CFA Institute Research Challenge

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Team A

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Merck & Co., Inc.

New York Stock Exchange (NYSE)

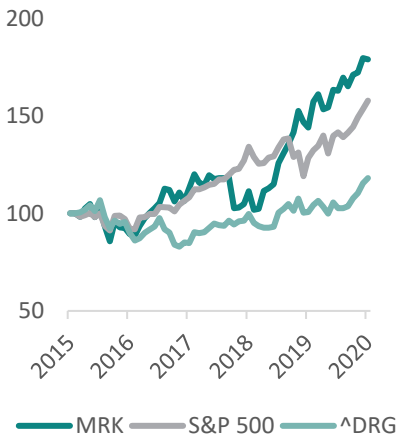
Ticker: MRK
Sector: Healthcare
Industry: Drug Manufacturers - General

Current Price (as of Jan 21, 2020): $89.97
Target Price: $100.94
Recommendation: BUY (12.2% upside)

Price Highlights	
Valuation Date	01-21-20
Share Price	89.97
52 weeks high	92.64
52 weeks low	72.05
Avg. daily vol. (mil.)	8.14
Market cap (bil.)	231.6
Shares out. (bil.)	2.55
Free float	99.9%

Source: Capital IQ

Relative Price Performance



Source: Yahoo Finance

Investment Summary

We issue a BUY recommendation on Merck & Co., Inc. (NYSE: MRK) with a target price of $100.94, representing 12.2% upside. We believe Keytruda is the beginning of MRK's fundamental pivot to the high-margin oncology market. This transition will allow MRK to grow consistently even in the long run.

Best-Selling Drug Ushering Strategic Pivot to Oncology

Any discussion of MRK's market value should begin with Keytruda, the company's anti-PD-1 immuno-oncology drug that has been a core revenue driver since 2016. Keytruda generated 22% of MRK's total LTM sales, with a 62.5% YoY growth in 3Q19. With an abundance of opportunities for indication expansion in the pipeline, Keytruda is expected to maintain steady growth into mid-2020s and possibly become the best-selling drug in history. The success of Keytruda is not an accident but represents MRK's concerted effort to pivot to the fast-growing high-margin oncology market from its primary care business. This transition will continue as MRK broadens its oncology assets through strategic collaborations with other large pharma and bolt-on acquisitions of early-stage innovators.

Non-Cyclical Industry Enjoying Favorable Macro-Trends

The relatively low demand elasticity for prescription drugs makes pharma a defensive industry, an attractive trait in a time of heightened economic uncertainty. Pharma also benefits from ongoing demographic shifts. In developed countries, aging population becomes more susceptible to chronic illnesses such as cancer, further justifying MRK's strategic pivot. In developing countries, healthcare demand is accelerated by the combination of population growth and economic expansion. Moreover, efficiency improvement made possible by adoption of AI technology will be another driver of industry growth. Brand-name developers like MRK will especially benefit from AI's ability to reduce drug discovery costs. We are confident that these industry-level macro-trends provide a solid foundation for MRK's value appreciation in the future.

Underappreciated Value from Long-Term Growth and Margin Expansion

So much of the story around MRK focuses on Keytruda, the patent of which will eventually expire in 2028, that analysts often adopt a short-term perspective when evaluating MRK. However, we believe MRK's value lies in the long-run and that Keytruda is only the beginning of MRK's emergence as an oncology, and likely immunology, powerhouse. Its growth will be persistent and continue even after Keytruda's LOE. Our DCF model based on our forecasts predicts a target price of $100.94. Relative valuation offers support as well.

Excellent Governance and Risk Management Protect Shareholder Interests

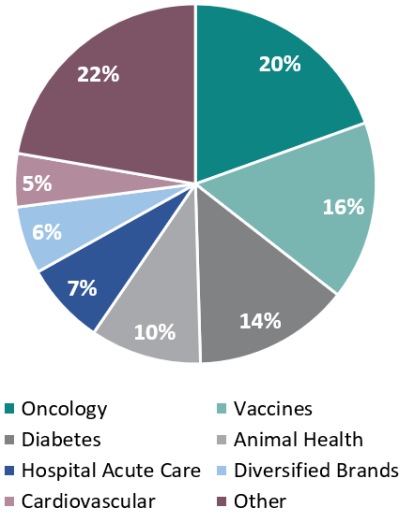
The most crucial risks that can hamper the realization of target price include: 1) underperformance in sales of key products, 2) failure to replace Keytruda with equally successful products, and 3) regulatory pressure towards drug price reduction. Fortunately, the company has displayed considerable efforts in mitigating and managing these risks, through both operational (e.g. pipeline diversification) and legal (e.g. lobbying) channels. MRK also outperforms its industry peers in governance metrics, showing commitment to protecting shareholder rights and interests. In addition, MRK's conscientious endeavors in CSR and sustainability will allow its stock to benefit in a world where ESG excellence is gaining an increasing premium.

Key Statistics	2017A	2018A	2019E	2020E	2021E	2022E	2023E	2024E
Revenue (mil. USD)	40,121	42,294	47,090	48,973	50,932	52,970	55,088	57,292
Revenue growth (%)	0.79%	5.42%	11.34%	4.00%	4.00%	4.00%	4.00%	4.00%
EBIT Margin (%)	20%	23%	34%	37%	37%	38%	38%	39%
EBITDA Margin (%)	11.51%	10.69%	9.27%	9.29%	9.13%	8.99%	8.72%	8.47%
Net Income Margin (%)	5.97%	14.71%	22.78%	25.25%	25.68%	26.11%	26.54%	26.96%
EPS (USD)	3.98	4.34	5.18	5.69	6.34	6.60	6.86	7.51
EPS Growth (%)	5.29%	9.05%	19.32%	9.92%	11.39%	4.14%	3.85%	9.50%
Dividend (USD)	1.88	1.92	2.13	2.17	2.22	2.26	2.31	2.35
ROIC (%)	17%	21%	34%	36%	36%	35%	35%	34%

Source: Capital IQ, Team Analysis

Business Description

Figure A1: Revenue Distribution by Product Category



Source: Company Data

Established in 1891, Merck & Co., Inc. has since been a prominent constituent of the American pharmaceutical industry, with early achievements including the discovery of vitamin B1, the development of the first measles vaccine, and the mass production of penicillin. Over time, MRK has transformed into a multinational pharmaceutical company that develops and markets prescription medicines, vaccines, biologic therapies, and animal health products. Incorporated and headquartered in Kenilworth, New Jersey, the company operates in more than 140 countries, serving communities across all stages of economic development.

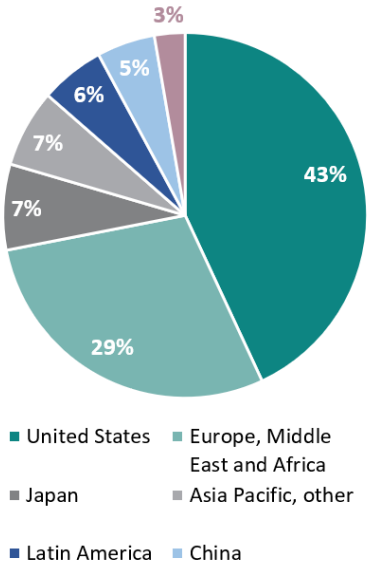
Diverse Product Offerings Headlined by Blockbuster Keytruda

MRK divides its business into four operating segments, namely the Pharmaceutical, Animal Health, Healthcare Services, and Alliances segments. Generating 89% of MRK's sales in 2018A, the Pharmaceutical segment represents the core business of MRK. It consists of multiple categories of products, with the main ones being oncology, vaccines, hospital acute care, and diabetes. The strong rally of MRK's stock price over the past two years can be mostly attributed to stellar performance of Keytruda (pembrolizumab), the company's anti-PD-1 therapy that assists the body's immune system in fighting cancer. Keytruda has the potential to surpass AbbVie's Humira to become the best-selling drug in history by 2023. Other noteworthy products by MRK include Januvia/Janumet (type-2 diabetes), Gardasil (HPV vaccine), Isentress (HIV antiviral), and Bridion (hospital acute care).

China Bolsters the Growth of International Markets

Although the U.S. has always been MRK's most important market (43% of total revenue in 2018A), MRK has been successful in expanding its business presence within international markets. Such global presence allows the company to explore healthcare demand opportunities across economic spectrum. While MRK often sells its products at a price discount in international markets, the high unmet demand, combined with large contribution margin intrinsic to pharmaceuticals, means international businesses will continue to be a major source of earning. In particular, the Chinese market, which represented only 5.2% of total revenue in 2018A, has been growing at a rapid rate (79% YoY in 3Q19A), thanks to favorable demographic, economic, and regulatory shifts. Major growth opportunities ahead include entry into China's National Reimbursement Drug List (NRDL) by Keytruda and other best-sellers.

Figure A2: Revenue Distribution by Geographic Area



Source: Company Data

Robust Pipeline to Sustain Revenue Growth

Pharmaceutical developers like MRK face the unique challenge of sharp revenue cliff once the patents of their brand-name drugs expired and market share devoured by generics and biosimilars. Specifically, MRK's second most important asset, Januvia/Janumet, will lose its exclusivity in 2022 and Keytruda in 2028. Though there is still a long runway before the loss of exclusivity (LOE), MRK invests heavily in internal R&D to develop a robust pipeline of potential products that can offset future revenue vulnerabilities. Of particular interest are phase 2 HIV-1 infection treatment Islatravir, phase 3 pneumoconjugate vaccine V114, and phase 3 chronic cough medication gefapixant. Success with these pipeline products can also diversify MRK away from concentration in oncology. Results from associated clinical trials will be near-term catalysts for share price movement.

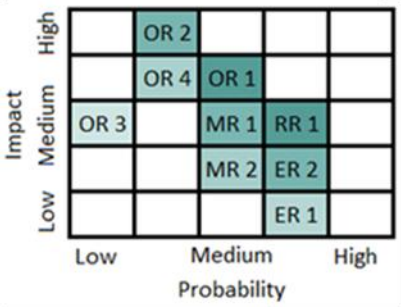
R&D Augmented by Strategic Business Development

Other than internal R&D, MRK also actively engages in M&A activities to acquire assets that can complement its existing portfolio. However, management makes clear its intention to avoid large-scale M&A transactions, which can be costly, complex, and disruptive, and prioritize small- to mid-sized deals that are compatible with MRK's research direction. Highlights of the company's recent M&A transactions include the acquisitions of Immune Design, Peloton Therapeutics, Tilos, and Arqule, all of which have developed promising assets that can solidify MRK's leadership position in immuno-oncology (IO). However, the company does engage in strategic alliances with large pharma on the development and sales of specific drugs, such as oncology drugs Lynparza (AstraZeneca) and Lenvima (Eisai), and cardiovascular medicine Adempas (Bayer AG).

Disciplined Capital Allocation Delivers Cash to Shareholders

With high cash flow from Keytruda's recent success and relatively low spending on M&A, MRK returns its excess cash to shareholders through dividends and shares repurchases. Annual dividend per share jumped by 15% to $2.20 in 2019A, with another 11% increase expected for 2020E. Over the long-run, MRK aims for a dividend payout ratio of 47-50%. The company also spent $9.1B in stock repurchases in 2018A and $3.7B in 2019A. High cash return suggests the company pursues a disciplined capital allocation strategy that assigns capital to the most productive uses foreseeable. MRK's stock should especially appeal to shareholders who prefer a healthy source of current income.

Figure E1: MRK Risk Matrix



Source: Team Analysis

Figure E2: Mitigating Factors

Risks	Mitigating factors
Underperformance in sales of key products	Diversification of product offering
	Expansion of drug indications
Failure to replace Keytruda with equally successful products	Investment in R&D
	Bolt-on acquisitions of compatible drug developers
Disruption to operations due to cyber-attacks	Modernization of IT systems
	Insurance
Unexpected safety and efficacy concerns	Control systems improvement
	Increased testing through AI
Regulatory pressure towards price reduction	Lobbying
Intense competition from generic and biosimilar products	Legal defenses
	Patent term extension
Slowdown of revenue growth in the Chinese market	Aging Chinese demographics
	Increased purchase of foreign drugs
Unfavorable exchange rates fluctuations	Hedging through forward contracts and options
Possibility of global economic downturn	Counter cyclical industry
	Still strong macro-economic conditions

Source: Team Analysis

Investment Risks

Underperformance in Sales of Key Products (Operational Risk 1)

In 3Q19A, 5 drugs (Keytruda, Gardasil, Januvia, Janumet, and Bridion) generated 49% of MRK's total revenue. Any events that adversely affect the market conditions of these products can weaken the company's top-line performance and cash flow. For instance, Keytruda's dominant position in the PD-1/PD-L1 immunotherapy market can be undermined by the drug's close competitor Opdivo and newcomers like Roche's Tecentriq and AstraZeneca's Imfinzi. MRK preserves key products' market share by consistently expanding their indications and diversifies its offering by building a strong product pipeline.

Failure to Replace Keytruda with Equally Successful Products (Operational Risk 2)

The main source of the stock's recent rally is the sustained sales growth of Keytruda (62% growth to $3.1B in 3Q19A). However, MRK loses exclusivity of Keytruda in 2028. After that, the drug's profitability will significantly deteriorate due to generic competition. To maintain its position as a leader in the pharmaceutical industry, MRK needs to develop products that can replicate Keytruda's success within the next decade. Therefore, MRK invests heavily in R&D ($3.2B in 3Q19A) and engages frequently in bolt-on acquisitions. Its recent acquisitions such as Peloton Therapeutics ($2.2B), Tilos ($773M), and ArQule ($2.7B) will help bolster MRK's oncology pipeline.

Disruption to Operations due to Cyber-Attacks (Operational Risk 3)

The company relies on sophisticated IT systems for its operations. Intentional or accidental disruption to such systems could impact key business processes. In 2017, MRK was victim to a ransomware attack due to vulnerability in one of its Ukraine offices. It suffered a $260M loss in sales and incurred $285M in remediation-related expenses. In particular, the resulting business disruption forced MRK to borrow $240M worth of Gardasil from CDC stockpile to fulfill orders. As a preventive measure, the company has dedicated considerable efforts in modernizing its IT systems. It has also insured against potential costs from future cyber-attacks.

Unexpected Safety and Efficacy Concerns (Operational Risk 4)

Drugs face constant surveillance over their side-effects and efficacy even after successful clinical trials and regulatory approval. Safety and efficacy concerns can lead to recalls, withdrawals, or adverse labeling of marketed products. In early 2000s, MRK had to withdraw its arthritis drug Vioxx due to evidence of increased risk of heart attack in patients. Eventually, the company paid $950M to settle a criminal charge over the marketing and sales of the drug. To prevent similar incidents from occurring again, the company has since strengthened its control systems and used AI to more quickly discover drug vulnerabilities.

Regulatory Pressure towards Price Reduction (Regulatory Risk 1)

Health care reform is a center of contention for the 2020 election cycle. Prescription drug price reduction has become a key item in the agenda of politicians across the aisle. Recent proposals include the Prescription Drug Pricing Reduction Act (PDPRA), which would establish a cap on out-of-pocket Medicare Part D spending, and Lower Drug Costs Now Act, which would adopt international reference pricing to bring U.S. drug prices more in-line with international peers. The White House is also considering direct importation of prescription drugs from other countries, particularly Canada. MRK, along with other pharmaceutical companies, continues its lobbying efforts to advocate for more favorable changes in price reform.

Intense Competition from Generic and Biosimilar Products (Market Risk 1)

Companies producing lower-cost generic drugs often challenge the duration and extent of MRK's patents. Also, patent protection is often significantly weaker in countries outside of the U.S. and the EU. Many governments favor early adoption of generic and biosimilar products as a means to reduce medical spending. Earlier-than-expected LOEs can lead to sharp deterioration in long-term sales. Fortunately, MRK has been able to consistently defend its patents in courts and get approval on patent term extension.

Slowdown of Revenue Growth in the Chinese Market (Market Risk 2)

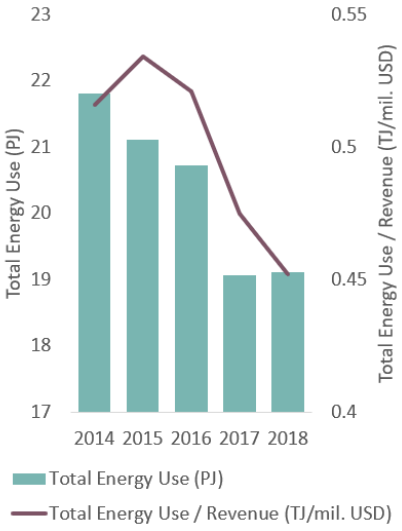
Though sales from China represented only 7.4% of total sales in 3Q19A, it saw YoY growth of 79%. This growth is expected to continue due to the country's rapidly aging demographics and its government's increased willingness to import foreign drugs. The 2019 update to the NRDL, which specifies drugs covered by China's state medical insurance, adds MRK's diabetes drug Janumet. However, Keytruda failed to make the list. Future expansion into the market may also come at the cost of decreased profitability, since additions to the list faced average price cuts of 61%.

Figure F1: Top Institutional Shareholders

Institution	% of Shares Out.
Vanguard Group	8.2%
Blackrock	7.3%
State Street Corporation	4.5%
Capital World Investors	3.2%
Wellington Management	2.3%
Bank of America Corporation	1.8%

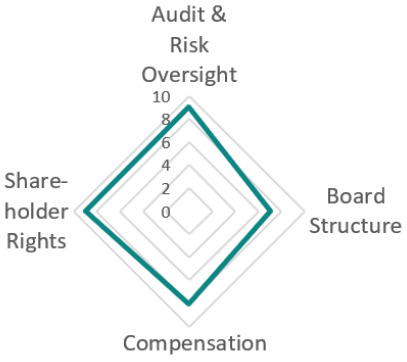
Source: Yahoo Finance

Figure F2: Energy Conservation Effort



Source: Company Data

Figure F3: Corporate Governance Assessment



Source: Team Analysis

Unfavorable Exchange Rates Fluctuations (Economic Risk 1)

MRK's foreign sales (57% of total revenue in 2018A) are mostly denominated in local currencies. Financial transactions further expose the company to currency and interest rate fluctuations. For 2019A, foreign exchange movements had a negative impact of 2% on revenue and 1% on earnings. MRK hedges its exposure through put options, forward contracts, and collars. After consideration of the hedging program, the expected strengthening of the dollar would benefit the company's net income.

Possibility of Global Economic Downturn (Economic Risk 2)

Having experienced an exceptionally long period of economic expansion, many investors are concerned with a new global recession, which can bring about significant decrease in economic activities. Drug wholesalers, hospitals, government agencies, and healthcare providers may reduce their purchases for the company's products or demand lower prices. Credit conditions may also worsen, increasing the company's financing costs. Fortunately, pharma is a relatively non-cyclical industry with low demand elasticity. Merck is likely to outperform companies in more cyclical industries.

Corporate Governance

Board of Directors and Management

MRK values independence, diversity, and industry expertise when forming its board. Kenneth Frazier serves both as CEO and as chairman. However, this will likely change as he is expected to soon retire and step down from the CEO position. A succession plan is in place. The other 11 directors are all independent. One-third of the board consists of female directors. All directors stand for re-election every year. There are four committees, overseeing audit, compensation & benefits, governance, and research, respectively. For 2018A, base salary constituted 19% of senior management's total compensation. Of the variable remuneration, a quarter was cash incentive based on current-year performance and the rest was stock options and grants based on a three-year performance period. Since the inception of say-on-pay advisory vote in 2011, MRK has consistently garnered ~95% approval for its executive compensation proposals. Sustainability objectives are not explicitly linked to compensation.

Stock Ownership Distribution and Stockholder Rights

Insiders own less than 0.1% of MRK's outstanding stocks. 77% of the free float is owned by institutions, which are mostly traditional investment managers that hold the stock either in market index funds or in large-cap growth-style funds. Top investors include Vanguard, BlackRock, and State Street. Every common share carries equal voting rights. Significant company transactions, e.g. M&A, require shareholders' approval. MRK conducts shareholder outreach programs twice a year, with participation from chairpersons representing the Governance Committee, the Audit Committee, and the Compensation Committee. Outreach efforts focus on the 30 largest shareholders, which collectively represent ~43% of company ownership.

Takeover Defense and Activist Shareholders

The board has authority to issue essentially unlimited capital stocks without prior shareholder approval. 80% shareholder approval is required for acquisition by interested shareholder without board approval. Ownership threshold for becoming an interested shareholder is 5%. There is also a golden parachute provision for senior management in the event of a change of control. However, there is no poison pill and no staggered board. MRK faces no significant threat from investor activism. No activist controls more than 0.1% of MRK's shares. In 2019, an activist proposal requiring board chairman to be independent was not approved.

Business Ethics and Controversies

MRK prepares annual corporate responsibility reports in accordance with the Global Reporting Initiative (GRI) standards, disclosing the economic, environmental, and social impacts of its operations. It also publishes both an internal Code of Conduct and a Business Partner Code of Conduct, enumerating the ethical principles that its employees and business partners are expected to follow. However, related corporate policies are stated in general terms and lack clear guidance. MRK is committed to responsible pricing and promises not to increase the average net price across its portfolio of products by more than annual inflation. Though the company has steered clear of major controversies since the Vioxx scandal in early 2000s (see Investment Risks OR4), it has faced allegation from Oxfam that it systematically shifted to profits to tax havens and been investigated by the UK for alleged anti-competitive practices.

Social Responsibility and Environmental Sustainability

As a pharmaceutical company, MRK directs its philanthropic efforts mainly towards providing people in underserved communities access to high-quality health care. Since its inception in 1957, the company's charitable foundation has dedicated $921M in supporting global initiatives that target diseases such as Alzheimer's, cancer, diabetes, and HIV/AIDS. MRK's vaccine donation program has contributed to the eradication of onchocerciasis (river blindness) and lymphatic filariasis (LF) in many developing countries. The company's sustainability strategy includes setting specific targets to minimize its operations' overall environmental impact. By 2025, at least 50% of purchased electricity will come from renewable sources, at least 50% of production sites will send zero waste to landfill, and greenhouse gas emissions will be reduced by at least 40% from 2015 levels. MRK is on track of meeting all of its sustainability targets.

Relative Valuation

For MRK's peers, we selected 11 multinational large-cap biotech or pharmaceutical companies, as they best mirror MRK's core businesses. We examined three multiples commonly used in relative valuation: 1) TEV/Revenue, 2) TEV/EBITDA, and 3) P/E. These multiples are all applicable because our sample includes only mature companies with comparable revenue and significant cash flow generation. To calculate representative multiples, we chose weighted average based on market cap instead of simple average because MRK has a greater market cap than most of its peers. Companies closer in size should better represent MRK. TEV/EBITDA and P/E give implied prices of $99.48 and $100.79, respectively, closely matching our target price of $100.49 derived from DCF. However, MRK is trading rich compared to its peers based on TEV/Revenue. This may suggest that the market expects MRK to grow its revenue more consistently than its peers.

Peers	Market Cap (mil. USD)	TEV/Revenue (x)	TEV/EBITDA (x)	P/E (x)
AbbVie	130,136	4.8	10.2	40.4
Amgen	143,489	6.5	12.8	18.6
AstraZeneca	133,679	5.9	35	60.5
Bristol-Myers Squibb	156,404	6.2	19.2	19.3
Eli Lilly	134,015	6	20.2	30.9
GlaxoSmithKline	118,266	3.8	11.5	20.1
Johnson & Johnson	392,596	5	14.4	28.5
Novartis	216,654	4.2	12.5	30.7
Pfizer	224,187	5.1	12.1	14.3
Roche	289,069	4.7	12.3	24
Sanofi	127,703	3.7	12.4	36.3
Merck	231,608	5.5	13.9	25.4
Multiples				
High		6.5	35	60.5
Low		3.7	10.2	14.3
Weighted Average		5.0	15.1	28.2
Implied Price				
High		$109.86	$241.05	$216.59
Low		$59.31	$64.93	$51.19
Weighted Average		$83.53	$99.48	$100.79

Source: Capital IQ, Team Analysis

Sensitivity Analysis

We conducted sensitivity analysis to evaluate how variance in key drivers can affect the realization of our target price. We examined MRK's near-term growth, which we project to be at 4%, and its EBIT margin by 2024, which we expect to reach 39%. Results suggest that deviation of these drivers from our projections can have meaningful effect on share price. However, the upside potential is significant enough that the stock

deserves a BUY recommendation under most scenarios. We also performed a Monte Carlo simulation based on these two drivers to arrive at a distribution for target share price. The result reaffirms our findings here.

Near-term Growth Rate	EBIT Margin by 2024				
	29%	34%	39%	44%	49%
2.0%	88.60	91.15	93.70	96.25	98.79
3.0%	92.03	94.64	97.25	99.86	102.47
4.0%	95.60	98.27	100.94	103.61	106.29
5.0%	99.29	102.03	104.77	107.50	110.24
6.0%	103.13	105.93	108.74	111.54	114.34

Source: Team Analysis

Appendix

Appendix A1: Core Pharmaceutical Products

Product	Category	Sales in 2018 ($ in mil.) [% of Total Sales]	Clinical Uses
Keytruda	Oncology	7,171 [17.0%]	Immuno-therapy for melanoma, lung cancer, head and neck cancer, Hodgkin lymphoma, and stomach cancer
Januvia/Janumet	Diabetes	5,914 [14.0%]	Treatment for type 2 diabetes through regulation of body insulin levels
Gardasil/ Gardasil 9	Vaccines	3,151 [7.5%]	Prevention of diseases caused by human papilloma virus (HPV)
ProQuad/M-M-R II/Varivax	Vaccines	1,798 [4.3%]	Prevention of virus infections such as measles, mumps, rubella, chickenpox
Zetia/Vytorin	Cardiovascular	1,355 [3.2%]	Treatment for high cholesterol
Isentress/ Isentress HD	Virology	1,140 [2.7%]	Treatment for human immunodeficiency virus (HIV)
Bridion	Hospital Acute Care	917 [2.2%]	Restoration of muscle function after surgical procedures
Pneumovax 23	Vaccines	907 [2.1%]	Prevention of infection caused by pneumococcal bacteria
NuvaRing	Women's Health	902 [2.1%]	Vaginal ring used as contraception to prevent pregnancy
Simponi	Immunology	893 [2.1%]	Treatment for rheumatoid arthritis, psoriatic arthritis, ankylosing spondylitis, or ulcerative colitis

Source: Company Data, Drugs.com

Appendix A2: Upcoming Patent Expiration

Product	Sales in 2018 ($ in mil.) [% of Total Sales]	Year of Expiration (U.S)	Year of Expiration (EU)	Year of Expiration (Japan)
Januvia	3,686 [8.7%]	2022	2022	2025-2026
Janumet	2,228 [5.3%]	2022	2023	N/A
Isentress	1,140 [2.7%]	2024	2022	2022
Lenvima	149 [0.4%]	2025	2021	2026
Simponi	893 [2.1%]	N/A	2025	N/A
Bridion	917 [2.2%]	2026	2023	2024
Nexaplanon	703 [1.7%]	2027	2025	2029
Keytruda	7,171 [17.0%]	2028	2028	2032
Gardasil	3,151 [7.5%]	2028	2021	Expired
Gardasil 9		2028	2025	N/A
Lynparza	187 [0.4%]	2028	2024	2028-2029

Source: Company Data

Appendix A3: Recent M&A Transactions

Target Company	Announced Date	Price	Research Focus
Vaki	Dec 17, 2019	Not yet disclosed	Fish health monitoring equipment
ArQule	Dec 9, 2019	$2.7B	Oncology medicine
Calporta Therapeutics	Nov 13, 2019	$576M	Neurodegenerative disorders
Tilos Therapeutics	Jun 10, 2019	$773M	Cancer, fibrosis, and autoimmune diseases

Peloton Therapeutics	May 21, 2019	$2.2B	Oncology medicine, with an attractive phase 3-ready kidney cancer drug
Immune Design	Fed 21, 2019	$300M	Vaccines that can prompt immune response to fight cancer
Antelliq	Dec 14, 2018	$2.1B	Digital monitoring on livestock health
Viralytics	Feb 21, 2018	$502M	Oncolytic immunotherapy, viruses that preferentially infect and kill cancer cells
KalVista Pharmaceuticals	Oct 10, 2017	$752M	Diabetic macular edema, a diabetes related eye disease
Rigontec	Sep 6, 2017	$465M	Cancer immuno-therapy
Vallée S.A.	Mar 22, 2017	$400M	Parasiticides, anti-infectives, and vaccines for animals
Afferent Pharmaceuticals	Jun 9, 2016	$1.25B	Chronic coughs caused by hypersensitized neurogenic conditions
IOmet Pharma	Jan 11, 2016	$400M	Cancer immuno-therapy

Source: Company Announcements, Capital IQ, Crunchbase

Appendix A4: Breakdown of Major Strategic Collaboration Partners

Company	Description
AstraZeneca PLC	Global strategic oncology collaboration to co-develop and co-commercialize Lynparza, which has been approved for several types of ovarian and breast cancer. Merck and Astra Zeneca will commercialize Lynparza in combinations with their respective PD-1 and PD-L! medicines, Keytruda and Imfinzi. The companies are also co-developing selumetinib, a drug potentially useful as treatment for non-small cell lung cancer and thyroid cancer.
Eisai	Strategic collaboration for the world-wide co-development and co-commercialization of Lenvima, a kinase inhibitor for treatment of differentiated thyroid cancer. Merck commercializes Lenvima both as monotherapy and in combination with Keytruda.
Bayer AG	Joint development and commercialization of Adempas, a soluble guanylate cyclase (sCG) modulators to treat pulmonary arterial hypertension and chronic thromboembolic pulmonary hypertension. Merck and Bayer also plan to co-develop vericiguat, which is currently in clinical trials as treatment for heart failure.

Source: Company Data

Appendix A5: Flow of Funds and Services within the System of Prescription Drug Sales

Drug manufacturers like Merck do not reach drug pricing agreements directly with health plans (insurance companies), but instead negotiate with middleman known as Pharmacy Benefit Managers (PBMs). In the process, PBMs receive fees, portion of the negotiated rebates, and oftentimes a "spread payment" between what health plans and employers pay and what PBMs pay to pharmacies as drug dispensing fee. The deals made by PBMs are not at all disclosed to the public. Thus, it is hard to determine how much money they charge for their services. PBMs' existence is becoming increasingly controversial as many government officials and healthcare service providers, including Merck, believe that PBMs' opaque practices decrease market competition and make lowering drug prices almost impossible. In his 2019 Senate testimony, Ken Frazier argued that the rebating system involving PBMs needs major overhaul before U.S. drug prices can be significantly lowered.

Appendix F1: Board of Directors

Name	Position	Age	Years of Affiliation	Background and Affiliations
Kenneth C. Frazier	Chairman, President, CEO	64	21	• Director, Exxon Mobil and PhRMA • Member, Board of Overseers, Weill Cornell Medicine • Trustee, Cornerstone Christian Academy • J.D. from Harvard Law School
Leslie A. Brun	Lead Independent Director	66	11	• Chairman and CEO of Sarr Group, LLC • Non-executive chairman, Broadridge Financial Solutions, Inc. and CDK Global, Inc. • Director, Hewlett Packard Enterprise Company and NXT Capital, Inc.
Thomas R. Cech, Ph.D.	Independent Director	72	11	• Investigator, Howard Hughes Medical Institute • Distinguished Professor, University of Colorado • Director, BioFrontiers Institute, University of Colorado • National Medal of Science, 1995 • Nobel Prize in Chemistry, 1989 • Ph.D. in Chemistry from UC Berkeley
Mary Ellen Coe	Independent Director	52	1	• President, Google Customer Solutions • Member, Ross School Advisory Board at University of Michigan • M.B.A. from Kellogg School of Management
Pamela J. Craig, CPA	Independent Director	62	4	• Former CFO, Accenture • Director, The Progressive Corporation and 3M Company • M.B.A. from New York University
Thomas H. Glocer	Independent Director	59	12	• Retired CEO, Thomson Reuters Corporation • Founder and managing partner, Angelic Ventures, L.P. • Director, Morgan Stanley • Member, Supervisory Board, Publicis Groupe • J.D. from Yale Law School
Rochelle B. Lazarus	Independent Director	71	15	• Chairman emeritus and former CEO, Ogilvy & Mather • Director, The Blackstone Group L.P. • M.B.A. from Columbia University
Paul B. Rothman, M.D.	Independent Director	61	4	• Dean of medical faculty and vice president for medicine, The Johns Hopkins University • CEO, Johns Hopkins Medicine • M.D. from Yale Medical School
Patricia F. Russo	Independent Director	67	25	• Chairman, Hewlett Packard Enterprise Company • Former CEO and director, Alcatel-Lucent • Director, General Motors Company and KKR Management LLC
Inge G. Thulin	Independent Director	65	2	• Former chairman, president, and CEO, 3M Company • Director, Chevron Corporation • M.B.A. in Economics and Marketing from Gothenburg University
Wendell P. Weeks	Independent Director	59	16	• Chairman, president and CEO, Corning Incorporated • Director, Corning Incorporated and Amazon.com, Inc. • M.B.A. from Harvard Business School
Peter C. Wendell	Independent Director	68	16	• Managing director, Sierra Ventures • Faculty, Stanford University Graduate School of Business • Senior advisor and director, WestBridge Crossover Fund, LLC • M.B.A. from Harvard Business School

Source: Company Data, Capital IQ, Thomson Reuters Eikon

Appendix F2: Senior Management

Name	Position	Age	Years in Position	Background and Affiliations
Sanat Chattopadhyay	EVP and President, Manufacturing Division	59	4	• SVP, Operations, Merck Manufacturing Division, 2009-2016 • SVP, New Products & Process Development, Wyeth Pharmaceuticals 2007-2009
Frank Clyburn	EVP, Chief Commercial Officer	54	1	• President, Global Oncology Business Unit, Merck & Co., Inc., 2013-2018 • VP, Oncology & Internal Medicine Business Units, Sanofi Aventis, 2004 – 2008 • Director, DowDuPont Inc.
Robert M. Davis	EVP, Global Services, and CFO	52	4	• Corporate VP and president, Baxter Medical Products, 2010-2014 • Director, Baxter Finco BV, C. R. Bard, Inc., and Duke Energy Corporation • J.D. from Northwestern University School of Law • M.B.A. from Kellogg School of Management
Richard R. DeLuca Jr.	EVP and President, Animal Health	56	8	• CFO, Becton Dickinson Biosciences, 2010-2011 • President, Wyeth's Fort Dodge Animal Health division, 2007-2010
Julie L. Gerberding, M.D., M.P.H.	EVP and Chief Patient Officer, Strategic Communications, Global Public Policy and Population Health	62	4	• Co-Chair, Board of Directors, Sanofi Pasteur MSD Joint Venture • President, Merck Vaccines, 2010-2014 • Director, Cerner Corporation and U.S. CDC • M.P.H. at UC Berkeley • M.D. from Case Western Reserve University
Steven C. Mizell	EVP, Human Resources	58	1	• EVP and chief HR officer, Monsanto Company, 2007-2018 • M.S. in Management and Public Policy from Carnegie Mellon University
Michael T. Nally	EVP, Chief Marketing Officer	43	1	• President, Global Vaccines, Global Human Health, Merck & Co., Inc., 2016-2018
Roger M. Perlmutter, M.D., Ph.D	EVP and President, Merck Research Laboratories	67	7	• EVP and head of Research and Development, Amgen Inc., 2001-2012 • Director, Exonics Therapeutics, Inc. • M.D. and Ph.D. from Washington University, St. Louis, Missouri
Jennifer Zachary	EVP and General Counsel	41	2	• Partner, Covington & Burling LLP, 2013-2018 • U.S. Food and Drug Administration, Associate Chief Counsel for Enforcement, 2005-2011

Source: Company Data, Capital IQ, Thomson Reuters Eikon

Appendix F3: Committee Assignments

Audit Committee	Compensation and Benefits Committee	Governance Committee*	Research Committee
Pamela J. Craig (Chair)	Thomas H. Glocer (Chair)	Leslie A. Brun (Chair)	Thomas R. Cech, Ph.D. (Chair)
Leslie A. Brun	Rochelle B. Lazarus	Pamela J. Craig	Paul B. Rothman, M.D.
Thomas R. Cech, Ph.D.	Patricia F. Russo	Thomas H. Glocer	Wendell P. Weeks
Mary Ellen Coe	Inge G. Thulin	Rochelle B. Lazarus	Peter C. Wendell
Paul B. Rothman, M.D.	Peter C. Wendell	Patricia F. Russo	
		Inge G. Thulin	

* Governance Committee is also responsible for the nomination of directors.
Source: Company Data

Appendix F4: Corporate Governance Assessment

Our analysis of the quality of MRK's corporate governance is applied to a framework established by the Institutional Shareholder Services (ISS). Highlights of MRK's governance policies are listed for four evaluation categories: Shareholder Rights, Board Structure, Compensation, and Audit & Risk Oversight.

Categories	Rating
Shareholder Rights	9/10
● Every common share carries equal voting rights.	
● Significant company transactions (M&A) require shareholders' approval.	
● There is no shareholder rights plan (also known as a poison pill).	
● Holders of 15% of common shares may call a special meeting.	
● MRK conducts shareholder outreach programs twice a year and broadcasts its annual general meetings live.	
Board Structure	7/10
● CEO serves as chairman of the board, but there is a lead independent director.	
● 11 out of 12 (92%) board members are independent, and 4 out of 12 (33%) board members are women.	
● All four board committees consist solely of independent directors.	
● Board structure is not classified or staggered.	
● Current board members have an average age of 63.7 and an average tenure of 10 years.	
Compensation	8/10
● Non-binding annual say-on-pay advisory vote has been conducted since 2011.	
● All incentive compensation paid to executives is subject to a clawback policy.	
● Compensation for executives is publicly disclosed on an individual basis and sub-divided to base salary and variable performance-based components.	
● For 2018, the ratio of CEO to median employee compensation was 228:1.	
● Social responsibility and sustainability objectives are not linked to senior management's compensation.	
Audit & Risk Oversight	9/10
● Between 2014 and 2018, the ratio of non-audit to audit fees paid to auditors was between 19% to 28%.	
● The company has employed its current auditor (PricewaterhouseCoopers) since 2002.	
● Internal audit department reports directly to the audit committee.	
● MRK has established an Enterprise Risk Management (ERM) process that is periodically reviewed by the audit committee.	
● Anonymous and confidential reporting channels are available to employees.	
Overall Corporate Governance Score	8.3/10

10	Insignificant threat to shareholders	6	Moderate threat to shareholders	2	High threat to shareholders
8	Low threat to shareholders	4	Significant threat to shareholders		

Source: 2019 Merck Proxy Statement, Thomson Reuters Eikon, ISS-oekom Report