

The World-System of Vaccine Distribution Global Inequalities and Geopolitical Conflicts During the COVID-19 Pandemic

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Abstract

This article analyzes spatial hierarchies and geopolitical conflicts during the COVID-19 pandemic from a world-systems perspective. Drawing on data on global vaccine production and distribution, we argue that the trimodal structure of the capitalist world-system—core, semi-periphery, and periphery—has been reproduced through unequal access to vaccines, constituting hierarchically structured “vaccine worlds”. These vaccine worlds are geopolitically contested, as Chinese companies compete with American and European corporations for influence and markets. Against this background, we outline the Chinese state-led vaccine internationalization strategy with its focus on the global South, and discuss its achievements and contradictions.

Keywords: China, Vaccine Diplomacy, Vaccine Nationalism, COVAX, Periphery



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“The COVID-19 pandemic is far from over. It will not end, if it does not end everywhere,” warned the director-general of the World Health Organization (WHO), Tedros Adhanom Ghebreyesu, in May 2021 against the backdrop of the vaccine paucity in the global South. The identification of the Omicron variant of COVID-19 and its global spread since late 2021 has confirmed this fear. Already in 2021, many scientists and aid organizations had raised concerns that countries with low vaccination rates could become the breeding ground for new resistant variants that could lead to new waves of infection in other regions (Bollinger, Ray, and Maragakis 2022).

The spread of new variants has shown the pandemic to be a global challenge. Three years after the World Health Organization (WHO) assessment of COVID-19 as a pandemic, the virus was still a leading cause of death worldwide; numbers only declined through 2023. In addition, it became clear that governments around the world had varying resources to respond to the health crisis. This was particularly true for the distribution of COVID-19 vaccines. Vast regional disparities in the pandemic response have been striking: While the adult population and children over five in the United States and Europe have been eligible for booster shots since the autumn of 2021, only about a quarter of the total African population was fully vaccinated (excluding booster shots) in December 2022; this rose to about half by October 2023.

Moreover, distribution patterns of the different COVID-19 vaccines have diverged. While the European Union and the United States have mainly used Western mRNA vaccines from BioNTech or Moderna, Chinese inactivated virus vaccines from Sinovac and Sinopharm have been delivered to large parts of the global South. This is important since clinical trials indicate that the vaccines vary in the level of protection they give against new infections with COVID-19, and against mild and severe courses of the disease. Clinical studies show that the Sinovac and Sinopharm vaccines provide less protection against symptomatic infection with the Alpha, Beta, Gamma, and Delta variants than Western mRNA vaccines (WHO 2022b-f).¹ In 2021, when the Gamma and Delta variants spread worldwide countries with high vaccination rates such as Chile and the United Arab Emirates, which had relied on the Chinese vaccines, experienced a surge of infections that was largely attributed to their relatively low efficacy against infections.²

In this article, we analyze the global hierarchies in vaccine distribution. Where existing studies focus on COVID-19 vaccine diplomacy and geopolitics, “vaccine nationalism” and the unequal distribution of vaccines, we provide a global overview of vaccine inequalities. We address two closely interrelated research questions: first, which patterns of global COVID-19 vaccine production and distribution can be observed, and which country groupings can be identified? And

¹ These study results should not obscure the fact that all WHO-approved COVID-19 vaccines show high overall efficacy. Their variation in efficacy, however, has significantly shaped and influenced the capacity of individual states to combat the pandemic.

² Half a year later, the emergence and spread of the highly contagious Omicron lineage led to new problems. Omicron challenged the efficacy of both Western mRNA and Chinese vaccines, particularly in the months after the inoculation once initial protection had attenuated. In China, when the government abruptly abandoned its Zero-COVID policy in late 2022, this became a major problem. Fueled by low (booster) vaccination coverage among the elderly and low protection of the Chinese vaccines, the Omicron variant spread rapidly in China’s population. In the month after the country ended its Zero-COVID policy, China reported more than 60,000 COVID-related deaths.

second, how does the production and distribution of COVID-19 vaccines relate to broader geopolitical conflicts in the global political economy?

Our first argument forms hypothesis one (H1): that three separate “vaccine worlds” have emerged in the pandemic that largely mirror the trimodal structure of the world-system.³ We show that in the first (almost exclusively core countries), high vaccination rates with mRNA vaccines (BioNTech, Moderna, etc.) manufactured in core countries, exhibiting high efficacy rates, had already been achieved in 2021; in the second (almost entirely semi-periphery), comparatively high vaccination rates had been achieved somewhat later, using vaccines produced in different zones of the world-system, with slightly lower efficacy rates (CoronaVac, AstraZeneca). A third heterogeneous vaccine world exists on the periphery of the first two, where access to COVID-19 vaccines has been limited, vaccination rates have been comparatively low, and a wide range of vaccines have been in use.

Our second argument forms hypothesis two (H2): that the second and third vaccine worlds have become an arena of hegemonic conflict in the world-system, where vaccine manufacturers from China compete with U.S. and European companies for market shares. China, in particular, has pursued an active vaccine diplomacy in the semi-periphery and periphery that has relied on a state-driven model of product licensing and sales deals. After a series of initial successes, the strategy fell into crisis due to a loss of reputation of the Chinese inactivated virus vaccines, and the increasing availability of mRNA vaccines from Western core countries.

Our primary contribution to the existing literature on global vaccine inequalities and geopolitical conflicts over COVID-19 vaccine distribution is thus the analysis of COVID-19 vaccine inequalities from a world-systems perspective. First, we show that historically established power relationships between core, semi-periphery, and periphery have structured the global production and distribution of COVID-19 vaccines, and thus constituted the above-mentioned vaccine worlds; and second, we analyze how the global race for vaccine supply became an arena of hegemonic conflict in the capitalist world-system between the United States (and its allies) and its emerging competitor, China.

To substantiate our claims, we first discuss the benefits of applying world-systems analysis to that of global vaccine inequalities, making use of two primary concepts: the core/semi-periphery/periphery model and the notion of hegemonic transitions. We show that the trimodal structure of core, semi-periphery and periphery is reproduced by COVID-19 vaccine distribution through the development of three vaccine worlds. We then describe Chinese vaccine internationalization, driven both by economic and counter-hegemonic goals. We highlight its limits and conclude that contradictions in the solutions provided by China to the system-level problem of the pandemic confined their viability to a short period of time, and thus cut short the country’s challenge to the hegemony of the United States and its allies in the pharmaceutical sector.

³ We use the term “vaccine worlds” to refer to the zones of the world-system characterized by their distinctive roles in vaccine production and distribution. As we will argue, the three vaccine worlds deviate only slightly from the core-semiperiphery-periphery categorization.

World-Systems Analysis and Global Vaccine Distribution

Our research questions are rooted in two prominent strands of the debate about disparities in global COVID-19 vaccine distribution. First, several scholars of International Relations have focused on the geopolitics of vaccine usage and highlighted China's vaccine or health diplomacy, arguing that China exploits global vaccine sales and gifts for diplomatic purposes (Huang 2022; Kobierecka 2023; Vadlamannati and Jung 2023). These studies have also described China's use of this diplomacy as a vehicle for "soft power" (Kobierecka 2023; Lee 2023) and the ways in which its vaccine export strategy differs from those of other donor countries in the global South (Suzuki and Yang 2022). World-systems scholars have contributed to this debate by discussing the role of individual countries in global vaccine commodity chains and the underlying geopolitical dynamics (see Blinder, Zubeldía, and Surtayeva 2021).

A second strand highlights the unequal distribution of vaccines. These studies have analyzed vaccine nationalism in North America, the EU, and India (Chatterjee, Mahmood, and Marcussen 2021; Zhou 2022) as well as the role of intellectual property rights as a barrier to scaling up vaccine production capacity (Altindis 2022; Amin and Kesselheim 2022) and the consequent undersupply of vaccines in the global South (Nhamo et al. 2021). Several articles have also emphasized the shortcomings of the COVAX (COVID-19 Vaccines Global Access) initiative, which was established to provide low-cost vaccines to developing countries but has seen limited success (de Bengy Puyvallée and Storeng 2022). Only a few studies have addressed patterns of global vaccine distribution (Acharya, Ghimire, and Subramanya 2021; Basak et al. 2022), and these have not investigated causal linkages for unequal distribution nor have they conceptualized different country groupings.

In this paper, we refer to world-systems analysis as a theoretical heuristic. World-systems analysis is particularly helpful here in linking key findings of both debates and providing a global picture but has not yet been used for this purpose. World-systems analysis provides useful concepts, both for analyzing global vaccine inequalities, specifically its relation to the trimodal core/semi-periphery/periphery structure, and for the geopolitics of vaccine distribution, especially the notion of systemic cycles of accumulation and hegemonic transitions.

World-systems analysis implies that the causes of vaccine inequalities are connected to global wealth inequalities and hence unequal access to technology and financial resources. World-systems analysis relates to our first research question because, according to Immanuel Wallerstein (2004), spatial inequalities are a key feature of today's capitalist world-system, as the global economy is structured hierarchically and divided into three zones. The core, the semi-periphery, and the periphery are characterized by Wallerstein by specific local structures of production, their integration into an international division of labor, and the transfer of value through unequal exchange from the periphery to the core.⁴ Wallerstein (2000) and Arrighi and Drangel (1986)

⁴ We do not refer to a structural-functionalist model of the hierarchy in the world-system or to definitions using the size of nation-states as indicators of semi-periphery status (Wallerstein 1979) but rather, to a relation-mix model of the periphery/semi-periphery/core-division (Arrighi and Drangel 1986; Wallerstein 2004) which focuses primarily on economic criteria.

describe core-like activities as those that comprise the production of commodities using relatively capital-intensive technology and skilled labor; the export of capital goods or highly specialized services; and the import of primary goods. Periphery-like activities are production processes that are relatively low in capital intensity, based on unskilled labor, and characterized both by the export of primary goods and dependency on imports of capital-intensive products (Lee 2009). Core-like and periphery-like activities in nation states are embedded in hierarchically structured global commodity chains, with core-like economic activities predominating in core countries, periphery-like activities prevailing in peripheral countries, and the semi-periphery combining a mix of both.

The semi-periphery is more than a residual category, however. Arrighi and Drangel (1986: 26–27) highlight its dynamics: semi-peripheral countries “resist peripheralization by exploiting their revenue advantage vis-à-vis peripheral states and their cost advantage vis-à-vis core states.” With the “new international division of labor” (Fröbel et al. 1980) initiated in the 1970s, semi-peripheral countries acquired declining industrial production activities with decreasing profit margins from core states; control of the production processes and highly profitable stages of production remained in the core. In this way, semi-peripheral countries “can be thought of as a sort of second-run theater for what were formerly core activities” (Babones 2005: 32).

The global core/semi-periphery/periphery division has remained largely stable, despite individual countries in East Asia (South Korea) and the Gulf Region (Qatar) moving up or down (Argentina) the hierarchy (Babones 2012). Non-economic determinants such as the military dominance of the core countries tend to stabilize these global disparities.

The hierarchical structure of the world-system results in unequal access to technology, research funds, and skilled labor (as well as in a “brain drain” to the core). Global research and development (R&D) spending, top research institutions, and universities are almost exclusively in North America, the EU, and Japan, with the notable exceptions of China and South Korea. Spatial inequalities in the capitalist world-system are perpetuated by this concentration of R&D in the capitalist core: productivity-increasing technological innovations—reducing the innovator’s production costs below the sectoral average—as well as product innovations facilitate temporary monopoly positions for a product and, therefore, surplus profits for companies (Wallerstein 2004). Patents play a decisive role in maintaining unequal exchange and the production of surplus profit, as they guarantee long-term exclusivity in the valorization of an innovation and thus a competitive advantage for the company introducing the innovation. Once the innovation is generalized, the competitive advantage vanishes, and with it, the prospect of realizing surplus profit (Silver 2003). As a result, high-tech companies—headquartered in the capitalist core—have a vested interest in protecting patented innovations. At the same time, these structures make sure that core countries command a large share of the total surplus generated in global commodity chains. In the long run, a continuous stream of innovations and patents reproduces core positions in the capitalist world-system (Arrighi and Drangel 1986; Arrighi, Silver and Brewer 2003).

Another important claim of world-systems analysis is that closely interwoven with the hierarchical structure of the capitalist world-system are global health issues (Wallerstein 1995). In

fact, its spatial disparities are reflected in the levels of health of individual countries (Elling 1981; Collins 2013). World-system scholars have shown that a country's position in the world-system correlates strongly with its overall health standard: a subordinate position not only impairs its access to drugs and medicine, but can also be associated with lower life expectancy, higher infant mortality rates or malnutrition (Elling 1981; Shandra et al. 2004; Collins 2013). According to dependency theory and world-systems analysis, healthcare systems in peripheral countries are often poorly developed due to technological and financial dependencies: The financial resources, and the technology and know-how for the production of high-tech medicine and provision of well-functioning public health services are concentrated in the core countries (Wallerstein 1995). Some authors even use the term medical imperialism to describe these phenomena, referring to the brain drain of qualified health workers from peripheral to core countries, leaving peripheral countries to serve primarily as markets for medical products designed and patented in countries in the core (Waitzkin 1978; Elling 1981).

Even today, the largest pharmaceutical companies in the medical research field worldwide, such as Johnson & Johnson, Roche, Pfizer, and Bayer, are based in core countries. In this sector so far, Chinese, Indian, and Russian companies have been unable to join the ranks of the global top 20. Core states, as a result, have significant financial and technological advantages in pandemic control: Western and Japanese pharmaceutical companies have the research capacities, own the patents, and control the commodity chains; and their governments alone have the necessary financial resources to promote vaccine development, purchase efficient vaccines, and provide resilient healthcare systems.

In order to address our second research question, it is important to highlight the specific role of China in global high-tech competition. China's role points to a second structural feature of the capitalist world-system, crucial to an understanding of the global dynamics of COVID-19 vaccine production and distribution. This is its cyclical reorganization and hence, shift of the center of global capital accumulation and political power between nation states. During the pandemic in these periods of transformation, individual states (Netherlands, the United Kingdom, the United States) gained hegemony and shaped the nature of global capitalism. Several world-systems scholars have developed concepts to describe these shifts including "hegemonic cycles" (Hopkins and Wallerstein 1982) and "systemic cycles of accumulation" (Arrighi 1994; Arrighi and Silver 1999). From Arrighi's (1994) perspective, historical capitalism is defined by the pattern of systemic cycles of accumulation that follows Marx's general formula of capital (MCM'): Periods of material expansion (MC phases of capital accumulation) are superseded by epochs of financial expansion (CM' phases) and vice versa (Arrighi 1994). The 1970s' energy crisis was thus a "signal crisis" of U.S. hegemony (Arrighi 2007), where the MC-phase of the U.S. cycle of accumulation ended, and its CM' phase began, accompanied by the emergence of new production capacities in East Asia.

Arrighi (1994) also determined that the cyclical reorganization of global capitalist accumulation depends on ever larger state-business-complexes. The expansion of the world-system was thus perceived "as proceeding...through several switches to new tracks laid by specific

complexes of governmental and business agencies.” (Arrighi and Silver 1999: 22). This development followed an historical

progression from a city-state and a cosmopolitan business diaspora (the Genoese); to a proto-national state (United Provinces) and its joint-stock chartered companies; to a multinational state (United Kingdom) and its globe-encircling tributary empire; to a continent-sized national state (United States) and its world-encompassing system of transnational corporations, military bases, and institutions of world governance. (Arrighi 1994: 235)

U.S. hegemony today can, consequently, only be challenged by state-business-complexes comparable in scope and scale.

New hegemonies arise when a state-business-complex develops that is able to reorganize systemic world governance capabilities and address system-level problems (Arrighi and Silver 1999: 28). This state-business-complex must internalize expanding systemic dynamics within increasingly complex governance institutions and structures. Historically, interstate rivalries and inter-enterprise competition with emerging state-business-complexes have led to hegemonic crises; these have been followed by hegemonic breakdowns initiated by a “terminal” financial crisis.

The rise of China is clearly reminiscent of earlier hegemonic transitions. China is not only catching up with the United States economically, but Chinese companies have also increasingly internationalized and established global networks and governance institutions. Several world-systems scholars have therefore debated whether China could replace the United States as a global hegemon (Arrighi 2007; Hung 2016; Li 2016; Babones 2017). After the global financial crisis of 2008–2009, China started to shape new global governance structures, most prominently the Belt and Road Initiative (BRI) launched in 2013. Unlike the U.S. market-liberal financial capitalism, China has developed a form of state capitalism and has become the largest manufacturing country worldwide. Chinese companies have upgraded technologically, gained market shares and invested globally. China has also created Chinese-led governance institutions such as the Asian Infrastructure Investment Bank and joined new Southern alliances such as BRICS. The geo-space of China’s state-business-complex has expanded quickly (Birley 2023), but the state-supported internationalization of Chinese companies has increasingly provoked conflicts with the United States over market competition and technological leadership as well as the nature of China’s state-led model of economic governance.

Since 2020, and throughout the COVID-19 pandemic, international politics have been shaped by these geopolitical conflicts. In recent years, a dynamic biotech industry has emerged in China (Wong et al. 2020), and with the 14th Five-Year Plan (2021–2025), the country’s pharmaceutical industry has received substantial financial support. As we later detail, China has therefore been able, independently, to design, manufacture, and export domestically produced COVID-19 vaccines. In addition, China’s Health Silk Road initiative has provided medical protective equipment and vaccines to many countries in the global South (Huang 2022; Vadlamannati and Jung 2023). As mentioned, this type of vaccine diplomacy has been perceived as an instrument of

“soft power” (Lee 2023), through which the Chinese party-state seeks to challenge the (declining) U.S. hegemony in the capitalist world-system.

To encapsulate, both features of world-system analysis described here—the trimodal core/semi-periphery/periphery model and the notion of hegemonic transition—provide a useful entry into an analysis of the diverging access to and the geopolitical conflicts over high technology worldwide. It is therefore not surprising that the cyclical dynamics and spatial structures of the capitalist world-system have shaped global vaccine distribution and geopolitical conflict during the COVID-19 pandemic.

Methodological Remarks

To reiterate, our empirical study addresses two interrelated research questions: first, which patterns of COVID-19 vaccine production and distribution can be observed, and which country groupings can be identified? Second, how does the production and distribution of COVID-19 vaccines relate to broader geopolitical conflicts in global capitalism? Drawing on the framework of world-systems analysis, we form two hypotheses: (H1) that country group patterns will relate closely to the trimodal structure of the capitalist world-system, with core states achieving high vaccination rates most quickly, using COVID-19 vaccines with the highest efficacy rates produced in core countries; and (H2) that vaccine distribution will reflect the hegemonic conflict between China and the United States and its allies, with Chinese vaccines being exported primarily to states of the semiperiphery and periphery, in South America, Africa, and developing Asia, particularly BRI countries.

To operationalize these research questions, we use the World Bank’s country classifications which divide countries into income groups according to Gross National Income (GNI) per capita (high-income countries, upper-middle income countries, lower-middle income countries, and low-income countries). Debate has been longstanding within world-systems analysis on whether the category of GNI or—more broadly—income per capita, is adequate for classification of a state as core, semi-periphery or periphery. World-system scholars referred to a variety of methods for country categorization. Babones (2005) distinguishes network-based (trade, political, military networks), continuum-based (rankings of states based on a continuum of status and power), and income-based methods. By using GNI per capita as calculated by the World Bank, we use a method situated in the income tradition. We agree with Arrighi and Drangel (1986) and Babones (2005) that income per capita serves as a suitable proxy for quantification of the level of core-like activities within a given country because it is entirely consistent with key arguments of world-systems analysis: as elaborated earlier, each state in the capitalist world-system comprises a certain mix of core-like and periphery-like processes. Core-like processes are typically high-profit economic activities (i.e., R&D activities, capital-intensive production, skilled labor with relatively high salaries) which are more remunerative than periphery-like processes. These core-like processes “command aggregate rewards that incorporate most, if not all of the overall benefits of the world division of labor, whereas peripheral activities command aggregate rewards that

incorporate few, if any, of those benefits” (Arrighi and Drangel 1986: 31). It thus follows that the larger the share of core-like activities within the boundaries of a state, the higher will be its value-added and income per capita level. Differences in the share of core-like activities between states should therefore be reflected in differences in their income per capita levels, as expressed, for example, by the GNI per capita ratios provided by the World Bank (Arrighi and Drangel 1986; Babones 2005; Karataşlı 2017).

We refer to the World Bank classification of high-income, upper-middle income, lower-middle income, and low-income countries for two reasons: these country groups largely reflect the global wealth hierarchies of the capitalist world-system, in particular the core/semi-periphery/periphery division (explained in more detail below); and they can be linked to datasets on vaccine production and distribution.

High-income countries (GNI per capita: > US\$ 13,205) comprise those considered by world-systems analysis as the (organic) core (the United States, Canada, Western Europe, Japan, Australia, New Zealand) (Arrighi and Drangel 1986; Chase-Dunn, Kawano, and Brewer 2000; Babones 2005); as well as some countries in East Asia (South Korea and Singapore), and in the Middle East (Saudi Arabia, United Arab Emirates). Several financial centers (Cayman Islands, Bermuda) have also (temporarily) ascended to core status. Only a few countries among this group (e.g., Uruguay, Portugal, and some East European countries) have historically moved between both zones.

Similarly, upper-middle income countries (GNI per capita: US\$ 4,256–13,205) include several large countries (e.g., Brazil, South Africa, Mexico, Russia, Turkey, China) in Latin America, Asia, and Africa, as well as many smaller countries (e.g., Malaysia, Panama) usually considered part of the semi-periphery. Among the upper-middle income countries, a few have been described as temporally core-like (Argentina) due to commodity swings (Babones 2012), as well as being part of the periphery (e.g., Peru, Iraq) (Chase-Dunn et al. 2000). The lower-middle income countries (GNI per capita: US\$ 1,086–4,255) such as Egypt, Indonesia, and Pakistan and low-income countries (GNI per capita: < US\$ 1,085) like Afghanistan, Democratic Republic of Congo, and Niger have usually been classified as peripheral countries. This country group is highly diversified. Low-income countries with a GNI per capita that is sometimes less than a tenth of the lower-middle-income countries are thus also considered to be part of the periphery.

Our investigation is based on a descriptive analysis of data on global COVID-19 vaccine production and distribution and focuses on the period from January 2021 to November 2023. To examine the unequal access to COVID-19, we use datasets providing information on the local dimension of COVID-19 vaccine production and distribution (Our World in Data 2022; WTO 2022), as well as on the export markets of vaccine manufacturers (Duke Global Health Innovation Centre 2022). We also draw on data provided by Bridge Beijing’s (2023) Vaccine Tracker to shed light on Chinese vaccine exports and production licensing agreements.

The Three Vaccine Worlds

The spatial hierarchy of the capitalist world-system is evident in the strategies used worldwide to deal with the COVID-19 health crisis. Resources to respond to the pandemic have been unevenly distributed: Only a few countries of the capitalist core (e.g., the United States, Great Britain, EU member states, and South Korea) and even fewer countries of the semi-periphery and periphery (India, Cuba, Russia, and China) have sufficient technological knowledge to promote collaborative research, to develop and produce vaccines, and to develop and sustain technologically sophisticated pharmaceutical and biotech companies. This advantage has led to privileged access to COVID-19 vaccines. The governments of core countries such as the United States, Great Britain, and the EU member states⁵, for example, were able to sign sales contracts with vaccine producers guaranteeing the delivery of high quantities of vaccine doses, before the vaccines were approved by local authorities. Patent protection then monopolized vaccine production in a few countries, restricting technology and knowledge transfer to the semi-periphery and periphery.

Most core countries consequently had privileged access to new vaccines. In contrast, several countries of the semi-periphery and the periphery, such as Argentina, India, Pakistan, Egypt, and South Africa, have been integrated into the international division of labor as regional vaccine producers. They have the advanced industrial capacities, infrastructure, and logistics networks to produce locally once production licenses have been granted by the pharmaceutical industry (Blinder et al. 2021). The remaining peripheral countries depend on “vaccine charity” (Sparke and Levy 2022: 89) and thus international distribution mechanisms such as COVAX or bilateral agreements with vaccine manufacturers and producing countries to receive sufficient vaccine doses. In practice, however, their interests have largely been marginalized, since the vaccine-producing countries have, albeit to varying degrees, prioritized the immunization of their populations over vaccine exports. This kind of vaccine nationalism—export bans of vaccines and medical protective equipment—has been pursued by many countries such as the United States, India, and also to a lesser extent the EU (Chatterjee et al. 2021; Kampmark and Kurečić 2022; Zhou 2022).

The consequence of this constellation of interests and practices has been the globally unequal distribution of COVID-19 vaccines. In their study of the correlates of Gross Domestic Product (GDP) and COVID-19 vaccine distribution, Basak and his co-researchers (2022: 9) found that “in general, the wealthier a country is, the higher the vaccination rate.” When taking into account the diverging speed of vaccination and the various types of vaccines distributed worldwide, it can be argued that three vaccine worlds have emerged during the pandemic, mirroring the trimodal structure of the capitalist world-system. The first vaccine world of technologically advanced countries maps onto the high-income countries comprising the core. These are leading in vaccine

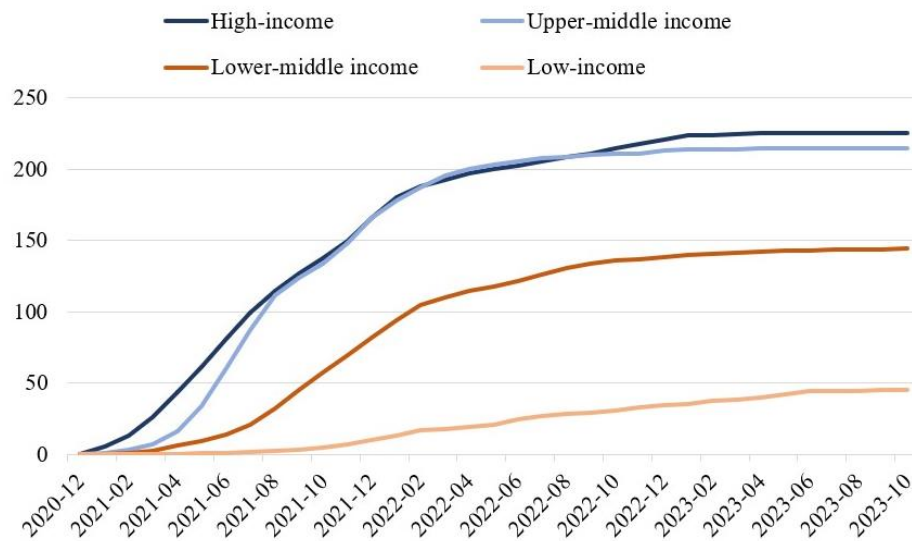
⁵ The European Commission was responsible for securing access to COVID-19 vaccines for all EU member states through purchase agreements with vaccine producers, to achieve greater bargaining power in the negotiations. The vaccine doses were then distributed to member states to provide equal access to all EU citizens. This approach was subject to criticism, however, for its lack of transparency, as the EU kept contracts secret and appeared to have overpaid Pfizer for its products.

research and manufacturing, and were among the first whose populations received vaccine shots in summer 2021. In high-income countries today, all adults and children above the age of five have been offered initial vaccinations and booster shots. The second vaccine world, mapping onto the upper-middle income countries forming the semi-periphery, is heterogeneous: many of these were able to achieve relatively high vaccination rates by late 2021 due to their bargaining or purchasing power and favorable geopolitical constellations (e.g., Mexico's proximity to the United States). Most of these countries, however, have neither the local vaccine research capacities nor the innovative pharmaceutical companies. Booster vaccinations were administered about two to three months later than in the first vaccine world and mRNA vaccines were usually not available before the spring of 2022. Finally, a third vaccine world is coincident with the countries comprising the lower-middle income and low-income periphery. Even today, their access to COVID-19 vaccine doses and booster shots is not fully guaranteed and due to a temporary vaccine unavailability, those with slightly lower efficacy rates (mainly inactivated virus vaccines and viral vector-based vaccines) have been predominantly used.⁶ In this group, some countries in Sub-Saharan Africa and Asia were unable to protect vulnerable groups and medical staff with vaccinations as late as 2023. Due to a lack of financial resources, lower-income countries remain dependent on donor initiatives such as COVAX.

Figure 1 illustrates the unequal distribution of vaccines between the three vaccine worlds. Data for individual country groups indicate that almost 70 percent of all vaccine doses were administered in high-income and upper-middle-income countries (and thus in the core and the semi-periphery), about 23 percent in lower-middle-income countries and only 7 percent in low-income countries and, hence, the periphery (Our World in Data 2023). Consequently, there is—even in November 2023—a striking difference in the number of delivered vaccine doses per 100 inhabitants among the different country groups (see Figure 1). While high-income countries, and with some delay, upper-middle-income countries had, by early 2022, already offered vaccinations to almost their entire population, lower-middle and low-income countries have, to the present, been unable to (fully) vaccinate large portions of their population; in low-income countries, further, there remains a substantial shortage of vaccine supply. The spread between lower-middle income and low-income countries seems to validate current debates in world-systems analysis, according to which the periphery has, since the turn of the twenty-first century, split into an upper and a lower peripheral zone (Karataşlı 2017).

⁶ This is particularly striking as the EU has already destroyed millions of COVID-19 vaccine doses, since BioNTech/Pfizer has vetoed their donation.

Figure 1: Total COVID-19 Vaccine Doses Administered per 100 People by Country Income Groups

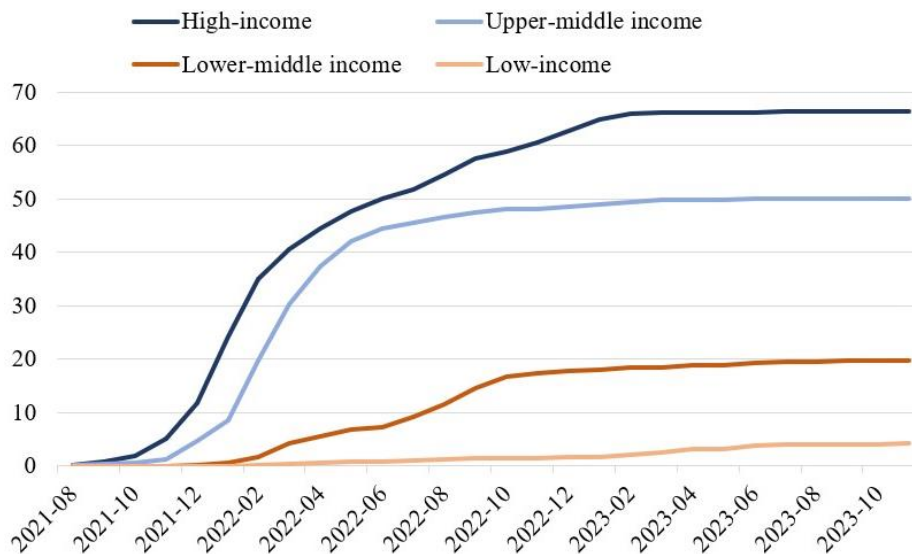


Source: Own compilation with data from Our World in Data (2023) as of November 2023; country income classification by World Bank (2022).

The spatial hierarchy in vaccine distribution is particularly evident when it comes to booster shots (see Figure 2). A major share of booster vaccine doses (47.3 percent) has been administered in the first vaccine world and a significant share (35.7 percent) in the second vaccine world. Already by the end of December 2022, booster shots were offered to all adults and children five years and above in most countries of the first two vaccine worlds. Conversely, a total of only 17 percent of all administered booster doses are accounted for by the third vaccine world (lower-middle with a share of 14 percent and low-income countries with 3 percent). Both country groups face a significant shortage of booster doses. As a result, the pattern of unequal access to vaccine doses among different country groups is reproduced with each new vaccination cycle.

In April 2020, the WHO launched the COVAX initiative in collaboration with the private-public organizations Gavi (Global Alliance for Vaccines and Immunization) and CEPI (Coalition for Epidemic Preparedness Innovations). The function of COVAX was to allocate COVID-19 vaccines to poorer and non-vaccine-producing countries by ordering doses directly from vaccine producers and distributing them, if necessary with subsidization, to poorer countries. The initial aim of COVAX was to provide a total of two billion doses to participating countries by the end of 2021 (WHO 2021a), either financed by affluent COVAX member countries or through donations of vaccine doses from countries of the first and second vaccine worlds.

Figure 2: COVID-19 Vaccine Booster Doses Administered per 100 People by Country Income Groups



Source: Own compilation with data from Our World in Data (2023) as of November 2023; country income classification by World Bank (2022).

However, this target was missed: as of late December 2021, COVAX had distributed just 800 million doses of the vaccine, while in November 2023, this number eventually reached two billion (UNICEF 2023). COVAX officials not only criticize the initiative's funding as insufficient but also the vaccine manufacturers for prioritizing profitable agreements with core and semi-peripheral countries over the COVAX mechanism (Usher 2021). This constellation has been further aggravated by the vaccine nationalism of vaccine-producing countries, which translates to non-compliance with supply commitments and protectionist measures (Zhou 2022). This is illustrated by decisions like that of the Indian government in April 2021 to ban the export of vaccines produced by the Serum Institute of India, as domestic demand for vaccines surged with an increase in infections.

The severe regional disparities in global pandemic response are not limited to the quantitative distribution of vaccines, however. Another crucial aspect is the specific type of vaccine that is predominantly used in each country. As clinical trials suggest, the efficacy of existing COVID-19 vaccines depends upon the underlying manufacturing technology. Vaccines from Pfizer/BioNTech and Moderna, produced with the new mRNA technology, show high efficacy (over 90 percent) against symptomatic infections caused by the Delta variant (Olliaro, Torreele, and Vaillant 2021); lower efficacy was found for viral vector vaccines such as those from Johnson & Johnson and Oxford/AstraZeneca (WHO 2022a, d), as well as for inactivated vaccines, for example, from the Chinese producers Sinopharm and Sinovac. For the latter, the range of variation in the results of

the clinical trials is relatively large (WHO 2022b, c). Data on the efficacy of these vaccines for more recent virus variants such as Omicron do not provide a clear picture. Evidence for Pfizer/BioNTech and Chinese Sinovac suggests that after two doses, vaccine efficacy against mild to severe infections of Omicron is lower than it had been for Delta (cf. WHO 2022c, e). However, some studies found that a third dose significantly increased efficacy and provided protection similar to that of Western mRNA vaccines (McMenamin et al. 2022; and critically, Ng et al. 2022).

Because distribution of the different types of vaccine is so concentrated across regions, variation in vaccine effectiveness has profound implications for spatial inequalities: In North America, the EU, and Japan, for example, the vaccines most frequently used are those from Pfizer/BioNTech and Moderna, whose production is based on mRNA technology. Conversely, inactivated virus and viral vector vaccines have been predominantly used in South America and Africa, as well as Central, South and Southeast Asia (UNICEF 2023). The regional concentration of the distribution of vaccine types thus constitutes a further dimension of spatial hierarchy in the global pandemic response. This hierarchy has been reproduced by the spread of new virus variants (e.g., Delta and Omicron and their subvariants) and by the speed of booster vaccinations.

Considering that intellectual property rights put key decisions in the management of the global pandemic into the hands of the leading vaccine producers—Pfizer/BioNTech, Moderna, Johnson & Johnson, and AstraZeneca (and thus in the core countries)—the quantitative and qualitative inequality in COVID-19 vaccine distribution raises questions about their strategies. Table 1 shows the proportions of manufacturers' purchase agreements negotiated with targeted country groups. According to Duke University's dataset, documenting agreements between producers and buyer countries to June 2022⁷, with countries again grouped according to the World Bank's income classification, more than 76.7 percent of Pfizer/BioNTech vaccine doses were delivered to high-income countries, another 18.4 percent to upper-middle income countries, and only 4.9 percent to lower-middle income countries. Pfizer/BioNTech's pledge to deliver 40 million doses to COVAX represented less than 1 percent of all deliveries. Moderna's vaccine deliveries went almost exclusively to high-income countries (85.7 percent)⁸, as did those of Johnson & Johnson (57.7 percent). But Johnson & Johnson pledged to deliver 200 million doses to COVAX, and in contrast to Pfizer/BioNTech and Moderna, allocated a significant share (32.4 percent) to low-income countries in the African Union.⁹

⁷ Duke University stopped collecting data and information as of June 2022.

⁸ Moderna initially announced plans to sell up to 750 million doses to COVAX throughout 2021 and 2022. According to UNICEF (2023) data, however, as of November 2023, the company had delivered just 104 million doses.

⁹ The reason for use of Johnson & Johnson in the periphery is that it is a single shot vaccine, and easily transported as it is stored at a refrigerated temperature of 2° to 8°C (35.6°F to 46.4°F).

Table 1: Purchase Agreements of the Largest Vaccine Manufacturers, Share by Country-Income Group

	High-income	Upper-middle income	Lower-middle income	Low-income
Pfizer/BioNTech (USA/Germany)	76.7%	18.4%	4.9%	0%
Moderna (USA)	85.7%	6.1%	0.9%	7.3%
Johnson & Johnson (USA)	57.7%	8.7%	1.3%	32.4%
Oxford/AstraZeneca (UK)	33.4%	20%	46.5%	0%
Sinovac (China)	7.1%	78.9%	14%	0%
Sinopharm (China)	2.4%	33.3%	60%	4.2%
Gamaleya Research Institute (Russia)	1.1%	60%	38.4%	0.5%

Source: Own compilation from Duke University's Global Health Innovation Centre (2022) data as of June 2022.

Note: The data does not include donations of vaccine doses.

Among Western producers, AstraZeneca is most prevalent in the second and third vaccine world: More than 46.5 percent of AstraZeneca shipments have gone to lower-middle income countries, with India alone accounting for more than 80 percent of shipments to the country group. This proportion is the result of a licensing agreement between AstraZeneca and the Serum Institute of India, facilitating local production of the vaccine. Additionally, AstraZeneca delivered 720 million doses to COVAX, accounting for more than 20 percent of all deliveries. Compared to Western manufacturers, relatively few doses of the Chinese Sinovac and Sinopharm vaccines have been supplied to the first vaccine world; as we will discuss in more detail below, they have instead been exported to the second (Sinovac) and third (Sinopharm) vaccine worlds. Similarly, the Russian Sputnik V vaccine has been distributed almost exclusively in the second and third vaccine worlds.¹⁰

It is evident, then, that vaccine producers from Western core countries, in particular Pfizer/BioNTech and Moderna, privilege wealthy countries. In addition, Western producers have

¹⁰ Although clinical trials with Sputnik V showed high efficacy of more than 90 percent against symptomatic infections, production and export could not keep up with the original plans. This was due to a lack of appropriately skilled personnel and insufficient domestic pharmaceutical production capacity.

strictly opposed the suspension of patent protection to maintain their monopoly position and associated high profit margins, thereby impeding the expansion of global vaccine production. In October 2020, India and South Africa tabled a proposal at the World Trade Organization's Council for Trade-Related Aspects of Intellectual Property Rights (TRIPS Council) for a temporary suspension of patents and other intellectual property rights (TRIPS waiver) on vaccines and the medical equipment used to treat COVID-19. The proposal was supported by many WTO members and even endorsed by the U.S. government but has long been blocked, particularly by Germany and the EU, Norway, the United Kingdom, and Switzerland, with Western pharmaceutical companies explicitly voicing their opposition to the proposal (Amnesty International 2021: 22f.). In June 2022, after protracted negotiations, WTO member states finally agreed to a temporary suspension of intellectual property rights relating to COVID-19 vaccines, allowing (semi-)peripheral countries to waive protections for the production of vaccine doses. Notably, the Chinese government agreed not to avail itself of the waiver following strong demands from the U.S. government for an explicit exclusion of China. Also, the suspension of patent rights does not apply to therapeutics and diagnostics. The agreement thus substantially watered down the original proposal by India and South Africa as it accommodated the concerns of Western core countries and their corresponding pharmaceutical companies (Amin and Kesselheim 2022).¹¹

Vaccine producers from Western core countries not only primarily supply core and some semi-peripheral countries with vaccine doses but also block the transfer of intellectual property, technology, and knowledge to semi-peripheral and peripheral countries. This mode of vaccine production and distribution has provoked vigorous criticism by governments of semi-peripheral and peripheral states, numerous non-governmental organizations, and the WHO (see WHO 2021b). This has been fueled by the exploding profits of vaccine producers exploiting their monopoly positions: Pfizer increased its earnings before interest and taxes (EBIT) fivefold between 2019 (US\$ 7 billion) and 2022 (US\$ 35 billion); Moderna announced a combined EBIT of over US\$ 22 billion in 2021 and 2022, after reporting deficits in 2019 and 2020. As suggested by world-systems analysis, EBITs of Chinese producers are slightly lower. The Chinese state-owned company Sinopharm generated an EBIT of US\$ 3 billion in 2022 (2019: US\$ 2.3 billion); the private company Sinovac started with a low pre-pandemic EBIT of US\$ 70 million in 2019 that skyrocketed in 2021 to US\$ 17.5 billion.¹² These numbers can be interpreted as reflecting the subordinate position of Chinese producers, as compared to their Western competitors, in terms of their ability to command the benefits of the international division of labor. Sinovac's surging profits, however, could also indicate the (temporary) success of China's state-business-complex, as we will discuss below.

¹¹ With the exception of Moderna's announcement in March 2022 that it would not enforce patent rights in 92 low- and middle-income countries, pharmaceutical companies have opposed attempts to suspend intellectual property rights on COVID-19 vaccines.

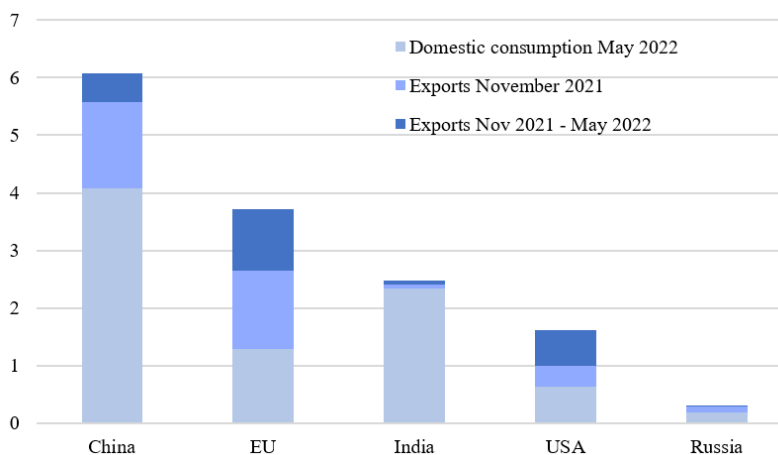
¹² At the time of writing, Sinovac's data for 2022 is not yet available.

Overall, as we have noted, the global distribution of vaccines strikingly reflects the trimodal structure of the world-system: core countries and some countries in the semi-periphery (the first vaccine world) quickly achieved high vaccination rates and were able to access vaccines with high efficacy manufactured in core countries, whereas other countries in the semi-periphery and periphery (second and third vaccine worlds) have lower vaccination rates with vaccines showing lower efficacy produced in different zones of the world-system. This pattern is reproduced with new cycles of booster vaccinations and is related to global vaccine commodity chains that are largely controlled and exploited for high profits by Western and to a lesser extent by Chinese lead companies.

The Rise and Demise of Chinese Vaccine Internationalization

The initial reluctance of Western core states and their domestic pharmaceutical industries to supply COVID-19 vaccines to the semi-periphery and periphery paved the way for Chinese producers to become major players in global vaccine supply (Lee 2023). Indeed, the internationalization of the Chinese pharmaceutical industry reflects China's rise in the capitalist world-system and a hegemonic conflict with the United States and its allies. As discussed, China's ascent is also evident in the production and export of COVID-19 vaccines: in 2019, just before the outbreak of the COVID-19 pandemic, most vaccines were produced in Europe (76 percent), followed by North America (13 percent) and Asia (8 percent) (Vaccines Europe 2021). China, by contrast, had not been a relevant player in the international vaccine trade and primarily produced for the domestic market (Veugelers, Poitiers, and Guetta-Jeanrenaud 2021). The pandemic has shifted these patterns (see Figure 3): China has massively expanded its vaccine production capacity and accounted for 45 percent of global COVID-19 vaccine production by late 2021. China thus became the world's largest producer of COVID-19 vaccines.

Figure 3: COVID-19 Vaccine Doses Produced per Country/Region (in Billion Doses)



Source: Own compilation with data from WTO-IMF COVID-19 Vaccine Trade Tracker (2022), as of November 2021 and May 2022. The data collection has stopped as of May 2022.

The rapid expansion of vaccine production capacity has two major political and economic implications. First, it has enabled China to accomplish a remarkable vaccination rate at high speed, despite the challenge of achieving mass immunization of its large population (1.4 billion). Already in January 2022, about 85.6 percent of the Chinese population was fully vaccinated (Our World in Data 2022). Second, the quick expansion of production capacities turned Chinese COVID-19 vaccines into export success stories: having exported hardly any vaccines before the pandemic outbreak (Veugelers, Poitiers, and Guetta-Jeanrenaud 2021), China emerged as the largest exporter of COVID-19 vaccines in 2021. Almost 1.5 billion vaccine doses had been exported by the end of November 2021, particularly to Latin America, Africa, and Asia. The second and third vaccine worlds are thus the key target regions of Chinese vaccine shipments (Bridge Beijing 2023), giving Chinese producers the lead in vaccine supply to the semi-periphery and periphery in 2021.

In addition to massively expanding exports, then, Chinese vaccine developers have also internationalized production into the second and third vaccine worlds, thereby challenging U.S.- and EU-dominated vaccine commodity chains. Sinovac (CoronaVac), Sinopharm (BBIBP-CorV/Vero) and, to a lesser extent, CanSino Biologics (Ad5-nCoV) facilitated the establishment and expansion of local vaccine production capacity in countries in Latin America, North Africa, Central and Southeast Asia, and Eastern Europe by granting production licenses to local pharmaceutical companies (see Table 2). These licensing agreements were intended to develop local production facilities in semi-peripheral and peripheral countries into regional vaccine manufacturing hubs of COVID-19 vaccines. This internationalization strategy contrasts sharply with those of Western manufacturers Pfizer/BioNTech, Moderna, Johnson & Johnson, and AstraZeneca whose production is almost exclusively concentrated in capitalist core countries. Notable exceptions are Pfizer/BioNTech's production facilities in Brazil and South Africa, Johnson & Johnson's in South Africa and India, and AstraZeneca's facilities in India and Thailand (Duke Global Health Innovation Center 2022). Vaccine developers' granting of production licenses to production partners in semi-peripheral countries, leaving R&D in the core, illustrates the role of the semi-periphery as a "second-run theatre" for core activities (Babones 2005: 32).

The Chinese government's leverage of the export of vaccines for foreign policy goals extended its soft diplomacy, the established institutional networks for which could be exploited in a new way. In particular, the Health Silk Road as part of the Belt and Road Initiative (BRI) was used at the beginning of the pandemic for propaganda purposes by giving donations of medical equipment (masks, tests, and respirators) to "almost all countries in the world" (Rudolf 2021: 4; Vadlamannati and Jung 2023). This political campaign was supported by various private (Huawei, Alibaba Foundation) and state actors (cities and municipalities, People's Liberation Army). Chinese vaccine diplomacy followed up on it. In addition, most vaccine exports went to BRI countries: China exported vaccines to 119 countries, 100 of which formed part of the BRI (Bridge Beijing 2023).

Table 2: International Production Licenses of Chinese COVID-19 Vaccine Producers as of December 2022

Region	Country	Vaccine developer	Local manufacturing partner	Estimated annual production capacity (in million doses)
Africa	Algeria	Sinovac	Saidal	60
	Egypt	Sinovac	Vacsera	80
	Morocco	Sinopharm	Sothema	60
Asia	Bangladesh	Sinopharm	Incepta Pharmaceuticals	-
	Cambodia	Sinovac	Cambodian Pharmaceutical Enterprise	-
	Indonesia	Sinovac	Bio Farma	250
	Indonesia	Abogen Bioscience	PT Etana	100
	Malaysia	Sinovac	Pharmaniaga	2
	Malaysia	CanSino	Solution Biologics	-
	Myanmar	Sinopharm	Myanmar Ministry of Industry	
	Pakistan	CanSino	National Institute of Health	36
	UAE	Sinopharm	Group 42	200
	Uzbekistan	Anhu Zhifei	Jurabek Laboratories	10
Europe	Russia	CanSino	Petrovax	120
	Serbia	Sinopharm	Group 42	24
	Turkey	Sinovac	-	-
Latin America	Argentina	Sinopharm	Sinergium Biotech	52
	Brazil	Sinovac	Butantan Institute	100
	Chile	Sinovac	Innovation Center of University of Chile	60
	Colombia	Sinovac	Colombian Ministry of Science, Technology and Innovation	50-60
	Mexico	CanSino	Drugmex	85

Source: Own compilation, information retrieved from Bridge Beijing (2023) as well as from company websites and press releases.

In addition to selling vaccines to countries that lacked access to those produced in the West, China provided free samples for subsequent sales (Pakistan, Philippines) and donated vaccine doses. A large share of these donations was directed to countries that maintain close relations with China (Laos, Zimbabwe) or which are important for geostrategic interests (Afghanistan, Bolivia), but also to neighboring countries (Mongolia, Vietnam) (Bridge Beijing 2023). Overall, by the end of 2021, vaccine diplomacy had been successful in improving China's image: A quantitative

analysis of English-language media reports shows that, during this period, media coverage was primarily associated with a positive assessment of Chinese vaccines (Lee 2023), notwithstanding ongoing concerns about their efficacy.¹³ Until late 2021, China's vaccine diplomacy can be considered a tool for building up counter-hegemony in the capitalist world-system. With this initiative, China made use of the geo-space of its state-business-complex around established institutional networks (primarily BRI countries in Southeast Asia, Middle East, and Africa), orchestrating an ability to resolve the system-level problem of the COVID-19 pandemic.

By 2021, China's vaccine internationalization had, consequently, filled the vacuum left by Western core countries. By massively expanding production capacity, exporting high volumes of vaccine doses, and granting production licenses to semi-peripheral and peripheral countries, China emerged as a key player in global pandemic response. Chinese vaccine internationalization followed a state-led model: state-owned (Sinopharm) and private companies (Sinovac) benefited from massive government funding, state campaigns, and diplomatic relationships that facilitated market entry. Exports and sales were eased by loans from state banks, funds, and agencies, and political networks played a key role in granting licenses for foreign production of Chinese vaccines.

Despite these successes, Chinese vaccine internationalization contains several contradictions which contributed to a setback in its diplomatic efforts: First, about 85 percent of Chinese exported vaccine doses were sold, leaving just 15 percent as donations (Bridge Beijing 2023).¹⁴ Vaccine deliveries are thus highly dependent on the financial resources of potential recipient countries, which also explains the shortage of vaccines in many of those countries in the periphery. Second, according to UNICEF (2023) data, the prices of Sinopharm's and Sinovac's COVID-19 vaccines are only slightly lower than those of Moderna's COVID-19 vaccine, similar to the prices of Pfizer/BioNTech¹⁵ and even higher than those of Oxford/AstraZeneca and Johnson & Johnson. Hence, the financial advantages for recipient countries are relatively low. Third, although most of the populations of the first and second vaccine worlds have been eligible for the first and second booster shots, vaccination rates have stagnated in many Western countries, and production capacities have been expanded, leading to an oversupply of Western vaccines. The window of opportunity to sell Chinese vaccines to the second and third vaccine worlds without serious competitors consequently closed by early 2022. Fourth, until the approval of China's first mRNA vaccine AWCorna in Indonesia in autumn of 2022, Chinese vaccines were based on conventional

¹³ For example, China's vaccine diplomacy has allowed it to gain in reputation in Serbia. Already in March 2020, China sent medical devices and experts to Serbia to support the management of the COVID-19 pandemic and as early as by May 2021 China sent the country over 4 million doses of Sinopharm vaccine. As an expression of gratitude to China, billboards were erected in Belgrade depicting Xi Jinping with the inscription "Thank you, Brother Xi."

¹⁴ According to the U.S. Department of State (2022), by December 2022, the United States had donated nearly 671 million doses of vaccine, while China's donations amounted to just 328 million doses (Bridge Beijing, 2023).

¹⁵ In late 2022, Pfizer announced plans to quadruple the price of a vaccine dose sold to health insurers to between \$110 and \$130 in 2023, once the U.S. government purchase program expired. Given Pfizer's doubling of its COVID-19 vaccine revenues in 2021, this announcement was heavily criticized, both by U.S. policymakers and civil society actors.

vaccine manufacturing technology. In the case of the Alpha, Beta, Gamma, and Delta variants, clinical studies had found their efficacy and adaptability to be lower than that of Western mRNA vaccines (WHO 2022c, d). In several countries that had benefited from China's massive vaccine rollout such as Chile and Bahrain, they had proved unable to prevent new waves of infections, intensifying concerns about their efficacy. Already in 2021, these experiences and the increasing availability of Western mRNA vaccines had prompted countries such as Bahrain and the United Arab Emirates to offer people previously vaccinated with Chinese vaccines booster vaccinations with Western mRNA vaccines. Concerns about their efficacy had led other countries such as Costa Rica to reject vaccine shipments from China altogether. The initial image boost of China's vaccine diplomacy had thus evaporated, and in public debates Chinese vaccines were often considered being less effective than their Western counterparts. Chinese mRNA vaccines were approved only after the peak of the pandemic had passed.

This loss of image could not even be stopped by the spread of the highly contagious Omicron variant, against which Western vaccines also showed lower efficacy rates. In combination with the factors already described (economic reasons, higher availability of Western vaccines in 2022), the Chinese export strategy was coming under increasing pressure. In 2022, the country's vaccine sales plummeted, and the EU replaced China as the largest COVID-19 vaccine exporter worldwide. Where by November 2021, China had exported 1.49 billion doses, between that date and May 2022, its dose exports declined to about 380 million. The EU, in contrast, had delivered about 1.37 billion by November 2021, and a further 910 million doses by May 2022 (see Figure 3).¹⁶ The success story of China's vaccine internationalization, as a result, turned out to be temporary, enabled by its global company networks and bilateral ties with many countries along its BRI. China's attempt to challenge U.S. hegemony in the world-system by offering solutions to the system-level problem of the pandemic was thus undermined by the significant contradictions frustrating its vaccine internationalization.

Conclusion: Prospects of Global Vaccine Competition

In this article, we have analyzed the spatial hierarchy of vaccine distribution developed during the COVID-19 pandemic. We argued that three vaccine worlds have emerged which are characterized by unequal access to COVID-19 vaccines and largely reflect the trimodal structure of the world-system (H1). With the start of the major vaccine rollout in early 2021, large portions of the second and third vaccine worlds were initially excluded from access to vaccines, a pattern that was reproduced with each new vaccination cycle. During this time, core countries had almost exclusive access to the Western mRNA vaccines produced in the core with high efficacy rates in clinical trials; at the same time, other types of vaccines with lower efficacy rates manufactured in different zones of the world-system have primarily been used in the global South.

¹⁶ The WTO and IMF stopped collecting data and information for the WTO-IMF COVID-19 Vaccine Trade Tracker as of May 31, 2022.

Chinese pharmaceutical companies were thus able to seize a window of opportunity by supplying large amounts of doses to the semi-periphery and periphery of South America, Africa and developing Asia, particularly BRI countries (H2). Until early 2022, Chinese vaccine diplomacy was therefore successful in building soft power by mobilizing its vast state-business-complex of transnational companies and state agencies to address the system-level problem of the pandemic and hence challenge U.S. hegemony in the world-system. China's strategy led to fierce competition with the United States and the EU over vaccine sales in the second and third vaccine worlds (Kampfner 2021), while leaving vaccine supply insufficient for mass immunization in the global South.

As a result, vaccine export competition became part of the hegemonic conflict between the United States (and its allies) and China. This conflict becomes particularly visible in increasing competition over technological leadership. As with the information technology industry, technological spheres of influence have emerged in vaccine distribution. These comprise both export markets and the domestic markets of producer countries due to the failure of the vaccines of its main competitors to be approved by national (and EU) regulators. For example, CoronaVac and Sputnik V have not been approved in the EU and the United States, and in turn both Pfizer/BioNTech and Moderna have not been approved in mainland China.¹⁷ The development of Chinese and Western vaccine geo-spaces was fostered by patent protection, as core countries such as the EU member states, the United Kingdom, and Switzerland blocked patent suspension arguing that Chinese corporations would gain competitive advantage.

In 2022, however, China's vaccine internationalization strategy went into crisis. Although multiple vaccine worlds continue to exist, Chinese COVID-19 vaccine exports have shrunk dramatically, as they have been considered less efficient than mRNA vaccines and have led to an image loss in many countries of the second and third vaccine world. Further, the spread of the highly infectious Omicron variant, leading to prolonged lockdowns and massive popular discontent, forced the Chinese leadership to abandon its domestic Zero-COVID strategy. From a world-systems perspective, global vaccine competition during the pandemic has shown that the Chinese state-business-complex was temporarily able to challenge the core countries in the traditionally Western- and Japanese-dominated pharmaceutical sector. For a short period of time, China was able to provide solutions to the system-level problem of the pandemic but in its internationalization strategy and domestic COVID-19 response, it was outcompeted by Western companies and remained largely isolated in the long run.

¹⁷ There are notable exceptions such as Hungary's approval of Sputnik V, and an autumn 2022 China-Germany agreement to approve BioNTech/Pfizer for German citizens in China and, in turn, Sinovac for Chinese citizens in Germany.

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