

# **COVID-19 Vaccine Production and Potential Market Characteristics for Pharmaceutical Companies to Enter the Market- Perfect Competition, Profit Maximization, and Externalities**

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## **Abstract**

**Background:** Healthcare is a special case in several economic markets especially in the United States. It is vital to determine if COVID-19 vaccine production fulfills the conventional economic prediction model to inform policy evolving vaccine productions. To determine potential market characteristics, externalities and profit maximization conditions for entry and exit in the COVID-19 vaccine market. To establish the factors that play vital role in production decision making for new and or existing pharmaceutical companies producing COVID-19 vaccines. The determination of perfect competition and potential violation assumptions where the government can play a role for social welfare.

**Economic Conceptual Model:** The economic theory for perfect competition, and profit maximization conditions that must hold to achieve efficient market point is utilized to project possible solutions. The theory serves as a foundation in determining if indeed the existing COVID-19 vaccine production align with perfect competition characteristics and what characteristics a potential pharmaceutical company may consider to enter or exit the existing market. The synthesis of the theory framework helps determine the externalities, potential violations caused by real world vaccine production scenario, and barriers to entry. Synthesis of existing literature helps support the theory assumptions.

**Observation and relevance:** The government subsidies play a vital role in encouraging new pharmaceutical companies to participate in research and development of COVID-19 vaccines. The current real world scenario has limited demand and supply side heads, introducing uncertainties in production decision making. Vaccine patent, price negotiation constrains, co-pay/deductibles on vaccine, and information asymmetry may all contribute to externalities. Booster doses and more information on the life cycle of COVID-19 virus can help mitigate the uncertainties of production. Existing corporate giving, government subsidies, and pricing mechanism on vaccines might impose positive and negative externalities depending on the country of distribution. Future studies might evaluate the existing theory from the perspective of imperfect competition.

**Keywords:** perfect competition, pharmaceutical industry, COVID19 vaccines, externalities

## **Highlights:**

- i. Both negative and positive externalities persist in the vaccine market
- ii. Evaluation from the perspective of perfectly competitive market characteristics, decisions to shut down for existing vaccine producing companies
- iii. Potential pharmaceutical R&D might consider existing government intervention for barriers to entry and profit maximization under uncertain delta variant vaccine production

**Introduction**

Several assumptions and key characteristics exist for a perfectly competitive market model [1]. For a perfectly competitive market assumption, all individuals and firms are price takers [1]. All individuals maximize utility, all firms in the market maximize profits, and all individuals and firms are fully informed [1]. The assumption in a perfectly competitive market is that the goods produced by the firms must be identical, there are a higher proportion of buyers and sellers who cannot influence the price of the good in the market by either buying more or selling more [2-4]. Moreover, the buyers and sellers have all the information they need about the market at low-cost availability, no barriers to entry or exit the market for any firms [2-4], the inputs required for the production of good are also homogenous [3], no externalities associated, no government regulations required except for the fact to make the market more competitive, and firms can make only normal profits on the long-run but abnormal profits in short-run [1,3].

Healthcare is a special case for several factors associated with imperfect competition characteristics, including uncertainty conditions and treatment efficacy [5]. The demand for healthcare services is uncertain because it provides the highest utility for those who fall sick [5]. It is also established that the risk of falling ill cannot be certainly avoided by one factor like income in case of food deprivation [5]. On the supplier side, an abundance of not-for-profit hospitals, subsidies, and taxes to support nonprofit hospitals, and the physicians' behavior contrast a seller in the market for other commodities where profits are solely self-interests [5]. The information about the quality of service received and provided is uncertain and incomplete to both buyers and sellers in the market [5]. Several limitations exist to entry in the supply side (in commodity market called firms) due to several characteristics that contrast a competitive market [5]. Physicians licensing procedures, high-cost educational training, and restricted range of quality of the product (medical services) are the characteristics that depart from the competitive market [5]. Finally, the pricing practices in the medical care sector have been influential and differing, which

contrasts the no influence on price characteristics of a perfectly competitive market [5]. While some claim that healthcare is not a special case and is unlike any other commodity market [6].

The healthcare sector ownership in the United States is diverse as it comprises for-profit and not-for-profit hospitals [7], insurance companies, and pharmaceutical companies. The type of institution to which government makes payment in return to public service differs depending on their underlying mission and values, as depicted in Figure 1 in the appendix [7]. Depending on the type of ownership, not-for-profit and for-profit hospitals are meant to behave differently [7]. The for-profit organizations in healthcare are owned by stockholders whose sole motive is to gain economic growth, in other words, profit maximization through the firm's growth in which they invest [7]. Although not-for-profit firms are not regulated against earning profits, the sole purpose of earning profits is to sustain the firms functioning to serve the purpose it was formed for [7]. In recent times the motive for a not-for-profit has changed as a significant portion of the revenue is generated through services they provide in their firms [7]. So it can be established that the not-for-profit profits also intend to maximize profit because the management and staff of not-for-profit firms in healthcare are profit-sharing holders through several legal channels [7]. Hence it is crucial to determine to what extent the tendency towards maximizing profit in the healthcare sector depends on the type of ownership to conclude if the existing competitive market model characteristics align with the medical care sector [7].

The Healthcare industry, including the pharmaceutical industries, has been adversely impacted by the COVID-19 pandemic [8]. There is a divergence between public health needs and private incentives of for-profit companies like the pharmaceutical industry [8]. The divergence leads to suboptimal and sometimes negative health outcomes in the U.S. [8]. Hence relying on profit-driven models of Research and Development of pharmaceutical companies in the production of vaccines and drugs

**TABLE 1.1 Common Distinctions Between For-profit and Not-for-profit Organizations**

For-profit	Not-for-profit
Corporations owned by investors	Corporations without owners or owned by "members"
Can distribute some proportion of profits (net revenues less expenses) to owners	Cannot distribute surplus (net revenues less expenses) to those who control the organization
Pay property, sales, income taxes	Generally exempt from taxes
Sources of capital include	Sources of capital include
a. Equity capital from investors	a. Charitable contributions
b. Debt	b. Debt
c. Retained earnings (including depreciation and deferred taxes)	c. Retained earnings (including depreciation)
d. Return-on-equity payments from third-party payers (e.g., Medicare)	d. Governmental grants
Management ultimately accountable to stockholders	Management accountable to voluntary, often self-perpetuating boards
<i>Purpose:</i> Has legal obligation to enhance the wealth of shareholders within the boundaries of law; does so by providing services	<i>Purpose:</i> Has legal obligation to fulfill a stated mission (provide services, teaching, research, etc.); must maintain economic viability to do so
Revenues derived from sale of services	Revenues derived from sale of services and from charitable contributions
<i>Mission:</i> Usually stated in terms of growth, efficiency, and quality	<i>Mission:</i> Often stated in terms of charity, quality, and community service, but may also pursue growth
Mission and structure can result in more streamlined decision making and implementation of major decisions	Mission and diverse constituencies often complicate decision making and implementation

From: 1. Profits and Health Care: An Introduction to the Issues



For-Profit Enterprise in Health Care. Institute of Medicine (US) Committee on Implications of For-Profit Enterprise in Health Care; Gray BH, editor. Washington (DC): National Academies Press (US); 1986.

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**Figure 1: Distinction between For-Profit and Not for Profit Organization to understand profit maximizing perspectives [7].**

during pandemic might not provide efficient health outcomes [8]. Through literature, it is also evident that the pharmaceutical industry intends to maximize profits in the U.S. [8]. The competitive market characteristics are an ideal characteristic that the pharmaceutical companies producing vaccines might be interested in. However, several departures from the ideal market characteristics in a non-pandemic situation for pharmaceutical companies exist [8]. While the government provides subsidies for the research and development of vaccines or drugs to the pharmaceutical companies for social welfare, it is vital to understand the profit maximization conditions that must hold to allow free entry and exit from the vaccine market [8].

#### **Profit maximization conditions and COVID-19 Vaccines**

Profit-seeking is justifiable ethically as the firm has to recover its expenses to produce goods the consumer's demand [9]. So, it is assumable to be a ubiquitous concept in any product market. The firms maximize profits when Marginal Revenue (MR) equals Marginal Costs (MC) in a competitive market where both the supplier and the demanders are price takers [1,9]. In other words, if the assumptions of a perfectly competitive market hold, the firms in the market will only maximize profits where they can generate revenue through production to recover the input costs [1]. Profits are incurred after deducting total revenues from total costs for a firm [1,10], and the profits are maximized when there is the most significant gap between the total revenues and total costs [1,10].

In healthcare, depending on the firm's ownership, it is vital to understand how nonprofit hospitals vary in their perspective for profit maximization. The type of ownership helps identify the consumer demand for services as the not-for-profit hospitals over for-profit successfully retain consumers' trust [11]. When the information is asymmetric among the consumers about the quality of services (product), they tend to lean towards ownership whose face value perspective is to do social welfare [11].

The pharmaceutical industry is a special case where the research and development of particular drugs, vaccines are subsidized by public funds but can commercialize the product and get patent rights [8]. This also indicates that the pharmaceutical companies intend to serve their owners and shareholders by making profits by commercializing such health-relevant products [8]. Although patent rights and the government's inability to negotiate prices create barriers to entry [12] and discourages competition, government plays a crucial role in encouraging competition during pandemic [8] by providing public funding [12]. The following paragraphs help understand each component of profit maximization in a competitive market and the associated shutdown decisions. The following paragraphs will also elaborate on components that play a vital role in for-profit decision-making maximization from both the supply and demand side and other factors like type of costs a firm incurs, and input prices associated with it to rely their production decision upon. The production decision or output decision of a price taker firm in a competitive market depends on factors such as cost minimization, supply and demand [1].

#### **Cost Minimization**

It is vital to understand factors that play a role in determining whether the firm is recovering its cost, maximizing profits, or not predicting its future closure or tangential decisions

[1]. Firms minimize costs when their output equals the costs of spending (inputs) like wage and rental rates on labor and capital [1]. It is also evident that the relationship between the output and inputs (total costs) of a firm is dependent on its nature of production [1]. Depending on the different output levels, the level of inputs exists for the cost minimization of a firm, also known as the expansion path [1]. The factors that play a role in determining if the firm is indeed minimizing costs are the types of fixed and variable costs, returns to scale, input marketing prices, prices of the product, and the overall output decisions in the short and long run, depending on the cost curve shifts [1].

**Types of costs:** There exist different types of costs a firm might face. It includes explicit and implicit costs like opportunity, accounting, economic, labor, and capital costs [1]. For the predictive ability of the economic model, only labor and capital costs are considered to determine the cost minimization techniques of a firm [1]. The COVID-19 vaccine involves two areas: production and vaccination services [12]. Generic pharmaceutical companies differ in the type of product they produce, i.e., the difference in the production of vaccines compared to drugs [12]. The manufacturing of vaccines is more complex and involves supply chain concerns alongside production and R&D [12]. Several costs involved in vaccine production include capital (technology, skills, high GMP standards), R&D costs, and labor-associated costs like clinical trials [12].

**Economies of Scales (returns to scale):** The economies of scale help us determine the firm's production function and the aspects that help minimize input costs [1]. Different factors like mergers, consolidation, or certain outsourcing services help save costs for the firms in the healthcare sector [13-16]. The economy of scale for vaccine production seems to be decreasing returns to scale [12]. The critical determinants for the economy of scales for vaccine productions are investment capacity and efficient risk management [12].

**Shifts in cost curves:** Firms in the short-run tend to face inflexibility about input decisions, while firms have flexible inputs decision-making opportunities in the long run [1]. The goal of any firm is to minimize cost and maximize profits, so it is vital to understand it from the long-run and short-run periods [1]. The cost curves for a firm shift if a change in input prices, technological innovation, or substitution rate of inputs [1]. Pharmaceutical companies receive incentives through public funding to convince them to undertake research and development with minimal concerns for cost curve shifts [8].

**Input market pricing (Costs for labor and capital/time):** In a perfectly competitive market scenario, all the inputs are hired at the same rate, and no one person influences the wage or rental rates of the inputs [1]. In the U.S., pharmaceutical companies benefit from hiring at minimal cost for inputs as a significant proportion of R&D capital comes from public-funded science and subsidies [8]. However, for the research and development of new vaccine the estimated cost is about \$68 billion [17].

**Price:** In a perfectly competitive market, both the suppliers and the demanders are price takers [1]. Hence, in a perfectly competitive market scenario, firms have only one decision: how much to produce [1]? Price also plays a role in rationing demand and indicators for suppliers on output to help achieve efficient points [1]. However, it is established that healthcare providers engage in price discrimination which helps them cost shift for charity services [18]. Price discrimination violates the assumption of efficient equilibrium and carries social costs [1,18]. It is also established that price secrecy encourages anti-



competitive markets, but it is acceptable behavior in healthcare due to differential costs incurred by different types of healthcare service providers [18]. If the consumer and supplier have complete information on prices, they could decide which is the best option for them to buy or hire [18]. However, if the price discrimination persists, the marginal revenue cannot be equal to the marginal cost for a firm, and it violates the assumption of competitive markets [19]. Since the pharmaceutical company can decide its price for commercialization, the case for vaccine pricing is quite different (Agarwal, 2020; Sarangi & Damodaran, 2021; Vaccine Capitalism: A Run-down of the Huge Profits Being Made from COVID-19 Vaccines, 2021).

**Output decisions:** When a firm is making losses, it has two decisions to make in a competitive market: whether to shut down or continue production [22]. Marginal revenue is less than marginal costs, in which case the hospitals might decide to reduce output. To maximize profits, total revenue must be higher than the total cost [22]. Only then could it sustain itself in the market [22]. The decision to shut down depends on fixed and variable costs, which vary in the long and short run, as mentioned before in this paper.

Moreover, in the literature, it is established that total assets and revenue/cost are positively correlated in the healthcare service sector [23]. At the same time, gross profits are negatively associated with assets and revenue/cost for a hospital's financial performance [23]. Hence, this paper established that the key predictors for a pharmaceutical company in healthcare would depend on the type of ownership, size of the pharmaceutical company producing vaccines, and other R&D relevant factors. The decision to shut down hence depends on the following scenarios in a competitive market [22]:

1- If the firm decides to shut down now, revenues are zero without incurring any variable costs like administrative staff, health care staff, etc. In such a scenario, it will only have to continue paying fixed costs like lease amount, capital rental rates, etc.

2- The firm earns revenues that are lower than the variable costs incurred. In such a scenario, the firm would decide to shut down immediately [24]. They would have to pay out of pocket to cover the variable costs exceeding the revenues made.

3- If the firm generates revenue exceeding the variable costs, it might continue operating and staying in business.

In the COVID-19 pandemic, several private sector hospitals and clinics are shutting down due to multifactor effects of discontinuity in medical tourism, elective procedures, increases the cost for PPE and other necessary equipment to treat patients, patients deferring treatment out of fear for infection, and finally, the inability of the patients to pay out of pocket [24].

### Supply and Demand Side

The equilibrium price is the price at which quantity demanded equals quantity supplied. While determining equilibrium price, it's essential to consider the time frame in which supply response occurs [1]. Supply response is the change in quantity supplied due to change in demand conditions. Time frames can be categorized into [1]:

1-Very short run in which the quantity supplied is fixed

2-Short run in which existing firms can respond but no new entry

3-Long run in which existing firms can respond, and new firms can enter

In the very short run, the prices rise if demand increases as the

supply are fixed, so to keep up the supply, the rationing is done by increasing the price [1]. The elasticity of both the supply and demand curve help determine how responsive each curve is to the price change [1]. In healthcare services, staffing decisions depend on the hospital's financial performance [25]. It includes downsizing caregiving staff and replacing expensive qualified staff with assistive, less expensive personnel [25]. In staffing decision-making, several evaluations like benefits are incurred by hiring each additional staff member contingent on the patient's illness severity, reimbursements amount for that patient, and caseloads [25]. Vaccines face minimal generic and price competitions, and the major demander is the government of any country [12]. It is also evident that the two key identified parties for both supply and demand-side are government (Demand) and Pharmaceutical companies (Supply) [12].

### Externalities and why markets fail in healthcare

An externality is the effect of one party's economic activity on another party not considered by the price system [1,26]. It could be positive (benefits) or incurring negative costs [1]. Externalities occur between Firms, firms, and people, and between people [1]. Externalities lead to inefficient resource allocation as in externality,  $Price = Marginal\ Social\ Cost$ , which could be positive or negative [1]. An externality, which is negative,  $Price = Marginal\ Cost$  will output too many goods than efficient allocative outcomes ( $P = MSC$ ) [1]. When there exist positive externalities government can intervene in several ways like providing subsidies on the demand side, supply-side subsidy, or both sides subsidies [19]. The government, through policy interventions, can also help solve externalities [27].

### Externalities, COVID-19 Vaccines, and role of Government

Infectious disease like COVID-19 is associated with several externalities, and it is vital to understand such infectious disease from an economic perspective [26]. The two types of externalities associated with such pandemic are infection externality and pure prevention externality [26]. Ultimately both these types of externalities guide government interventions for any country [26]. The externalities can be efficiently tackled through public policies like mass vaccination [26]. An eradication policy is not necessarily a policy that can efficiently offset the externalities, so governments need to weigh the benefits of subsidies [26]. The negative externalities and their mitigation costs in the COVID-19 pandemic are heterogeneously present among different vulnerable groups of people [28].

Vaccines and vaccination have a positive externality to not just a few people but inclusive of a greater proportion of the population [12]. The negative externality involved for COVID-19 vaccination is denial to get vaccinated out of fear of side effects [29]. This, in turn, impacts the country and its federal system if herd immunity isn't achieved [29]. The potential solution to this is providing incentives to get vaccinated [29]. In terms of negative externality to the public, the only prominent one seems to be allowing the pharmaceutical companies to set the price for the vaccine [21]. The role of the government in resolving this is to regulate and or cap the price the pharmaceutical company can charge in the long run and not in the short run other than the agreed price [21]. However, the pharmaceutical company seems to be on neither side of the externality horizon due to the criticality of the pandemic and the support they receive [20,30,31].

## Conclusion

This paper addresses potential threats the pharmaceutical company poses for other similar suppliers in vaccine production and the role of the government in mitigating it. It describes what ideal market characteristics a likely pharmaceutical company might look for entry and exit in the vaccine market. The following section describes the profit maximization characteristics the companies might consider in making production decisions for a competitive market. Finally, externalities associated with pandemics and vaccines are discussed.

## References

- Nicholson W, Snyder C. Intermediate Microeconomics and Its Application. 12th ed. CENGAGE; 2015.
- Original [Author removed at request of. 9.1 Perfect Competition: A Model. Published online June 2016.
- Perfect competition Characteristics - analysis . Economics Online.
- Perfect Competition. Boundless Economics.
- Arrow K. Uncertainty and the Welfare Economics of Medical Care. *Am Econ Assoc.* 1963;53(5):941-973. doi:10.1257/pandp.108.636
- Chambers S. Why the economic aspects of healthcare are not unique. *Sultan Qaboos Univ Med J.* 2020; 20(2): 165-172. doi:10.18295/squmj.2020.20.02.006
- Gray BH. Profits and Health Care: An Introduction to the Issues. National Academies Press (US); 1986.
- Heled Y, Rutschman A, Vertinsky L. The problem with relying on profit-driven models to produce pandemic drugs. *J Law Biosci.* Published online 2020: 1-23.
- Koch C. An ethical justification of profit maximization. Published online 2010. doi:10.1108/17465681011079491
- Prateek Agarwal. The Profit Maximization Rule | Intelligent Economist. Intelligent Economist.
- Deneffe D, Masson RT. What do not-for-profit hospitals maximize? *Int J Ind Organ.* 2002; 20(4): 461-492. doi:10.1016/s0167-7187(00)00104-1
- Kaddar M. Economic Characteristics of Vaccines and Immunizations.; 2020.
- Bernet PM, Singh S. Economies of scale in the production of public health services: An analysis of local health districts in Florida. *Am J Public Health.* 2015; 105(Suppl 2): S260-S267. doi:10.2105/AJPH.2014.302350
- Singh S, Bernet PM. Economies of Scale and Scope in Public Health: An Analysis of Food Hygiene Services Provided by Local Health Departments in Florida. *Am J Public Health.* 2014; 104(12): e44-e44. doi:10.2105/ajph.2014.10412e44.2
- Singh SR. Public health spending and population health: a systematic review. Published online 2014. doi:10.1016/j.amepre.2014.05.017
- Dranove D, Lindrooth R. Hospital consolidation and costs: Another look at the evidence. *J Health Econ.* 2003; 22(6): 983-997. doi:10.1016/j.jhealeco.2003.05.001
- Vaccine Capitalism: a run-down of the huge profits being made from COVID-19 vaccines . Corporate Watch.
- Grinols EL, Henderson JW. Consequences of Price Discrimination in Health Care. *Atl Econ J.* 2021; 49(1): 113-115. doi:10.1007/s11293-021-09706-5
- Warburton CES. Uneasy coexistence: Profit maximization and affordable healthcare in the US. *Appl Econom Int Dev.* 2019; 19(1): 55-84.
- Agarwal R. Finding Good Profit From Covid-19 Vaccines. *Forbes.*
- Sarangi S, Damodaran H. A single price for Covid-19 vaccines will stimulate production, ensure efficient vaccination. *The Indian Express.*
- OpenStax. How Perfectly Competitive Firms Make Output Decisions. In: Principle of Economics. Rice University; 2016.
- Dubas-Jakóbczyk K, Kocot E, Kozieł A. Financial performance of public hospitals: A cross-sectional study among polish providers. *Int J Environ Res Public Health.* 2020; 17(7). doi:10.3390/ijerph17072188
- Williams OD. COVID-19 and Private Health: Market and Governance Failure. *Dev.* 2020; 63(2-4): 181-190. doi:10.1057/s41301-020-00273-x
- Zhao M, Bazzoli GJ, Clement JP, Lindrooth RC, Nolin JM, Chukmaitov AS. Hospital staffing decisions: Does financial performance matter? *Inquiry.* 2008; 45(3): 293-307. doi:10.5034/inquiryjrn1\_45.03.293
- Gersovitz M, Hammer JS. Infectious diseases, public policy and the marriage of economics and epidemiology. *World Bank Res Obs.* 2003; 18(2): 129-157. doi:10.1093/wbro/lkg011
- Rosenthal MB. What Works in Market-Oriented Health Policy? *N Engl J Med.* 2009; 360(21): 2157-2160. doi:10.1056/nejmp0903166
- Boettke P, Powell B. The political economy of the COVID-19 pandemic. *South Econ J.* 2021; 87(4): 1090-1106. doi:10.1002/soej.12488
- Mankiw G. Pay People to Get Vaccinated . *The New York Times.*
- Loftus P, Grossman M. Moderna Turns First Profit, Boosted by Its Covid-19 Vaccine . *WSJ.*
- Coronavirus vaccine: Did Pfizer put profit first? . DW .