

DRIVING MARKET FORCES FOR COVID-19 VACCINES INDUSTRY: THE CASE OF THE COMIRNATY VACCINE

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Abstract In order to identify the fundamental economic reasons for market behaviour, this study offers a market analysis that serves as a diagnostic process. Comirnaty, a COVID-19 vaccine developed by BioNTech and Pfizer, has been a significant player in the global fight against the coronavirus pandemic. We studied the Comirnaty vaccine's demand, supply, demand and supply elasticity and the strategic analysis that consisted of SWOT analysis and PESTEL analysis. Several factors, including the global spread pattern of COVID-19, the vaccine's effectiveness, and the availability of alternative vaccines, drive the demand for Comirnaty. The supply of Comirnaty is influenced by factors such as manufacturing capacity and the development of new vaccines. The elasticity of demand for Comirnaty is high, with a significant increase in demand at lower prices and a decrease in demand at higher prices. Overall, the market for Comirnaty is complex and dynamic, with demand and supply being influenced by various factors. We expect a dramatic change in the market forces after the announced commercialisation of Comirnaty directly to the end consumer in the USA.

Keywords: Market analysis ; COVID-19 vaccines' market ; Market Forces ; Demand and Supply

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Introduction

Since 1950, the cost of pharmaceuticals and healthcare has increased significantly, accounting for 4.5% of GDP in 1950, 16.0% of GDP in 2004, and about 0.7 trillion dollars in 2008. In 2008, the cost of healthcare surpassed 2.3 trillion dollars. Part of the money is provided by the federal government and business, Spitz & Wickham, (2012). By the end of 2019, the first cases of unknown-cause pneumonia were detected in Wuhan City, China (World Health Organization (WHO), 2020). This pneumonia was later recognised to be caused by the SARS-CoV-2 virus (publicly known as Coronavirus disease or COVID-19), which led the global economy to witness a massive shutdown.

The covid-19 is an infectious disease that causes mild to moderate respiratory illness. It differed from one person to another as some people did not experience any symptoms while others experienced most of them, and the mortality rate was high to the extent that many counties made complete curfews and lockdowns. The pandemic's effects on placing everyone and everything on hold were unimaginable. Covid-19 made almost all countries pause and wait for a solution that will slow their infection and death rates and give the economy a chance to recover.

The COVID-19 vaccines market has seen significant growth and evolution in the past year. As the global pandemic spreads, demand for effective vaccines has increased. The market is highly competitive, with a range of different vaccines available from various manufacturers. The market structure is complex, with various players, including pharmaceutical companies, government agencies, and health organisations. The production and distribution of vaccines are heavily regulated, with different policies and processes in place in different countries.

BioNTech is a leading biotechnology company focused on developing innovative mRNA-based therapies. The company was founded in 2008 by Turkish-German couple Uğur Şahin and Özlem Türeci, both of whom are doctors and scientists with a strong background in cancer research. BioNTech company's most notable product is Comirnaty, a COVID-19 vaccine developed in partnership with Pfizer. Comirnaty was developed using BioNTech's mRNA technology, which allows the vaccine to target specific proteins in the virus and trigger the body's immune response. Comirnaty showed high efficacy rates in clinical trials and has been approved for use in multiple countries.

Due to Comirnaty's effectiveness in preventing coronavirus infections and its worldwide distribution, demand for the vaccine has been high, and analysts have closely watched the market for the vaccine.

One key aspect of Comirnaty's market analysis is the supply and demand for the vaccine. As the vaccine is highly effective and there is a high demand for it, the supply of the vaccine has been limited in some areas. This supply vs demand imbalance has led to a situation where the demand for the vaccine is greater than the supply, which has caused prices for the vaccine to rise temporarily. Another critical aspect of Comirnaty's market analysis is the elasticity of the vaccine's demand. Elasticity refers to the degree to which a product's demand changes in response to changes in its price. In the case of Comirnaty, the demand for the vaccine has been relatively inelastic, meaning that the demand for the vaccine has not changed significantly even as its price has increased. This inelasticity is likely because the vaccine is seen as essential for public health, and people are willing to pay a higher price to get it.

Overall, Comirnaty's market analysis has shown that the vaccine has a high level of demand, a limited supply, and a relatively inelastic demand. These factors have all contributed to the vaccine's market performance and will continue to be essential factors to consider as the market for the vaccine evolves. Moreover, BioNTech has continued to expand its portfolio and partnerships, including collaborating with Chinese company Fosun Pharma to develop and commercialise mRNA-based therapies in China. The company is also working on several other mRNA-based therapies for cancer, influenza, and other diseases.

In terms of future expectations, the COVID-19 vaccines market will likely continue to evolve and adapt to the changing situation of the pandemic. As new virus variants emerge, manufacturers may need to develop new vaccines or adapt existing ones to remain effective. Additionally, as more people are vaccinated, the demand for vaccines may decrease, leading to potential changes in the market structure. Overall, the future of the COVID-19 vaccines market is uncertain, but it is likely to continue being a key area of focus in the global fight against the pandemic.

Literature review

The pharmaceutical sector is regarded as an oligopoly market since it is a unique market with a small number of significant firms and numerous customers. Each vendor controls a substantial portion of the market. Each industry in an oligopoly has a significant role to play in the market and has the potential to affect how much a product is sold for. In addition, there are many consumers in the market. Since there are so many, no single customer can have an impact on the product's market price. New enterprises face a few obstacles to entrance, many of which are essentially identical to monopoly-era obstacles. Although exceedingly challenging, entry into the new firm is not impossible. In addition, cartels may be formed by industries to avoid competition. A cartel is a formally recognised arrangement among businesses to limit market competition. Prices in an oligopoly market may be controlled, and since each rival firm responds promptly to a change in price, the market price remains fixed. Additionally, industries tend to avoid price competition, Craig & Malek, (1995).

Once the World Health Organization (WHO) declared the COVID-19 outbreak a global pandemic in March 2020 (Cucinotta & Vanelli, 2020), many pharmaceutical and biotechnology companies rushed to research and develop new vaccines. Moderna and BioNTech with Pfizer, were the first to take the initiative (BioNTech Investor Relations, n.d.; Cucinotta & Vanelli, 2020; Steenhuisen & Kelland, 2020). Both vaccines used the novel messenger ribonucleic acid (mRNA) approach. The COVID-19 vaccines market started as an oligopoly, with a few major players dominating the market. However, as the pandemic continued to spread and the demand for vaccines increased, the market evolved into a more competitive structure known as monopolistic competition. This market structure is characterised by firms producing similar but differentiated products, such as vaccines with varying efficacy rates and side effects.

The WHO approved the COVID-19 emergency use list for certain types of vaccines. This list was made for the countries that could not go through all the laboratory tests and procedures due to a lack of resources; however, they needed to save their people from the virus and provide them with a vaccine to be used. Therefore, the WHO has prepared a list of vaccines that can be used for public health emergencies (World Health Organization (WHO), 2022). Among the list, the top three vaccines that had the highest number of approved countries included the COMIRNATY vaccine, VAXZEVRIA vaccine, and SPIKEVAX vaccines, which Pfizer/BioNTech, AstraZeneca and

Moderna Biotech, developed respectively (Snyder & Root-Wiley, 2020; World Health Organization (WHO), 2022).

According to the UNICEF COVID-19 vaccine market dashboard, there are 50 vaccines at least approved by one national authority, with more than eighteen billion doses supplied globally with a reported price ranging between 2\$ and 120\$ per dose (UNICEF Supply Division, 2022). Currently, the COVID-19 vaccines market is in a state of monopolistic competition, with multiple firms competing for market share. Comirnaty, developed by BioNTech and Pfizer, is currently the leader of the COVID-19 vaccines market. It has been distributed widely and has demonstrated high efficacy rates in clinical trials, leading to high demand for the vaccine. However, other vaccines, such as Moderna and AstraZeneca's Vaxzevria, compete for market share, leading to a dynamic and competitive market.

The COVID-19 vaccination started by the end of 2020 when the first emergency-use-approved vaccines were shipped worldwide. From the end of 2020 till today, the peak of COVID-19 vaccination has been fluctuating, with the highest peaks approximately between the second and fourth quarter of 2021 (Mathieu et al., 2020). Since the beginning of 2022, a considerable drop has happened, probably due to multiple factors (Mathieu et al., 2020).

We propose that the reason behind this vaccination drop might be that people globally started to focus on other essential aspects such as inflation, social inequality, unemployment, violence and crime, corruption, and taxes, while Coronavirus has dropped to eighth ranking in what worries people in 27 countries on April 2022 (Ipsos, 2022). Currently, BioNTech with Pfizer has announced many COVID-19 vaccines products other than the original Comirnaty vaccine, such as the Bivalent (Original and Omicron BA.4/BA.5) vaccine, Comirnaty and influenza combination mRNA vaccine, and BNT162b4 (T cell antigen mRNA encoding for SARS-CoV-2 non-spike proteins) vaccine (BioNTech, 2022; Pfizer, 2022).

Methodology

Using data of Comirnaty vaccine for units sold and units delivered to describe market forces relationship and calculate elasticity depending on data from the BioNTech company's quarterly financial results and corporate updates documents since Q2/2020 (BioNTech Investor Relations, n.d.). Prices were obtained through the same method in addition to COVID-19 Market Dashboard (UNICEF Supply Division, 2022).

We used the regression equation to test the price effect on buying decision-making within the duration started Q2/2020 up to and including Q3/2022. Moreover, we used SWOT and PESTEL to consider the factors that affected BioNTech's success.

Demand driving factors

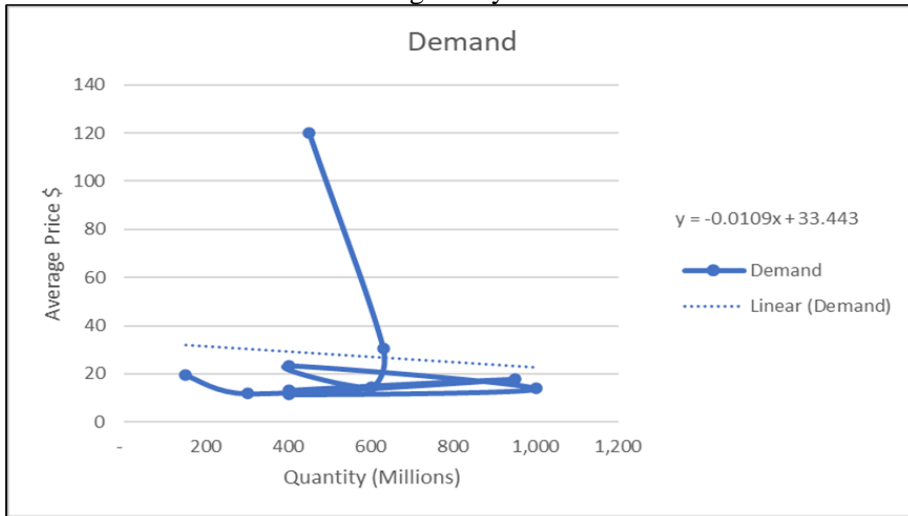
Three elements that have a significant impact on the pharmaceutical sector are the cost of associated items, consumer income, population size, and technology. First, there are two sorts of linked commodities: substitute goods and complementary goods. Since both drugs can be used in place of one another, they are both called substitute goods. The demand for other goods rises when the price of one commodity does, Abdou, and Ali (2020). Up to the third quarter of 2022, most COVID-19 vaccine manufacturers dealt with governments and organisations to sell their vaccines and not offer them directly to end consumers. This situation started to change with the October announcement of Pfizer/BioNTech that their Comirnaty vaccine will be offered to the public with a price ranging between 110\$-130\$ which could be bared cost by private or public insurance systems in the USA market (Erman, Humer, Berkrot, & Pullin, 2022).

Frequent new variants appeared every couple of months since the pandemic's start, affecting how the population perceived the vaccination efficacy with these variants (Al-Qerem, Al Bawab, Hammad, Ling, & Alasmari, 2022; Rzymiski, Poniedziałek, & Fal, 2021). Moreover, one of the demand-affecting factors is the new substitutes offered even by BioNTech, like Next-Generation vaccines.

Change in the population's desire to vaccinate is another demand-affecting factor, as mentioned earlier, which is an expected outcome of the dynamic change in global population concern (Ipsos, 2022; Mathieu et al., 2020).

Figure 1 shows the demand curve for Comirnaty's vaccine and how its demand is affected by different factors.

Figure 1. Demand Curve for the BioNTech/Pfizer Comirnaty vaccine globally.



Source: Data extracted from (BioNTech Investor Relations, n.d.; UNICEF Supply Division, 2022).

Elasticity of demand

The elasticity of demand (E_D) is the degree of response in demand due to price change. Comirnaty's E_D has fluctuated over the quarters since BioNTech and Pfizer announced a collaboration for vaccine development in March 2020 (BioNTech Investor Relations, 2020). E_D analysis shows the beginning of 3 quarters of Comirnaty with elastic demand, which means the price changes affected the quantity demanded considerably. This behaviour is rational due to the development stage of the vaccine, and the first authorisation from health authorities received in Q4 2020.

With the announcement of the Delta variant in Q2 2021 (World Health Organization (WHO), 2022b), the elasticity changed to perfect inelastic demand as the average price/dose decreased, but the quantity demanded remained the same. This pattern is explained by the concerns regarding the COVID-19 efficacy with these newly identified variants. Afterwards, two-quarters of elastic demand (Q3 2021-Q4 2021), then inelastic demand till Q3 2022. These fluctuations are explained by the availability of new substitutes from new market entrants and newly developed versions of the old vaccine.

Supply driving factors

One factor contributing to Comirnaty's success is the increased governmental funding, support, and subsidies that the company received at the early stages of the vaccine's development. This support allowed the company to invest in research and development and scale up production to bring the vaccine to market quickly and effectively. As a result, Comirnaty gained a strong position within the market and established itself as a leading provider of COVID-19 vaccines.

Another factor that has affected Comirnaty's market analysis is the increase in taxes and the movement from governmental agreement to individual final consumer commercialisation. With the wide availability of the Comirnaty vaccine, governments have begun to shift the responsibility for purchasing and distributing the vaccine from public health agencies to individual consumers. This behaviour has resulted in increased taxes on the vaccine and a shift in how the vaccine is commercialised.

A third factor contributing to Comirnaty's market success is the improvement in technology and the scale-up of production. As the demand for the vaccine has increased, BioNTech was able to invest in new technologies and processes that have allowed it to increase production and meet the growing demand for the vaccine. These vast investments have helped to ensure that the vaccine supply can keep up with the demand and have allowed Comirnaty to maintain its position as a leading provider of COVID-19 vaccines.

Another factor that has impacted Comirnaty's market analysis is the production of alternative products, such as the Omicron variant vaccine. As the COVID-19 pandemic has evolved, new variants of the virus have emerged, and Comirnaty has responded by developing new effective vaccines against these variants. This new development has helped Comirnaty to maintain its position as a leader in the market and has allowed it to continue to provide practical solutions to the challenging situations posed by the pandemic. One factor that has affected Comirnaty's market analysis is the presence of 46 direct competitors. As the demand for COVID-19 vaccines has increased, many other companies have entered the market, offering their vaccines and competing with Comirnaty for market share. These new entrants have created a highly competitive environment, and Comirnaty has had to work hard to maintain a leadership position in the market.

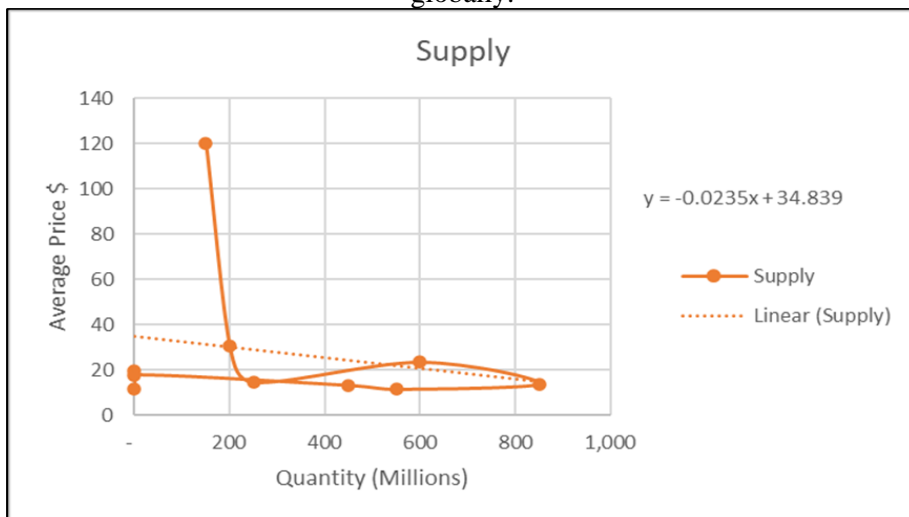
Another factor that is expected to impact Comirnaty's market analysis is the expectation that the individual price of the vaccine will be raised in the USA up to 130\$ starting next year. This price increase

is likely driven by factors including the increasing cost of raw materials, research and development investment to continue improving the vaccine and keep pace with emerging virus variants.

A final factor that has impacted Comirnaty’s market analysis is the decrease in production and raw material costs that has resulted from improvements in the global supply chain. As the demand for the vaccine has increased, Comirnaty has been able to negotiate better deals with suppliers and improve its supply chain efficiency, which has allowed it to decrease its production costs and remain competitive in the market.

Figure 2 shows the supply curve for Comirnaty’s vaccine and how its supply is affected by different factors.

Figure 2. Supply Curve for the BioNTech/Pfizer Comirnaty vaccine globally.



Source: Data extracted from (BioNTech Investor Relations, n.d.; UNICEF Supply Division, 2022).

Elasticity of supply

The elasticity of supply (E_s) for the Comirnaty vaccine has fluctuated over time, with both elastic and inelastic supply periods. In Q1 2021, the E_s indicated a highly elastic supply. This elastic supply was likely due to the announcement of two new manufacturing facilities. In Q2 2021, the elasticity of supply decreased, indicating an inelastic supply.

In Q3 2021, the E_S increased more than in Q2 2021, indicating a continued elastic supply. The announcement of a new plant in South Africa may have influenced this elasticity of supply. In Q4 2021, the E_S decreased significantly, indicating an inelastic supply. This inelasticity may have been due to the FDA expanding the label of Comirnaty to include use as a booster for children.

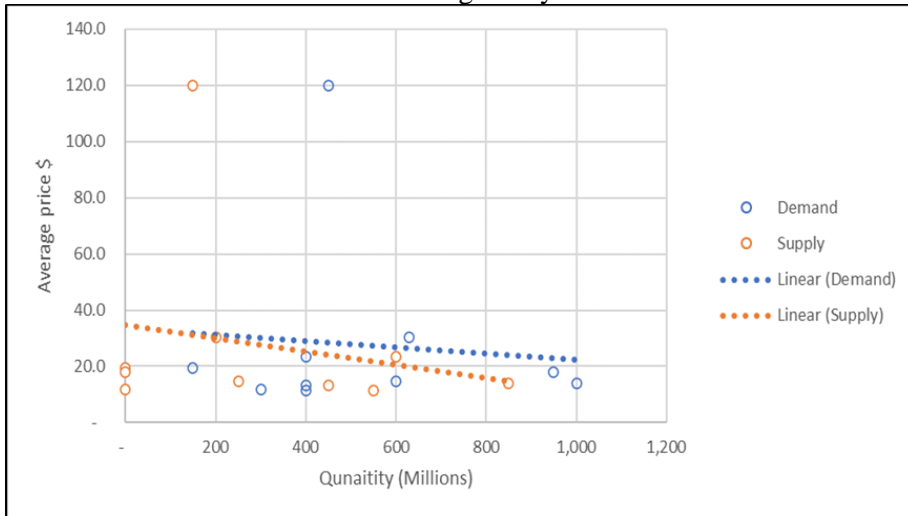
Also, in Q1 2022, the E_S increased again to indicate a return to an elastic supply. This return to elastic supply may have been due to the developing of a new vaccine for the Omicron variant. In Q2 2022, the E_S decreased, indicating an inelastic supply. The announcement of several new COVID-19 developments other than the original Comirnaty vaccine may have influenced this inelasticity. Finally, in Q3 2022, the E_S decreased even further and kept indicating a highly inelastic supply. This inelasticity may have been due to the approval of an Omicron-adapted bivalent vaccine booster.

Overall, the elasticity of supply for the Comirnaty vaccine has been variable, with periods of both elastic and inelastic supply.

Supply and Demand Equilibrium

The equilibrium point for Comirnaty was calculated by matching the linear trendlines equations for supply and demand, as shown in Figure 3. This equilibrium point indicates that at this price, the quantity of Comirnaty doses supplied by the manufacturer will equal the quantity demanded by consumers. The result is that the equilibrium price for a Comirnaty dose is \$32.25, and the equilibrium quantity is 110.79 million doses. This equilibrium point is the point at which the market for Comirnaty is considered to be in balance, with neither surplus nor shortage for supply and demand exists.

Figure 3. Demand and Supply equilibrium Curve for the Comirnaty vaccine globally.



Source: Data extracted from (BioNTech Investor Relations, n.d.; UNICEF Supply Division, 2022).

SWOT analysis

Strengths Using a strategic partnership and collaboration with a substantial pharmaceutical company like Pfizer led BioNTech to capture the opportunity and have the capabilities to develop the vaccine and achieve the current massive growth.

BioNTech and Pfizer, taking the first move in COVID-19 vaccine innovation, booked their place in the leadership of this new market. With a long-term focus on many immunological therapies (oncology and infectious diseases), BioNTech has a promising situation within the pharmaceutical and biotechnology companies. This variety of pipeline products also improves their investment plans as the profits they gain from Comirnaty, and other COVID-19 vaccines are used in other disciplines, pipeline drugs and clinical trials.

Weaknesses The absence of a commercial team inside BioNTech at the beginning negatively impacted their ability to finalise the commercial operations. However, with support from the Pfizer team and massive financial support, BioNTech started a hiring campaign for the entire commercial team.

Currently, BioNTech company does not own other commercialised products other than the COVID-19 vaccines portfolio.

BioNTech's dependence on outsourcing and partnership to succeed can raise questions about its ability to develop final products that could succeed in the market without these partnerships.

Threats One of the principal threats the Comirnaty vaccine faces is the possibility of people losing their desire to be vaccinated. Also, the number of authorised vaccines worldwide increased dramatically to a limit that could be considered a threat even for a market leader such as Comirnaty.

Opportunities There is a vast potential for mRNA technology in healthcare and therapeutics, which allows BioNTech to succeed and be the market leader in that technology-based treatments. Moreover, BioNTech currently has the power of speed design and manufacturing abilities, especially for vaccines, which is considered an opportunity to cope with any new potent coronavirus variants.

PESTEL analysis

Political Political factors have played a significant role in Comirnaty's market analysis. During September 2020 USA event, nine vaccine-developing companies pledged to adhere to scientific standards and integrity, which helped to build trust in the vaccine and increase demand for it. Another example is the WHO's COVAX program is dedicated to making vaccines available worldwide, which has helped increase the vaccine's global supply and expand its market.

In addition, the vaccines are being offered free by the government under pressure from the population, which has made them more accessible to people who could not have been able to afford them otherwise. Finally, the government has supported the development and manufacture of the vaccine locally, which has helped to increase the supply of the vaccine and reduce its cost.

Social Social factors have also had an impact on Comirnaty's market analysis. One negative social factor is the perception of COVID-19 vaccine commercialisation, which has led some people to view the vaccines as a profit-making venture rather than a public health

necessity. This perception has led to conspiracy theories, rumours, and incorrect medical information about the vaccine, which has reduced demand for the vaccine in some cases.

Economic Economic factors have also played a role in Comirnaty's market analysis. The global recession caused by lockdowns and curfews has negatively impacted the economy, reducing demand for vaccines in some areas. In addition, the impact of the pandemic on the supply chain has caused disruptions at the global level, which has increased the cost of the vaccine and reduced its availability in some cases. However, the fast growth of the healthcare sector has provided opportunities for companies like Comirnaty to develop and market their vaccines, which has helped to increase demand for the vaccine.

Technological Technological factors have also had an impact on Comirnaty's market analysis. The development of new mRNA vaccine designs, such as the one used by Comirnaty, has helped to increase the vaccine's effectiveness and improve its market performance. In addition, using new technologies in the manufacturing process has helped increase the vaccine supply and reduce its cost.

Environmental Environmental factors significantly influence the demand for Comirnaty and other vaccines. Climate change and pollution have been suggested as key factors accelerating the incidence of infectious diseases. As the global population rises and the environment becomes increasingly degraded, the demand for vaccines to protect against these diseases is likely to increase.

Legal Legal factors also play a role in the market analysis of Comirnaty and other vaccines. The accelerated approval pathway by health authorities, which allows for expedited approval with minimal clinical trial data, has increased demand for Comirnaty and other vaccines. Additionally, the numerous lawsuits and disputes over patents for vaccine development products have resulted in a volatile market. Furthermore, pricing is up to the company, and deviant agreements with no means of price control lead to uncertainty in the market.

Conclusions

The new substitutes offered by BioNTech are leading to a left shift of Demand since Q2 2022. However, the focus and global support for BioNTech and other COVID-19 vaccine developers decreased, leading to higher operation and production costs and a shift in the supply.

Once the business model of the Comirnaty vaccine changes from a business-to-government (B2G) model to business to customer (B2C) model in which the marketing and selling efforts of the vaccines are directed to individuals and end consumers, the income and consumer taste (preference for particular vaccine brand) is expected to affect the demand which could be within fourth quarter 2022 to first quarter 2023 in the case of BioNTech/Pfizer vaccines.

We expect BioNTech to lead the COVID-19 vaccine market until they finish other product categories; afterwards, they may focus more on the new product portfolio than the COVID-19 vaccine market.

Overall, the market for Comirnaty is complex and dynamic, with demand and supply being influenced by various factors. Further research is needed to understand the market and its implications for the global fight against COVID-19.

Conflict of interest

The first author is an employee at West Pharmaceutical Services Deutschland GmbH & Co KG, Eschweiler, Germany.

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