

## **A threatened broad-based economic recovery**

### **— Examining the deepened global vulnerability and imbalance caused by the unequal distribution of COVID-19 vaccine in high and low-income countries**

COVID-19 marks a tremendous turning point for all states and civilians worldwide as it prompted global jitters with the continuous threat of the infectious coronavirus. By drawing a scar, this global epidemic has reflected the flaws in the existing systems and structures and articulated the significance of solidarity and mutual support while revealing the self-interest of many players in this chaotic game. No one was prepared for the unexpected arrival of the epidemic, and no one was willingly ready to encounter the detrimental consequences of severe social and economic loss. At present, the COVID-19 is still spreading worldwide, among which the accelerating spread of the new mutant virus has gradually become a threat to the fight against the epidemic. The cost to alleviate the damage by investing in preventive measures has encouraged the global society to cooperate in combating the pervasive diffusion of the disease. With heavy investments in making covid vaccines, the global society awaits the moment of victory through advanced scientific progress. Notably, a race of vaccines was held among developed countries with mature scientific research conditions and economic support to compete for a dominating position as the tech leader and savior of the global crisis. Intense competition fosters progressive vaccine innovations and the significant release of the vaccines simultaneously shifts the global market from a race of developing it to a battle over resource allocation.

Despite a joint effort and collective expectation for covid vaccines, parallel developments are still far from reach. Not all countries' economic and scientific conditions enable them to develop vaccines independently, nor can the purchase of foreign-made vaccines make up for the imbalance as evident unequal distribution of vaccines contributed to the regional improvement and regional deterioration. All the developed nations are accumulating a large number of vaccines in preparation for another wave of pandemic, and thus, their holdings of supply exceeds far more than their demand, while the developing countries in demand still lack enough vaccines to give a round of first shots for all of its civilians. Regional development would not improve the overall status quo of the pandemic, yet, but deepens global vulnerability in resistance to the ongoing and upcoming challenges as an imbalance impede the way for parallel medical development.

Furthermore, the competition in the trade market led to policies regarding the production of vaccines. Not only are developing countries' access to vaccines limited for their lack of research development and their helpless control towards developed country's monopolization and private deposit, but the monopoly is also strengthened by the patent and intellectual property held by the investors. The most effective way to curb the posted challenges of the COVID-19 pandemic is through vaccine development, production, and universal access. However, this is unobtainable as the intellectual property rules designed to protect the interests of pharmaceutical companies discourage the sharing of science, and hinder the progress towards global public health, in particular hampering economic recovery in developing countries.

Recognizing this profound issue under the context of the pandemic, this research paper aims to examine how the unequal distribution of covid vaccines would shape an imbalanced market, particularly how limited access to the vaccine was created and reinforced by research development & marketing and market exclusivity of patents. Hypothetically, it is reasonable to deduce that the distribution would lead to an inflated market, along with an imbalance in the supply-demand chain between high-income and low-income countries. To tack this tendency of economic extremity, despite that solution on patents are unable to suggest due to challenge of its complexity, possible solutions such as encouraging the local establishment of factories to alleviate the market imbalance while maximizing supply production; the use of AI Mathematical Optimization to analyze rational allocation and the call for more producer states' participation in the COVAX facility are proposed to tackle the unequal distribution.

## **Vaccine Market Investment & Monopoly**

One major issue that leads to the unequal distribution of covid vaccines worldwide is the monopolization of vaccine production by high-income countries that are heavily invested in the field. The making of vaccines entails a tremendously high fixed cost in scientific research. The U.S. federal government has invested about \$6 billion in the Covid-19 vaccine producer Moderna, the Cambridge, Mass., biotech that few outside the scientific and investment worlds had heard of a couple of years ago (Saltzman, "Statnews"); The record-breaking amount of \$3.7 billion investment in the German biotech sector last year led to the successful breakthrough in creating the first Western COVID-19 vaccine which attracted the attention of investors.

The world has four primary sources of coronavirus vaccine producers. According to data shared with Axios by the science information and analytics company Airfinity, China holds 33% of all doses produced, while the U.S. produced 27%, the E.U. with 19%, and India with a total of 13%. Notably, while China exported around 60% of its total vaccines produced — partly for the steady control and lesser domestic urgency, the U.S. has exported 0% as it focuses on covering all U.S. adults. The U.S. has reserved 800 million doses but accounts for a fifth of all covid-19 cases globally (11.02 million cases). In contrast, Japan, Australia, and Canada have collectively reserved more than one billion doses but do not account for even 1% of current global covid-19 cases globally (0.45 million cases). (So&Woo, "BMJ")

The high-income countries independently develop their vaccine production, their monopoly, and the ransacking of the global market and foreign products worldwide by occupying the advance sales and forming alliance trade partnerships. "Through the summer and fall of last year, wealthy nations cut deals directly with vaccine-makers, buying up a disproportionate share of early doses — and undermining a World Health Organization-backed effort, called Covax, to equitably distribute shots." (Mirza&Rauhala, "Washingtonpost") The English Medical Journal BMJ reports that the premarket purchase commitments took place by November 15th of 2020, totaling 7.48 billion doses, or 3.76 billion courses, of covid-19 vaccines from 13 vaccine manufacturers. Just over half (51%) of these doses will go to high-income countries, representing 14% of the world's population. Rich countries already receive at least half of the new coronavirus vaccine from the world's leading 13 vaccine manufacturers. Low- and middle-income countries use only a fraction of the rest. Although these countries are home to more than 85% of the world's population, they have less than half of the world's COVID-19 vaccine. (So&Woo, "BMJ") While the United Kingdom has pre-ordered enough vaccines for five doses per person, as statistically analyzed by Ewen Callaway, a PubMed author, the United States is estimated with more than two doses per capita, second to the United Kingdom with a predicted potential expansion on embracing vaccine supply to as much as the U.K. currently holds. Notably, the low and middle-income countries and economies — made up of 92 countries who are eligible to receive aided doses through the COVAX international fund — facilitated by WHO and CEPI to secure one billion doses for these countries, were only able to hold less than one-tenth of a dose per capital averagely among 92 countries, with no potential further supplies even under the assistance of international institutions. This reveals that despite multilateral support urgently trying to assist low-income countries by providing export from producer states, unequal distribution is still standing in a highly imbalanced tendency as the high-income states all accumulate their vaccines while expanding their occupation in the global market for potential expansion.

"We're not going to get rid of the pandemic until we get rid of it everywhere," says Mark Feinberg, head of the International AIDS Vaccine Initiative in New York City, which is developing a COVID-19 vaccine with U.S. drug company Merck. "We need to prevent vaccine nationalism," said Tedros Adhanom Ghebreyesus, the World Health Organization (WHO) director, at an August 18th briefing. (Callaway, "Nature")

### **Intellectual Property & patents of vaccines**

In 2021, the globe has been split into coronavirus vaccine "haves" and "have-nots," creating a gap that may define the next phase of the pandemic. (Mirza&Rauhala, "Washingtonpost"), as awareness of vaccines, inequalities have grown, vaccine development, production, and universal

access are the most effective ways to curb the continued spread of the disease. However, the intellectual property rules designed to protect the interests of pharmaceutical companies pose a challenge to global public health, in particular hampering economic recovery in developing countries. The cost of the pharmaceutical industry research and development of new drugs or preparations for the protection of intellectual property rights has a very high dependence, and the public's right to health and technical permission to have a strong demand for drugs holds contradictory overlaps.

The research and development of new drugs imply big investment, big risk, great significance, big market, and long cycle. Due to the exclusive market right of the original drug through patent protection, its high price will result in even higher medical expenses of the state and citizens. (Liu, "Tencent News") Moreover, major vaccine manufacturers argue that simply giving up patents will not solve the problem of inadequate supplies. The vaccine patent covers the basics but not the precise manufacturing process. Pfizer and Moderna, for example, have new products that only a few people understand about their manufacturing processes. The German government, which owns vaccine maker Biotech, argues that "what restricts vaccine production is capacity and the high standards needed to produce the vaccine, not patent protection." (Kong, "China News")

Pharmaceutical companies argue that these high prices are necessary to recoup substantial research and development (R&D) expenditures, but patent rules also prevent developing countries from producing medicines locally to meet domestic needs. As the U.S. Constitution puts it, ideally, the patent system aims to improve public welfare by incentivizing the creation and dissemination of lifesaving products to promote the progress of science and the useful arts. In practice, the global patent system has enabled the pricey sale of drugs owned by the pharmaceutical companies, serving largely for diseases prevalent in wealthy countries that could afford them. (Okediji, "CNN")

Notably, the Biden administration, on May 5th, claimed its support to waive intellectual property protections for covid vaccines, leading to debates. In October 2020, South Africa, Kenya, and the co-sponsors submitted a report to the WTO in ask for all countries not to grant patents and intellectual property rights on drugs and vaccine technologies related to COVID-19 during the period of the outbreak of novel coronavirus until the global herd immunity is realized. The United States voted against the petition with the non-grantor enforcement of relevant patents. (Liu, "Tencent News") Arguably, the change in U.S.'s attitude would contribute to a vaccinated world. Controversially, it undermines innovation without helping near-term supply issues.

Pfizer CEO Albert Bourla responsively warned that the waiver for patent protections would set off a worldwide race for raw materials that threatens the safe and efficient manufacturing of Covid shots. (BerkeleyJr, "CNBC") Moreover, he stresses that by taking different measures to give a reasonable price, their vaccine pricing has deliberate calculations. According to the current situation of the country, the price for developed countries is very acceptable, while the price for developing countries will be lower or even free, thus delivering public welfare while receiving payback and profit from the research. He considers that the importance of innovation overwhelms equality. Without the protection of intellectual property rights, it is really impossible to return the capital.

India is the world's third-largest producer of generic drugs, as it is currently suffering under uncontrollable epidemic, India's two-dose vaccination rate is only 2% of the total population. Similar low-income countries like India are in urgent need for more vaccines, yet the unshared technologies posts barriers, and the making of generics would lead to condemnation.

### **Consequential Outcomes**

Under the aim to accelerate the development and manufacture of COVID-19 vaccines and to guarantee fair and equitable access for every country globally (WHO, "WHO"), COVAX did not sufficiently obtain its aim as the unequal holding still pervasively exist from the review of the current progress. While the high-income states can recover quickly as most of the population gets vaccinated and resume work, low-income countries continue to suffer under the endless surge of the pandemic. By May 10th, announced by Gov. Gretchen Whitmer, 55% of Michiganders have

received at least one dose of the COVID-19 vaccine, allowing in-person work to resume in two weeks. (Hutchinson, “Clickondetroit”) Meanwhile, the variants of the virus discovered in India may have developed to evade some protections provided by vaccines. (BerkeleyJr, “CNBC”)

Consequently, the dominating high-income countries' monopolizing of vaccine market and debates over the release of intellectual properties gave the high-income countries time to reorganize internally, meanwhile slowing down the overall pace of global recovering progress as certain countries are left far behind. This constructs a global vulnerability despite high-income countries' advanced firsthand takes of the vaccine because the monopoly in the vaccine market led to the out-sync of the global economic market. The taking of vaccines ensured possibly a full resumption of work in the high-income countries, such the United States, under the effort of the internal economic revival, the states would restore its economic system — industries require supplies to function, and the consumeristic demand of the people calls for importing goods. However, recognizing that the low-income countries serve as the central export states for raw materials and production supplies that meet up to the demand, this tie of business intercourse cannot perform as the demanded supply could not be delivered or produced when the export state is under a pandemic. As low-income countries cannot obtain production recovery, their limited supply could not keep up with the unfulfilled demand, which would lead to the inflation of prices. As analyzed by Jared Bernstein and Ernie Tedeschi, the pandemic disturbs the economic regulation and led to inflation “primarily due to three different temporary factors: base effects, supply chain disruptions, and pent-up demand, especially for services.” (Tedeschi, “White House Government”)

## **Solutions**

Under the current situation where many countries could not ensure one shot for all citizens, solutions must address efforts to strive for equal vaccine distribution through trade and export policies. One significant way to support vaccine import in lower-income countries is to encourage global top leading vaccine brands to establish a business market in the lower-income countries or to states in emergent need. To achieve this, the construction of local factories and the recruitment of locals are needed to regulate this high-demand business on a regulated basis that takes out tremendous consumption. The establishment of local factories enables the technology holding states and companies to maximize their profit with minimum input and maximum profit in reward as meeting up the demand of an unfilled population could bring quantitative sales and strengthen its business prestige worldwide. Moreover, the establishment of locally produced vaccines assisted by the vaccines brands enables convenient and direct access for local purchase, and the trade network in the larger zone in which countries are located would expect an extensive expansion and thus improved global access. As inflation in the global market is deduced due to little supply to meet the demand, one angle to put this problem is by looking at the supply side's demand. Currently, the highest and most urgent demand from the supply states — the lower-income countries, is vaccine supplies; by establishing more global trade interconnection by using vaccine trade, it is now time for the vaccine holding states to realize that not only are their vaccines sufficient for a second or a third shot for all citizens, by trading the vaccines and developing business from it can bring them economic profit and from a long term, quell the market turmoil through the come-and-go trade. The low-income states get to develop and regulate their economy through recovering with vaccines, while the high-income states get to profit and eventually fulfill their demands when the lower-income countries restore their supply.

On the other hand, equal distribution of vaccines can be enhanced by government participation and AI Mathematical optimization to strengthen the COVAX facility with more technological support and intelligent distribution. The facility aims to give countries vaccine quantities in proportion to the country's populations until they can help 20 percent of their population, yet the reports revealed

potential space COVAX to improve support insufficiency to vulnerable countries due to the lack of vaccines it holds. First, countries with the first shot for all citizens must join the COVAX facility and facilitate with their supply because, as noted by Ronald Bailey from [reason.org](http://reason.org), "first dose of the Pfizer/BioNTech vaccine is 82 percent effective—well above the 50 percent threshold the U.S. Food and Drug Administration (FDA) set for vaccine approvals" (Joffe&Nastasi, "Reason")

Second, it is also important to note how to allocate the amount of vaccines at hand rationally, when it is impossible to ask for abundance at the time. When countries are not willing to offer their support with supplies, or when the storage of vaccines is facing depletion, the application of AI Mathematical optimization could help to suggest rational allocation of vaccines by examining significant priorities of the current situation and the populations by age, the poor, workers, and or minorities, thus maximizing the ethicalness of vaccine distribution to the masses most efficiently and equitably as possible. By doing this, even if the vaccine shortage could not be solved in the short term, rationally distributing them can make the limited vaccine serve to the best effect possible.

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