



Stock Rating:

SELL

Target Range: \$78 – \$113

Current Price: \$107.11

Analysts

Nathan Lodes | nathan-lodes@uiowa.edu

Malachi Stille | malachi-stille@uiowa.edu

York Wang | yuehao-wang@uiowa.edu

Ryan Spaeth | ryan-spaeth@uiowa.edu

Investment Thesis

We recommend a **SELL** rating for MRNA with a target share price of \$78 – \$113 which would represent a -25% – 8% upside from its current share price. MRNA is a young biotechnology company focused solely on developing mRNA based vaccines, well-known for the COVID-19 vaccination.

Drivers of Thesis

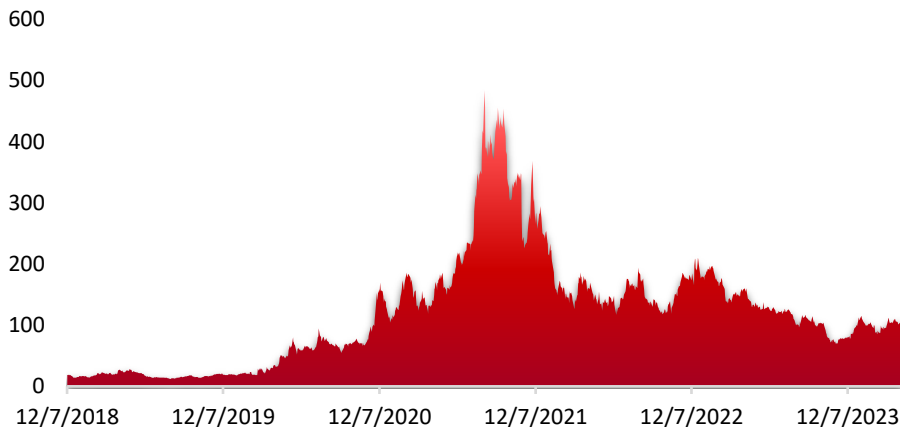
- MRNA is solely focused on mRNA vaccines and is a big up and coming player in the space, as evidenced by their quick response to developing one of the few effective COVID-19 vaccines.
- The MRNA RSV vaccine is expected to launch in 2024, which would yield significant revenues and further prove MRNA's ability to develop effective mRNA vaccines.
- MRNA's outsized pandemic gains are being heavily reinvested into R&D.
- The EU has published a new mRNA COVID vaccine tender, up to 36 million doses per year for up to four years, and MRNA is expected to receive the contract.

Risks to Thesis

- If the RSV vaccine, or any other pipeline product, fails to launch in 2024 or onwards, revenue projections will be significantly lower.
- MRNA's revenue currently comes entirely from the COVID-19 vaccine. If something happens to disrupt this market, they will be impacted significantly.

Future revenues are entirely dependent on developing new products and passing them through governmental regulations, failure to do either of these things will result in significantly lower revenue projections.

Moderna 2018-2023 Stock Performance



Company:	Moderna, Inc.
Sector:	Healthcare
Industry:	Biotechnology
Exchange:	NASDAQ [MRNA]

Financial Snapshot

Model Price Projections

DCF/EP:	\$34.51
P/S(24E):	\$113.27
P/B(24E):	\$86.69

Price Data

Current Price:	\$107.11
52-Week Range:	\$62.55 - \$156.75
% of 52-Wk Range:	43.85%
YTD Performance:	4.36%

Key Statistics:

Shares Outstanding:	400.6M
2023 EPS:	\$(12.33)
2024E EPS:	\$(0.35)

2023 Revenue:	\$6,847M
2024E Revenue:	\$5,566M
Forecasted Revenue Growth (CAGR):	7.80%
Dividend Yield:	0.00%
Market Capitalization:	39,766M
Beta:	1.68
WACC:	13.93%

Ratios

Gross Margin:	22.40%
Price-To-Sales:	5.55x
Debt-To-Equity:	0.00x
Price-To-FCF:	4.34x

Company Overview

Moderna, Inc. engages in the development of transformative medicines based on messenger ribonucleic acid (mRNA). The company was founded by Noubar B. Afeyan, Robert S. Langer, Jr., Derrick J. Rose and Kenneth R. Hien in 2010 and is headquartered in Cambridge, MA. Chien in 2010 and is headquartered in Cambridge, MA.⁴

Company Analysis

Revenue Analysis

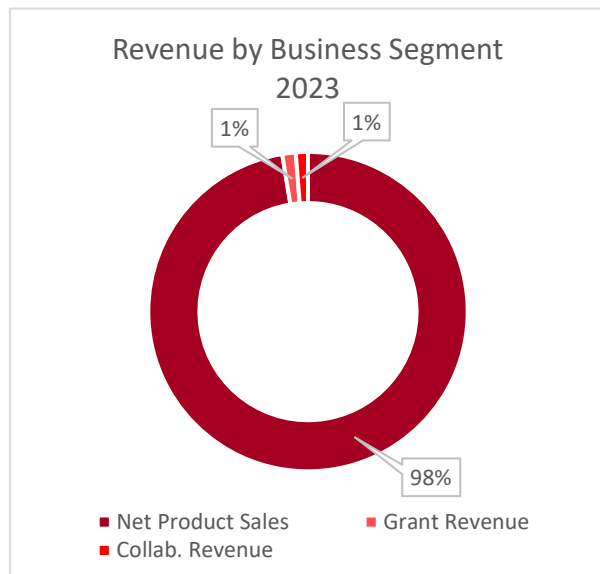
Company Overview

MRNA is relatively new to the biotechnology space with its founding in 2010 but is at the forefront of the industry with innovation in the realm of messenger RNA (mRNA) technology.

MRNA is known best for its quick development of an mRNA COVID-19 vaccine which was in high demand during the global pandemic. Since then, MRNA has continued to invest heavily in its product pipeline which encompasses many mRNA products across various programs.

Revenue Summary

Almost all of MRNA's revenues come from its flagship drug in that of Spikevax (Covid-19 vaccine). MRNA reported revenues of \$6.8B in 2023 which was a YoY decrease of -64.5% from \$19.3B in 2022. Revenues for MRNA can be split up into the following categories: Product Sales, Grant Revenue, and Collaboration Revenue.



Business Segments

Product Sales

Product Sales makes up the company's direct product revenues from regions across the globe. Spikevax, MRNA's only commercially available product, brought in \$18.4B worth of sales in 2022. Due to market saturation and loss of demand for COVID-19 vaccines, MRNA's total product sales dropped to around \$6.6B in sales for 2023, signaling a decline of more than 64% year-over-year¹⁵. For 2024, the company has forecasted sales in the range of \$6 billion to \$8 billion, slightly rebounding from the 2023 projection but still far below peak sales figures¹⁶. This proves to be a substantial risk for the company as it has no other products to fall back on. One of the products in its pipeline an RSV vaccine is expected to be approved and come to market later this year. While the other six late-stage products are anticipated to be approved by 2025. When projecting out potential revenues, MRNA is expected to have revenues of \$10.8B from these seven specific drugs by 2033.

Grant Revenue

Grant Revenue is important for young biotechnology firms like MRNA, especially during the early stages of developing a robust R&D program. With MRNA, this was most evident in 2020 and 2021, during which MRNA received \$735M and \$529M in grant revenue, respectively. The global pandemic led to this large increase in grant funding for MRNA as the United States enacted Operation Warp Speed aimed at the rapid discovery, and production of a global vaccine. Due in part to funding, MRNA was able to develop Spikevax and generate \$17.7B of revenues in 2021. The success has helped establish a foundation for MRNA moving forward. In 2023 MRNA reported grant revenues of \$93M. Management has not provided guidance as to what grant revenues are expected to be in the future. However, they should stay stable around the current 1% of total revenues generate.

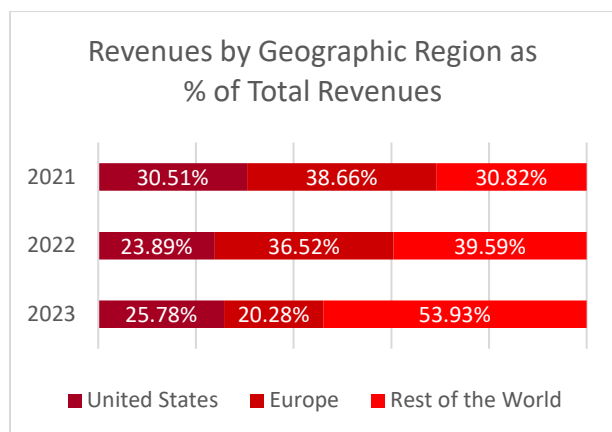
Collaboration Revenue

Collaboration Revenues are another important part of total revenues for biotechnology companies. Giving companies the ability to share resources, industry expertise, and financial risks while developing new drugs and therapies. In 2023 MRNA saw collaboration

revenues of \$84M a decrease of 82.7% from 2022. MRNA is currently in a collaboration agreement with Vertex. The first agreement was announced in 2016 with the goal of creating a traditional mRNA therapy for the treatment of cystic fibrosis. This agreement lists out various development and regulatory processes which if met will result in a payment of \$270M from VRTX, and further royalties on net product sales. MRNA entered a second agreement with VRTX in 2020, geared towards developing lipid nanoparticles and mRNA gene-editing therapies for cystic fibrosis treatments. This agreement lists out the potential for MRNA to receive \$380M if certain milestones are met, and potential future royalties. Management has proved expectation of growth related to this collaboration of around 1% but there is potential for this percentage to grow higher, if a breakthrough therapy is approved by the FDA. Previously, MRNA had collaborations with Merck and AstraZenca but both of these collaborations were terminated following the end of 2022.

Geographic Location Segments

Revenues by geography can be broken up into three categories: United States, Europe, and Rest of the World.



United States

The United States made up \$1.7B worth of total revenues for MRNA during 2023, with this all coming from the sale of Spikevax. This represents a decrease of 79.3% seen in the United States from its peak of \$5.4B in 2021. Looking forward MRNA will look to leverage its new products coming out of its pipeline to generate a large percentage of revenues, as Spikevax revenues continue to decrease in United States.

Europe

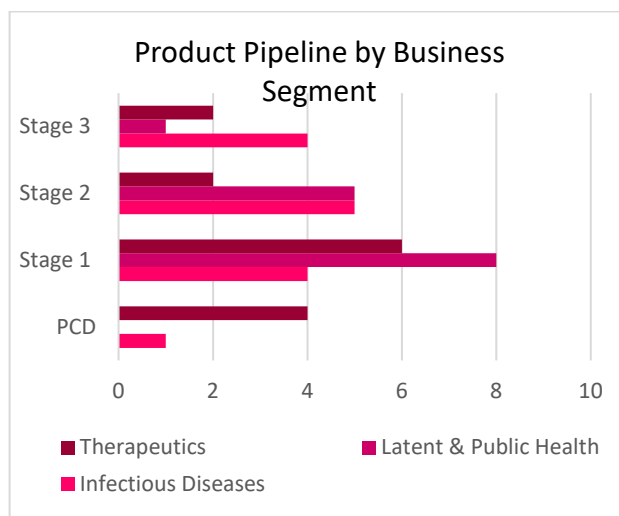
Total revenues within Europe were also on a decline in 2023 because of Spikevax, revenues were reported to be \$1.4B. Since 2021 Europe has seen a decrease of 81.4% in revenues which is the largest decrease among the three distinct geographic regions. Although, MRNA has seen poor performance in Europe this past year, new pipeline drugs which have yet to be approved are showing promise. MRNA's new mRNA COVID-19 vaccine which differs from Spikevax has already seen interest from the EU, who has pledged to purchase up to 36 million doses of this specific vaccine per year for the first four years after it is approved.¹⁰

Rest of the World

The Rest of the World generated the largest amount of revenues with \$3.6B in 2023, once again all coming from the sales of Spikevax. Management does not offer a description of the countries listed within this region; however, it can be assumed that a majority of this portfolio is made up of emerging markets. This is important because emerging markets provide MRNA with a great opportunity to expand its presence globally and develop mRNA vaccines for specific diseases predominantly found outside of the United States and Europe.

Drug Pipeline

MRNA's drug pipeline is currently made up of 42 products all built around mRNA-based technologies.²¹ These drugs sit in the following groups: Infectious Disease Vaccines, Latent & Public Health Vaccines, and Therapeutics. These three categories of products can be further split into their respective sub-categories.



The Infectious Disease Vaccines group can be split up into adult and adolescent products spanning mRNA vaccines focused on COVID-19, Flu, and RSV treatments. In total the infectious disease group is made up of 14 projects, with four projects in Stage 3 of the FDA approval process, five projects in Stage 2, four projects in Stage 1, and one project in the pre-clinical development stage. This area looks to be promising especially with MRNA's RSV vaccine and Flu + COVID-19 vaccine which are both expected to be on the market by 2025 helping to diversify the company's revenues. The Latent & Public Health Vaccines group can be split into products focusing on treatments for CMV, EBV, HSV, HIV, Norovirus, Lyme disease, and Zika virus. There are a total of 14 drugs classified under the Latent & Public Health group. One of these products is MRNA's CMV vaccine, which is currently, in Stage 3 of the FDA approval process. This vaccine is targeted at providing a treatment for CMV, a common virus belonging to the herpesvirus family. Historically, there have been companies who have tried to develop a vaccine for CMV, but who have had to terminate their projects because of failure to pass Stage 2 approval. MRNA has had great success with the drug and is hoping to bring it to market by 2026 pending approval. Besides this CMV vaccine, there are five products in Stage 2, and eight in Stage 1 underneath the Latent & Public Health group. Finally, MRNA's Therapeutic group is made up of 14 drugs, and is overall the least developed of the three distinct groups. MRNA currently has two mRNA-based cancer vaccines underneath this therapeutic category, both of them in Stage 3 of the FDA approval process, with MRNA projecting both products to reach the market by 2026. mRNA based cancer vaccines are promising and quite new to the arena of cancer treatment. These drugs are aimed at 1.) providing treatment for those currently living with cancer, and 2.) preventing future cases of cancer, by rewriting the hosts mRNA to recognize dangerous cancer cells before they develop into tumors. Outside of these two products the Therapeutic group has two products in Stage 2 approval process, six in Stage 1, and four in projects in the pre-clinical development stage. The Therapeutic group is predominantly made up of newer products in earlier stages of the approval process but has the potential to provide great growth to MRNA's revenues if these products continue to have success in clinical trials.²⁰

Expense Summary

As is the case with most biotechnology companies, MRNA witnessed a lot of its revenues going towards operating expenses necessary for continued growth of the business. Total expenditures seen in 2023 lead to a net loss for the business and can be broken out as follows.

Cost of Goods Sold

MRNA's COGS includes raw materials, personnel and facility and other costs associated with manufacturing their commercial products. Historical COGS is 33.90% of revenue on average. Management has set guidance to 35% of sales for 2024, which we have incorporated into our model. Thereafter, COGS is forecast as an average of historical years plus our inflation estimate.

Depreciation & Amortization

MRNA's D&A primarily reflects depreciation on fixed assets and technological infrastructure, vital for vaccine and therapy development and has historically been a very minor driver of expenses and is forecast to continue to be at the rate of average historical Depreciation Expense of Beginning Net PPE.

Research & Development

R&D spending is crucial to MRNA as a young biotech company. Spending following the pandemic constituted 71% of sales in 2023 at \$4.8 billion. Management expects \$4.5 billion R&D spend in 2024 and we have forecast a decline of 7% per year until they reach the average ratio of R&D to sales for the biotechnology industry of 21.7% plus an additional estimated 10% for being a young company, which levels out R&D at about 32% of Sales in 2027.¹²

Selling, General and Administrative

SG&A reflects the company's costs related to marketing, administration, and the expansion of commercial operations to support its product portfolio and digital initiatives. SG&A in 2023 took up over 22% revenue at \$1.5 billion. Management expects \$1.5 billion of SG&A in 2024, which we included in our model and thereafter projected SG&A as 17.62% of revenue to meet that expectation.

Interest Income Expense

MRNA has a lot of extra cash from the pandemic that it collects interest income on, with \$709 million in 2023. We have forecast this as a sum of beginning ST + LT Investments and Cash and Cash Equivalents at a rate of return equal to the 2-year treasury of 4.54%.

Other Expenses

MRNA's other expenses of \$124 million in 2023 show an increase, which could include various operational costs such as legal, regulatory, and other non-operational financial obligations. We forecast this expense as the historical average percentage of sales of 2.21%.

Capital Structure

Capital Summary

MRNA has always had a relatively low Debt-To-Equity ratio, however, following returns from Spikevax during the pandemic, they have completely wiped all debt from their balance sheet.

Investment

Recently, MRNA's executive team has had laser focus with regards to capital allocation. In 2022, ST Investments hit a high of \$6.6B, with LT Investments at a high of \$8.3B, and Cash and Cash Equivalents of \$3.2B. In 2023, they have liquidated about 50% of their LT Investments and about 15% of their ST Investments while maintaining Cash and Cash Equivalents of around \$2.9B. We expect ST Investments to continue to grow at the current rate of the 6-month treasury and LT Investments to continue to grow at the rate of the 10-year treasury.

Capital Expenditures

In 2023, MRNA reported CapEx of \$707M which is expected to increase in the coming years. This is a result of developing manufacturing plants in both Canada and the U.K. CapEx spending for both of these projects is projected to be around \$900M in 2024. The following year, management expects CapEx to be down significantly in 2025,¹⁰ which we have forecast as a 33% decrease thereafter.

Payout Policy

MRNA has historically paid no dividends and management does not plan on changing this at any point

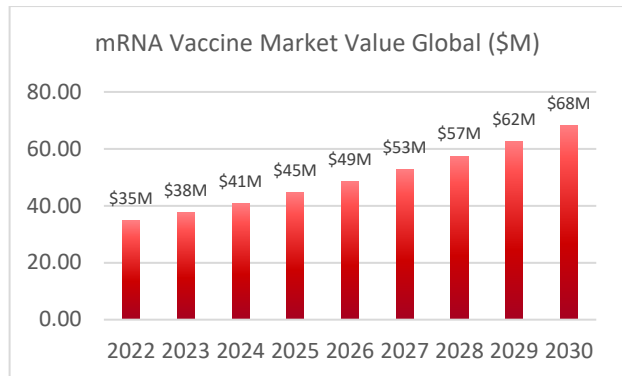
in the foreseeable future.⁸ At this point in the company's history, management is focused on the continued growth and development of the business and intends to do this through the continued reinvest of all earnings back into the company. Additionally, treasury stock does not appear on MRNA's balance sheet, thus we have not projected any share repurchases.

S.W.O.T Analysis

Strength

Innovative mRNA Platform

mRNA stands for messenger ribonucleic acid. At a high level, it is responsible for instructing cells in the body to make specific proteins. This proprietary mRNA technology has been a game-changer for MRNA, dramatically increasing the vaccine development timeframe, as evidenced by Spikevax. The technology is useful for a variety of vaccines and therapies, and MRNA has emerged as a clear industry leader with the technology. In the United States MRNA has achieved a 48% market share in the retail market for the 2023 fall season with the technology.⁷



Source: Statista¹⁷

As depicted in the graph, the mRNA market, given the new technology, is expected to explode in value by 2030 representing a 9.7% CAGR. MRNA should be well positioned to capitalize.

Top-Talent

While difficult to measure, it's evident that MRNA retains top scientists and researcher personnel surrounding mRNA technology. This should lead to

successful developments in their pipeline. Currently, MRNA has 45 programs in development, spanning infectious diseases, immuno-oncology, rare diseases and autoimmune diseases.⁷ In an attempt to quantify the talent MRNA holds, 41% of MRNA's 5,600 employees hold Ph.D., Doctorate, M.D., J.D. or Master's degrees.⁷

Promising Product Pipeline

With significant investment in R&D, totaling \$4.8 billion in 2023, MRNA is advancing a broad pipeline, including vaccines for RSV, CMV, and influenza.¹ The RSV vaccine, which stands for respiratory syncytial virus, is expected to launch commercially in late 2024.

Strategic Collaborations

In 2020 MRNA entered into a collaboration agreement with the pharmaceutical company Vertex for the discovery and development of potential mRNA medicines for cystic fibrosis.⁷ The agreement lasted three years resulting in payments each year. In 2023, Vertex paid \$82M to MRNA as part of the agreement.

Similarly in 2013 and 2016, MRNA also partnered with AstraZeneca to conduct research for mRNA vaccines in cardiovascular, cardiometabolic diseases, and cancer. These agreements provided AstraZeneca with exclusive development and commercialization rights for specific programs. MRNA received upfront payments totaling \$240 million.

Collaboration agreements remain key in MRNA's top line growth. MRNA has built connections with top firms and can continue mutually beneficial collaboration agreements which could potentially lead to the next blockbuster vaccine.

Weakness

Overreliance on Vaccine Sales:

In 2023, Approximately 97% of MRNA's total revenue is tied to Spikevax, the COVID-19 vaccine. This also means that 100% of product sales are dependent on Spikevax⁷. Due to lower vaccination rates, products sales in 2023 have dropped a harsh 64%.⁷ In addition to this, in the first half of 2023 MRNA reported product sales of \$2.1 billion. However, the majority of these sales were from advanced purchase agreements signed for delivery in 2022 that were deferred into 2023.⁹ Per management guidance, MRNA does not expect these deferred sales to repeat in 2024. This will greatly reduce top-line growth in the coming years and could pose problems if MRNA

is not able to find a competent substitute that is able to drive high sales numbers from their pipeline.

Relatively Young Company:

MRNA was founded 14 years ago in 2010 meaning they are still a relatively new company. Other than the successful commercial launch of Spikevax, MRNA has limited experience with sales, distribution, and marketing which may lead to unsuccessful future rates of return for products.⁷ Considering the shift to a more stable Covid vaccine market, much is uncertain about the future product releases of MRNA. This includes the anticipated RSV vaccine that is set to launch in late 2024.

Pipeline Risks

MRNA currently has 40 products in the developmental pipeline. Despite these prospective opportunities, the rigorous screening processes in place by the FDA may lead to the termination of certain programs within MRNA's pipeline, and potential write-offs of R&D investments. MRNA's pipeline is shallow in relation to other players in the industry. With a majority of its products in early pre-clinical development or Stage 1 of the FDA approval process. This means that a rejection by the FDA could spell disaster. A close eye must be kept with the projected 2024 launch of the RSV vaccine as a result.

Opportunity

RSV Vaccine

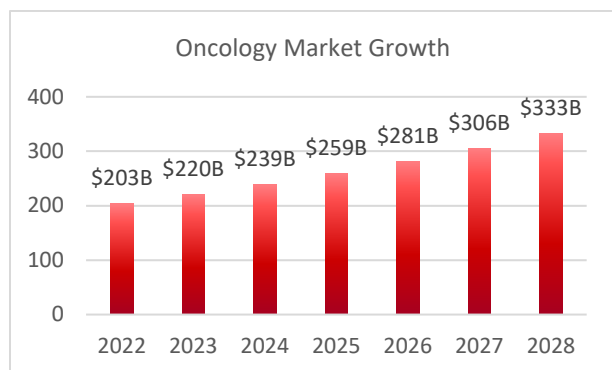
MRNA has filed for approvals for their RSV vaccine to regulatory bodies around the world. Approval is anticipated in late 2024⁹. Every year there is an estimated 60,000 – 160,000 RSV-associated hospitalizations occurred in the United States.¹⁰ The total number of cases in the U.S. is in the millions. This means there will be high demand for MRNA's upcoming vaccine and potential for huge upside in the coming year. However, it is important to note that Pfizer and GlaxoSmithKline already have outstanding RSV vaccines. Still, the RSV market is expected to be a \$10B opportunity targeting 6-8 billion older adults and 2-4 billion for pediatric and maternal care.⁶

Oncology Pipeline

Oncology is quickly becoming a focal point for many biotech companies. This has been driven by a large portion of the global population who are currently living with cancer. Within the United States, more than 18 million people had been diagnosed with cancer as of

January 1, 2022. Research shows that 1 in 2 women and 1 in 3 men will develop cancer at some point in their lifetime within the United States, and similar rates were shown for European studies. Overall, rising cases of cancer can be attributable to increased lifespans. Naturally, as humans live longer, the risk of cancer goes up.

To capitalize, MRNA currently has 2 oncology related vaccines in the pipeline that are in stage 3 of clinical trials. Around 70% of products in clinical stage 2 fail²⁶ so it is promising news that MRNA has two vaccines that have survived the scrutiny. In the event that these vaccines are able to pass regulation, commercial success is highly probable due to being the first cancer vaccine incorporating mRNA technology.



INT

INT vaccines (Individualized Neoantigen Therapies) are a specific type of vaccine that incorporate mRNA. At a high level, they target specific cells and re-write genetic code to strengthen your body's response to potential cancer cells. MRNA and Merck & Co. have entered in a 50/50 strategic collaboration and have become pioneers in INT's. They are the only companies to have two INT's in stage 3 trials. One vaccine targets melanoma and the other targets lung cancer. The potential upside if either one of these drugs come is evidently very large.

European Tender

Just recently the European Union (EU) published a new mRNA Covid vaccine tender, requesting 36 million doses per year for up to 4 years.¹⁰ According to MRNA management, they are actively preparing a bid for this tender. If they win the tender, this will boost production and provide a strong sales base almost immediately. The tender is widely expected to be won by MRNA.¹³ Pfizer currently has a tender agreement with the EU until 2026. However, the EU has come under fire from public health

officials to ensure that there is more than one vaccine available to countries, to offer a choice to people allowing MRNA to step up.

Threats

High Competition

MRNA competes fiercely in the highly competitive biopharmaceutical arena. Its only commercial product, Spikevax, contends with well-established pharmaceutical companies and their long list of products. In 2023, Pfizer achieved sales of \$11.2 billion with its mRNA-based Covid vaccine, Johnson & Johnson, using a non-mRNA technology, recorded sales of \$1.1 billion. MRNA secured \$6.6 billion from Spikevax sales, positioning it between the two giants. The competitive pressures are intensified by the rapid pace of innovation. MRNA and the other players have begun to turn their attention to developing effective booster vaccines.

Regulatory Risks

The regulatory landscape can significantly impact MRNA's operations. Delays or denials in approvals can affect the company's ability to bring products to market. Additionally, policy changes regarding vaccine patents and pricing can also pose risks.

Legal and Litigation Issues

Within the biotech and pharmaceutical industry, it is quite common for there to be patent litigations. Companies often engage in litigation over the legitimacy of patents, which is costly and time-consuming. If MRNA is swept into these disputes, it might divert allocated costs away from R&D, hurting the pipeline. Furthermore, since MRNA is a pioneer in new mRNA technology, there is the possibility that unexpected side effects occur in the recipients. While it is difficult to conclude the full effect of a potential lawsuit, it is something to be aware of. In the case of MRNA, this applies to vaccines or variants in the pipeline that might see commercial success in the coming years.

Conclusion

MRNA's S.W.O.T analysis highlights the numerous potential opportunities dependent on vaccines passing clinical trials. If certain vaccines, like the RSV vaccine, pass FDA regulation then MRNA will be poised to realize commercial success. On the contrary, if these vaccines either fail in the clinical stage or are blocked by regulatory bodies then it's time to start raising the red

flags. Should they fail, MRNA will have a tough time growing their market share since they rely on only one commercial product.

Economic Analysis

Overview

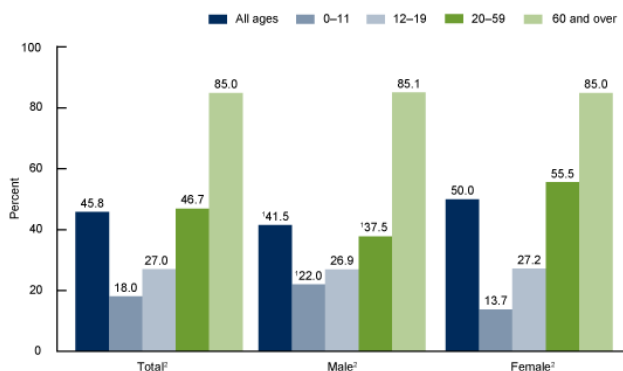
U.S. Focus

Given that MRNA operates primarily out of the United States where a large portion of its revenues come from, we chose to focus primarily on the U.S. economy. We chose a variety of factors to forecast that have a significant impact on healthcare, particularly the biotech industry: Population demographics, the Fed Funds rate and inflation measured by CPI, the unemployment rate, and real GDP growth. While many of these forecasts are not directly programmed into the model, they influence our overall assumption of a growing economy and subsequent growth in the biotech space.

Population Demographics

Relevance

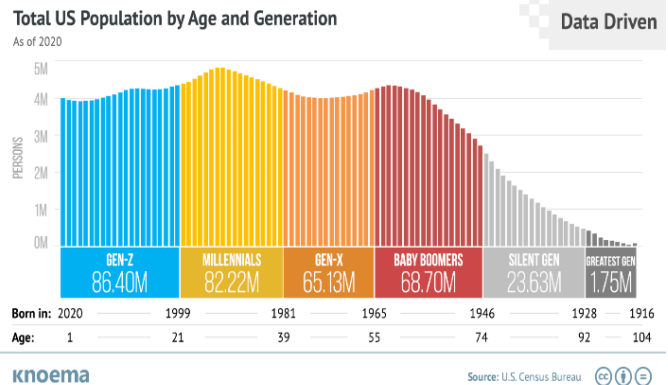
The types and dosages of drugs prescribed are dependent on the demographics of the country. The amount of people over the age of 60 has more than doubled since 1980 and is estimated to double again before the year 2050. This growing demographic will require specific drugs related to later in life complications. Nearly 9 in 10 (90%) adults over the age of 65 report using more than one prescription daily, compared to 4 in 10 (40%) 18-29 year olds. Therefore, most of the industry’s revenue will rely on a growing population, specifically, baby boomers and Generation X. The graph below depicts the percentage of people that take prescription drugs broken into demographic groups by total, male, and female and further into age groups.



Source: CDC²⁵

Aging Population:

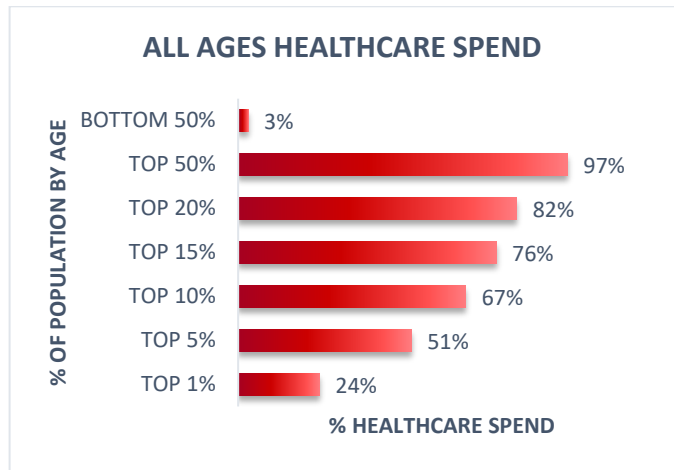
Data shows the U.S. has 68.7 million baby boomers (those aged 55-74) and 65.13 million Gen-Xers (aged 39-55) as of 2020.²⁸ As larger portions of the population get older, their demand for prescription drugs will increase.



Source: U.S. Census Bureau²⁸

Healthcare Spend by Demographic

Furthermore, data shows that out of all people, the top 50% in regards to age make up 97% of healthcare spending, and the top 10% make up 67%.²⁵ As the general population ages, healthcare spending follows. See below graph with healthcare spent by age.



Source: AHRQ²⁹

Expectations

We expect that in the near term, a small percentage of aging populations will enter the next demographic group, leading to an increase in healthcare spending and prescription drug demand. Long term, we are expecting this percentage to grow significantly, especially since younger generations have significant increases in population, leading to significant long term sustained growth in demand for prescription drugs.

Fed Funds Rate, 10 Year Treasury, and Inflation (CPI)

Current Rates

Fed Funds: 5.25-5.50%¹⁵

10-yr treasury: 4.52%²⁹

CPI: 3.5% March 2024,³⁸ 4.13% in 2023.³⁰

Relevance

The biotech industry is reliant on M&A and R&D to stay profitable in the long run. Since the fed funds rate and ten-year treasury are used as benchmark rates to determine the cost of capital and borrowing capabilities, we determined it to be an important variable in our economic forecast, having a high impact on the profitability of biotech companies. Inflation is key to the COGS of drug manufacturers as well with higher inflation leading to higher costs of production. Although medical inflation historically has outpaced other goods overall, we chose to use CPI as a benchmark for inflation due to the difficulty of segmenting which portions of COGS or sales prices would be associated with the respective groups.

Expectations

We expect in the near term that the fed funds rate will come down from its current 23 year high of 5.25-5.50% to somewhere around 4.75-5.00% by the end of 2024. The recent CPI print in 2024 has continued to come in hotter than expected and consumer confidence and spending remains high⁶. Many analysts are predicting no landing,⁵ rather than the previously expected soft landing, and we tend to agree. We expect rates to stay higher for longer than anticipated as the economy continues to grow at an unexpected pace until the fed hits its long-term CPI goal of 2%. Due to the difficulty of predicting so far in the future, we have forecasted inflation to stay at a constant rate of 2% and the fed funds rate to stay constant at 3% for the last 10 years of our model.

Unemployment Rate

Current Rates

The current unemployment rate as of March 2024 is 3.8%.³

Relevance

Changes in unemployment rate can affect individuals' access to employer sponsored healthcare plans. The unemployment rate should have some impact on the availability to vaccines, given 87% of private sector workers are covered under employee healthcare insurance policies³⁰. However, we did not include any reference to unemployment in our model as we could not conclusively determine this to be true.

Expectations

As inflationary pressure keeps up and the economy continues to expand, we expect short-term falls in the unemployment rate to somewhere in the 3.4-3.6% range. As growth contracts in

the long term, we would expect a moderate increase in the unemployment rate to somewhere in the 4-4.2% range.

Real GDP Growth

Current Rates

RGDP growth: 2.5% increase in 2023, 1.9% increase in 2022,² 3.10% average increase (estimated at all time CAGR of RGDP with 2017 as the base year)³⁰.

Relevance

RGDP growth is a widely used indicator of economic health and is also correlated with the aforementioned unemployment rate. Healthcare expenditure has historically made up an average of 17.2% of U.S. GDP from 2005-2022 and the percentage has been increasing by a CAGR of 15.55%,⁸ meaning the healthcare industry has made up a significant portion of GDP and continues to outpace overall economic growth. Additionally, given RGDP is impacted by or correlated with many of the aforementioned indicators, it is a good overall indicator of healthcare growth. That being said, RGDP growth is not directly incorporated into our model, but influences our positive growth outlook on many model assumptions which are covered further in the valuation discussion.

Expectations:

We expect RGDP to increase very moderately in the range of 1-2% in 2024 as inflationary pressure continues. Long term, as economic expansion slows, we expect consumer and government spending to follow suit, with fewer monetary policy adjustments as the fed nears its inflationary target, resulting in low RDGP growth in the range of 2-3%.

Capital Markets

Historical Performance (LTM)

S&P 500: 25.21%³³

S&P 500 Health Care: 3.67%³⁵

S&P Biotechnology Select Industry Index: 11.80%³⁶

Investment Landscape

As evidenced by the S&P Healthcare Select Industry Index, the sector as a whole had subpar performance in 2023, compared to the broader S&P 500. As we come out of the pandemic era, companies are shifting focus to positioning themselves well for taking advantage of the changing investment landscape. We believe now is a good time to take advantage of the lower prices in the biotech industry as companies reinvest the returns made during the pandemic to take advantage of the aforementioned economic factors like growing population, aging demographics, expanding economy, and as we will get into in the industry analysis, the advancement of technology.

Forecasted Industry Performance

We forecast the industry to outperform expectations. The global biotech industry is expected to reach a market size of USD 465.9 billion in 2024, with the cell and gene therapy market anticipated to see over 20% growth, reaching approximately USD 11 billion²². Based on our economic outlook, technological advancements, and the emergence of numerous products in spaces like oncology, immunology, neurology, and obesity⁸, we think there is much room for growth. These drugs are capable of treating, and nearly curing in some cases, some of the most difficult to treat ailments such as cancer, autoimmune diseases, Alzheimer's, and obesity. As technology, particularly AI, advances, R&D will become more efficient and new advancements will be made at breakneck pace to develop drugs that will have incredible demand. We think this will happen faster and on a larger scale than generally expected. In addition, the approval of groundbreaking gene therapies, including the first CRISPR gene therapy in late 2023, has set the stage for significant advancements and launches of new therapies in 2024. There are projections for up to 21 cell therapies and as many as 31 gene therapies to be launched²³.

Industry Analysis

Biotech Industry Landscape

Biotech refers to the application of biological and biochemical sciences in the large-scale production of products to change human health, food supplies, or the environment. Biotech companies typically spend heavily on R&D in hopes of releasing a new drug that will exponentially boost their sales/revenue. Peak drug sales typically occur five to seven years following the launch of a new drug.

The biotech industry has seen a significant upward trend, as reflected by a global market expected to be valued around \$3.4T by 2030. This includes a CAGR of 17.83%.¹⁴ This robust growth is fueled by a high degree of innovation in genomics and molecular biology, and a strong tendency towards mergers and acquisitions. For instance, key players like Amgen have expanded through acquisitions, such as their purchase of Horizon Therapeutics.

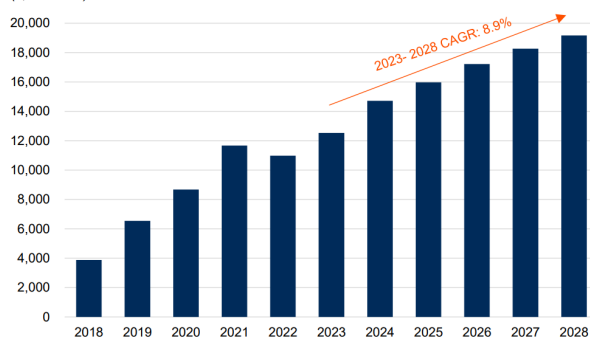
Recent Development and Trends

Biosimilars

Biosimilars are Generics that create near copies of branded biologic drugs. Legislators originally hoped they would alleviate drug costs much like generic drugs did for the pharmaceuticals market, with the first approval in 2015. Makers of biologic drugs have retained significant market share despite approval of biosimilars and other alternative therapies because of barriers like significant development, manufacturing, and commercialization costs. Biosimilars have a slower regulatory process, biologic companies can do extensive patent litigation, and there is a lack of an interchangeability designation in the US as well as insufficient patient and physician education about the safety and efficacy.

To this day, there is not a single FDA approved biosimilar that is considered interchangeable with its similar biologic counterpart, and this deters physicians from prescribing them. Additionally, there is significantly more regulation surrounding the FDA guidelines for them since they are slightly different than the actual drug, making it expensive and lengthy to prove they are interchangeable. Biologic companies have had much success extending patents or finding ways to get new patents for the same drugs in nuanced ways. This has made it significantly harder for biosimilars to fulfill their promise of cheaper drug alternatives. The 2012 Inter Partes Review (IPR) made it possible for third parties to challenge the validity of an issued patent in a way that is much faster, cheaper, and more likely to succeed than litigation, which has slowed down the extension of patents in the biologic space.

WORLDWIDE BIOSIMILARS MARKET OUTLOOK
(\$, in billions)



Source: Evaluate³²

The graph exemplifies the prevalence of biosimilars which are expected to grow at 8.9% through 2028.

End of COVID-19 public health emergency

The public health emergency officially ended in the US on May 11, 2023, ending a period of rapid expansion for the biotech industry. Emergency use authorization for coronavirus vaccines and treatments propelled the industry and it experienced a decline in 2022 as the policies were gradually phased out.

Since the pandemic, regulators have changed their attitude about a lot of trends in the biotech market:

- The FTC has strengthened its position against antitrust practices, potentially discouraging large scale acquisitions.
- The Consolidated Appropriations Act (December 2022) gave the FDA the power to enforce stricter requirements for fast approval pathways for drugs.
- The US government intends to safeguard the national supply of pharmaceutical products, which could impact future supply chains globally, potentially leading to more domestic production.

Inflation Reduction Act (2022)

This Act includes 2 policies that impact drug and vaccine prices directly. One requires the government to negotiate prices for some high-cost vaccines covered under Medicare, particularly Medicare Part D and B vaccine spending, which is concentrated among a small group of single source vaccine that mostly do not have generic or biosimilar competitors.

(To be eligible for this, the vaccines need to be 9+ years (for small molecule vaccines) or 13+ years (for biologics) from their FDA approval). The second policy requires Medicare vaccine manufacturers to pay rebates if they raise prices faster than inflation.

Digital transforming

A 2020 survey by EY³³ found that 2/3 executives had invested in AI and machine learning that have expedited launches, enhanced operational effectiveness, mechanized procedures, and implemented ESG activities, but in many instances, the industry has not fully realized the potential of digital transformation. For example, an area that was severely affected by the pandemic was the supply chain, and companies could develop a comprehensive system that monitors key performance indicators in real time, keeping track of every asset and running complex, real-time data analytics on them.

The pandemic led to innovation in mRNA-based therapies:

mRNA is like DNA, but single stranded and carries the instructions for protein production. Prior to the pandemic, there was no mRNA-based vaccine that had been approved by the FDA, but in 2022, the leading

COVID-19 vaccines were mRNA-based, with MRNA's sales over \$18.4 billion. mRNA-based therapies work by introducing mRNA strands that tell cells to produce certain proteins, like an inert virus particle that can be used to develop immunity, as opposed to traditional vaccines or therapies that is much a much more complex and lengthy process of growing very delicate cell cultures in particular ways. This technology has big implications in the biotech industry going forward, with companies looking into ways to modulate the immune system to target mutated cells and essentially create cancer vaccines as well as other targeted therapies.

Competition and Peer Comparisons

MRNA is at the forefront of mRNA technology, a distinguishing feature that helps the company stand out from many traditional biotech and pharmaceutical companies. MRNA's major competitions are AbbVie Inc. (ABBV), Amgen Inc. (AMGN), Regeneron Pharmaceuticals, Inc. (REGN), and Gilead Sciences, Inc. (GILD).

Symbol	Name	GICS Ind Name	Market Cap(\$B)	Total Revenue (\$K)	Net Income (\$K)
ABBV	AbbVie Inc.	Biotechnology	\$ 286.2	\$ 54,318	\$ 4,863
AMGN	Amgen Inc.	Biotechnology	\$ 142.3	\$ 28,190	\$ 6,717
GILD	Gilead Sciences, Inc.	Biotechnology	\$ 84.5	\$ 27,116	\$ 5,665
REGN	Regeneron Pharmaceuticals, Inc.	Biotechnology	\$ 99.3	\$ 13,117	\$ 3,954
MRNA	Moderna, Inc.	Biotechnology	\$ 40.3	\$ 6,754	\$ (4,714)

The table of competitors above indicates that MRNA Inc. (MRNA) has a considerably lower market capitalization compared to its competitors, which may reflect a smaller share of the market or overall investor confidence. Despite respectable revenue figures, MRNA's substantial net loss contrasts sharply with the profitability of its competitors, which may be an indicator of operational challenges or an aggressive investment in its pipeline that has not yet matured financially. Such financial performance might lead to concerns about the company's sustainability and future profitability, particularly if the losses are due to declining product demand post-pandemic or inefficiencies that competitors have managed to avoid.

ABBV

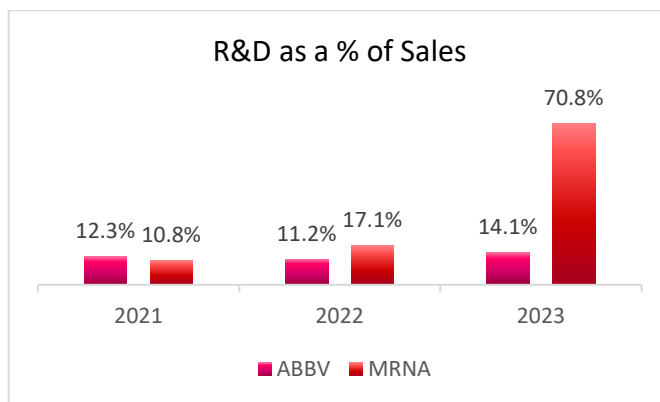
AbbVie, Inc. founded in 2013 as a spin-off from Abbott Laboratories, is headquartered in North Chicago, Illinois. ABBV is a global, research-driven biopharmaceutical company focused on the development of innovative advanced therapies for complex and critical medical conditions. ABBV's mission is to make a lasting impact on people's lives through the deep understanding of patients' and their specific needs. ABBV's revenues can

be broken down into the following key therapeutic areas: Immunology, Oncology, Aesthetics, Neuroscience, and Eye Care.

ABBV's R&D efforts are focused mainly on the key therapeutic areas listed above. The company is well known for its extensive Immunology portfolio with blockbuster drugs for a range of autoimmune diseases like rheumatoid arthritis, psoriasis, and Crohn's disease. ABBV's flagship drug Humira helps reduce pain for those living with rheumatoid arthritis. In 2023 Humira contributed to \$14.4B worth of sales, making up 26.5% of ABBV's revenues for the year. However, looking forward to this number is expected to decrease as ABBV lost exclusivity of Humira in January of 2023. This patent cliff led to a YoY decrease of -32% in Humira specific revenues in 2022 – 2022 saw the drug bring in \$21.2B worth of sales accounting for an astonishing 36.5% of total company revenues. Moving forward, ABBV hopes to pursue strategies aimed at maintaining a dominant market share for Humira, however, with the entrance of biosimilars, it cannot be said how effective this strategy will be. ABBV's second leading drug by sales was Skyrizi, a treatment for those suffering from Psoriasis, a common skin disease. Revenues for Skyrizi came in at \$7.8B equal to 14.4% of overall company revenues. Unlike Humira, Skyrizi still has quite a few years left on its patent, until it expires around sometime close to 2030. ABBV will look to increase production and distribution of Skyrizi to account for the losses seen with Humira's patent cliff. Humira along with Skyrizi brought in over 40% of total revenues seen by ABBV in 2023 and over 45% in 2022. This large percentage of overall revenues, points to the company's industry knowledge, and expertise within the immunology space, helping to distinguish ABBV from other competitors, pointing to potential future success with other drugs in its immunology pipeline. Currently, ABBV has 8 immunology drugs in various stages of the FDA approval process, with 2 being recently approved and expected to come to market soon¹⁸.

When evaluating MRNA Inc. (MRNA) alongside AbbVie Inc. (ABBV), it's essential to consider factors such as the breadth of the product pipeline, market presence, and strategic initiatives. MRNA, known for its pioneering mRNA technology, made a global impact with its COVID-19 vaccine, Spikevax. However, its portfolio is less diversified compared to AbbVie, which has a wide array of established products in immunology,

oncology, and more. AbbVie's market cap reflects a strong presence and investor confidence, bolstered by its acquisition of Allergan, which expanded its footprint and product diversification. In contrast, MRNA's recent financials indicate a significant net loss, suggesting potential vulnerability to market changes and a narrower focus in its pipeline. Furthermore, AbbVie's established global presence, with a broader demographic reach and higher revenue generation, presents a more diversified risk profile compared to MRNA's more specialized approach. Considering these aspects, AbbVie may appeal to investors looking for a company with a strong, varied product offering and stable market position, whereas MRNA represents a more focused bet on the innovative potential of mRNA technology but with higher associated risks.



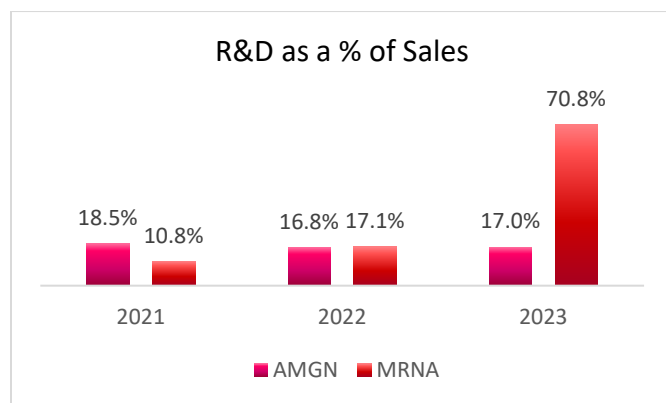
AMGN

Founded in 1980 and headquartered in Thousand Oaks, CA, Amgen, Inc. is one of the world's leading biotechnology companies. With a mission to serve patients, Amgen uses advanced science and technology to discover, develop, manufacture, and deliver innovative human therapeutics. AMGN specializes in areas of high unmet medical demand and leverages its biologic manufacturing to create innovative therapies. AMGN focuses on several key therapeutic areas including Oncology, Hematology, Cardiovascular Disease, Inflammation, Bone Health, Neuroscience¹⁹

AMGN had total revenues of \$28.2 billion in 2023, a moderate increase from 2022 from \$26,323. Throughout the pandemic, revenues grew at a relatively steady pace, with margins following suit. They are committed to innovation within the biotechnology space, this is best reflected through the companies well laid out R&D program. The company invests heavily in R&D to help drive the discovery of new treatments within its key

therapeutic groups. In 2023 AMGN spent \$4.8B on R&D or 16.9% of total revenues for the year. AMGN's R&D program focuses on the use of cutting-edge science and technology, most noticeably through its use of human genetics, and molecular biology to develop new therapies aimed at improving health outcomes. AMGN's business also relies heavily on strategic initiatives to stay ahead of other companies within the biotech industry. Recent acquisitions and strategic partnerships have helped AMGN build out its pipeline of drugs and therapies in recent years, and overall presence in the industry.

Comparing Amgen (AMGN) and Moderna (MRNA) reveals two different pictures within the biotechnology industry. Amgen, an established company with a diverse portfolio, has maintained stability and offers a dividend, which could appeal to investors looking for steady income and lower volatility. On the other hand, Moderna, known for its mRNA-based COVID-19 vaccine, does not offer a dividend and may represent a higher-risk investment option, given its focus on a narrower range of products. Moderna's financials have shown significant volatility, particularly with the changes in demand for COVID-19 vaccines.

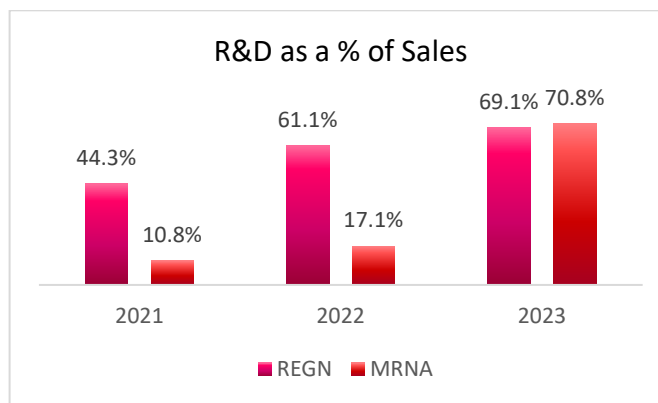


REGN

Regeneron Pharmaceuticals was founded in 1988 and is headquartered in Westchester County, New York. REGN is a pharmaceutical company who focuses on the development of biotech products aimed at revolutionizing healthcare through precision medicine. Key areas of focus for REGN are precision medicine, genomic research, and bioinformatics. The precision medicine segment of REGN is targeted at using genomic insights and advanced technologies to develop therapies for a wide range of diseases including cancer, rare genetic conditions, and autoimmune disorders. In 2023

REGN reported R&D expenses of \$4.4B a 33% of revenues for the year. There has been an increased focus on R&D spending for the company since 2021, with growth of 35% seen since then.

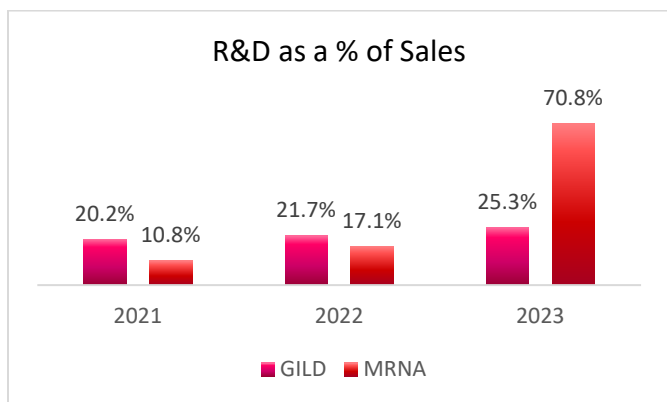
Overall, when comparing REGN to MRNA it's important to look at global presence, and product pipeline. REGN has established itself as an industry leader since its inception and has seen a successful track record of collaborations and partnerships, leading to many profitable products. MRNA has recently seen an increase in its global presence because of Spikevax, but with demand decreasing it is hard to say whether or not this dominance will continue. In terms of product pipelines, both companies have extremely robust programs. REGN's pipeline extends into various therapeutic areas including ophthalmology, immunology, and oncology with twelve products in Stage 3 of development. MRNA currently has seven products in Stage 3 of the development process seen within its oncology, RSV, and COVID-19 + Flu products. At this point, REGN is better positioned than MRNA because of its established track record and larger group of products which are expected to come to market soon and help recoup its large R&D expenses.



GILD

Founded in 1987 and headquartered in Foster City, California, Gilead Sciences is a biopharmaceutical company which focuses on the development of therapies for life-threatening diseases. Key areas of focus for GILD are HIV/AIDS, Liver Disease, Oncology, and Inflammatory and Respiratory Diseases. Since its founding GILD has continued to invest heavily into its R&D infrastructure. In 2023 GILD spent \$5.7B on R&D or 25% of total revenues. This has been a focus area for

GILD devoting an additional 5% of revenues towards its R&D program since 2021.



When potential performance for GILD versus MRNA, it's important to take into account both companies product pipelines, and yearly R&D expenses. GILD has a more mature product pipeline with a total of 55 programs in the following therapeutic areas: virology, oncology, and inflammation.³¹ GILD has 13 products in Stage 3 of the approval process and has recently registered 2 products. This can be attributable to the companies' continued investment into new technologies for diseases in these focus areas. With stable R&D investments it is no surprise that GILD has as extensive and mature a product pipeline as it does. On the other hand, MRNA is not far behind with its total of 42 products in its pipeline. However, MRNA is at a disadvantage in this regard because of its large percentage of products early stages of the approval process. Yet, MRNA continues to invest heavily in its R&D program with the hopes that a majority of its products will be able to make it to market and help to diversify the company's total revenues. Looking towards the near future, GILD is better positioned in the industry than MRNA, because of its expansive product pipeline with a substantial number of products coming to market soon which will help to separate it from MRNA.

Valuation Discussion

Revenue Decomposition

Product Sales

The total revenue of this segment is \$6.67 billion in 2023, and we expect a decrease to \$3.93 billion in 2024, finally reaching \$3.61 billion at the end of 5-year forecast period in 2028. As of their latest financial

reporting, the product sales are specifically from its respiratory franchise⁵. This respiratory franchise includes their COVID-19 vaccine, Spikevax, which continues to be a significant contributor to sales. They have also filed for regulatory approvals for an RSV vaccine (mRNA-1345), which, pending approval, they expect to launch in 2024. This vaccine has shown positive efficacy data in trials and is targeted at adults 60 years and older.

In addition to these, MRNA's pipeline showcases a diverse array of products in various stages of development. These include vaccines for flu (mRNA-1010, mRNA-1020, mRNA-1030, mRNA-1011, mRNA-1012), a next-generation COVID-19 vaccine (mRNA-1283), and combination vaccines targeting flu and COVID-19, among others. There are also therapeutics in development for diseases such as propionic acidemia, methylmalonic acidemia, and cystic fibrosis⁶.

Grant Revenue

The total revenue of grant revenue is \$93 million in 2023, and we expect an increase to \$97 million in 2024. These revenues are generated through grants from various government-sponsored and private organizations. The company holds contracts with many organizations, including the Bill & Melinda Gates Foundation, the Defense Advanced Research Projects Agency (DARPA) of the United States government, and the Biomedical Advanced Research and Development Authority (BARDA). When funding is committed and MRNA provides services in connection with the contract arrangements, it records revenue from these contracts⁸.

Collaboration Revenue

In 2023, the total collaboration revenue is \$82 million, which accounts for a tiny fraction of total revenue. We expect it will increase over the years and reach \$ 106 million at the end of the 5-year forecasting period. MRNA has formed strategic alliances with AstraZeneca, Merck & Co. Inc. (MRK), and Vertex Pharmaceuticals Inc. (VRTX) to discover, develop, and commercialize potential mRNA medicines. These collaboration arrangements include research, licenses, development services, and commercialization of certain products and product candidates. These arrangements generate revenue through upfront fees, commercial milestone payments, licensing fees, option exercise fees, royalties, and other types of payments.

Cost of Equity

The cost of equity was calculated as 13.03% using the CAPM. The beta of 1.68 is calculated by using the average of 2,3,4, and 5 year monthly raw betas²⁴. We used the 10-year treasury rate of 4.57% as the risk-free rate and an equity risk premium of 5.59% using a 10.16% geometric average return of the S&P 500 from the past 30 years.²⁷

Cost of Debt

MRNA doesn't have any debt. We used a rate of 6% to estimate what it might cost, however, since they would have no interest payments, it is only used to calculate the implied interest on leases.

WACC

To find our estimate of the Weighted Average Cost of Capital of 13.01%, we took the assumptions of cost of equity and cost of debt after tax and weighted them by equity as a percentage of total capital and debt as a percentage of total capital, respectively. To calculate the weight of equity, we took the current share price of \$107.11 and multiplied it by the total shares outstanding at the end of 2023 to get a market value of common equity of \$40.9 billion. To calculate the weight of debt, because MRNA doesn't have corporate debt, we only use the present value of operating leases as the market value of debt of \$92 million. MRNA has no preferred stock. The total capital amounted to \$41 billion.

Valuation Analysis

Valuation Range

The lower bound for our range (\$78) was calculated using an equal weight of the per share price proved by each of the following methods: DCF/EP, Price-To-Book and Price-To-Sales. Although we don't think the DCF/EP method is a great representation of Moderna's value due the difficulty of projecting future drug revenues and approvals, we want to incorporate equal weights from the information that we have from both relative and intrinsic analysis. The upper bound for our range (\$113) was calculated by taking the maximum valuation of the 3 aforementioned valuation methods. Both of these bounds were rounded down to the nearest whole number as to not reflect a decimal level of accuracy in our assumptions and rounded down for

modesty. All of our projections have been forecasted out 10 years to try to find a state of stable growth and positive cash flow.

DCF/EP

Key Inputs

CV Growth of NOPLAT: 3.10% (Average RGDP growth)

CV Year ROIC: 174.24%

WACC: 13.94%

Cost of Equity: 13.96%

Non-Operating Adjustments

We made the following Non-Operating Adjustments to the value of the Operating Assets to get the value of Equity:

Plus: Long-Term Investments, Short-Term Investments, Excess Cash, Other Non-Operating Assets

Less: ESOP (calculated as number of options outstanding times exercise price), Operating Lease Liability, and Other Non-Operating.

The value of equity was then divided by number of shares outstanding and adjusted for the portion of the fiscal year that has elapsed (26.7%).

Valuation

Our DCF/EP model gives us a per share price of \$34.51, a 66.78% discount to the current share price of \$107.11. We don't believe this is an accurate representation of the value of Moderna, because it is difficult to intrinsically value their potential.

Relative Valuation

Comparable Peers

Amgen, Eli Lilly, Johnson & Johnson, Abbvie, Bristol-Myers Squibb, Merck, GSK, AstraZeneca, Gilead Sciences. All peer EPS estimates, and financial data were pulled from FactSet consensus estimates while price data was taken from Yahoo Finance.

Multiples

We used two different multiples to evaluate Moderna. Due to negative EPS and negative EBITDA, it is very difficult to find a valuable metric for Moderna. We settled for Price-To-Book and Price-To-Sales to estimate what their sales and book value are worth in the industry.

Price-To-Book

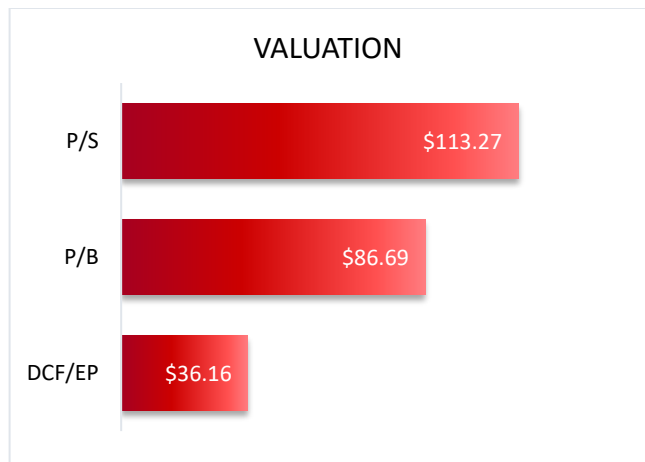
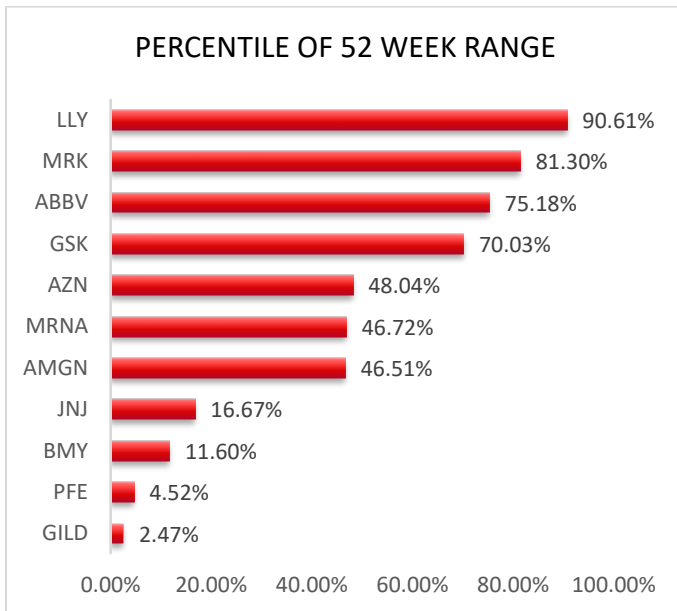
The P/B ratio gives us a valuation of 86.69, or a 16.69% discount on the current share price. We took an average of ratios in the industry and took out any outliers with outstanding values, erring on the higher side of valuation. We believe this valuation may be a little high and it's important to note that this valuation method captures a lot of different reasons for why a share price may relate to book value.

Price-To-Sales

The P/S ratio gives us a valuation of \$113.27 per share, a 9.06% premium to the current share price. While we think this multiple may be a better representation than P/B and the DCF/EP analysis, we still believe this to be a high share price.

52 Week Range

We created a percentile range of the 52-week range with 0% being the low and 100% being the high. While this method may not be based in theory and doesn't directly correlate to price, earnings, or growth, we think it is still an interesting piece of data to compare against other companies.



Sensitivity Analysis

Additional Oncology Growth vs. Additional RSV Growth on DCF

Given the nature of the unpredictability of drug revenues and market share acquisition, we have included a table on the effect of changes to additional growth in two of the big drivers of Moderna's revenue moving forward.

DCF	Adt'l Oncology Growth						
	36.16	-15.00%	-10.00%	-5.00%	0.00%	5.00%	10.00%
-15.00%	28.99	29.16	29.36	29.61	29.90	30.25	30.68
-10.00%	30.56	30.72	30.93	31.17	31.47	31.82	32.24
-5.00%	32.68	32.85	33.05	33.30	33.59	33.94	34.36
0.00%	35.55	35.71	35.91	36.16	36.45	36.81	37.23
5.00%	39.38	39.54	39.74	39.99	40.28	40.64	41.06
10.00%	44.46	44.62	44.83	45.07	45.37	45.72	46.14
15.00%	51.15	51.31	51.52	51.76	52.06	52.41	52.83

WACC vs CV Growth of NOPLAT

Since Moderna has a unique capital structure, we figured it would be valuable to include a table that shows the effect on valuation from modulating the WACC. We contrasted this to a change in the continuing value growth of NOPLAT given Moderna is a relatively young company, and we expect much growth to occur after our forecast period as well.

DCF	CV Growth of NOPLAT						
	34.51	2.80%	2.90%	3.00%	3.10%	3.20%	3.30%
12.74%	36.54	36.63	36.72	36.81	36.90	37.00	37.09
13.14%	35.74	35.82	35.90	35.98	36.06	36.14	36.23
13.54%	35.00	35.07	35.14	35.21	35.29	35.36	35.44
13.94%	34.32	34.38	34.44	34.51	34.57	34.64	34.71
14.34%	33.68	33.73	33.79	33.85	33.91	33.97	34.03
14.74%	33.08	33.14	33.19	33.24	33.29	33.35	33.40
15.14%	32.53	32.58	32.62	32.67	32.72	32.77	32.82

Average Pharmaceutical R&D % of Sales vs. R&D Yearly Decrease %

We assumed an average % of sales for R&D and assumed a decrease of 7% for Moderna until they reach that amount, given the extraordinary R&D expenditures they currently have.

R&D Yearly Decrease	Average Pharma R&D								
	DCF	36.16	15.70%	17.70%	19.70%	21.70%	23.70%	25.70%	27.70%
4.00%		41.99	39.43	36.69	33.91	30.96	27.97	24.80	
5.00%		43.81	40.96	37.97	34.98	31.81	28.61	25.34	
6.00%		44.98	41.99	38.82	35.62	32.42	29.04	25.64	
7.00%		45.83	42.63	39.43	36.16	32.75	29.34	25.93	
8.00%		46.44	43.24	39.87	36.46	33.05	29.64	26.06	
9.00%		46.98	43.57	40.17	36.76	33.35	29.77	26.16	
10.00%		47.28	43.87	40.46	37.06	33.48	29.87	26.26	

COGS % of Sales vs. R&D % of Sales (2024E)

Given the assumptions we made about % of Sales for R&D and for COGS, figured it would be valuable to see the effect that different values would have on our valuation.

COGS % of Sales (2024)	R&D % of Sales (2024 Est.)								
	DCF	36.16	55.00%	60.00%	65.00%	71.00%	75.00%	80.00%	85.00%
20.00%		68.93	66.89	64.34	60.82	58.78	56.99	53.46	
25.00%		58.92	56.87	54.33	51.73	50.58	47.49	43.45	
30.00%		48.90	46.85	44.87	43.53	41.09	37.48	33.43	
33.90%		41.09	39.20	38.48	35.88	33.27	29.66	25.62	
40.00%		29.43	29.20	27.18	23.66	21.05	17.44	13.39	
45.00%		21.23	19.70	17.16	13.64	11.04	7.42	3.38	
50.00%		11.73	9.69	7.14	3.62	1.02	(2.59)	(6.64)	

Marginal Tax Rate vs. Equity Risk Premium

Since tax breaks are often given out to pharmaceutical and biotechnology companies, the marginal tax rate in reality can be difficult to predict, which is why we included it in this table. The same goes for equity risk premium, which is a widely debated metric. We think this shows a good

Equity Risk Premium	Marginal Tax Rate								
	DCF	36.16	18.90%	19.90%	20.90%	21.90%	22.90%	23.90%	24.90%
4.33%		37.40	36.99	36.57	36.16	35.75	35.34	34.93	
4.75%		37.40	36.99	36.57	36.16	35.75	35.34	34.93	
5.17%		37.40	36.99	36.57	36.16	35.75	35.34	34.93	
5.59%		37.40	36.99	36.57	36.16	35.75	35.34	34.93	
6.01%		37.40	36.99	36.57	36.16	35.75	35.34	34.93	
6.43%		37.40	36.99	36.57	36.16	35.75	35.34	34.93	
6.85%		37.40	36.99	36.57	36.16	35.75	35.34	34.93	

Receivable % of Sales vs. U.S. COVID-19 Vaccine Additional Growth

Since the COVID vaccine is currently MRNA's only product, it seemed valuable to include a table that shows a range of potential additional growth or loss from that

product in the United States, given the unpredictability of it.

Accounts Receivable %	US COVID-19 Vaccine Adt'l Growth								
	DCF	43.65	-15.00%	-10.00%	-5.00%	0.00%	5.00%	10.00%	15.00%
6.00%		33.71	34.06	34.61	35.47	36.79	38.75	41.64	
8.00%		33.44	33.78	34.33	35.17	36.47	38.42	41.28	
10.00%		33.17	33.50	34.04	34.88	36.16	38.08	40.93	
12.46%		32.84	33.16	33.68	34.51	35.77	37.67	40.49	
14.00%		32.63	32.95	33.46	34.28	35.53	37.42	40.22	
16.00%		32.36	32.67	33.18	33.98	35.21	37.08	39.86	
18.00%		32.09	32.40	32.89	33.68	34.90	36.75	39.51	

Conclusion

Given the assumptions and estimations we have made, we believe that Moderna is overvalued based on both its intrinsic and relative valuations. We expect a valuation range of \$78 – \$113, representing a -25% to 8% upside to the current share price of \$107.11. Despite MRNA's market share with the COVID-19 vaccine and all of the revenue growth throughout the pandemic, we do not believe Moderna to be valued fairly. Relative to peers, Moderna is underperforming in nearly all multiple valuations, and intrinsically, there is too much risk of failure to produce sustainable, significant revenues to create value.

References

1. <https://investors.MRNAtx.com/news/news-details/2023/MRNA-Reports-First-Quarter-2023-Financial-Results-and-Provides-Business-Updates/default.aspx> (MRNA Reports First Quarter 2023 Financial Results and Provides Business Updates Used for SWOT analysis)
2. <https://investors.MRNAtx.com/news/news-details/2022/MRNA-Announces-Its-Global-Public-Health-Strategy/default.aspx>
3. (MRNA Announces Its Global Public Health Strategy)
4. <https://investors.MRNAtx.com/news/news-details/2024/MRNA-Reports-Fourth-Quarter-and-Fiscal-Year-2023-Financial-Results-and-Provides-Business-Updates/default.aspx> (MRNA Financial report)
5. <https://www.grandviewresearch.com/industry-analysis/biotechnology-market> (Biotech market size and trend)
6. <https://investors.MRNAtx.com/news/news-details/2024/MRNA-Reports-Fourth-Quarter-and-Fiscal-Year-2023-Financial-Results-and-Provides-Business-Updates/default.aspx> (MRNA Reports Fourth Quarter 2023 Financial Results and Provides Business Updates)
7. <https://www.MRNAtx.com/en-US/research/product-pipeline> (mRNA medicines that are currently developing)
8. MRNA. (2018,2019,2020,2021,2022,2023,2024). Form-10k. <https://www.sec.gov/edgar>
9. How MRNA Makes Money. <https://www.investopedia.com/how-MRNA-makes-money-5179565>
10. <https://finance.yahoo.com/news/MRNA-inc-nasdaq-mrna-q4-173137188.html> (Q4 earnings call)
11. [https://www.cdc.gov/mmwr/volumes/72/wr/mm7240a2.htm#:~:text=Introduction,%E2%89%A565%20years%20\(1\).](https://www.cdc.gov/mmwr/volumes/72/wr/mm7240a2.htm#:~:text=Introduction,%E2%89%A565%20years%20(1).) (CDC RSV hospitalizations)
12. <https://www.investopedia.com/ask/answers/060115/how-much-drug-companys-spending-allocated-research-and-development-average.asp> (average R&D spend)
13. <https://www.politico.eu/article/europe-new-covid-vaccine-plan-tender/> (tender eu plans for MRNA)
14. <https://www.biospace.com/article/biotechnology-market-size-to-worth-around-us-3-44-trillion-by-2030/> (bio space market size and growth)
15. <https://www.fiercepharma.com/pharma/COVID-19-sales-continue-sink-MRNA-sees-hope-private-market-raises-spikevax-guidance> (Sales crater of MRNA)
16. <https://www.fiercepharma.com/pharma/MRNA-covid-vax-scarfed-sales-184b-2022-company-says> (COVID vaccine sales)
17. <https://www.statista.com/statistics/1398234/mrna-vaccine-and-therapy-market-value-worldwide/> (statista mRNA market global)
18. AbbVie. (2018,2019,2020,2021,2022,2023,2024). Form-10k. <https://www.sec.gov/edgar>
19. Amgen. (2018,2019,2020,2021,2022,2023,2024). Form-10k. <https://www.sec.gov/edgar>
20. <https://www.cancer.gov/news-events/cancer-currents-blog/2022/mrna-vaccines-to-treat-cancer>
21. <https://www.modernatx.com/en-US/research/product-pipeline>
22. <https://www.marketsandmarkets.com/blog/HC/The-Global-Biotechnology-Industry-Outlook-2024> Global Biotechnology Industry Outlook – 2024

23. <https://www.globenewswire.com/news-release/2023/12/15/2797104/0/en/The-Global-Biotechnology-Industry-Outlook-2024-MarketsandMarkets.html>
24. Bloomberg L.P. (2024). Raw beta for MRNA, Inc.. Retrieved from Bloomberg database
25. Martin, C., Hales, C., Gu, Q., & Ogden, C. (2020, July 27). Products - Data briefs - Number 332. February 2019; CDC. <https://www.cdc.gov/nchs/products/databriefs/db334.htm> (prescriptions by demographics graph)
26. Pfizer. (2024). MRNA pipeline. [https://cdn.pfizer.com/pfizercom/product-pipeline/Pipeline_Update_30JAN2024_0.pdf?VersionId=rV_MQ9a_j2LPoLQGzWI5Pp9ciQ1JLp1i](https://cdn.pfizer.com/pfizercom/product-pipeline/Pipeline_Update_30JAN2024_0.pdf?VersionId=rV_MQ9a_j2LPoLQGzWI5Pp9ciQ1JLp1i)
27. CAGR of the stock market: Annualized returns of the S&P 500. (n.d.). MoneyChimp. Retrieved April 15, 2024, from
28. U.S. Census Bureau. "Comparative Demographic Estimates." American Community Survey, ACS 1-Year Estimates Comparison Profiles, Table CP05, 2022. <https://data.census.gov/table/ACSCP1Y2022.CP05?q=Population Total&t=Older Population>. Accessed on April 15, 2024. (demographics data)
29. Medical expenditure panel survey. (2023, August). Agency for Healthcare Research and Quality. [https://meps.ahrq.gov/mepsweb/data_stats/download_data_files_detail.jsp?cboPufNumber=HC-233](https://meps.ahrq.gov/mepsweb/data_stats/download_data_files_detail.jsp?cboPufNumber=HC-233) (demographics healthcare spend)
30. Nguyen, A., Guttentag, A., Li, D., & Meijgaard, J. van. (2022). The Impact of Job and Insurance Loss on Prescription Drug use: A Panel Data Approach to Quantifying the Health Consequences of Unemployment During the COVID-19 Pandemic. *International Journal of Health Services : Planning, Administration, Evaluation*, 52(3), 312–322. <https://doi.org/10.1177/00207314221078749> (prescription sales vs unemployment study)
31. (<https://www.gilead.com/science-and-medicine/pipeline>)
32. <https://www.mckinsey.com/industries/life-sciences/our-insights/an-inflection-point-for-biosimilars>
33. https://www.ey.com/en_us/newsroom/2023/12/ey-survey-ai-adoption-among-financial-services