCFs to the most fundamental economic size of an enterprise, namely the revenue (because without it, there is no entrepreneurial activity), seems a very reasonable approach. Besides, Bayer and Monsanto are two mature firms that we can expect would carry on into the future, the historical patterns of the past.

For the revenue forecasts from WRDS, I use announcement dates 01.01.2016 – 31.03.2016 for Bayer, and 01.01.2016 – 31.05.2016 for Monsanto. This way, the valuation model relies on updated estimates that are not affected by the announcement of the preliminary negotiations. Forecast figures are reported in USD, so I convert them to EUR (for Bayer) using the exchange rate 1.138 on 31.03.2016.

For Monsanto, there are available quarterly sales forecasts until Q4 FY18 (satisfying the announce date restriction). This is not the case for Bayer, for which forecasts run until Q4 FY16. There exist however annual forecasts for FY17. Thus, quarterly forecast sales for FY17 are defined as:

$$\left(\frac{\text{Quarter forecast sales FY16}}{\text{Annual forecast sales FY16}} \right) * \text{Annual sales forecast FY17}$$

meaning, for example, that Q1 FY17 sales would be: $\left(\frac{Q1 \text{ FY16 forecast sales}}{FY16 \text{ forecast sales}} \right) * \text{FY17 forecast sales}$

As mentioned earlier, these quarterly forecast revenues, multiplied by the average FFCF/(Quarter Revenue) ratio, produce the planning period firm free cash flows. **Tables 4 and 5** in the Appendix outline the forecast sales and planning period FFCFs respectively. It is noteworthy that Monsanto's free cash flows display a pattern of seasonality. A closer look at the annual report of 2015 reveals that sales generally boom around second and third quarters, consistent with agricultural cycles of seed purchasing and growing, mostly in North and South America (**Monsanto Co., 2015, p.28-29**). **Table 6** also shows the calculation for the historical Net Working Capital that is used as input for the historical FFCFs calculations.

4.2 Discount Factor

The discount factor is given by the Weighted Average Cost of Capital (**Titman & Martin, 2016, p.102**):

$$WACC = \left(\frac{E}{D+E} \right) K_e + \left(\frac{D}{D+E} \right) (1 - t) K_d$$

where:

E: value of equity capital

D: value of debt capital

K_e : Cost of equity

K_d : Cost of debt

t: average historical effective tax rate

“The cost of capital is a measure of the composite cost of raising money that a firm faces. It will generally be lower than the cost of equity, which is the cost of just equity funding” (**A.Damodaran, 2015, p150**).

As **A.Damodaran (2015, p.89)** stresses, the risk-free rate should be in the same currency as the cash flows (EUR for Bayer, USD for Monsanto). In addition, since there is no default risk associated and no uncertainty around reinvestment rates, the closest proxy to use is a long-term government bond. **Titman & Martin (2016, p.115)** also concur with this reasoning: “Most textbooks suggest short-term rates, because they are consistent with the simplest version of CAPM. Because the estimated cost of equity is typically used to discount distant cash flows, however, it is common practice to use a long-term rate for, say, 10- or 20-year maturities as the risk-free rate.” As such, for Bayer I use the German Bund 10-year rate on 31.03.2016 (0.155%) (**Thomson Reuters, 2020**) and for Monsanto the 10-year U.S. treasury bond rate on 31.05.2015 is considered (1.84%) (**U.S. Department of the Treasury, 2020**).

4.2.1 Cost of Debt

For the cost of debt, I follow two approaches. The first is to calculate the Yield to Maturity (YTM) on the latest issued corporate bonds prior to the announcement date of the negotiations. The YTM is defined as “the total return anticipated on a bond if the bond is held until it matures. Yield to maturity is considered a long-term bond yield but is expressed as an annual rate. In other words, it is the internal rate of return (IRR) of an investment in a bond if the investor holds the bond until maturity, with all payments made as scheduled and reinvested at the same rate” (Chen, 2020).

Information on corporate bonds were gathered from businessinsider.com. The latest bond issued by Bayer prior to the announcement of negotiations was BAYER AG 2015/2075 (Business Insider, 2020a), with a volume of €1.3bn, issued at par, coupon 2.375%, paid annually to bondholders and maturity date 01.04.2075 (thus satisfying the long-term criterium). Since the bond was issued at par, $YTM = \text{coupon}$, meaning $YTM = 2.375\%$.

On the side of Monsanto, the bond of interest is MONSANTO 15/45 (Business Insider, 2020b), with a volume of \$500mln, issue price of \$997, coupon 3.95%, paid semi-annually to bondholders and maturity date 15.04.2045. Using this data and a YTM calculator (DQYDJ, 2020), we arrive at the $YTM = 3.97\%$.

The downside of the YTM in our case, is that the issuance dates of the corporate bonds precede the valuation dates of the two companies by a calendar year.

The second approach entails estimating the cost of debt using the firms’ credit risk ratings and associated default spreads. This method is usually followed when “firms have bonds outstanding that do not trade on a regular basis” (A. Damodaran, 2015, p.138) or when “debt is privately held and thus does not have market prices that are readily available” (Titman & Martin, 2016, p.108). While this is not the case for Bayer and Monsanto, the method serves as an excellent benchmarking tool.

Monsanto’s Standard & Poor’s long-term credit rating in 2016 is obtained from Thomson Reuters Eikon (Refinitiv Eikon, 2020b) and is BBB, while Bayer’s rating is obtained from its Q1 FY16 financial report (Bayer AG, 2016b) and is A-. Default spreads for 2016 are retrieved from (Damodaran, 1/14, 1/19) and shown in Table 7 in the Appendix. Bayer’s default spread for 2016 was estimated at 1.75% based on its credit risk. Adding that to the 10-year German Bund rate of 0.155% on 31.03.2016 valuation date, we arrive at a pre-tax cost of debt of 1.91%. Following the same steps for Monsanto, provides an estimated default spread of 2.25%. Adding that to the 10-year U.S. treasury bond rate of 1.84% on 31.05.2016 valuation date, we obtain a pre-tax cost of debt of 4.09%. The two methodologies (YTM and default spread approximation), yield fairly similar results.

4.2.2 Cost of Equity

The cost of equity is obtained from the Capital Asset Pricing Model (CAPM) (**Sharpe, 1964**):

$$K_e = R_f + b * ERP$$

where R_f is the risk-free rate, b (beta) is a measure of systematic risk and ERP is the equity risk premium. As mentioned earlier, the risk-free rates are 0.155% (German Bund rate on valuation date) for Bayer and 1.84% for Monsanto (U.S. treasury bond rate on valuation date).

For the calculation of the beta, I follow the bottom-up fundamental beta methodology, outlined by (**A. Damodaran, 2015, p.122**):

“1. Identify the business or businesses that make up the firm whose beta we are trying to estimate. Most firms provide a breakdown of their revenues and operating income by business in their annual reports and financial filings.

2. Estimate the average unlevered betas of other publicly traded firms that are primarily or only in each of these businesses. In making this estimate, we have to consider the following estimation issues:

- **Comparable firms** In most businesses, there are at least a few comparable firms and in some businesses, there can be hundreds. Begin with a narrow definition of comparable firms and widen it if the number of comparable firms is too small. Consider the possibilities of widening your search globally or up and down the production chain to get more firms in your sample.

- **Beta estimation** Once a list of comparable firms has been put together, we need to estimate the betas of each of these firms. Optimally, the beta for each firm will be estimated against a common index. If that proves impractical, we can use betas estimated against different indices.

- **Unlever first or last** We can compute an unlevered beta for each firm in the comparable firm list, using the debt-to-equity ratio, and tax rate for that firm, or we can compute the average beta, debt-to-equity ratio, and tax rate for the sector and unlever using the averages. Given the standard errors of the individual regression betas, we would suggest the latter approach.

- **Averaging approach** The average beta across the comparable firms can be either a simple average or a weighted average, with the weights based on market capitalization. Statistically, the savings in standard error are larger if a simple averaging process is used. If there are outliers that are skewing the averages, consider using the median values.

- **Adjustment for cash** Investments in cash and marketable securities have betas close to zero. Consequently, the unlevered beta that we obtain for a business by looking at comparable firms may be affected by the cash holdings of these firms. To obtain an unlevered beta cleansed of cash:

$$\text{Unlevered beta corrected for cash} = \frac{\text{Unlevered beta}}{(1 - \text{Cash}/\text{Firm value})}$$

The resulting number is sometimes called a **pure play beta**, indicating that it measures the risk of only the business and not any other corporate holdings.

3. To calculate the unlevered beta for the firm, we take a weighted average of the unlevered betas, using the proportion of firm value derived from each business as the weighting factor. These firm values will have to be estimated because divisions of a firm usually do not have market values available. If these values cannot be estimated, we can use operating income or revenues as weights. This weighted average is called the **bottom-up unlevered beta**. In general, it is good practice to estimate two unlevered betas for a firm, one for just the operating assets of the firm, and one with cash and marketable securities treated as a separate business, with a beta of zero.

4. Calculate the current debt-to-equity ratio for the firm, using market values if available. Alternatively, use the target debt-to-equity ratio specified by the management of the firm or industry-typical debt ratios. If you can break the debt down by business, calculate the debt ratios for each business that the firm is in.

5. Estimate the levered beta for the equity in the firm (and each of its businesses) using the unlevered beta from Step 3 and the debt-to-equity ratio from Step 4. Clearly, this process rests on being able to identify the unlevered betas of individual businesses. There are three advantages associated with using bottom-up betas, and they are significant:

- We can estimate betas for firms that have no price history because all we need is an identification of the business or businesses they operate in. In other words, we can estimate bottom-up betas for initial public offerings, private businesses, and divisions of companies.
- Because the beta for the business is obtained by averaging across a large number of regression betas, it will be more precise than any individual firm's regression beta estimate. The standard error of the average beta estimate will be a function of the number of comparable firms used in Step 2 and can be approximated as follows:

$$\sigma(\text{Average beta}) = \frac{\text{Average } \sigma\text{Beta}}{\sqrt{\text{Number of firms}}}$$

Thus, the standard error of the average of the betas of 100 firms, each of which has a standard error of 0.25, will be only 0.025. $\left(\frac{0.25}{\sqrt{100}}\right)$

- The bottom-up beta can reflect recent and even forthcoming changes to a firm's business mix and financial leverage, because we can change the mix of businesses and the weight on each business in making the beta estimate."

Based on prof. Damodaran's recommendation, I also use sector-wide data. Sector unlevered betas and EV/Sales ratios on a global scale (since Bayer and Monsanto extend their sales worldwide) are obtained from Damodaran's website (**Damodaran, 1/16a, 1/16b**). Companies within each sector can be found by clicking the relevant link in the excel sheets cited above. The industry-level data, relevant to the companies under scrutiny, are depicted on **Tables 8 and 9**, which illustrate unlevered (cash-adjusted) betas and EV/Sales per sector of interest.

From Damodaran's sector unlevered betas, it is apparent that he uses Hamada's formula (**Hamada, 1972**) for unlevering the betas:

$$\beta_L = \beta_u \left(1 + (1 - t) \frac{D}{E} \right)$$

where:

β_L = Levered beta for equity in the firm

β_u = Unlevered beta of the firm (i.e., the beta of the assets of the firm)

t = tax rate

$\frac{D}{E}$ = Debt/equity ratio

Consequently, this is also the formula I use for relevering betas.

The computations for the levered betas are shown in **Table 10**. First, revenues of each business are outlined. Note that Covestro is a Bayer spin-off, which produces specialty chemicals for heat insulation foams and transparent polycarbonate plastics (**Reuters, 2019**), and was listed as one of the company business segments (**Bayer AG, 2016b, p.15**). Using the industry EV/Sales ratios, an estimated value for each business segment is produced. Then using these values and Damodaran's sector unlevered betas, I construct a segment weighted average unlevered beta, which functions as a proxy for the firm unlevered beta. Finally, the estimated firm unlevered beta is relevered using the examined company's capital structure and tax rate as inputs in the aforementioned Hamada's formula. Using t= average effective tax rate and the firm's D/E ratio (while considering the YTM operating lease adjustment, described in the following Capital Structure chapter), we end up with a levered beta of 1.17 for Bayer and 1.37 for Monsanto.

The final component required to estimate the cost of equity, is the equity risk premium. For this task, I use Damodaran's dataset "Risk Premiums for Other Markets", found in the archived data section of his webpage (**Damodaran, 1/16c**), updated July 1st, 2016, barely two months after Bayer's initial approach, so no material discrepancies are expected. The methodology employed to arrive at the "Country Risk Premium" follows:

Step 1: Estimating the mature market risk premium

To estimate the mature market risk premium, the implied equity risk premium for the S&P 500 is computed. **A. Damodaran, 2015, p.102** describes the process in detail. It is effectively solving for the IRR of the expected S&P 500 dividends and stock buybacks in a multi-stage Gordon Growth Model. **Damodaran (2015, p.103-104)** also stresses the power of the implied premium versus a historical premium, as it is “market driven and forward-looking and does not require any historical data” and that “it will change in response to changes in market conditions”, citing the financial crisis of 2008 which eventually pushed the implied premium above the historical value.

Step 2: Estimate the default spread for the country in question.

Two choices are offered, one based upon the local currency sovereign rating for the country from Moody's and the other is the CDS spread for the country (if one exists). For this study, the first approach is chosen, consistent with how default spreads were previously estimated for the cost of debt.

Ratings to spreads: Based upon Damodaran's estimates of typical spreads for each ratings class. His spreads are computed by averaging CDS spreads and sovereign US\$ bond spreads by ratings class, at the start of every year. The difference between the two is the default spread.

Step 3: Convert the default spread into a country risk premium

With sovereign rating default spreads, two choices are offered:

Choice 1: Use the default spread as the measure of the additional country risk premium.

Choice 2: Scale the default spread up to reflect the higher risk of equity in the market, relative to the default spread. Damodaran uses the ratio of the S&P Emerging Market Equity Index standard deviation to the BAML Emerging Public Bond index standard deviation. I opt for this option for the country risk premium estimation.

Step 4: Compute a total equity risk premium

The mature market premium from step 1 is added to the country risk premium from step 3 to get the total equity risk premium.

Step 5: Compute regional averages or regional weighted averages

Regional averages are provided in two forms:

- i) simple average of the total and country risk premiums by region.
- ii) weighted averages, using the World Bank GDP estimates from the most recent year. This is my preferred option onwards.

More detailed explanations and information on country risk premiums can be found in **A.Damodaran, (2015, p.98-100)**.

Table 11 shows the calculation for the equity risk premiums of the companies, alongside with the input data that was used. According to **A. Damodaran (2015, p.106-107)**, “The conventional practice in corporate finance and valuation has been to identify the country of incorporation for a company and to use the equity risk premium for that country to assess the cost of equity for the company. This practice has its

roots in times when companies tended to cater primarily to local markets, but it is, in our view, a bad one, as companies globalize. Put differently, you can be a developed market company that derives a large portion of your revenues from emerging markets, like Coca Cola, or an emerging market company that obtains a substantial amount of revenues from developed markets, like Embraer or Tata Consulting Services. When companies get their revenues from many countries, with different equity risk premiums, the prudent practice is to take a weighted average of risk premiums across the countries”. As such, sales and their regions of origin are outlined for Bayer and Monsanto (Table 11). Using Damodaran’s country ERPs and these revenues, I compute a sales weighted-average ERP per company. Note that the ERPs for the regions of Europe (Total), Latin America/Africa/Middle East and Europe-Africa (shown as bold on Table 11) are manually constructed using GDP weighted averages of their respective sub-regions. We finally obtain a Bayer ERP=7.74% and a Monsanto ERP=7.79%.

Now using all the aforementioned inputs of R_f , beta and ERP for the companies, we can calculate their respective costs of equity:

$$K_e (\text{Bayer}) = 0.16\% + 1.17 * 7.74\% = 9.22\%$$

$$K_e (\text{Monsanto}) = 1.84\% + 1.37 * 7.79\% = 12.51\%$$

These figures are considering the operating lease adjustment, where $K_d=YTM$ (see “Capital Structure” section). Henceforth, I will refer to the K_e derived from the estimation of bottom-up betas and the sales-weighted ERPs as “Damodaran’s K_e ”, for economy of text space.

As a benchmarking tool, I also estimate the implied cost of equity by inverting a multi-stage variant of the Gordon Growth Model (GGM). **Titman & Martin (2016, p.129-134)** point out that “the Gordon Growth Model assumes that the firm’s dividends grow at a constant rate forever (i.e., that there is a single growth rate or single stage of growth). The resulting single-stage DCF model of equity value can easily be deduced from the general DCF model found in equation”:

$$P_0 = \sum_{t=1}^{\infty} \frac{Div_t}{(1 + k_e)^t}$$

where:

P_0 = the current stock price of the firm’s shares

Div_t = expected dividend for year t

k_e = the cost of equity capital

when constant dividend growth rate g is assumed, then:

$$P_0 = \frac{Div_0(1+g)}{k_e - g} = \frac{Div_1}{k_e - g}$$

Consequently, solving for k_e :

$$k_e = \frac{Div_1}{P_0} + g$$

If the growth rate g varies over the years, a multi-stage DCF model can be obtained similar to the following:

$$P_0 = \sum_{t=1}^5 \frac{Div_0(1+g_{1-5})^t}{(1+k_e)^t} + \sum_{t=6}^{10} \frac{Div_0(1+g_{1-5})^5(1+g_{6-10})^{t-5}}{(1+k_e)^t} + \frac{Div_0(1+g_{1-5})(1+g_{6-10})^5(1+g_{11})}{k_e - g_{11}} * \frac{1}{(1+k_e)^{10}}$$

From Thomson Reuters Datastream (**Thomson Reuters, 2020**), I acquire historical dividend per share (DPS) data for Bayer and Monsanto, while from WRDS, I obtain DPS forecasts for the companies (**WRDS, 2020a, 2020b**), satisfying the announce date criteria set earlier. Using historical DPS data back to 2003 and WRDS forecasts until 2021 for Monsanto and 2018 for Bayer, I derive average long-term DPS log growth rates of 11.52% for Monsanto (assumed market expectation from 2021 onwards) and 7.01% for Bayer (assumed market expectation from 2018 onwards). Note that forecast DPS figures in WRDS are in USD, so for Bayer I convert to EUR using the exchange rate of 1.138 on 31.03.2016.

For Bayer, with a valuation date price of €101.632, the model is:

$$101.632 = \frac{2.6603}{1+k_e} + \frac{2.7216}{(1+k_e)^2} + \frac{\left[2.7216 * \frac{1+0.0701}{k_e - 0.0701}\right]}{(1+k_e)^2}$$

Using (**symbolab.com, 2020**), we get $k_e=9.52\%$, thus the benchmark is fairly close to the earlier estimated cost of equity for Bayer of 9.22%. For Monsanto, with a valuation date price of \$112.47, we get:

$$112.47 = \frac{2.14}{1+k_e} + \frac{2.4382}{(1+k_e)^2} + \frac{2.4675}{(1+k_e)^3} + \frac{2.14}{(1+k_e)^4} + \frac{2.14}{(1+k_e)^5} + \frac{\left[2.14 * \frac{1+0.1152}{k_e - 0.1152}\right]}{(1+k_e)^5}$$

Resulting in $k_e=12.77\%$, again quite close to the 12.51% estimated earlier on for Monsanto.

4.2.3 Capital Structure

The final input required to compute the WACC of the companies is their mix of debt and equity capital (capital structure).

For Bayer, the starting point is the market value of equity on the valuation date 31.03.2016, retrieved from Datastream (**Thomson Reuters, 2020**) of €85,402.94mln. Then another €2,263mln is added, as 50% of €4,526mln in hybrid bonds is classified as equity by Moody's and S&P Global Ratings (**Bayer AG, 2016b, p.23**), resulting in a total equity value of €87,665.94mln. Total reported debt consists of the remaining €2,263mln hybrid bonds, €11,627mln bonds and notes, €2,805mln liabilities to banks, €449mln liabilities under finance leases and €146mln commercial paper, resulting in €17,290mln.

The market value of equity for Monsanto on 31.05.2016, according to Datastream (**Thomson Reuters, 2020**), was \$49,131.93mln. Total reported debt consists of short-term debt of \$2.557mln and long-term debt of \$7,948mln (**Monsanto Co., 2016**), amounting to \$10,505mln.

There are however adjustments to be made in order to arrive at the final debt value. **A. Damodaran (2015, p.140-141)** argues that “The essential characteristic of debt is that it gives rise to a tax-deductible obligation that firms have to meet in both good times and bad, and the failure to meet this obligation can result in bankruptcy or loss of equity control over the firm. If we use this definition of debt, it is quite clear that what we see reported on the balance sheet as debt may not reflect the true borrowings of the firm. In particular, a firm that leases substantial assets and categorizes them as operating leases owes substantially more than is reported in the financial statements. After all, a firm that signs a lease commits to making the lease payment in future periods and risks the loss of assets if it fails to make the commitment”. **Titman & Martin (2016, p.206)** also advise cautiousness regarding operating leases that are included in a firm's balance sheet under liabilities.

For this reason, **Damodaran (2015, p.140-141)** recommends that lease payments should be treated as financial expenses. Future lease commitments should be converted into debt by being discounted back to the present at the pre-tax cost of debt. This would be the debt value of operating leases and should be added back to reported debt. Consequently, operating income will also have to be restated:

$$\begin{aligned} \text{Adjusted operating income} \\ &= \text{Stated operating income} + \text{Operating lease expense for the current year} \\ &\quad - \text{Depreciation on leased asset} \end{aligned}$$

To perform this calculation, I use Damodaran's Operating Lease Adjustment Spreadsheet (**Damodaran, 2020**), and modify it accordingly to accommodate for quarterly values. The task is repeated for all the quarters back to 2014 from which I draw the average historical FFCF/Quarter Sales ratio (**Tables 2 and 3**) in order to correctly restate EBIT for all these periods. Debt value of leases is computed at Q1 FY16 for Bayer and Q3 FY16 for Monsanto (their respective valuation dates) and then added back to reported debt. Since operating leases are reported only annually for both companies, I assume that these future

commitments are equally distributed among quarters and I use information from the most recently available annual report to the quarter for which I am restating EBIT. Financial statements aggregate the commitments after 6 years in the future. I find the average of all prior future commitments (year 1-5) and divide year 6 aggregate by this average to arrive at the “number of quarters embedded in year 6 estimate”. Commitment beyond year 6 is then converted into a quarterly “annuity” for the “number of quarters embedded in year 6 estimate”, using the quarterly pre-tax cost of debt. Commitments for quarters in years 1-5 are also discounted to the present. The total sum of these present values is the debt value adjustment.

Table 12 shows the process for Bayer’s Q1 FY16 and Monsanto’s Q3 FY16 (respective valuation quarters), when $K_d=YTM$. The same logic is followed for all other quarters back to Q1 FY14 in order to arrive at the adjusted EBIT. Depreciation on leased asset is straight line over all quarters of years 1-5, plus “number of quarters embedded in year 6 estimate”. Note that for all quarters, the most recently available at the time $K_d=YTM$ (using information from Business Insider, similarly to chapter 4.2.1) and $K_d=R_f+Default\ Spread$ estimation, are considered ($K_d=R_f+Default\ Spread$ is required to produce summary results later on).

Debt value of leases for Bayer is thus found €781,6mln and \$381.4mln for Monsanto. Adding these numbers to their respective reported debt, we arrive at total Bayer debt of €18.1bn and total Monsanto debt of \$10.9bn. All the aforementioned inputs suggest a Bayer D/E ratio of 20.61%, while the D/E ratio for Monsanto is 22.16%.

4.2.4 Weighted Average Cost of Capital

Now all the inputs for the WACC are readily available. **Table 13** depicts the inputs and outputs of the WACC for Bayer and Monsanto. Both the YTM and $R_f + Default\ Spread$ approaches for the cost of debt are considered, along with the benchmark costs of equity derived from the multi-stage Gordon Growth Model. It is noteworthy, that for both companies, $WACC < k_e$, confirming the expectation at the start of this chapter. It is also interesting to point out that Bayer’s average WACC is fairly close to the reported 7.6% of the (**Bayer AG, 2016a, p.172**).

4.3 Terminal Value

Based on the derivation of the firm free cash flows in chapter 4.1, the WRDS long-term sales growth forecasts (**WRDS, 2020a**) and the WACC calculated in chapter 4.2, the terminal value is computed. In general, the terminal value is defined as:

$$Terminal\ Value_t = FCF_{t-1} * \frac{1 + terminal\ growth\ rate\ g}{WACC - terminal\ growth\ rate\ g}$$

As described in chapter 4.1 the projected FFCFs are tied to revenue forecasts: First the historical average FFCF/Quarter Revenue is computed, and then it is multiplied by analysts' average sales forecasts from WRDS. Consequently, using the average long-term **annual sales** growth forecast from WRDS (with announce dates as described under the "Data and Methodology" chapter), the Terminal Value_t will be:

$$TV_t = \frac{\frac{\text{Planning Period FFCF}_{t-1}}{\text{Projected Annual Sales}_{t-1}} * \text{Projected Annual Sales}_{t-1} * (1 + \text{Quarterly Long Term Sales Growth})}{WACC - \text{Quarterly Long Term Sales Growth}}$$

However, an adjustment is required for Monsanto. As we observed in chapter 4.1, Monsanto's FFCFs follow the seasonal patterns of sales fluctuation due to agriculture cycles. As such, FFCFs tend to be higher in 2nd and 3rd quarters of seed selling, and lower in the remaining quarters of seed growing. Therefore, if we consider the final planning period FFCF in the Terminal Value, Monsanto's fundamental value will be understated because this cash flow is a 4th quarter cash flow. To combat this issue, I set the "Planning Period FFCF_{t-1}" in the TV formula equal to "Average Planning Period FFCF over the last two full fiscal years". Thus, the terminal value considers a "smoothened" free cash flow that would be realized if Monsanto's annual sales were equally distributed across quarters and not subject to seasonality patterns.

4.4 Discovery of the intrinsic value

Now, that all the necessary inputs have been produced and compiled, the fundamental valuations of Bayer and Monsanto can be derived. **Tables 14 and 15** depict the results, using Kd=YTM and the Ke derived using Damodaran's methodology. Results from multiple approaches are presented later in the study. The tables present all the planning period FFCFs along with the terminal values. Discount factors and growth rates are presented in both annualized and quarterly form, even though only the latter is, of course, inserted into the valuation model, due to the quarterly projected FFCFs. The formula for the quarterly rate is: $(1 + \text{annualized rate})^{0.25} - 1$

Equity value is computed as Enterprise Value – Debt + Non-operating Cash. Bayer's Enterprise Value is €109.3bn, while Monsanto's \$56.3bn. As such, equity value for Bayer is €94.5bn and for Monsanto \$47.1bn. Then dividing by shares outstanding on valuation date (retrieved from Datastream (**Thomson Reuters, 2020**)), we obtain the intrinsic share prices: €112.47 for Bayer and \$107.57 for Monsanto.

Monsanto's price fell to \$107.4 five days later, very close to the output fundamental price. For Bayer, we observe an €11 difference compared to the market price on valuation date. Further investigation reveals that Bayer's share price continued to increase, reaching €108.80 three weeks later. If we assume efficient markets (**Fama, 1998**), the aforementioned future price movements provide even more credibility to the valuation model since they imply that investors quickly shifted their expectations and views towards what the model suggested: an overvalued Monsanto and an undervalued Bayer.

4.5 Synergy Valuation

Now that we have the fundamental valuations of the two companies readily available, we can delve deeper into answering important questions such as: Is the value of the projected synergy justifying Bayer's initial bid? Did Bayer ultimately overpay? What is the combined value of the two behemoths with and without synergies?

Our starting point is the first official announcement of the \$122/share bid by Bayer on 23.05.2016 (37% premium over Monsanto's share price one day prior to the offer on May 9, 2016). It was the first time that the \$1.5bn projected synergies (after year 3) were disclosed. Since the synergies are in USD, I value the synergies and the combined value (with and without synergies) in USD. Amounts in EUR for Bayer are converted using the exchange rate of 1.1131 on 31.05.2016, consistent with the independent valuation of Monsanto on the same date, and the initial investor call on 23.05.2016, where Bayer also uses this exchange rate in its investor handout. The calculations consider the operating lease adjustment where $K_d = YTM$.

Tables 16 and 17 show the process in detail (again in the case of Damodaran's K_e and $K_d = YTM$). Using shares outstanding from Datastream (**Thomson Reuters, 2020**) and the bid of \$122, we find that Bayer's offer was effectively \$53.41bn. It was planned to finance the transaction using a mix of debt and equity. The equity portion was projected to be 25% of \$62bn enterprise value (including net debt), namely \$15.5bn, therefore debt portion was projected at \$53.41bn - \$15.5bn = \$37.91bn. This produces a debt/capital ratio 71% and equity/capital ratio of 29% for the offer. Bayer's debt after the deal would include its debt prior, debt issued to cover the cash payment for the offer, and Monsanto's debt, all amounting to €61.9bn. Equity prior plus equity issued would amount to €101.6bn. D/E ratio would be 60.94%.

Using Monsanto's and Bayer's independent values and unlevered betas, I compute the value weighted unlevered beta (=1.06), which I relever using Hamada's formula (**Hamada, 1972**) with Bayer's average historical effective tax rate and revised post-merge D/E ratio as inputs. The levered combined beta is 1.58. The equity risk premium of the new entity is the value weighted ERP of the individual companies, equal to 7.76%. Using Bayer's R_f of 0.155%, we derive cost of equity post-merge $K_e = 12.41\%$.

In the Wall Street Journal (**Eyk Henning, 2016**), it is mentioned that S&P Global Ratings expected to downgrade Bayer by up to two notches post-closing. Since Bayer's rating was A-, this translates into a downgrade to BBB. The estimated cost of debt for BBB, under **Table 7** is $K_d = 0.155\% + 2.25\% = 2.405\%$ post-merge.

Even though there were few details disclosed about the synergies on the investor call of 23.05.2016, the investor call on 14.09.2016 (deal announcement date), digs a bit deeper. I am going to embed this information in the synergy valuation model since little is expected to have changed in these four months in terms of projections. It was revealed that the \$1.5bn synergies after year three were constituted of \$0.3bn sales synergies and \$1.2bn cost synergies (**Bayer AG, 2016e, p.20**). **Graph 1** in the Appendix (**Bayer AG, 2016e, p.21**) also shows that total projected synergies in the long-term amount to \$2.5bn. In the investor handout, it is also stated that "initial sales synergies expected mainly from broader product variety materializing already near-term". As such, I place this \$0.3bn synergy in year 1. In absence of further details, I assume:

				PV
Year 1	\$300	mln	sales synergies	\$276
Year 2	\$600	mln	cost synergies	\$505
Year 3	\$600	mln	cost synergies	\$458
Year 4	\$167	mln	additional benefits	\$114
Year 5	\$167	mln	additional benefits	\$102
Year 6	\$167	mln	additional benefits	\$92
Year 7	\$125	mln	additional benefits	\$63
Year 8	\$125	mln	additional benefits	\$57
Year 9	\$125	mln	additional benefits	\$51
Year 10	\$125	mln	additional benefits	\$47
TV	\$0	mln		\$0
				\$1,764

As can be shown above, I assume long-term equal to ten years, in which the combined company will be able to harvest the full synergistic benefits. **Damodaran (2005, p.33-35)** provides evidence that “markets think that there is potential for synergy at the time of mergers (albeit far less than manager assessments at the same time) but it is also clear that only a small proportion of mergers deliver substantial synergy. Both these findings are consistent with the notion that synergy does exist but that it is far more difficult to generate it in practice than it is on paper”. Therefore, I follow a somewhat conservative approach regarding synergy assumptions, meaning I set the terminal value equal to 0, thus expecting all synergies to be reaped in the first 10 years post-merge. Furthermore, based on **Graph 1** and the aforementioned definition of the long-term (ten years), we can infer that expected synergy between year 3 and 10 is \$2.5bn-\$1.5bn=\$1.0bn. Consistent with the “law of diminishing returns” (**Samuelson & Nordhaus, 2009**), I assign a higher proportion of this \$1.0bn in years 4-6 and less for years 7-10, which I distribute equally among said periods. It is reasonable to expect that in early years, the most agile segments of the combined entity will be the ones to produce the largest part of the synergy. As years go by and segments will become more integrated, more people will be involved in strategy planning and decision making, thus inducing complexity and rigidity to the organization. That is the time when synergistic benefits will start to gradually diminish.

Graph 2 was presented in the first investor call of May 2016 (**Bayer AG, 2016d, p.22**) in an attempt to convince about Bayer’s rapid deleveraging capabilities, demonstrated in previous acquisitions. Driven by these deleveraging benchmarks, I retrieve historical total debt and market value of equity data for Bayer from Datastream (**Thomson Reuters, 2020**). It appears that it took the company roughly 21 quarters to deleverage back to its standard D/E ratios after closing the deals with Aventis and Schering. In addition, its average D/E ratio over the period of (beginning quarter) Q4 2009 – Q2 2016 was 22%. I assume this as the target D/E ratio that the deleveraging process will try to achieve (quite plausible considering Bayer’s D/E ratio of 20.61% on Q1 FY16). Following the historical pattern of the aforementioned deleveraging benchmarks, I, too, assume a length of 21 quarters for the deleveraging process of the Monsanto acquisition. From the initial post-merge D/E ratio of 60.94% I deleverage equally every quarter until it reaches the assumed target ratio of 22%, 21 quarters later. Using the varying D/E ratios over this period, I compute D/V and E/V ratios that function as inputs for the annualized, and therefore, quarterly WACC. The cost of

debt is 2.41% for the first 20 quarters and the cost of equity is 12.41% as previously mentioned. Bayer's target investment-grade rating post-closing is "A", thus using the default spreads from **Table 7**, estimated cost of debt equals $0.155\% + 1.25\% = 1.405\%$ after completion of the deleveraging process. **Table 17** depicts these calculations in more detail. A point of concern might be "why would Bayer achieve A rating with D/E=22%, while pre-merge it was rated A- for D/E=20.61%?". The answer lies within the S&P corporate methodology (**S&P Global Ratings, 2013, p.1**), where S&P Global Ratings mentions that both the business risk and financial risk profiles play an important role in defining a corporate rating. While financial risk might be higher for D/E=22% compared to 20.61%, it is plausible that the merger would enhance Bayer's business profile by strengthening its competitive position in the product market. Another point of concern might be "why not use the APV model to account for the changing D/E ratios instead of implementing varying WACCs?" The answer lies in the complication of estimating the planning period interest tax savings since there is no disclosure on pricing and terms of the bridge financing facility that was agreed to fuel the Monsanto transaction (**S.E.C, 2016a**). Proceeding with this approach would require even more assumptions regarding interest expenses in the future. The methodology that was ultimately implemented, relies on tangible historical data about D/E ratios and is simpler to execute, thus avoiding errors. We must recall though, that according to corporate finance theory, if we are consistent with our assumptions, both approaches will yield the same results. In economics and finance we tend to opt for efficiency, so based on the arguments above, results for the APV model are not reported.

Now that we have the quarterly WACCs, we move on calculating the cash flows for the DCF model. I combine planning free cash flows and terminal values of the two companies based on (**Damodaran, 1998**) and then I discount them by the proper quarterly WACC (see **Table 17** for details). The result is \$177.9bn value of the combined company without synergy. Finally, I discount the projected synergy gains by the appropriate annualized WACC. The total value of synergy is \$1.76bn. Consequently, the value of the combined company with synergies is \$179.7bn.

The results of the analysis provide quite a few interesting metrics: First of all, the \$122 offer denotes a 13.41% promised premium over the fundamental price of Monsanto (\$107.57). The maximum justified premium over the fundamental equity value was 3.75% (Synergy Value/Monsanto's Intrinsic Equity Value), remarkably lower than the 37% premium over Monsanto's price one day prior to the offer. Paying very high unjustified premiums is not surprising though as it is well documented in the literature (**Damodaran, 2005**). Synergy/Deal Value ratio is 3.30%, in accord with **Deloitte & the University of St. Gallen (2017, p.10)** who find that synergies typically range from 2.2% to 8.4% of the deal value. We have to keep in mind though that the assumed terminal value in this model was set equal to 0, while Bayer's management could have as well predicted additional synergy benefits long into the future, thus potentially overestimating the synergy value. Finally, overpayment under the original offer scenario and $K_d = YTM$, is estimated at 9.67% (promised minus max justified premium).

4.6 Summary results for multiple costs of capital

Table 18 provides a very informative overview of the results thus far, this time considering multiple approaches for the cost of capital. Results are reported in both the context of the original and the final offer scenario. The discrepancies are not large but exist. All fundamental prices suggest that Monsanto was overvalued, and Bayer was undervalued on their respective valuation dates, something that, as we saw earlier, was confirmed by investor views - reflected on future prices. Average fundamental price for Bayer is €110 and \$105 for Monsanto.

Original Offer: D/E ratio for Bayer in this case would be 60.9%. The average value of synergies is \$1.76bn. The average value of the combined entity with synergy is \$176.6bn, \$2.02bn higher than the average sum of the independent values (\$174.6bn). This is also \$259mln higher than the amount of the average projected synergies - suggesting a rather lucrative deal, at least on paper. It would require though that synergies be actually present, otherwise the gain of \$259mln does not seem significant for a deal of this size. The average promised premium over the fundamental price of 16.22% is substantially higher than the average maximum justified premium of 3.84%, meaning that Bayer would overpay by 12.38%, even with the original offer.

Final Offer: D/E ratio for Bayer in that case would then be 58.6% compared to the 60.9% of the original offer, thus minimally changing the quarterly WACCs. The average value of synergies is \$1.77bn. The average value of the combined entity with synergy is \$176.7bn, \$2.12bn higher than the average sum of the independent values (\$174.6bn). This is \$348mln higher than the amount of the average projected synergies - suggesting once again a rather lucrative deal, at least on paper. It would require though that synergies be actually present, otherwise the gain of \$348mln does not seem significant for a deal of this size. The average promised premium over the fundamental price of 21.93% is substantially higher than the average maximum justified premium of 3.85%, meaning that Bayer eventually overpaid an estimated stunning 18.08% over Monsanto's fundamental price.

4.7 Sensitivity Analysis

Now that an estimate for the value of the combined company with synergy has been produced, a natural next step is to discuss how confident we are about this estimate. **Titman & Martin (2016, p.59, p.72)** point out the importance of discovering key inputs and value drivers in the DCF model. One of the powerful tools they recommend for evaluating the sensitivity of the DCF output to such drivers, is the *tornado diagram*. **Graph 3** in the Appendix is a tornado chart, produced using the *Crystall Ball* add-on of MS Excel (**Oracle Corporation, 2020**), testing the potential impact of certain key inputs to the value of the combined company, plus synergy. At the top, the diagram places the assumptions that have the greatest impact on value, and successively the ones with lesser impact down the figure. The base case considers the final offer of \$56.3bn as well as the following (based on calculations in previous chapters):

Operating drivers:

- Projected FFCF/Revenue is 10.51% for Bayer
- Projected FFCF/Revenue is 21.27% for Monsanto
- Sales growth of 3.45% for Bayer
- Sales growth of 5.17% for Monsanto

Financing Drivers:

- Damodaran's K_e
- $K_d = YTM$
- Target D/E after merge of 22%

Deviations of $\pm 20\%$ are employed, except for:

Synergy Growth: Setting this variable equal to -100% produces $TV=0$, 0% is for constant synergy cash flow in perpetuity, and more than 0% if we wish to account for growth in the final planning period synergy cash flow. In the context of the sensitivity analysis, I assume 5% as the extreme synergy growth scenario. This higher ceiling is quite plausible if we consider that average sales growth for Bayer was projected at 3.45% and for Monsanto at 5.17% in chapter 4.3 on the terminal value.

Litigation Cost: This input variable naturally only decreases the value of the combined company with synergy. Bayer never disclosed such assumption during deliberations and planning of the deal, most likely not to displease investors but also because there had never been a sizeable negative verdict against Monsanto's herbicides so far – contrary to what actually transpired after deal completion, as discussed in the timeline section. Still though, the fact is that Monsanto was part of multiple litigation conflicts nonetheless, so for sake of completeness, I assume litigation cost equal to 20% of total deal value. This number is arbitrary because “companies hesitate to provide litigation data to researchers because of significant concerns about confidentiality coupled with the difficulty and costs of retrieving and providing data in the formats and for the time periods sought” (**Lawyers for Civil Justice et al., 2010**). However, most exercises in finance textbooks usually assume bankruptcy/litigation costs of $15\%-20\%$, so the choice of this figure is definitely not unreasonable.

Looking at **Graph 3**, we observe that Bayer's portion of the combined WACC, namely its Equity Risk Premium and its Beta seem to have the largest impact, a rather expected observation considering that Bayer's fundamental value is generally more than double the size of Monsanto's, as shown in **Table 18**. Bayer's projected FFCF/Revenue fills the top 3 of most impactful variables, followed by Monsanto's ERP, own sales growth and then Monsanto's beta, projected FFCF/Revenue ratio and sales growth, which seem to have moderate impact on the combined value. Litigation cost of 20% and synergy growth of 5% seem to have minimal impact. It is interesting to note, that in the final offer setting, the average overpayment under all WACC approaches of Table 18 is still 14.74% , even when considering 5% synergy growth in the terminal value (the overpayment with $TV=0$ was 18.08%). Target D/E ratio variability appears to have

almost zero effect, as shown at the bottom of the tornado diagram, alongside the costs of debt of the two companies. Note that bar labels illustrate the test range for each input variable. “Upside” (blue bars) exhibit the impact of the upper bound of the input variable and “Downside” (orange bars) exhibit the impact of the lower bound.

Table 19 provides more detail. The value of the combined company with synergy is presented for both the upper and lower bounds of the value drivers. The range of impact is also noted for each driver. Upper and lower bounds are also explicitly displayed, along with the base cases for each value driver.

These results suggest that Bayer’s management ought to have invested generally more time and money into accurately estimating the most impactful value drivers, such as the ERP, beta and projected FFCFs, in case they employed a similar synergy valuation model. It is important to note that sensitivity analysis is just another tool for clearing the waters regarding the underlying uncertainty of an investment, and should accordingly be “viewed as a decision tool and not a decision maker that provides a clear yes or no criteria” (Titman & Martin, 2016, p.74).

5. Event study of the acquisition deal

In the previous section, fundamental valuations provided insight on whether the deal seemed sensible, in the sense that it was value adding. We found that the combined company with synergies was actually a quite profitable opportunity, but as we saw earlier in the timeline chapter, value was not only **not** created but eventually destroyed. In this part of the paper, I analyze the impact of certain important events that shaped the future of the merger, by implementing the standard event study methodology of (Campbell et al., 1997), using the research apps provided by “Event Study Tools” (Schimmer et al., 2015). The study considers the effect of certain proceedings on the share prices of Bayer and Monsanto, as well as the prices of third parties affected by the deal, namely their competitors, customers and suppliers.

The companies that comprise these groups are outlined on **Table 20**, along with their respective market indices that are used in the process of defining their normal returns. They were retrieved from Thomson Reuters Eikon (Refinitiv Eikon, 2020b). Competitors for Bayer were chosen from within the industry classification “GICS - Health Care/Pharmaceuticals, Biotechnology & Life Sciences”. Competitors for Monsanto were chosen from within the industry classification “Agricultural Chemicals”. Customers and Suppliers were retrieved from the “Value Chains” section within Eikon.

Log returns are employed due to their additive properties, following the recommendation of Dittmann et al. (2008, p.9) who conduct similar case studies in the case of Preussag, a German conglomerate that invested in a barrage of tourism acquisitions. Prices for companies and their respective indices are retrieved from Thomson Reuters Datastream (Thomson Reuters, 2020). If available, the “total return index” is used for both the companies and the indices in the dataset, which assumes that “dividends are re-invested to

purchase additional units of an equity or unit trust at the closing price applicable on the ex-dividend date” (Thomson Reuters, 2020). Otherwise, the analysis relies on conventional stock and index prices.

The benchmark of choice for normal or expected performance is the market-adjusted model. **Dittmann et al. (2008, p.9)** highlight the importance of a stable beta when using the market model as the benchmark. This study examines a large number of companies, therefore the market model’s assumption of constant beta is far from guaranteed. **Brown & Warner (1985)** show that the power of tests based on the market-adjusted model is only marginally worse than tests based on the market model. Abnormal returns in the event window are defined as: Actual Company Return – Market Return.

Table 21 reports the results. Actual event dates are displayed, except when noted otherwise. All of the events have been thoroughly discussed in chapter 2: timeline of the deal. Monsanto’s results are naturally reported only for dates that it was still listed in the New York Stock Exchange.

Starting point is the event window of (0,3). Bayer’s first preliminary meeting with Monsanto appears to have caused a negative Cumulative Abnormal Return (CAR) of -3.93%, statistically significant at the 10% level. This is line with **Agrawal et al. (1992)** who find bidder returns to generally drop around the announcement date, but contrary to **Asquith et al., (1990)**, who find that “the bidding firm's returns are positive for cash bids”. We observe however a very positive impact on Monsanto’s price with a CAR of 12.07%, significant at 1% and in line with **Asquith (1983)** who documents similar patterns for target firms around announcement dates and **Damodaran (2005, p.39)**, who finds that “stock prices of target firms tend to do much better on the announcement of cash-based acquisitions”. Effect on competitors is very small and only significant at 10%, but the negative sign is in line with the logical assumption that competitors would feel threatened by a merger of this scale. Customer average cumulative impact (CAAR) is -4.92% and -1.66% for suppliers (both significant at 5% level), probably indicating a fear of loss in negotiating power with Bayer, should its size increased dramatically.

These preliminary discussions however, had not yet been confirmed by the companies, until later, on 18.05.2016, when Monsanto confirmed the approach and finally on 23.05.2016, when Bayer released the investor handout with all the relevant details of the offer. Now this time, Bayer’s share price took quite a hit, with CAR at -7.68%, significant at 1%. Monsanto’s price experienced another increase of 5.82%, significant at 5%. No statistically significant impact was noted on the sided of competitors, customers and suppliers.

After a game of back and forth offers and rejections, the deal was closed and announced on 14.09.2016 for \$128 per share. No significant impact is noticed on Bayer, but Monsanto surprisingly dropped by -4.73% (significant at 10%). Perhaps shareholders were hopeful for a seriously higher offer and the news came as a blow to their expectation of gaining even more substantial yield from the transaction. However, as shown further below, this impact is not significant in the (0,2) and (0,1) event windows, so it could as well be a different event that we are not aware of. Once again, no significant impact was noted on competitors, customers and suppliers.

Bayer finally completes the largest acquisition in its history on June 2018 (no statistically significant impact observed across all parties), but subsequent lawsuits against Monsanto's infamous herbicide "Roundup", alleging it causes cancer, pulled the breaks abruptly to a longed-for success story. The first negative verdict of such lawsuits imposed \$289.2mln in damages, striking Bayer's price hard with -12.19% CAR, significant at 1%. Surprisingly, customers suppliers and competitors were not affected.

Bayer's win of a favorable preliminary ruling prior to its second trial, awarded it with a 7.31% increase, significant at 5%. Almost two weeks later, another major victory was achieved, when a judge reduced Bayer's first verdict by \$200mln. However, this was not only **not** awarded by the market, but investors punished Bayer with a -13.04% CAR, significant at 1%. This puzzling finding urges the need for further investigation. A closer look at (**Randazzo & Bunge, 2018**), reveals that "A California judge reduced by more than \$200mln a jury verdict linking Bayer AG's Roundup weedkiller to cancer **but upheld the jury's findings that the company acted with malice**". Perhaps Bayer's investors grasped this as the foreshadowing of mounting litigation onwards, since that line alone could inspire new waves of lawsuits, thus explaining the sizeable negative return around this event. This time, competitors also experienced a notable -2.67% CAAR, significant at 1%. Most likely, their investors only focused on the bright side of the news for Bayer, fearing that such legal victory would reinforce the merger in the long run. Suppliers were also hit by a -3.14% CAAR, significant at 10%. This can be interpreted in two ways: either they desired negotiating power when transacting with Bayer, thus found the positive news for Bayer to be negative for them, or the judge's premise on "malice" inflicted fear of mounting forthcoming litigation that would force Bayer to restrict business with them in the long run. However, this impact is not significant in event windows (0,2) and (0,1), which might indicate that an event relevant to suppliers, but not relevant to the deal, might had taken place at that date.

Three months later, Bayer officially wins the previously tentative ruling of proceeding to the second trial in two parts, the first of which would consist of only presenting scientific evidence, regarding glyphosate, to the jury before plaintiff defense could present evidence that Monsanto acted with malice. Supplier prices gained a CAAR of 2.04%, significant at 10%, also in window (0,1) this time. This event can only be interpreted positively for Bayer, thus reinforcing the assertion above, that suppliers were afraid of losing business with Bayer in case of scaling litigation.

The two-fold trial did not prove enough on 19.03.2019, when Bayer lost for a second time. Its price was struck by a -11.59% CAR, significant at 1%, confirming potential fears of substantial losses to come from similar lawsuits, or even class actions. Suppliers also lost a cumulative market cap of -3.11% on average, significant at 10% level, however not significant in event windows (0,2) and (0,1), which might indicate that an event relevant to suppliers, but not relevant to the deal, might had taken place at that date.

Subsequent shortcoming regarding legal battles and banning of "Roundup" in certain countries did not seem to have a significant effect. Perhaps the investing public had already incorporated all of its concern in prior market "punishments" (exceptions for 0,1 window are explained onwards).

On 11.02.2020, Bayer finally seems to reach the end of the tunnel, when it announced a potential settlement with plaintiffs alleging Roundup caused their cancer. Shockingly, this came with no positive effect on Bayer's price, but competitors suffered a minor -0.91% CAAR, significant at 5%, most likely worrying that Bayer might eventually solve the legal issues that plagued the largest merger in agriculture ever observed.

Bayer announced a final agreement with plaintiffs for more than \$10bn on 24.06.2020, but the four-day CAR is not statistically significant. Performing the event study one day later though, when the settlement was announced on the Wall Street Journal (**Bender et al., 2020**), provides a stunning -12.87% CAR, significant at 5%. Taking a closer look on this issue of the Wall Street Journal, we see "The agreement, however, leaves open the potential of more lawsuits being filed against the company, **an issue about which investors have been particularly concerned**", thus explaining the investing public's rattled response to the news.

Results are similar for the event window of (0,2), only this time some of the CARs and CAARs lose their statistical significance, specifically Monsanto's stock price reaction on the day of deal closing as well as all results for suppliers following the very first event of the preliminary negotiations. Surprisingly, competitors experience a 0.64% CAAR, significant at 10%, on the day Bayer received a \$55mln cut for the damages of the second verdict (possible explanations follow – see window 0,1). Notably, the impact of the unofficial deal announcement on competitors is slightly increasing, both in size and statistical significance.

In window (0,1), CARs for Bayer around the announcement dates (official and unofficial) and the second trial loss, drop markedly (in absolute terms) and lose their statistical significance, showing that the market lagged its response relative to news disclosure. Monsanto's CARs around the unofficial announcement and deal closing dates exhibit similar behaviour. Suppliers, once more, show a small positive impact around the announcement of the second trial that would solely rely on scientific evidence regarding glyphosate in the first round (similar to window 0,3). Customers and competitors faced -2.7% and -0.58% CAARs, significant at 10% and 5% respectively, around the date when "Roundup" was banned in France. This latter reaction could reflect fear of customers losing part of their business with Bayer and other companies operating in the agriculture/herbicide industry in the long-term, due to increased subsequent regulation from other countries/markets (potential domino effect). Such development would naturally hurt competitors as well, via decreased sales in affected markets.

Competitors finally received a 0.69% CAAR, significant at 5% in the window surrounding Bayer's positive tentative ruling ahead of the second trial, contradicting the -1.36% CAAR, significant at 1%, around the \$200mln damages reduction of the first verdict (similar reaction to window 0,3). It is possible that other event(s) that we are not aware of, irrelevant to the deal that coincided around this time frame, had impacted (some of) the competitor companies around that date. We can similarly interpret the 0.63% competitors' CAAR (significant at 5%) around the damages cut related to the second verdict. Another possible explanation, is that on 10.10.2018 and 16.07.2019, competitors welcomed the positive rulings, despite those favouring Bayer, in the sense that it provides some relief to observe legal authorities trying to match compensatory and punitive damages, in the context of potential future similar litigations related to

agriculture/herbicides that could affect them directly this time. Then the negative effect on 22.10.2018 could signal just disappointment that Bayer specifically, was not penalized even more, thus further pummeling the merger. Another explanation could be that a “leader-follower effect is observed on 10.10.2018 and 16.07.2019, meaning that Bayer is a leader in its industry and it is expected that sometimes other comparable companies will follow the patterns of its stock prices. Finally, we should not forget that the t-tests are two-tailed, thus focusing on the sign of the impact is not advisable, simply because those tests are not designed for this, but merely to detect a statistically significant effect. The remaining results are in line with findings of window (0,3).

All in all, the deal announcement had the expected impact on both the target and the bidder, based on scientific literature. Impact from litigation clashes was concentrated around certain dates instead of spreading throughout events, showing that investors discounted their expectations fairly early. Positive proceedings were not always rewarded by investors, as they kept fearing the worst was yet to come. The effects on competitors, customers and suppliers were not sizable and sometimes not even observed on certain striking news, but are mostly implying that customers and suppliers showed interest in maintaining their business and negotiating power with Bayer, while competitors were displeased with news that would potentially strengthen the merger in the long run. Some individually surprising results for competitors and customers in the event window (0,1) are i) either attributed to events irrelevant to the deal, ii) a general positive outlook of how potential future lawsuits against them could ultimately unfold, iii) a leader-follower effect or iv) weakness of the t-tests to concretely define the sign of the impact of an event.

It is important to note that the event study reveals remarkable litigation costs. As expected, Bayer did not disclose any such assumption while formulating the deal in 2016, partly because it would provoke investor backlash, but also because there was no negative verdict up until this point regarding glyphosate, the active ingredient in “Roundup”. **Table 22** shows these costs in detail. Dates depicted are those of litigation events that had a statistically significant impact on Bayer’s share price. Bayer’s market value on these dates (**prior to the effect of the event**) is also shown. “% Loss/Gain” takes into account the statistically significant effects observed in the event window 0,3 because all events of interest are strongly significant across all windows except for one event in window 0,1. For that event date and event window, it turns out that the DAX index experienced large variability, thus the t-test fails to “catch” a statistically significant abnormal return, waning any concerns that the event did not actually have an impact on Bayer’s price, especially since the impact on windows 0,2 and 0,3 is strongly significant. “Loss/Gain” shows the currency loss or gain per date, alongside total amount in EUR. USD amount is computed using the exchange rate employed in the synergy valuation model and equals \$24.9bn. Litigation cost is also defined as actual USD loss over deal value, under the final offer scenario and equals 44.25%. This leads us to the conclusion that the actual overpayment was 72.25% over Monsanto’s fundamental price.

6. Conclusion

This is a quantitative analysis of one of the largest M&A deals of the past decade by means of contemporary scientific methods. The \$63.9bn merger of Bayer-Monsanto was only second to the AT&T–Time Warner deal of \$85.4bn in 2016. It was also the largest all-cash buyout on record (**Kumar, 2019**).

First, I provide a background of Bayer, Monsanto and the state of their increasingly concentrated industry that urged them to join forces. Then, a thorough review of the timeline of events relevant to the deal is conducted. It covers the whole scope from the initial negotiations to the deal closing, the subsequent legal battles alleging carcinogenic characteristics on “Roundup”, Monsanto’s most famous herbicide, and their eventual resolution with a multi-billion dollar settlement between Bayer and the thousands of plaintiffs that had accumulated since the very first verdict that found Monsanto liable, acting with malice.

Then, I move on with conducting fundamental valuations for both individual companies and the combined post-merge entity, employing multiple approaches for the cost of capital. The average fundamental price of Bayer is €110 and for Monsanto \$105, implying the former was undervalued and the latter was overvalued on valuation date. Starting with the original offer of \$122/share, the average fundamental value of the combined company is \$174.9bn, slightly higher than the sum of parts. The value of synergies is estimated at \$1.76bn, and therefore, the combined value with synergy is estimated at \$176.6bn, suggesting a rather lucrative deal opportunity, at least on paper. Still though, the premium embedded in the initial offer was 12.38% higher than the maximum justified premium. Considering the final offer of \$128/share after continuous negotiations, we find an estimated value of synergy of \$1.77bn, combined value with synergy of \$176.7bn and that Bayer overpaid by 18.08% for acquiring the agricultural giant. Finally, the estimated Synergy/Deal Value ratio of roughly 3% seems in accord with a study by Deloitte but is based on the author’s conservative assumptions about synergy cash flows, that could have as well been fairly inflated under management’s expectations.

Finally, event studies dig deeper into the impact that milestone proceedings had on the stock prices of the main players and indirectly affected parties, such as competitors, customers and suppliers. The deal announcement had the expected impact for the most part on both the target and the bidder based on scientific literature, meaning that Bayer’s stock price dropped by roughly 12% and Monsanto’s soared by roughly 18% on aggregate, during the days surrounding the announcement.

Impact from litigation clashes was concentrated only around the first two negative jury verdicts instead of spreading throughout relevant events, showing that investors’ confidence dropped fairly early. Positive legal proceedings were not always rewarded by investors, as they kept fearing the worst was yet to come. The effects on competitors, customers and suppliers were not sizable but were mostly directed according to logical expectations, meaning that customers and suppliers showed interest in maintaining their business and negotiating power with Bayer, while competitors were displeased with news that would potentially strengthen the merger in the long run.

In addition, the event study reveals substantial litigation costs, that were not accounted for, most likely to evade investor backlash during initial deal planning, but also because there had been no similar verdict in the past, assigning carcinogenic characteristics to glyphosate herbicides and imposing billions of dollars in damages. The total litigation cost is estimated at \$24.9bn – 44.25% of the appraised combined value plus synergy, under the final offer scenario. This leads us to the conclusion that the actual overpayment is estimated at 72.25% over Monsanto’s fundamental price.

It is apparent that Bayer’s top management did not take seriously the litigation that Monsanto had amassed throughout the years, most likely because there had never been a negative verdict thus far against its herbicides. **A.Ghosh (2001)** documents that operating performance significantly increases following acquisitions that are made with cash – such as the deal under scrutiny. **Table 23** shows the development of key operational performance metrics in a post-acquisition environment. While quarterly sales ramped up fairly early, they were significantly lower than the sum of average quarter sales of individual companies (Q2 FY15-Q1 FY16 for Bayer and Q4 FY15-Q3 FY16 for Monsanto) equal to €14,523, computed using **Tables 2 and 3**, and applying the exchange rate of 1.1131 for Monsanto’s sales. EBITDA and Net Income seem to seasonally spike around the first quarter of Bayer’s fiscal year but remain fairly stable for the remaining periods and comparable to their pre-merge levels.

These findings suggest that the management’s assumptions regarding the deal’s fundamentals were probably inflated. Exaggerated M&A investment appraisals seem to be in line with executives’ incentive to seize private benefits of control, according to **(Khorana & Zenner, 1998)**. It is safe to assume however, that industry conditions in 2016 were putting pressure on the two firms to consider a joint venture, as more and more competitors were signing merger deals. Nonetheless, Bayer’s crop division alongside Monsanto was the world’s second largest agriculture company in terms of sales in 2019 **(BizVibe, 2020; Chakravarty, 2019)**, poised to grow rapidly in the years to come by exploiting a deep combined R&D pipeline, leaving us intrigued and curious whether the deal will prove to be a success story in the long term.

APPENDIX**Table 1: Detailed overview of the Bayer-Monsanto acquisition timeline** (actual dates displayed)

Date	Event
21-03-16	Bayer Shares Lifted by Reported Monsanto Interest
10-05-16	Bayer approaches Monsanto privately
12-05-16	Bayer approach officially reported
19-05-16	In response to media coverage, Monsanto discloses they received a proposal from Bayer
23-05-16	Offer letter for \$122 confirmed by Bayer on investor call, estimated synergies \$1.5bn
24-05-16	Monsanto rejects offer \$122
11-06-16	Bayer sweet talks Monsanto and asks for due diligence, but is rejected once again
29-06-16	Monsanto Shops Around For 'Right Combination'
01-07-16	(verbally) Bayer increases offer to \$125 and provides certainty on financing and regulatory matters
09-07-16	(formally) Bayer increases offer to \$125 and provides certainty on financing and regulatory matters
19-07-16	Monsanto Spurns Sweeter Offer, but does not rule out further negotiations
06-09-16	Offer lifted to \$127.5
06-09-16	BASF expresses interest in potential Bayer divestitures, if required by regulatory bodies
14-09-16	Deal closed for \$128 (and financing plan revealed)
15-09-16	Regulatory approvals are speculated
12-10-16	Pre-agreed financing facility is now syndicated
10-11-16	Monsanto announces vote on merger 13-12-16
15-11-16	First \$4bn of \$19bn equity issued
13-12-16	Monsanto shareholders approve deal
17-01-17	Bayer AG pledges to add U.S. jobs and investment after meeting with President-Elect Donald Trump
22-08-17	"Serious doubts" by European anti-trust regulators
14-10-17	Bayer AG agreed to sell parts of its crop-science business to rival BASF SE for €5.9bn (\$6.98bn), a bid to assuage regulators.
01-12-17	CFIUS completes review of proposed merger and approves
01-03-18	Bayer AG is preparing to sell more assets to win antitrust approval (entire vegetable-seed business)
21-03-18	Bayer wins EU approval for \$62.5bn Monsanto buy (Reuters) - under conditions
09-04-18	The Justice Department grants approval conditional to divesting assets.
26-04-18	Bayer signs agreement to sell further Crop Science businesses to BASF for up to €1.7bn (to facilitate regulatory approvals)
29-05-17	The Justice Department grants approval, conditional to Bayer divesting a total of \$9bn assets to BASF SE.
04-06-18	Bayer plans closing of Monsanto acquisition on June 7th
07-06-18	Deal completed for \$128/share

19-06-18	Bayer issues new bonds with a volume of total \$20bn
10-08-18	Monsanto hit by jury verdict on cancerous product - \$289.2 mln in losses (plaintiff Dewayne Johnson - school groundskeeper)
05-09-18	Bayer Tallies Up More Weedkiller Lawsuits
10-10-18	Bayer Wins Round In Herbicide Case (tentative ruling ahead of actual trial)
22-10-18	Judge Reduces Bayer Verdict by \$200 Million
13-11-18	Despite mounting lawsuits, Monsanto's integration increased sales in Q3 2018
26-11-18	Summary: 9300 plaintiffs, \$30 bn Mcap loss since jury favoured plaintiff for the first time in such case. Award to plaintiff reduced to \$78.5mln from \$289 mln
30-11-18	Bayer to Cut 12,000 Jobs, Sell Some Brands (to win investors back)
04-01-19	New lawsuit (plaintiff Edwin Hardeman): two trials, the first relies solely on scientific evidence based on glyphosate, before plaintiff defense can present evidence about Monsanto's malice
15-01-19	France revokes approval of glyphosate-based "Roundup"
25-02-19	Roundup Trial Begins With Science Sparring
27-02-19	Bayer increases sales and earnings - leader in agriculture after acquisition
19-03-19	Bayer Loses in Weedkiller Verdict
20-03-19	Cancer Verdict Pummels Bayer: -9.6% share price
28-03-19	Damages Awarded in Bayer Herbicide Trial (\$80.3 mln)
13-05-19	A jury awarded on Monday \$2.055 billion to a California couple who blamed Bayer's Roundup weedkiller for causing their cancer
20-05-19	Bayer is worth less today than the \$63 billion it paid for Monsanto roughly a year ago.
14-06-19	Bayer AG plans to invest €5bn (\$5.64bn) on developing ways to combat weeds over the next decade, to win back trust
26-06-19	Bayer Adds Legal Help To Resolve Liabilities
02-07-19	Austria bans the key chemical in Roundup
16-07-19	A federal judge cut the verdict in favor of Edwin Hardeman by \$55 million
25-07-19	\$2bn damages award trimmed to \$86.7 million in the case of a couple
21-08-19	Bayer AG is selling its animal-health business to Elanco Animal Health Inc. for \$7.6bn
29-08-19	The \$63bn gambit ranks as one of the worst corporate deals in recent memory, with a total of 18,400 plaintiffs having filed suits and its shares dropped by roughly 30% since deal closing
04-09-19	Germany Joins Ban of Bayer Herbicide
02-10-19	Bayer's Board Adds Farming Expert
31-10-19	Bayer AG said the number of plaintiffs claiming its Roundup herbicides caused cancer more than doubled to 42,700 in the past three months
22-11-19	Bayer AG, has agreed to pay \$10.2 million in fines and plead guilty to spraying a banned pesticide in Hawaii
20-12-19	U.S. Backs Bayer in Weedkiller Appeal
11-02-20	Bayer and plaintiff lawyers are approaching a deal in which Bayer would pay a total of roughly \$10bn for current and future plaintiffs
14-02-20	Bayer boasts new herbicide research discovery to alleviate investor unrest
27-02-20	Bayer Toughens Scrutiny of Deals and agrees to allow expert reviews in wake of lawsuits.
28-04-20	Coronavirus pandemic ramps up farming and drugs business but also slows down Roundup litigation resolution
24-06-20	Bayer to Pay More Than \$10 Billion In Roundup Settlement

Table 2: Bayer AG - Calculation of historical firm free cash flows

	Q1 FY14	Q2 FY14	Q3 FY14	Q4 FY14	Q1 FY15	Q2 FY15	Q3 FY15	Q4 FY15	Q1 FY16
Revenues	€ 10,555	€ 10,458	€ 10,187	€ 11,039	€ 12,117	€ 12,090	€ 11,036	€ 11,081	€ 11,941
COGS	€ 4,815	€ 5,080	€ 4,943	€ 5,428	€ 5,566	€ 5,312	€ 4,956	€ 5,324	€ 5,086
Gross Profit	€ 5,740	€ 5,378	€ 5,244	€ 5,611	€ 6,551	€ 6,778	€ 6,080	€ 5,757	€ 6,855
OPEX (incl. DA)	€ 3,644	€ 3,905	€ 3,868	€ 5,050	€ 4,553	€ 4,945	€ 4,515	€ 4,903	€ 4,520
EBIT (oper. lease adj.)	€ 2,117	€ 1,495	€ 1,398	€ 580	€ 2,018	€ 1,854	€ 1,586	€ 868	€ 2,355
Taxes	€ 560	€ 397	€ 314	-€ 43	€ 486	€ 486	€ 365	€ 140	€ 557
NOPAT	€ 1,557	€ 1,098	€ 1,085	€ 624	€ 1,532	€ 1,368	€ 1,221	€ 728	€ 1,798
DA	€ 649	€ 703	€ 681	€ 903	€ 806	€ 815	€ 760	€ 952	€ 1,041
CAPEX	€ 357	€ 529	€ 546	€ 939	€ 345	€ 601	€ 655	€ 916	€ 363
ANWC	€ 1,537	€ 8	€ 3,560	-€ 3,619	€ 1,368	€ 46	-€ 543	-€ 911	€ 740
FFCF	€ 312	€ 1,264	-€ 2,340	€ 4,207	€ 626	€ 1,536	€ 1,869	€ 1,675	€ 1,735
Income before income taxes	€ 1,937	€ 1,300	€ 1,074	€ 214	€ 1,724	€ 1,546	€ 1,285	€ 690	€ 2,020
Income taxes	€ 512	€ 345	€ 241	-€ 16	€ 415	€ 405	€ 296	€ 111	€ 478
Effective Tax rate	26.43%	26.54%	22.44%	-7.48%	24.07%	26.20%	23.04%	16.09%	23.66%
FFCF as % of Quarter Revenue	2.96%	12.09%	-22.97%	38.11%	5.16%	12.70%	16.94%	15.12%	14.53%

Historical firm free cash flows are calculated back to 2014 in order to derive the historical average FFCF/Quarter Sales ratio of 10.51%.

This ratio is then multiplied by sales forecasts (Table 4) to derive the planning period firm free cash flows (Table 5).

Inputs from quarterly reports retrieved from investor.bayer.com. Figures are in millions.

Table 3: Monsanto Co. - Calculation of historical firm free cash flows

	Q1 FY14	Q2 FY14	Q3 FY14	Q4 FY14	Q1 FY15	Q2 FY15	Q3 FY15	Q4 FY15	Q1 FY16	Q2 FY16	Q3 FY16
Revenues	\$3,143	\$5,832	\$4,250	\$2,630	\$2,870	\$5,197	\$4,579	\$2,355	\$2,219	\$4,532	\$4,189
COGS	\$1,580	\$2,385	\$1,919	\$1,397	\$1,459	\$2,158	\$1,843	\$1,359	\$1,318	\$1,934	\$1,809
Gross Profit	\$1,563	\$3,447	\$2,331	\$1,233	\$1,411	\$3,039	\$2,736	\$996	\$901	\$2,598	\$2,380
OPEX (incl. DA)	\$998	\$1,029	\$1,082	\$1,390	\$992	\$1,019	\$1,092	\$1,556	\$1,173	\$935	\$1,131
EBIT (oper. lease adj.)	\$577	\$2,430	\$1,262	-\$148	\$434	\$2,035	\$1,659	-\$544	-\$256	\$1,680	\$1,266
Taxes	\$170	\$698	\$352	-\$52	\$133	\$570	\$428	-\$149	-\$86	\$418	\$510
NOPAT	\$407	\$1,732	\$909	-\$97	\$301	\$1,464	\$1,232	-\$396	-\$170	\$1,262	\$756
DA	\$162	\$170	\$175	\$184	\$182	\$180	\$176	\$178	\$181	\$183	\$178
CAPEX	\$303	\$168	\$217	\$317	\$347	\$164	\$190	\$266	\$326	\$163	\$177
ANWC	-\$536	\$1,497	\$2,780	-\$3,213	-\$524	\$1,029	\$3,019	-\$3,601	-\$983	\$1,181	\$1,644
FFCF	\$802	\$238	-\$1,913	\$2,984	\$660	\$452	-\$1,801	\$3,118	\$668	\$101	-\$887
Income before income taxes	\$516	\$2,340	\$1,221	-\$250	\$327	\$1,962	\$1,556	-\$684	-\$406	\$1,407	\$1,198
Income taxes	\$152	\$672	\$341	-\$87	\$100	\$550	\$401	-\$187	-\$137	\$350	\$483
Effective Tax rate	29.46%	28.72%	27.93%	34.80%	30.58%	28.03%	25.77%	27.34%	33.74%	24.88%	40.32%
FFCF as % of Quarter Revenue	25.53%	4.07%	-45.01%	113.45%	22.99%	8.70%	-39.33%	132.40%	30.11%	2.22%	-21.19%

Historical firm free cash flows are calculated back to 2014 in order to derive the historical average FFCF/Quarter Sales ratio of 21.27%.

This ratio is then multiplied by sales forecasts (Table 4) to derive the planning period firm free cash flows (Table 5).

Inputs from 10-Q statements retrieved from www.sec.gov. Figures are in millions.

Table 4: WRDS Revenue Forecasts*source: (WRDS, 2020a)*

Period	Bayer AG	Monsanto Co.
Q2 FY16	€ 12,298	-
Q3 FY16	€ 11,224	-
Q4 FY16	€ 11,373	\$2,398
Q1 FY17	€ 12,418	\$2,342
Q2 FY17	€ 12,789	\$5,201
Q3 FY17	€ 11,672	\$4,800
Q4 FY17	€ 11,827	\$2,434
Q1 FY18	-	\$2,696
Q2 FY18	-	\$5,785
Q3 FY18	-	\$5,138
Q4 FY18	-	\$2,413

WRDS receives forecasts from Thomson Reuters. Multiple analyst forecasts are available per period. Reported figures above are averages per period (in millions) that satisfy the announce date criteria of 01/01/16-31/03/16 for Bayer and 01/01/16-31/05/16 for Monsanto. This way, the valuation model relies on updated estimates that are not affected by the announcement of the preliminary negotiations.

Table 5: Planning Period Firm Free Cash Flows

Period	Bayer AG	Monsanto Co.
Q2 FY16	€ 1,293	-
Q3 FY16	€ 1,180	-
Q4 FY16	€ 1,196	\$510
Q1 FY17	€ 1,306	\$498
Q2 FY17	€ 1,345	\$1,106
Q3 FY17	€ 1,227	\$1,021
Q4 FY17	€ 1,244	\$518
Q1 FY18	-	\$573
Q2 FY18	-	\$1,230
Q3 FY18	-	\$1,093
Q4 FY18	-	\$513

Reported figures in millions

The above free cash flows are derived by multiplying the historical average FFCF/Revenue ratio (reported under Tables 2 and 3 for Bayer AG and Monsanto Co. respectively) by the quarterly projected revenues under Table 4.

Table 6: Historical Net Working Capital calculation
NWC=(Current Assets - Non-Operating Cash) - (Current Liabilities - Current Portion of Interest Bearing Debt/Notes)
The calculated NWC values are used to derive the FFCFs under Tables 2 and 3.

Bayer AG	Q4 FY13	Q1 FY14	Q2 FY14	Q3 FY14	Q4 FY14	Q1 FY15	Q2 FY15	Q3 FY15	Q4 FY15	Q1 FY16
Current Assets	€ 19,028	€ 22,085	€ 20,990	€ 25,359	€ 22,227	€ 24,951	€ 26,158	€ 24,997	€ 23,821	€ 26,726
Cash (reported)	€ 1,662	€ 2,631	€ 1,591	€ 1,824	€ 1,853	€ 1,607	€ 3,430	€ 2,573	€ 2,056	€ 3,560
Marketable Securities	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
Operating cash 2% of Revenue	€ 198	€ 211	€ 209	€ 204	€ 221	€ 242	€ 242	€ 221	€ 222	€ 239
Non-operating Cash	€ 1,464	€ 2,420	€ 1,382	€ 1,620	€ 1,632	€ 1,365	€ 3,188	€ 2,352	€ 1,834	€ 3,321
Current Liabilities	€ 14,023	€ 15,285	€ 14,670	€ 14,759	€ 15,503	€ 20,263	€ 20,764	€ 19,342	€ 16,980	€ 17,428
Current Portion of Interest-Bearing Debt/Notes	€ 3,441	€ 4,139	€ 3,589	€ 3,107	€ 3,376	€ 6,512	€ 7,676	€ 6,036	€ 3,421	€ 3,191
NWC	€ 6,982	€ 8,519	€ 8,527	€ 12,087	€ 8,468	€ 9,835	€ 9,882	€ 9,339	€ 8,428	€ 9,168

Inputs from quarterly reports retrieved from investor.bayer.com. Figures are in millions.

Monsanto Co.	Q4 FY13	Q1 FY14	Q2 FY14	Q3 FY14	Q4 FY14	Q1 FY15	Q2 FY15	Q3 FY15	Q4 FY15	Q1 FY16	Q2 FY16	Q3 FY16
Current Assets	\$10,077	\$12,496	\$11,550	\$11,237	\$9,675	\$11,398	\$10,699	\$10,589	\$10,625	\$10,467	\$8,483	\$9,055
Cash (reported)	\$3,922	\$4,745	\$3,845	\$1,898	\$2,407	\$3,176	\$2,732	\$1,207	\$3,748	\$2,324	\$1,062	\$1,216
Marketable Securities	\$6	\$6	\$6	\$6	\$6	\$4	\$4	\$4	\$4	\$3	\$3	\$3
Operating cash 2% of Revenue	\$44	\$63	\$117	\$85	\$53	\$57	\$104	\$92	\$47	\$44	\$91	\$84
Non-operating Cash	\$3,878	\$4,682	\$3,728	\$1,813	\$2,354	\$3,119	\$2,628	\$1,115	\$3,701	\$2,280	\$971	\$1,132
Current Liabilities	\$4,336	\$6,698	\$5,051	\$3,931	\$5,112	\$6,999	\$5,472	\$4,097	\$5,177	\$8,501	\$5,939	\$6,180
Current Portion of Interest-Bearing Debt/Notes	\$51	\$262	\$104	\$162	\$233	\$636	\$346	\$587	\$615	\$1,692	\$987	\$2,461
NWC	\$1,909	\$1,372	\$2,869	\$5,650	\$2,436	\$1,912	\$2,941	\$5,959	\$2,358	\$1,375	\$2,556	\$4,201

Inputs from 10-Q statements retrieved from www.sec.gov. Figures are in millions.

Table 7: Credit Ratings and associated Default Spreads*source: (Damodaran, 1/14, 1/19)*

<i>Rating is</i>	<i>Spread 2019</i>	<i>Spread 2018</i>	<i>Spread 2017</i>	<i>Spread 2016</i>	<i>Spread 2015</i>	<i>Spread 2014</i>
Aaa/AAA	0.75%	0.54%	0.60%	0.75%	0.40%	0.40%
Aa2/AA	1.00%	0.72%	0.80%	1.00%	0.70%	0.70%
A1/A+	1.25%	0.90%	1.00%	1.10%	0.90%	0.85%
A2/A	1.38%	0.99%	1.10%	1.25%	1.00%	1.00%
A3/A-	1.56%	1.13%	1.25%	1.75%	1.20%	1.30%
Baa2/BBB	2.00%	1.27%	1.60%	2.25%	1.75%	2.00%
Ba1/BB+	3.00%	1.98%	2.50%	3.25%	2.75%	3.00%
Ba2/BB	3.60%	2.38%	3.00%	4.25%	3.25%	4.00%
B1/B+	4.50%	2.98%	3.75%	5.50%	4.00%	5.50%
B2/B	5.40%	3.57%	4.50%	6.50%	5.00%	6.50%
B3/B-	6.60%	4.37%	5.50%	7.50%	6.00%	7.25%
Caa/CCC	9.00%	8.64%	6.50%	9.00%	7.00%	8.75%
Ca2/CC	11.08%	10.63%	8.00%	12.00%	8.00%	9.50%
C2/C	14.54%	13.95%	10.50%	16.00%	10.00%	10.50%
D2/D	19.38%	18.60%	14.00%	20.00%	12.00%	12.00%

As complimentary benchmark to the Yield to Maturity (YTM), an approximation of the cost of debt is calculated using corporate credit ratings to arrive at a default spread over the risk-free rate.

Table 8: Sector unlevered betas - Global*source: (Damodaran, 1/16a)*

<i>Industry Name</i>	<i>Number of firms</i>	<i>Beta</i>	<i>D/E Ratio</i>	<i>Tax rate</i>	<i>Unlevered beta</i>	<i>Cash/Firm value</i>	<i>Unlevered beta corrected for cash</i>
Chemical (Specialty)	713	1.18	25.82%	16.11%	0.97	6.20%	1.03
Drugs (Biotechnology)	831	1.27	12.62%	2.81%	1.13	5.83%	1.20
Drugs (Pharmaceutical)	926	1.10	14.24%	12.52%	0.98	4.13%	1.02
Farming/Agriculture	403	1.01	46.45%	10.89%	0.71	5.76%	0.76
Healthcare Products	661	1.02	17.93%	9.19%	0.88	4.90%	0.93
Healthcare Support Services	335	1.15	30.30%	18.01%	0.92	6.05%	0.98

Sector unlevered betas are used to estimate unlevered betas for Bayer and Monsanto based on proxy value weights of their own business segments (Table 10).

Table 9: Sector EV/Sales - Global*source: (Damodaran, 1/16b)*

<i>Industry Name</i>	<i>Number of firms</i>	<i>Price/Sales</i>	<i>Net Margin</i>	<i>EV/Sales</i>	<i>Pre-tax Operating Margin</i>
Chemical (Specialty)	713	1.54	7.85%	181.19%	0.12
Drugs (Biotechnology)	831	8.18	15.54%	866.89%	0.28
Drugs (Pharmaceutical)	926	3.94	16.10%	431.91%	0.20
Farming/Agriculture	403	0.95	2.63%	130.75%	0.05
Healthcare Products	661	3.48	7.81%	390.21%	0.16
Healthcare Support Services	335	0.53	2.18%	64.59%	0.05

Sector EV/Sales ratios are used to perform "multiples" valuation in order to proxy for the value of the business segments that constitute Bayer and Monsanto. These values are then used to obtain a weighted unlevered beta for the two companies (Table 10).

Table 10: Levered beta calculations**Bayer AG (Q1 FY16)****Levered beta: 1.17**

Business	Damodaran equivalent	Revenues	EV/Sales	Value of Business	Proportion of Bayer (%)	Unlevered beta
Pharmaceuticals	Drugs (Pharmaceutical)	€ 3,889	4.32	€ 16,797	50%	1.02
Consumer Health	Healthcare Products	€ 1,520	3.90	€ 5,931	18%	0.93
Crop Science	Chemical (Specialty)	€ 3,023	1.81	€ 5,478	16%	1.03
Animal Health	Healthcare Support Services	€ 408	0.65	€ 264	1%	0.98
Covestro	Chemical (Specialty)	€ 2,850	1.81	€ 5,164	15%	1.03
Total (or sumproduct)		€ 11,690		€ 33,633	100%	1.01

Monsanto Co. (Q3 FY16)**Levered beta: 1.37**

Business	Damodaran equivalent	Revenues	EV/Sales	Value of Business	Proportion of Monsanto (%)	Unlevered beta
Agricultural Productivity	Farming/Agriculture	\$982	1.31	\$1,284	4%	0.76
Seeds and Genomics	Drugs (Biotechnology)	\$3,207	8.67	\$27,801	96%	1.20
Total (or sumproduct)		\$4,189		\$29,085	100%	1.19

Unlevered betas for Bayer and Monsanto are estimated by employing "multiples" valuation for their business segments. These betas are then relevered using each firm's D/E ratio and average effective tax rate. The calculation considers D/E ratios under operating lease adjustments, where $K_d = YTM$. Sector Unlevered betas and EV/Sales: (Damodaran, 1/16a, 1/16b)

Table 11: Equity Risk Premium Calculation

Bayer AG	Sales	% Sales	ERP
Europe	€ 4,591	38.45%	3.06%
North America	€ 3,465	29.02%	1.81%
Asia/Pacific	€ 2,536	21.24%	1.66%
Latin America/Africa/Middle East	€ 1,349	11.30%	1.21%
Total	€ 11,941	100.00%	7.74%

Monsanto Co.	Sales	% Sales	ERP
United States	\$8,612	57.93%	3.62%
Europe-Africa	\$1,834	12.34%	1.03%
Brazil	\$1,725	11.60%	1.27%
Argentina	\$871	5.86%	0.96%
Asia-Pacific	\$686	4.61%	0.36%
Canada	\$601	4.04%	0.25%
Mexico	\$537	3.61%	0.29%
Other	\$135	-	-
Total	\$14,866	100.00%	7.79%

Country/Region	GDP (in billions)	Moody's rating	Rating-based Default Spread	Total Risk Premium	Country Risk Premium
Africa	\$1,926		4.81%	12.99%	6.74%
Asia	\$22,700		1.12%	7.82%	1.57%
Eastern Europe & Russia	\$3,974		2.80%	10.17%	3.92%
Middle East	\$2,448		0.93%	7.56%	1.31%
North America	\$19,204		0.00%	6.25%	0.00%
Western Europe	\$19,089		0.88%	7.49%	1.24%
Central and South America	\$5,839		3.58%	11.27%	5.02%
United States of America	\$17,419	Aaa	0.00%	6.25%	0.00%
Mexico	\$1,295	A3	1.35%	8.14%	1.89%
Argentina	\$538	B3	7.29%	16.46%	10.21%
Brazil	\$2,346	Ba2	3.37%	10.97%	4.72%
Canada	\$1,785	Aaa	0.00%	6.25%	0.00%
Europe (Total)	\$23,063			7.95%	
Latin America/Africa/Middle East	\$10,213			10.70%	
Europe-Africa	\$24,989			8.34%	

source: (Damodaran, 1/16c)

Equity Risk Premiums (ERPs) are weighted averages, computed based on company sales and the ERPs of their respective regions of origin. Total Risk Premium is the Mature Implied ERP of 6.25% on July 2016, plus the Country Risk Premium. The Mature Implied ERP is retrieved by reverse engineering a multi-stage Gordon Growth Model (GGM) on the expected S&P 500 dividends and stock buybacks. Rating-based Default Spread is the difference between average CDS spreads and average sovereign USD bond spreads by ratings class. Country Risk Premium is the Rating-based Default Spread, scaled up to reflect the higher risk of equity in the market, relative to the default spread, using the ratio of the S&P Emerging Market Equity Index standard deviation to the BAML Emerging Public Bond index standard deviation. ERPs for regions are computed using GDP weighted averages of the ERPs in their countries. ERPs for the regions in bold are custom calculated as GDP weighted averages of the ERPs in their sub-regions. Moody's rating is naturally reported only for countries.

Table 12: Operating Leases classified as Debt (using $K_d=YTM$)

Bayer AG

Quarter	Commitment	Present Value	Year	Commitment
Q2 2016	€ 48.75	€ 48.46	2016	€ 195.00
Q3 2016	€ 48.75	€ 48.18	2017	€ 155.00
Q4 2016	€ 48.75	€ 47.90	2018	€ 110.00
Q1 2017	€ 38.75	€ 37.85	2019	€ 94.00
Q2 2017	€ 38.75	€ 37.63	2020	€ 79.00
Q3 2017	€ 38.75	€ 37.41	2021 and later	€ 258.00
Q4 2017	€ 38.75	€ 37.19		
Q1 2018	€ 27.50	€ 26.24		
Q2 2018	€ 27.50	€ 26.09		
Q3 2018	€ 27.50	€ 25.93		
Q4 2018	€ 27.50	€ 25.78		
Q1 2019	€ 23.50	€ 21.90		
Q2 2019	€ 23.50	€ 21.77		
Q3 2019	€ 23.50	€ 21.65		
Q4 2019	€ 23.50	€ 21.52		
Q1 2020	€ 19.75	€ 17.98		
Q2 2020	€ 19.75	€ 17.87		
Q3 2020	€ 19.75	€ 17.77		
Q4 2020	€ 19.75	€ 17.67		
2021 or later	€ 32.25	€ 224.79		
Debt Value of leases:		€ 782		
Reported Debt:		€ 17,290		
Debt with Operating leases reclassified as debt:		€ 18,072		
Full Operating lease adjustment				
Reported Operating income =		€ 2,335		
+ Current year's operating lease expense =		€ 49		
- Depreciation on leased asset =		€ 29		
Adjusted Operating Income		€ 2,355		

Monsanto Co.

Quarter	Commitment	Present Value	Year	Commitment
Q4 2016	\$34.50	\$34.17	2016	\$138.00
Q1 2017	\$24.75	\$24.27	2017	\$99.00
Q2 2017	\$24.75	\$24.04	2018	\$78.00
Q3 2017	\$24.75	\$23.81	2019	\$61.00
Q4 2017	\$24.75	\$23.58	2020	\$50.00
Q1 2018	\$19.50	\$18.39	2021 and later	\$99.00
Q2 2018	\$19.50	\$18.22		
Q3 2018	\$19.50	\$18.04		
Q4 2018	\$19.50	\$17.87		
Q1 2019	\$15.25	\$13.84		
Q2 2019	\$15.25	\$13.70		
Q3 2019	\$15.25	\$13.57		
Q4 2019	\$15.25	\$13.44		
Q1 2020	\$12.50	\$10.91		
Q2 2020	\$12.50	\$10.80		
Q3 2020	\$12.50	\$10.70		
Q4 2020	\$12.50	\$10.60		
2021 or later	\$19.80	\$81.51		
Debt Value of leases:		\$381		
Reported Debt:		\$10,505		
Debt with Operating leases reclassified as debt:		\$10,886		
Full Operating lease adjustment				
Reported Operating income =		\$1,249		
+ Current year's operating lease expense =		\$35		
- Depreciation on leased asset =		\$17		
Adjusted Operating Income		\$1,266		

Operating leases constitute fixed commitments in the future that firms have to meet in both good times and bad, and the failure to meet this obligation can result in bankruptcy or loss of equity control over the firm. Therefore, they must be reclassified as debt. Consequently, operating income has to be restated according to the formula above. Debt commitments from annual reports are evenly allocated to quarters and then discounted to the present using the pre-tax cost of debt. Financial statements aggregate the commitments after 6 years in the future. I find the average of all prior future commitments (year 1-5) and divide year 6 aggregate by this average to arrive at the “number of quarters embedded in year 6 estimate”. Commitment beyond year 6 is then converted into a quarterly “annuity” for the “number of quarters embedded in year 6 estimate”, using the quarterly pre-tax cost of debt. Commitments for quarters in years 1-5 are also discounted to the present. The total sum of these present values is the debt value adjustment.

Table 13: Weighted Average Cost of Capital

Bayer AG			Monsanto Co.		
Cost of Debt			Cost of Debt		
Kd (YTM)		2.38%	Kd (YTM)		3.97%
Kd (Rf+Default Spread)		1.91%	Kd (Rf+Default Spread)		4.09%
Average historical effective tax rate		20.11%	Average historical effective tax rate		30.14%
	kd (YTM) (1 - t)	1.90%		kd (YTM) (1 - t)	2.77%
	kd (Rf+Spread) (1 - t)	1.52%		kd (Rf+Spread) (1 - t)	2.86%
Cost of Equity			Cost of Equity		
Risk-free rate		0.16%	Risk-free rate		1.84%
Beta		1.17	Beta		1.37
Equity risk premium		7.74%	Equity risk premium		7.79%
Multi-Stage GGM Ke:		9.52%	Multi-Stage GGM Ke:		12.77%
	ke=Rf+b*ERP	9.22%		ke=Rf+b*ERP	12.51%
Market Value of Equity (€ in millions)			Market Value of Equity (\$ in millions)		
Market Value, 31-03-2016		€ 87,666	Market Value, 31-03-2016		\$49,132
Value of Debt (\$ in millions)			Value of Debt (\$ in millions)		
Reported debt		€ 17,290	BV Long-Term Debt		\$7,948
Operating leases reclassified as debt		€ 782	BV Short-Term Debt		\$2,557
Total Debt		€ 18,072	Operating leases reclassified as debt		\$381
			Total Debt		\$10,886
Capital Structure			Capital Structure		
D/V		17.09%	D/V		18.14%
E/V		82.91%	E/V		81.86%
D/E		20.61%	D/E		22.16%
WACC = Ke(E/V) + Kd(1-t)(D/V)		7.97%	WACC = Ke(E/V) + Kd(1-t)(D/V)		10.74%
<i>Multiple approaches</i>	Damodaran's Ke	Multi-Stage GGM Ke	<i>Multiple approaches</i>	Damodaran's Ke	Multi-Stage GGM Ke
YTM	7.97%	8.21%	YTM	10.74%	10.96%
Rf+Default Spread	7.91%	8.15%	Rf+Default Spread	10.76%	10.97%

*Summary of the Weighted Average Cost of Capital Calculation. $Ke=Rf+b*ERP$ is following Damodaran's methodology, as outlined in Tables 8-11. Multi-Stage GGM Ke is derived by inverting a multi-stage Gordon Growth Model on the expected dividends of the companies. Displayed capital structure weights consider the reported debt from the financial statements and the operating lease adjustment where $Kd=YTM$. Market values of equity and Bayer risk-free rate (German Bund 10-year) are obtained from Datastream (Thomson Reuters, 2020). Monsanto risk-free rate (Treasury Bond 10-year) is retrieved from the U.S. Department of the Treasury (2020). All feasible outcomes for the cost of capital are reported at the bottom of the table.*

Table 14: Bayer AG Fundamental Valuation*using kd=YTM and Damodaran's Ke*

Annualized Discount Factor	7.97%
Quarterly Discount Factor	1.94%
Long-term annualized growth	3.45%
Long-term quarterly growth	0.85%

EUR in millions, except per share data

Period	t	FCFF(t) or TV(t)	Present value
Q2 FY16	1	€ 1,293	€ 1,269
Q3 FY16	2	€ 1,180	€ 1,136
Q4 FY16	3	€ 1,196	€ 1,129
Q1 FY17	4	€ 1,306	€ 1,209
Q2 FY17	5	€ 1,345	€ 1,222
Q3 FY17	6	€ 1,227	€ 1,094
Q4 FY17	7	€ 1,244	€ 1,087
Terminal Value	7	€ 115,639	€ 101,113

Intrinsic value of Bayer AG's capital	€ 109,259
Less: Debt	€ 18,072
Plus: Non-operating Cash	€ 3,321
Intrinsic value of Bayer AG's common stock	€ 94,508

Intrinsic value (per share):	€ 112.47
Share price 31/03/2016	€ 101.63

based on Q1 financial report 31/03/2016

Table 15: Monsanto Co. Fundamental Valuation*using kd=YTM and Damodaran's Ke*

Annualized Discount Factor	10.74%
Quarterly Discount Factor	2.58%
Long-term annualized growth	5.17%
Long-term quarterly growth	1.27%

US\$ in millions, except per share data

Period	t	FCFF(t) or TV(t)	Present value
Q4 FY16	1	\$510	\$497
Q1 FY17	2	\$498	\$473
Q2 FY17	3	\$1,106	\$1,025
Q3 FY17	4	\$1,021	\$922
Q4 FY17	5	\$518	\$456
Q1 FY18	6	\$573	\$492
Q2 FY18	7	\$1,230	\$1,029
Q3 FY18	8	\$1,093	\$891
Q4 FY18	9	\$513	\$408
Terminal Value	9	\$63,031	\$50,104

Intrinsic value of Monsanto Co.'s capital	\$56,296
Less: Debt	\$10,886
Plus: Non-operating Cash	\$1,685
Intrinsic value of Monsanto Co.'s common stock	\$47,095

Intrinsic value (per share):	\$107.57
Share price 31/05/2016	\$112.47

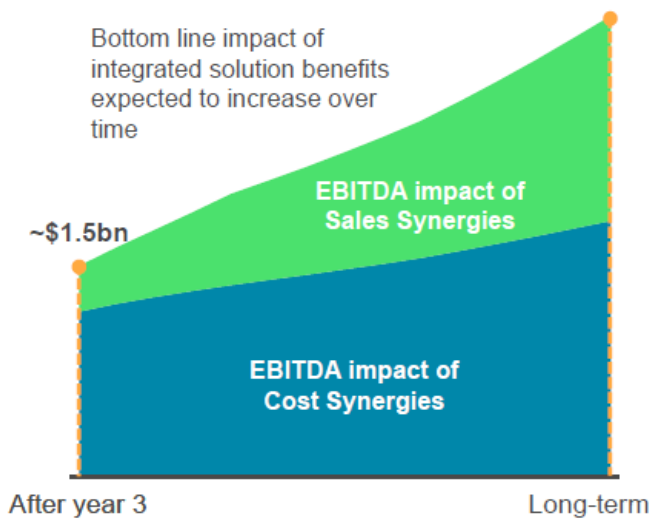
based on 10-Q 31/05/2016

Firm free cash flows are a combination of forecast and historical information, as outlined under Tables 4 and 5. Terminal Value for Bayer considers the final planning period cash flow, while for Monsanto it considers the average of the planning period cash flows projected for FY17-18, to account for seasonality patterns arising from agriculture cycles. Long-term growth rates and discount factors are used in their quarterly form to accommodate for the quarterly free cash flows. Growth rates are retrieved from WRDS (WRDS, 2020a). Intrinsic Value of Equity is defined as Enterprise Value – Debt + Non-Operating Cash, and divided by shares outstanding retrieved from Datastream (Thomson Reuters, 2020), yields the intrinsic value per share for the two companies. Intrinsic share prices, when compared to share prices on valuation dates, reveal that Monsanto was overvalued and Bayer was undervalued - confirmed in subsequent movements of their respective share prices just a couple weeks later, providing even more credibility to the valuation model, to the extent that we support the view of market efficiency.

Graph 1: Projected Synergies

source: Bayer Investor Call, September 14, 2016

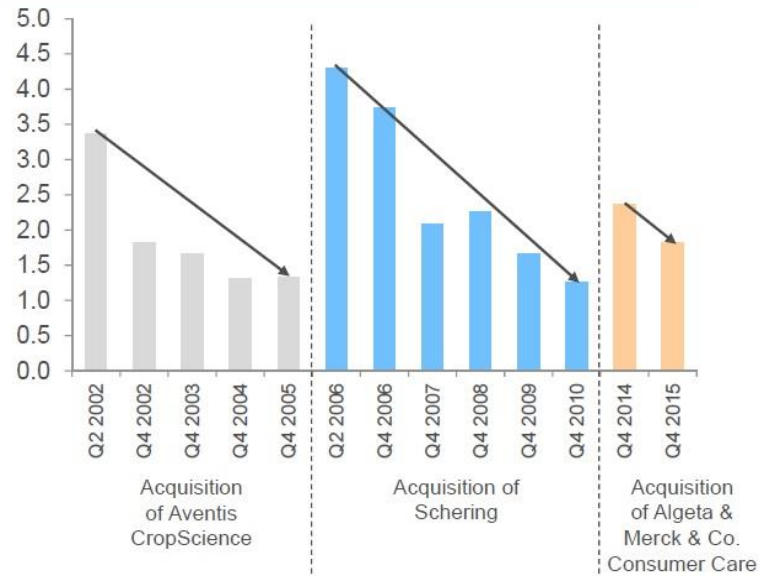
Net EBITDA Impact of Synergies



Graph 2: Deleveraging benchmarks

source: Bayer Investor Call, May 23, 2016

Net Debt / LTM EBITDA Multiple*



Graph 1 was disclosed in the investor handout on the day of the final deal announcement. It depicts the total amount of synergies expected by Bayer’s management throughout the years in a post-merge setting. It seems that \$2.5bn is the estimated total synergy amount, with a total \$1.5bn harvested by end of year 3. I use this piece of information to allocate synergy gains to time periods in the DCF synergy valuation of Table 17. Long-term is assumed ten years post-closing. I equally allocate \$0.5bn of synergies to years 4-6 and another \$0.5bn to years 7-10 (satisfying the law of diminishing returns), thus reaching the total of \$2.5bn synergy benefits by the end of year 10. A conservative approach is adopted regarding synergy cash flows, due to evidence that “synergy does exist but that it is far more difficult to generate it in practice than it is on paper” (Damodaran, 2005, p.33-35). Thus, terminal value is set to 0.

Graph 2 was disclosed in the investor handout the day of the original offer official announcement. It presents deleveraging benchmarks from past M&A deals with the purpose of convincing investors of management’s rapid deleveraging capabilities. Acquiring total debt and market value of equity historical figures for Bayer from Datastream (Thomson Reuters, 2020), I calculate historical D/E ratios in the time frame of those deals. It appears that it took the company roughly 21 quarters to deleverage back to its standard D/E ratios after closing the deals with Aventis and Schering. In addition, its average D/E ratio over the period of (beginning) Q4 2009 – Q2 2016 was 22%. I assume this as the target D/E ratio that the deleveraging process will try to achieve (quite plausible considering Bayer’s D/E ratio of 20.61% on Q1 FY16). Following the historical pattern of the deleveraging benchmarks, I, too, assume a length of 21 quarters for the deleveraging process of the Monsanto acquisition (Table 17 shows detailed calculations). From the initial post-merge D/E ratio (60.9% and 58.6% under the original and final offer scenarios respectively), I deleverage equally every quarter until it reaches the assumed target ratio of 22%, 21 quarters later. Using the varying D/E ratios over this period, I compute D/V and E/V ratios that function as inputs for the annualized, and therefore, quarterly WACC.

Table 16: Synergy Valuation: Summary of Inputs and Results
using Damodaran's K_e and $K_d=YTM$

Total offer:	\$53.41 bn		
Issued Equity:	\$15.50 bn		
Issued Debt:	\$37.91 bn		
Offer D/V:	71%		
Offer E/V:	29%		
Exchange rate 31-05-2016	1.1131 \$/€		
Bayer debt before deal:	€ 18,072		
Bayer debt after deal (combined company):	€ 61,911	37.87%	
Bayer equity before deal:	€ 87,666		
Bayer equity after deal (combined company):	€ 101,591	62.13%	
D/E after deal (combined company)	60.94%		
Monsanto Value:	\$56,296	€ 50,576	31.64%
Bayer Value:	€ 109,259	\$121,616	68.36%
Monsanto WACC:			10.74%
Bayer WACC:			7.97%
Monsanto unlevered beta:			1.19
Bayer unlevered beta:			1.01
Combined unlevered beta:			1.06
Combined LEVERED beta:			1.58
Weighted ERP:			7.76%
Ke after merge:			12.41%
Long-term target credit rating:			A
Rf:			0.16%
Kd after merge:			2.41%
Kd after Year 5 (Rf + Default Spread):			1.41%
Promised premium over fundamental price:			13.41%
Max justified premium over fundamental equity value:			3.75%
Synergy/Deal Value:			3.30%
Overpayment:			9.67%
Value of Synergy:			\$1,764
Value combined with no Synergy:			\$177,890
Value combined with Synergy:			\$179,654

Table 17: Synergy Valuation - Projected Deleveraging and DCF Model
using Damodaran's K_e and $K_d=YTM$

				PV	
Year 1	\$300 mln	sales synergies		\$276	
Year 2	\$600 mln	cost synergies		\$505	
Year 3	\$600 mln	cost synergies		\$458	
Year 4	\$167 mln	additional benefits		\$114	
Year 5	\$167 mln	additional benefits		\$102	
Year 6	\$167 mln	additional benefits		\$92	
Year 7	\$125 mln	additional benefits		\$63	
Year 8	\$125 mln	additional benefits		\$57	
Year 9	\$125 mln	additional benefits		\$51	
Year 10	\$125 mln	additional benefits		\$47	
TV	\$0 mln			\$0	
				\$1,764	
Quarter	Monsanto	Bayer	Combined (no synergy)	PV	
1	\$510	\$1,439	\$1,949	\$1,910	
2	\$498	\$1,314	\$1,812	\$1,739	
3	\$1,106	\$1,331	\$2,437	\$2,291	
4	\$1,021	\$1,453	\$2,474	\$2,276	
5	\$518	\$1,497	\$2,014	\$1,813	
6	\$573	\$1,366	\$1,939	\$1,708	
7	\$1,230	\$130,102	\$131,332	\$113,038	
8	\$1,093		\$1,093	\$919	
9	\$63,544		\$63,544	\$52,195	
				\$177,890	
Quarters	D/E	D/V	E/V	Annualized WACC	Quarterly WACC
1	60.94%	37.87%	62.13%	8.44%	2.05%
2	58.99%	37.10%	62.90%	8.52%	2.07%
3	57.05%	36.32%	63.68%	8.60%	2.08%
4	55.10%	35.53%	64.47%	8.69%	2.10%
5	53.15%	34.71%	65.29%	8.77%	2.12%
6	51.21%	33.87%	66.13%	8.86%	2.14%
7	49.26%	33.00%	67.00%	8.95%	2.17%
8	47.31%	32.12%	67.88%	9.04%	2.19%
9	45.36%	31.21%	68.79%	9.14%	2.21%
10	43.42%	30.27%	69.73%	9.24%	2.23%
11	41.47%	29.31%	70.69%	9.34%	2.26%
12	39.52%	28.33%	71.67%	9.44%	2.28%
13	37.58%	27.31%	72.69%	9.55%	2.31%
14	35.63%	26.27%	73.73%	9.66%	2.33%
15	33.68%	25.20%	74.80%	9.77%	2.36%
16	31.74%	24.09%	75.91%	9.88%	2.38%
17	29.79%	22.95%	77.05%	10.00%	2.41%
18	27.84%	21.78%	78.22%	10.13%	2.44%
19	25.89%	20.57%	79.43%	10.25%	2.47%
20	23.95%	19.32%	80.68%	10.39%	2.50%
21	22.00%	18.03%	81.97%	10.38%	2.50%

Table 16 depicts key inputs and final output of post-merge costs of debt and equity, as well as the summarized results of the DCF synergy valuation. Table 17 shows in detail the synergy cash flows used in the DCF synergy valuation (extracted using the method explained under Graph 1) and the deleveraging process, as described under Graph 2. Finally, the combined value of the firm without synergy is the sum of independent firm free cash flows in each period, discounted by the varying (due to deleveraging) combined quarterly WACC. Value combined with Synergy = Value combined with no Synergy + Value of Synergy.

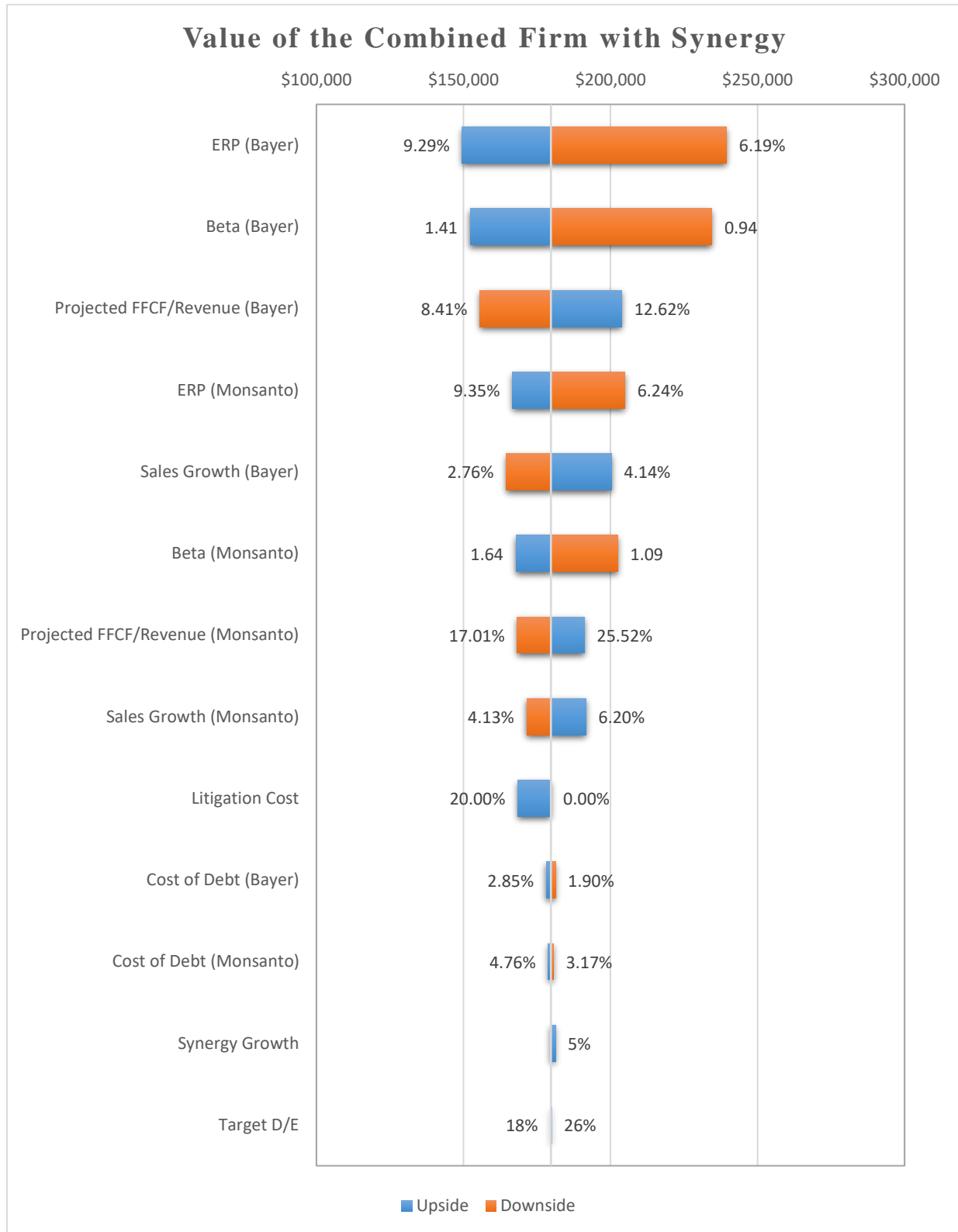
Table 18: Summary results - Fundamental Valuation

figures in millions, except prices per share

	Damodaran's Ke		Multi stage GGM Ke	
	YTM	Rf+Default Spread	YTM	Rf+Default Spread
Bayer's intrinsic price:	€ 112.47	€ 114.27	€ 106.02	€ 107.65
Monsanto's intrinsic price:	\$107.57	\$107.23	\$102.82	\$102.50
Bayer's intrinsic value:	\$121,616	\$123,314	\$115,580	\$117,126
Monsanto's intrinsic value:	\$56,296	\$56,144	\$54,218	\$54,075
Offer \$122/share, starting D/E: 60.9%				
Value of Synergy:	\$1,764	\$1,764	\$1,764	\$1,764
Value combined with no Synergy:	\$177,890	\$179,315	\$170,454	\$171,748
Value combined with Synergy:	\$179,654	\$181,079	\$172,218	\$173,512
Combined Equity Value:	\$116,123	\$117,536	\$108,686	\$109,969
Promised premium:	13.41%	13.78%	18.65%	19.02%
Max justified premium:	3.75%	3.76%	3.92%	3.93%
Synergy/Deal Value:	3.30%	3.30%	3.30%	3.30%
Overpayment:	9.67%	10.02%	14.73%	15.09%
Offer \$128/share, starting D/E: 58.6%				
Value of Synergy:	\$1,769	\$1,769	\$1,768	\$1,769
Value combined with no Synergy:	\$177,981	\$179,406	\$170,541	\$171,835
Value combined with Synergy:	\$179,749	\$181,175	\$172,310	\$173,604
Combined Equity Value:	\$116,863	\$118,277	\$109,423	\$110,706
Promised premium:	18.99%	19.37%	24.48%	24.88%
Max justified premium:	3.76%	3.77%	3.93%	3.94%
Synergy/Deal Value:	3.14%	3.14%	3.14%	3.14%
Overpayment:	15.23%	15.60%	20.56%	20.93%
<u>Averages</u>				
Bayer's intrinsic price:	€ 110.10		Monsanto's intrinsic price:	\$105.03
Offer \$122/share, starting D/E: 60.9%			Offer \$128/share, starting D/E: 58.6%	
<i>Value of Synergy:</i>	\$1,764		<i>Value of Synergy:</i>	\$1,769
<i>Sum of parts:</i>	\$174,593		<i>Sum of parts:</i>	\$174,593
<i>Combined with no Synergy:</i>	\$174,852		<i>Combined with no Synergy:</i>	\$174,941
<i>Combined with Synergy:</i>	\$176,616		<i>Combined with Synergy:</i>	\$176,710
<i>Combined Equity Value:</i>	\$113,079		<i>Combined Equity Value:</i>	\$113,818
<i>Promised premium:</i>	16.22%		<i>Promised premium:</i>	21.93%
<i>Max justified premium:</i>	3.84%		<i>Max justified premium:</i>	3.85%
<i>Synergy/Deal Value:</i>	3.30%		<i>Synergy/Deal Value:</i>	3.14%
<i>Overpayment:</i>	12.38%		<i>Overpayment:</i>	18.08%
<i>Bayer share price 31/03/2016:</i>	€ 101.63			
<i>Monsanto share price 31/05/2016:</i>	\$112.47			

This table displays summary results for multiple approaches to the cost of capital under both the original and final offer scenarios. Averaging across, reduces potential estimation errors of individual methodologies. The comparison of the two offers shows that Bayer would overpay an average minimum of 12.38%, had it even struck a deal for \$122/share instead of the final \$128/share, while eventual overpayment amounts to a substantial 18.08% over Monsanto's fundamental price.

Graph 3: Sensitivity Analysis – Tornado Diagram



Bar labels show the test range for each input variable

Values on the horizontal axis are in millions

Table 19: Sensitivity Analysis - Input Variables and Test Ranges

Input Variable	Value of the Combined Firm with Synergy			Input		
	Downside	Upside	Range	Downside	Upside	Base Case
ERP (Bayer)	\$239,527	\$149,609	\$89,918	6.19%	9.29%	7.74%
Beta (Bayer)	\$234,547	\$152,284	\$82,264	0.94	1.41	1.17
Projected FFCF/Revenue (Bayer)	\$155,586	\$203,907	\$48,321	8.41%	12.62%	10.51%
ERP (Monsanto)	\$204,918	\$166,640	\$38,278	6.24%	9.35%	7.79%
Sales Growth (Bayer)	\$164,556	\$200,410	\$35,854	2.76%	4.14%	3.45%
Beta (Monsanto)	\$202,502	\$167,846	\$34,656	1.09	1.64	1.37
Projected FFCF/Revenue (Monsanto)	\$168,311	\$191,184	\$22,873	17.01%	25.52%	21.27%
Sales Growth (Monsanto)	\$171,515	\$191,726	\$20,211	4.13%	6.20%	5.17%
Litigation Cost	\$179,749	\$168,496	\$11,253	0.00%	20.00%	0.00%
Cost of Debt (Bayer)	\$181,350	\$178,194	\$3,156	1.90%	2.85%	2.38%
Cost of Debt (Monsanto)	\$180,666	\$178,866	\$1,800	3.17%	4.76%	3.97%
Synergy Growth	\$179,749	\$181,284	\$1,534	-100%	5%	-100%
Target D/E	\$179,523	\$179,972	\$449	18%	26%	22%

Graph 3 depicts the tornado diagram for the value of the combined firm with synergy. Value drivers are stretched $\pm 20\%$ from their base cases, which are considering the final offer scenario of \$128/share and the WACC approach of $K_d = YTM$ and K_e derived from Damodaran's methodology. Blue bars on the graph illustrate the upper bound of the input variable and orange bars denote the lower bound (displayed as "Upside" and "Downside" in the legend of the chart respectively). Drivers with the largest impact appear at the top, while drivers with successively lesser impact appear at the bottom. Litigation Cost and Synergy Growth are exceptions to the deviation rule, as the first takes only the extreme value of 20% (it can't be negative) and the latter is equal to -100% for $TV=0$ in the synergy valuation model, 0% for constant synergy cash flow in perpetuity, and more than 0% if we wish to account for growth in the final planning period synergy cash flow. In the context of the sensitivity analysis, I assume 5% as the extreme synergy growth scenario. This higher ceiling is quite plausible if we consider that average sales growth for Bayer was projected at 3.45% and for Monsanto at 5.17%.

Table 19 provides more detail. The value of the combined company with synergy is presented for both the upper and lower bounds of the value drivers. The range of impact is also noted for each driver. Upper and lower bounds are also explicitly displayed, along with the base cases for each value driver.

These results suggest that Bayer's management ought to have invested generally more time and money into accurately estimating the most impactful value drivers, such as the ERP, beta and projected FFCFs, in case they employed a similar synergy valuation model. It is important to note that sensitivity analysis is just another tool for clearing the waters regarding the underlying uncertainty of an investment, and should accordingly be "viewed as a decision tool and not a decision maker that provides a clear yes or no criteria" (Titman & Martin, 2016, p.74).

Table 20: Overview of Competitors, Customers and Suppliers considered in the Event Study

<i>Competitors</i>	<i>Market Index</i>		
Johnson & Johnson	S&P 500 COMPOSITE		
Roche Holding AG	Swiss Market Index (SMI)		
Novartis AG	Swiss Market Index (SMI)		
Pfizer Inc	S&P 500 COMPOSITE		
Merck & Co Inc	S&P 500 COMPOSITE	Customers	Market Index
Eli Lilly and Co	S&P 500 COMPOSITE	Ionis Pharmaceuticals Inc	NASDAQ COMPOSITE
AstraZeneca PLC	FTSE All Share	ImmunoGen Inc	NASDAQ COMPOSITE
Bristol-Myers Squibb Co	S&P 500 COMPOSITE	Bausch Health Companies Inc	S&P/TSX COMPOSITE
Amgen Inc	NASDAQ COMPOSITE	Regeneron Pharmaceuticals Inc	NASDAQ COMPOSITE
Thermo Fisher Scientific Inc	S&P 500 COMPOSITE	Adhera Therapeutics Inc	NASDAQ COMPOSITE
Abbvie Inc	S&P 500 COMPOSITE	OZ Minerals Ltd	S&P/ASX 300
Sanofi SA	SBF 120	Merck & Co Inc	S&P 500 COMPOSITE
Yara International ASA	OSLO EXCHANGE ALL SHARE	Scotts Miracle-Gro Co	S&P 500 COMPOSITE
Scotts Miracle-Gro Co	S&P 500 COMPOSITE		
Saudi Arabia Fertilizers Co SJSC	SAUDI TADAWUL ALL SHARE		
Qinghai Salt Lake Industry Co Ltd	SHENZHEN SE COMPONENT		
CF Industries Holdings Inc	S&P 500 COMPOSITE		
Sociedad Quimica y Minera de Chile SA	S&P/CLX IGPA		
PhosAgro PAO	MOEX		
Icl Group Ltd	TA-125		
Mosaic Co	S&P 500 COMPOSITE		
UPL Ltd	NIFTY 500		
DOW Chemical	S&P 500 COMPOSITE		
Syngenta	Swiss Market Index (SMI)		
Eastman Chemical	S&P 500 COMPOSITE		
Evogene	TA-125	Suppliers	Market Index
Jiangsu Yangnong Chemical Co Ltd	Shanghai SE Composite	Teva Pharmaceutical Industries Ltd	TA-125
ADAMA Ltd	SHENZHEN SE COMPONENT	Kimball International Inc	NASDAQ COMPOSITE
PI Industries Ltd	NIFTY 500	Biogen Inc	NASDAQ COMPOSITE
OCI NV	AEX All Share	Arbutus Biopharma Corp	NASDAQ COMPOSITE
Coromandel International Ltd	NIFTY 500	Hansol Inticube Co Ltd	KOSDAQ COMPOSITE
Lianhe Chemical Technology	SHENZHEN SE COMPONENT	Huntsman Corp	S&P 500 COMPOSITE
Luxi Chemical Group Co Ltd	SHENZHEN SE COMPONENT	Jacobs Engineering Group Inc	S&P 500 COMPOSITE
Xinyangfeng Agricultural Technology	SHENZHEN SE COMPONENT	Deere & Co	S&P 500 COMPOSITE
Compass Minerals International Inc	S&P 500 COMPOSITE	Expert System SpA	FTSE Italia All Share
Taiwan Fertilizer Co Ltd	TAIEX	Grifols SA	IGBM index
Nufarm Ltd	S&P/ASX 300	Qumu Corp	NASDAQ COMPOSITE
Kingenta Ecological Engineering Group	SHENZHEN SE COMPONENT	Acura Pharmaceuticals Inc	S&P 500 COMPOSITE
K&S AG	DAX 30	Boston Scientific Corp	S&P 500 COMPOSITE
Lier Chemical Co Ltd	SHENZHEN SE COMPONENT	Nektar Therapeutics	NASDAQ COMPOSITE
Kumiai Chemical Industry	TOPIX	Salesforce.Com Inc	S&P 500 COMPOSITE
Zhejiang Hugel Leaf Co Ltd	Shanghai SE Composite	Natco Pharma Ltd	NIFTY 500
Anhui Huilong Agricultural	SHENZHEN SE COMPONENT	PeptiDream Inc	TOPIX
Novo Nordisk A/S	OMX Copenhagen	Moberg Pharma AB	OMX Stockholm
GlaxoSmithKline PLC	FTSE All Share	Compugen Ltd	TA-125
Gilead Sciences Inc	NASDAQ COMPOSITE	Evogene	TA-125
CSL Ltd	S&P/ASX 300	Ionis Pharmaceuticals Inc	NASDAQ COMPOSITE
Vertex Pharmaceuticals Inc	NASDAQ COMPOSITE	ImmunoGen Inc	NASDAQ COMPOSITE
Chugai Pharmaceutical Co Ltd	TOPIX	Regeneron Pharmaceuticals Inc	NASDAQ COMPOSITE
Jiangsu Hengrui Medicine Co Ltd	Shanghai SE Composite	BASF SE	DAX 30
Zoetis Inc	S&P 500 COMPOSITE		
Takeda Pharmaceutical Co Ltd	TOPIX		
illumina Inc	NASDAQ COMPOSITE		
Daiichi Sankyo	TOPIX		
Lonza Group AG	Swiss Market Index (SMI)		
Celltrion Inc	KOSDAQ COMPOSITE		
IQVIA Holdings	NASDAQ COMPOSITE		
BASF SE	DAX 30		

Table 21: Event Study Results
 , * and * denote 10%, 5% and 1% level of statistical significance respectively.
 Actual dates reported, except when noted otherwise

Date	Event	CARS		Competitors		CARS		CARS		CARS		CARS		CARS			
		Bayer	Monsanto	Bayer	Monsanto	Bayer	Monsanto	Bayer	Monsanto	Bayer	Monsanto	Bayer	Monsanto	Bayer	Monsanto		
10.05.2016	Preliminary Negotiations	-3.93%*	12.07%***	-0.8%*	-0.8%*	-4.92%**	-1.66%***	-3.3%*	9.18%***	-1.03%***	-4.24%	-1.84%*	-0.20%	1.12%	-0.48%	-0.31%	-0.48%
23.05.2016	Offer letter for \$122/share	-7.68%***	5.82%**	-0.30%	-0.30%	-6.80%	-1.63%	-5.58%***	7.67%**	-0.20%	-0.62%	0.73%	-2.13%	6.22%**	-0.08%	-1.27%	0.40%
14.09.2016	Deal closed for \$128/share	-1.94%	-4.73%*	-0.27%	-0.27%	-0.58%	0.55%	-1.65%	-3.12%	-0.06%	-0.17%	0.98%	-2.40%	-2.76%	-0.24%	-0.99%	0.38%
04.06.2018	Deal completion announced	-3.60%	-	0.33%	0.33%	1.74%	-3.86%	-2.76%	-	0.35%	0.77%	-3.19%	-2.65%	-	-0.16%	-1.01%	-2.67%
10.08.2018	Jury verdict-\$289.2m in losses	-12.19%***	-	-0.22%	0.76%	0.76%	-1.48%	-10.2%***	-	-0.29%	-0.90%	-0.30%	-10.6%***	-	-0.25%	0.77%	0.23%
10.10.2018	Bayer wins tentative ruling	7.31%***	-	0.60%	0.58%	0.58%	-0.40%	5.49%***	-	0.46%	-0.05%	-0.38%	7.42%**	-	0.69%**	3.08%	0.66%
22.10.2018	First Verdict reduce by \$200m	-13.04%***	-	-2.67%***	-2.99%	-2.99%	-3.14%*	-9.23%**	-	-2.06%***	-2.50%	-1.62%	-7.98%**	-	-1.36%***	-1.65%	-1.21%
04.01.2019	Second lawsuit (two-fold)	2.82%	-	0.55%	-0.16%	-0.16%	2.04%*	3.32%	-	0.45%	0.21%	1.66%	2.05%	-	0.53%	0.58%	1.51%*
15.01.2019	France herbicide ban	-0.34%	-	-0.36%	-1.81%	-1.81%	0.19%	-1.86%	-	-0.36%	-2.03%	-1.04%	-0.80%	-	-0.58%**	-2.7%*	-0.04%
19.03.2019	Bayer loses in second trial	-11.59%***	-	-0.62%	-0.69%	-0.69%	-3.11%*	-10.41%***	-	-0.59%	0.11%	-2.32%	-7.80%	-	-0.72%	0.14%	-0.67%
28.03.2019	Damages from second trial \$80.3m	2.88%	-	0.36%	-0.25%	-0.25%	-0.07%	1.84%	-	-0.10%	-0.10%	-0.09%	1.53%	-	-0.08%	1.10%	0.18%
13.05.2019	\$2.055bn damages in a third lawsuit	-3.48%	-	0.03%	-7.88%	-7.88%	-4.14%	-2.67%	-	-0.42%	-6.27%	-2.87%	-3.95%	-	-0.17%	-0.73%	-0.67%
02.07.2019	Austria herbicide ban	-1.40%	-	0.06%	-1.00%	-1.00%	1.31%	-1.36%	-	0.27%	-1.09%	0.78%	-1.12%	-	0.11%	-0.68%	1.00%
16.07.2019	Second verdict damages cut by \$55m	1.89%	-	0.63%	0.46%	0.46%	-1.04%	1.19%	-	0.64%*	-0.91%	-1.92%	0.46%	-	0.63%**	-0.25%	-1.21%
25.07.2019	\$2bn cut to \$86.7m (third lawsuit)	-2.11%	-	0.20%	1.70%	1.70%	1.21%	-0.23%	-	-0.10%	2.60%	-0.49%	-2.40%	-	-0.20%	-0.12%	1.25%
04.09.2019	Germany herbicide ban	-1.48%	-	-0.38%	-2.89%	-2.89%	1.36%	-2.02%	-	-0.10%	-1.44%	1.61%	-1.83%	-	-0.31%	-1.98%	1.03%
11.02.2020	Potential settlement announced	-1.87%	-	-0.91%**	3.38%	3.38%	0.18%	-2.01%	-	-0.76%***	4.52%	-0.36%	-1.43%	-	-0.7%*	4.29%	0.19%
24.06.2020	Settlement for \$10bn (Bayer website)	-5.89%	-	-0.20%	0.19%	0.19%	-0.67%	-5.00%	-	-0.34%	1.27%	-0.67%	-2.54%	-	-0.36%	0.72%	0.38%
25.06.2020	Settlement for \$10bn (WSJ)	-12.87%**	-	-0.67%	0.03%	0.03%	0.36%	-10.26%**	-	-0.03%	0.09%	-0.68%	-9.37%**	-	-0.17%	1.17%	-0.68%

Event Window: [0,3]

Event Window: [0,2]

Event Window: [0,1]

Competitor, Customer and Supplier stock price data was retrieved from Thomson Reuters Eikon (Refinitiv Eikon, 2020).

Competitors for Bayer were chosen from within the industry classification "GICS - Health Care/Pharmaceuticals, Biotechnology & Life Sciences".
 Competitors for Monsanto were chosen from within the industry classification "Agricultural Chemicals".

Customers and Suppliers were retrieved from the "Value Chains" section within Eikon.

The companies that comprise these groups are outlined on Table 20, along with their respective market indices.

Log stock returns are employed due to their additive properties.

The benchmark of choice for normal or expected performance is the market-adjusted model.

Monsanto's results are naturally reported only for dates that it was still listed in the New York Stock Exchange.

The study reveals:

i) Mild impact of the deal on competitors, customers and suppliers.

ii) Sizeable favourable impact on Monsanto.

iii) Remarkable negative impact on Bayer, mostly due to subsequent litigation costs incurred after deal completion.

Table 22: Litigation Costs*Amounts in millions.*

Date	Market Value	% Loss/Gain	Loss/Gain
10-08-18	€ 87,194	-12.19%	(€ 10,629)
10-10-18	€ 69,951	7.31%	€ 5,113
22-10-18	€ 71,555	-13.04%	(€ 9,331)
19-03-19	€ 64,878	-11.59%	(€ 7,519)
			(€ 22,366)
44.25%	Litigation cost		(\$24,895)
72.25%	Actual Overpayment		

Dates depicted are those of litigation events that had a statistically significant impact on Bayer's share price. Bayer's market value on these dates (prior to the effect of the event) is also shown. "% Loss/Gain" considers the statistically significant effects observed in the event window (0,3). Litigation cost is defined as actual \$ loss over deal value. "Loss/Gain" shows the currency loss or gain per event, alongside total amount in EUR. USD amount is computed using the exchange rate applied in the synergy valuation model and equals \$24.9bn. Litigation cost is also defined as actual USD loss over deal value, under the final offer scenario and equals 44.25%. This leads us to the conclusion that the actual overpayment is estimated at 72.25% over Monsanto's fundamental price.

Table 23: Bayer's comparative post-acquisition financial performance*Figures in € millions*

	Q1 FY17	Q2 FY17	Q3 FY17	Q4 FY17	Q1 FY18	post-merge Q2 FY18	Q3 FY18	Q4 FY18	Q1 FY19	Q2 FY19	Q3 FY19	Q4 FY19	Q1 FY20
Sales	€ 13,244	€ 12,193	€ 8,025	€ 8,596	€ 9,138	€ 9,481	€ 9,905	€ 11,062	€ 13,015	€ 11,485	€ 9,830	€ 10,750	€ 12,845
EBITDA	€ 3,893	€ 3,056	€ 2,204	€ 1,783	€ 2,896	€ 2,335	€ 2,202	€ 2,065	€ 4,188	€ 2,927	€ 2,291	€ 2,483	€ 4,391
Net Income	€ 2,083	€ 1,224	€ 3,881	€ 148	€ 1,954	€ 1,409	€ 1,165	€ 1,074	€ 2,500	€ 1,595	€ 1,138	€ 1,269	€ 2,623

source: investor.bayer.com (quarterly investor handouts). For Net Income data prior to Q2 FY18, see annual and interim reports

A.Ghosh (2001) documents that operating performance significantly increases following acquisitions that are made with cash – such as the deal under scrutiny. While quarterly sales ramped up fairly early, they were significantly lower than the sum of average quarter sales of individual companies (Q2 FY15-Q1 FY16 for Bayer and Q4 FY15-Q3 FY16 for Monsanto) equal to €14,523, computed using Tables 2 and 3, and applying the exchange rate of 1.1131 for Monsanto's sales. EBITDA and Net Income seem to seasonally spike around the first quarter of Bayer's fiscal year but remain fairly stable for the remaining periods and comparable to their pre-merge levels.

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