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Economic Impacts of COVID-19 in Asia

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Abstract

In this review paper, we explore the economic impacts of COVID-19 on Asia, encompassing the People's Republic of China (hereafter referred to as China), the Republic of China (Taiwan) (hereafter referred to as Taiwan), and Japan. Although these three countries are geographically close, they substantially differ in infection, economic impacts, and policies: China imposed very strict lockdowns, which caused significant economic loss; Taiwan was relatively successful in border control and quarantine policies to contain economic losses; and Japan suffered major economic damages despite relatively mild infection. We summarize the economic paths of these three countries under the COVID-19 era and provides lessons for future pandemics.

Keywords COVID-19, Economic impact, Lockdowns, Asia, China, Taiwan, Japan

JEL classification I18, O53

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1. Introduction

The COVID-19 pandemic has had multifaceted and profound social and economic impacts worldwide. The government responses to this pandemic have differed significantly across countries, both in their strategies and in their implementation. These differences have led to notable disparities in the spread of infections and the socio-economic impacts on their populations. By analyzing these responses and their consequences, we can derive valuable lessons and insights to better prepare for future global health crises, ensuring more effective solutions. Therefore, we extensively study economic and societal changes in East Asia (China, Taiwan, and Japan), focusing on the effects of government policies and shifts in the behaviors of businesses and consumers. Those countries are regionally close, but the government responses to the pandemic were substantially different. By summarizing the three countries' experiences, we propose lessons each region should consider to prepare for future pandemics.

The section on China focuses on the impact of government policies on the economy and society. The section on Taiwan explores how the "success" in managing the pandemic was achieved, examining contributions from both the private sector and the government. The section on Japan evaluates the effectiveness of government policies and highlights the analyses and contributions of economists during the pandemic. These differing perspectives underscore the varied impacts of the pandemic across the three regions.

2. China

2.1 Introduction

The economic repercussions of COVID-19 in China diverge from those experienced globally, a distinction that is evident from Google Trends[1] search data. Several studies[2] have highlighted the utility of Google Trends as a barometer of agenda-setting effects, reflecting the collective impact of diverse information streams on a given topic. Google Trends serves as a gauge of public perception influenced by policies, media discourse, and individual awareness. Figure 1 illustrates the disparities in search trends between China and the rest of the world from 11 February 2020, to 31 December 2022. This timeframe was selected because it coincided with the World Health Organization's (WHO) official designation of COVID-19. Despite Google's limited market share in China compared with Baidu, the country's predominant search engine, the search patterns are generally consistent[3]. It is important to note that direct comparisons between Chinese and global search volumes are not feasible. Instead, the analysis focuses on individual series patterns or their levels relative to their respective peaks.

[1] Google Trends (https://trends.google.com/trends/) is a platform provided by Google that analyzes the popularity of top search queries in Google Search across different regions and languages. By normalizing data based on query time and location, Google Trends enables meaningful comparisons across various dates and countries. Essentially, the numerical data displayed in Google Trends indicates the level of search interest relative to the peak point on the chart for the specified area and time.

[2] See https://onlinelibrary.wiley.com/doi/10.1111/apv.12352 and https://www.tandfonline.com/doi/full/10.1080/19331681.2023.2208105

[3] See https://www.tandfonline.com/doi/full/10.1080/20954816.2020.1814548. Meanwhile, this study observed certain subtle distinctions. However, given our emphasis on general trends rather than statistical analysis in this study, these variances are unlikely to be significant. Additionally, for improved comparability, it is better to utilize the same search engines.

Figure 1. Google Trends search data comparing China and global trends: 11 February 2020 – 31 December 2022

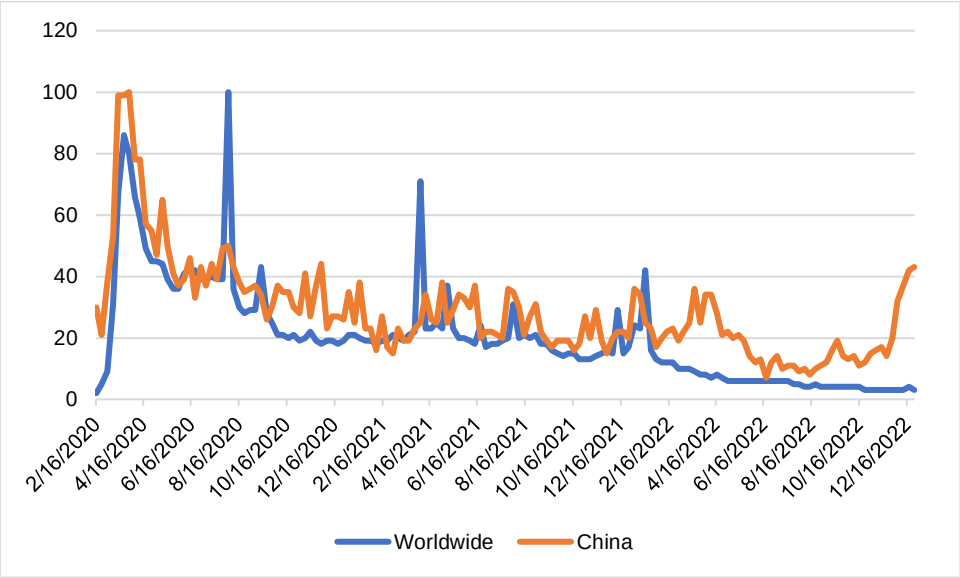


Figure 1 illustrates the public perception of the severity of COVID-19 and its economic impacts from 2020 to 2022. Three distinct phases were discernible in China[4]. The first phase spanned December 2019 to May 2020, marked by peak domestic that resulted in a more pronounced impact on the Chinese economy compared with the global scenario. The second phase, from June 2020 to the end of 2021, witnessed multiple global peaks of concern, whereas domestic Chinese concerns remained relatively stable. Consequently, the global economy experienced severe shocks, whereas the Chinese economy remained stable. The third phase, which occurred in 2022, saw heightened domestic concerns in China relative to its peak. As a result, while much of the world began to reopen, the dynamic zero-COVID policy in China severely impacted its economy.

[4] Different standards offer varied phase definitions. For instance, Liang et al. (2022) delineated phases differently. The initial phase, dubbed the emergency containment stage, unfolded within the first three months of 2020. Following this, the second phase transitioned into a normalization stage, emphasizing prevention and control, lasting from late April 2020 to July 2021. The third phase, labeled the dynamic COVID-zero stage, commenced in August 2021. Subsequently, the fourth phase began in April 2022, although it still retains the name "dynamic COVID-zero" stage. Moreover, economic indicators like industrial value-added, foreign trade, or retail sales can also prompt different classifications of phases.

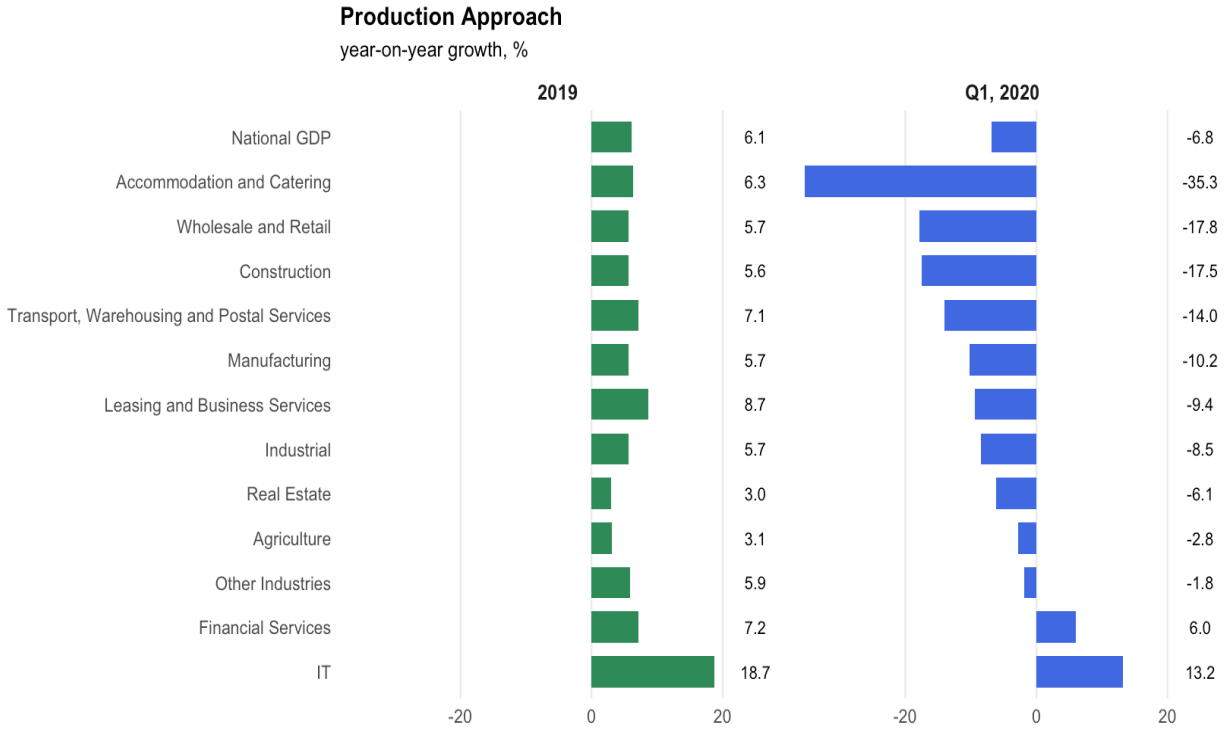
2.2 Three phases

Phase 1: December 2019 – May 2020

Figure 2 presents the Chinese economy's performance during Phase 1 of the COVID-19 pandemic. Given that the economic impact was minimal in December 2019, the reporting period spans from January to May 2020.

Figure 2. The Performance of the Chinese Economy during January – May 2020

2.1. Production Approach (Year-on-year growth, %)

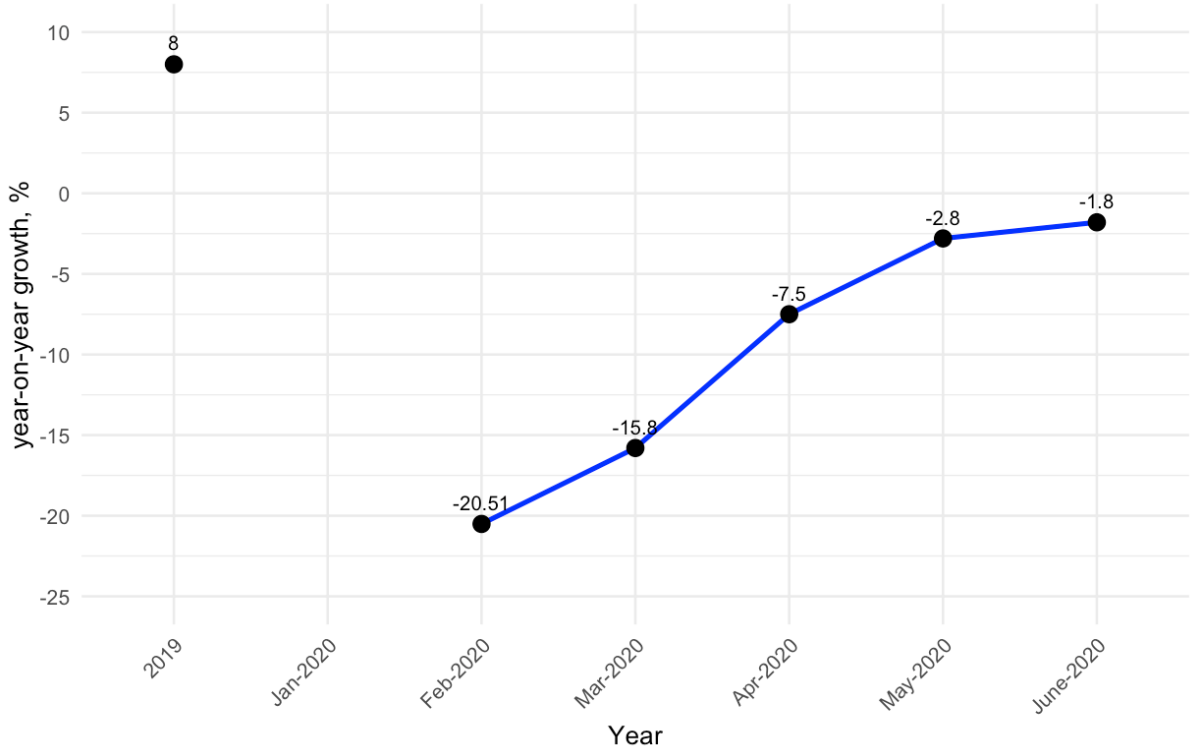


2.2. Expenditure approach

A. Fixed asset investments (FAI; accumulated year-on-year growth, %)

	Total FAI	Manufacturing	Infrastructure	Infrastructure (excluding electricity)	Real Estate
2019	5.4	3.10	3.33	3.80	9.90
Jan-2020	NA	NA	NA	NA	NA
Feb-2020	-24.5	-31.5	-26.86	-30.3	-16.3
Mar-2020	-16.1	-25.2	-16.36	-19.7	-7.7
Apr-2020	-10.3	-18.8	-8.78	-11.8	-3.3
May-2020	-6.3	-14.8	-3.31	-6.3	-0.3

B. Retail Sales (year-on-year growth, %)



C. Foreign Trade (3-month moving average for Monthly Data: Year-on-Year Growth, %)

year_month	Goods_Export	Goods_Import	Service_Export	Service_Import
2018 (trend)	2.0	2.0	6.0	4.0
2019 (trend)	0.0	2.0	6.0	2.0
Jan-2020	-7.4	3.2	0.1	-9.9
Feb-2020	-13.3	-2.8	-7.9	-17.4
Mar-2020	NA	NA	1.3	-26.0
Apr-2020	-2.2	-10.8	-6.5	-29.0
May-2020	-0.1	-9.7	-4.8	-31.5

Source: https://www.tandfonline.com/doi/full/10.1080/02692171.2021.1876641, and General Administration of Customs

Note:

- *Due to the Spring Festival effect, China's statistics bureau does not publish January data separately but rather combines it with February's data.*
- *China's foreign trade data are prone to volatility. Hence, the Hodrick-Prescott filter method, a mathematical tool to eliminate cyclical components from time series data, is employed. Raw data from annual growth during 1984-2019 are utilized.*
- *Although China's General Administration of Customs typically releases January data, it combined January and February goods trade data in 2020. Consequently, the 3-month moving average data for March is unavailable. This absence of data impedes the assessment of potential significant changes occurring in March.*

In Liu's (2021) analysis[5], China's economic performance in Q1 2020, measured using both production and expenditure approaches, reflected a significant contraction, notably the worst since the country adopted its economic accounting system in 1992. Production-wise, the accommodation and catering sector suffered the most, while the IT and financial sectors saw growth due to increased online services during the lockdown. Fixed asset investments plummeted, particularly in manufacturing, infrastructure, and real estate. Retail sales were also severely impacted during Jan-Feb 2020. In terms of foreign trade, while goods exports rebounded after factories resumed operations in March, goods imports remained insignificantly affected[6]. However, service imports, notably tourism, faced significant setbacks in aiding China's balance of international payments. The COVID-19 shock reverberated through China's job market, with urban unemployment rates reaching their highest levels, although these rates were likely underestimated due to the significant presence of migrant workers not fully captured in official statistics. Some estimates suggest the real unemployment rate to have been as high as 20% (Bloomberg News, 2020).

Phase 2: June 2020 – 2021

China generally had the COVID-19 pandemic under control from June 2020 to the end of 2021. During this phase, three key phenomena related to the Chinese economy were observed: the digital economy, global value chain, and structural reforms.

First, significant discussions have centred on the digital economy, a concept well-explored by Bukht and Richard (2017). A major aspect of China's digital economy is online shopping, propelled by advancements in smartphones, 3G/4G technology, rapid delivery services, mobile payments, and big-tech credit. Another crucial area of digital transformation

[5] See https://www.tandfonline.com/doi/full/10.1080/02692171.2021.1876641

[6] Although goods import data show that the demand shock is large, t-tests (not reported but available upon request) show that this impact is insignificant.

involves the digitization of commercial banks, as highlighted by Huang et al. (2021). Several studies have demonstrated further expansion of the digital economy during the pandemic. For instance, Shao and Kostka (2023) noted a significant increase in overall Internet usage in China owing to the pandemic. Additionally, Xu, Qian, and Pai (2022) observed that the digital economy played a prominent role in enhancing economic development, particularly during the initial stages of the COVID-19 pandemic. Table 1 presents the performance of China's digital economy during this pandemic.

Table 1. China's Digital Economy during 2016-2022

	Nominal GDP (trillion RMB)	Nominal Growth of GDP	Nominal Digital Economy (trillion RMB)	Fraction of Digital Economy in GDP	Nominal Growth of Digital GDP	Difference between Digital Economic Growth and Overall GDP Growth
2016	74.6	NA	22.6	30.3	NA	NA
2017	83.2	11.5	27.2	32.7	20.4	8.9
2018	91.9	10.5	31.3	34.0	15.1	4.6
2019	98.7	7.3	35.8	36.3	14.4	7.1
2020	101.4	2.7	39.2	38.7	9.5	6.8
2021	114.9	13.4	45.5	39.6	16.1	2.7
2022	120.5	4.8	50.2	41.7	10.3	5.5

Note:

- The GDP data *source for GDP is China's National Bureau of Statistics, accessible via https://data.eastmoney.com/cjsj/gdp.html.*
- *The exchange rate between USD and RMB (Chinese currency) from 2016 to 2022 fluctuates between 6.3 and 7.2 (per unit of USD).*

- *The data source for the digital economy is the China Academy of Information and Communications Technology's annual reports for 2021 (available at http://www.caict.ac.cn/kxyj/qwfb/bps/202207/P020220729609949023295.pdf in Chinese) and 2022 (available at http://www.caict.ac.cn/kxyj/qwfb/bps/202304/P020240326636461423455.pdf* in Chinese).

Table 1 illustrates the gradual increase in China's digital economy's share in the overall economy since 2016. However, its performance in 2020 was not particularly outstanding considering its absolute or relative growth. This is possibly due to the inaccuracy of GDP data, as highlighted by Kennedy and Mei (2023), leading to inconsistencies when comparing different years.

Second, China markedly augmented its global exports of goods during the pandemic. Between mid-2020 and 2021, as the Chinese economy returned to normal, the global economy faced ongoing challenges during its reopening. Additionally, spurred by the household stimulus programs implemented in the US and other economies, Chinese factories substantially increased their share of global goods exports. From 2015 to 2019, China's share remained at approximately 13 percent[7]. However, in 2020 and 2021, China's share increased to approximately 15 percent.

Third, by 2021, China embarked on a series of structural reforms. As the only major economy to achieve positive growth in 2020, Chinese leadership embraced a belief that 'The East is rising and the West is declining[8].' Fuelled by confidence in its pandemic management

[7] Please refer to https://unctad.org/news/china-rise-trade-titan for data from 1970 to 2020, and visit https://www.statista.com/statistics/256604/share-of-chinas-exports-in-global-exports/ for data from 2021 and 2022. Please note that there are very minor differences between these two data sources that are likely due to rounding errors.

[8] See https://www.scmp.com/news/china/diplomacy/article/3153379/china-says-east-rising-and-west-declining-has-it-been

and economic performance, China initiated a reform blitz, dubbed ‘a mini revolution’[9]. These reform endeavours encompassed initiatives such as promoting common prosperity, implementing a property tax, conducting regulatory crackdowns on technology firms, outlining a roadmap for peak carbon dioxide emissions and carbon neutrality, and other policies aimed at enhancing people's livelihoods[10]. While each policy addressed specific structural issues in the Chinese economy, they generated uncertainty and confusion among investors and entrepreneurs.

Phase 3: 2022

While much of the world opted to coexist with COVID-19 starting in 2022, China persisted with its zero-COVID policy. The greatest challenge was the emergence of the omicron variant, which spread swiftly across China. In response, China implemented more frequent and stringent lockdowns by 2022. The total lockdown of Shanghai during April-May 2022 was particularly notable, as it is China's largest city, a national hub for commerce, trade, and transportation, and a prominent global financial centre. This garnered worldwide attention and raised concerns among economists, investors, and policymakers. Until the abandonment of the zero-COVID policy in December 2022, April witnessed the most severe lockdowns and the poorest economic performance. Therefore, we selected April to showcase the Chinese economy’s performance (Table 2).

[9] See https://www.reuters.com/world/china/unleashing-reforms-xi-returns-chinas-socialist-roots-2021-09-09/

[10] See https://onlinelibrary.wiley.com/doi/10.1111/1759-3441.12365

Table 2. The Performance of the Chinese Economy: February 2020 vs April 2022 (%)

Category		Indicators	Feb-20	Apr-22
Supply Chain	Production	Electricity generation growth (YoY)	-4.6	-4.3
		Industrial value added growth (YoY)	-25.87	-2.9
		PMI (Purchasing managers' index): production (manufacturing)	27.8	44.4
	Storage	PMI: finished goods inventory (manufacturing)	46.1	50.3
		PMI: raw materials inventory (manufacturing)	33.9	46.5
	Delivery	Supplier delivery time: manufacturing	32.1	37.2
		Supplier delivery time: non-manufacturing	28.3	42.8
	Foreign Trade	3-month average goods export growth (YoY)	-13.3	11.6
		3-month average goods import growth (YoY)	-2.8	2.1
Domestic Demand		Aggregated fixed-asset investment growth (YoY)	-24.5	6.8
		Aggregated real estate development investment (YoY)	-16.3	-2.7
		Retail sales (YoY)	-20.5	-11.1
		Commercial housing sales area (YoY)	-39.9	-20.9

Source: *https://www.tandfonline.com/doi/full/10.1080/02692171.2022.2138836*

Table 2 indicates that the supply chain disruptions were less severe than those experienced in early 2020. China's foreign trade was also resilient. Concerning domestic demand, all the indicators, including fixed asset investment and retail sales, reflected significant impacts, albeit less severe than those observed in 2020. Overall, the Chinese economy contracted due to the shock from lockdown measures, but the impacts were milder than those observed in early 2020. However, youth unemployment increased, and in 2022, Chinese households and consumers exhibited weaker expectations than in 2020.

China's official GDP growth for 2022 is reported to be 3 percent. However, scepticism arose regarding the accuracy of China's economic data upon the release of this figure (Hancock, 2024). Based on a county-level daily panel dataset, Gong et al. (2024) discovered that the zero-COVID policy led to a 30% decline in mobility, a 1.17% decrease in PM2.5

levels (an air quality measure), a 7.7% reduction in nighttime lights, and an overall 3.9% GDP loss in 2022.

2.3 Looking ahead

The COVID-19 pandemic in China and its impacts on the economy illustrate a complex and evolving relationship. Initially, China experienced significant economic losses. However, this situation was successfully addressed, positioning China advantageously on the global stage. Eventually, the pandemic spiralled out of control and severely affected the economy. This underscores the need for policymakers to approach future pandemics with caution by carefully considering the complexity of the pandemic to avoid overconfidence and ensure sustainable measures. An insufficiently resilient policy may harm public confidence in policymaking and cause long-term scarring of the economy.

2.4 Concluding remarks

After China lifted its zero-COVID policy in December 2022, the world anticipated swift economic recovery. However, as Krugman (2024) observed in 2023, ‘China has underperformed in just about every economic indicator other than official GDP’. Some scholars attributed this underperformance to China’s COVID-19 pandemic policies. For instance, Jörg Wuttke, the current Chief Representative of BASF China and former president of the European Union Chamber of Commerce in China, likened the Chinese economy's plight to PTSD (post-traumatic stress disorder) (60 minutes, 2024), referring to post-zero-COVID policy effects. Adam Posen, president of the Peterson Institute for International Economics, described China’s economic situation as ‘economic long COVID’ (Liu, Pettis, and Posen, 2023). The underlying reasons for the post-COVID underperformance of the

Chinese economy are multifaceted, including long-term structural issues and declining confidence among Chinese consumers and entrepreneurs resulting from a series of policies pre-dating the pandemic. However, it is undeniable that China's pandemic policies played a significant role. In particular, China's initial success in controlling the pandemic led to overconfidence among Chinese leadership, resulting in a more aggressive foreign policy approach dubbed 'wolf warrior diplomacy'. For example, China's relations with major Western countries deteriorated since 2020. China's overconfidence also spurred the nation to implement more radical domestic reform agendas, causing confusion and panic. The intrusive zero-COVID policies of 2022 eroded Chinese consumer confidence in China's policies. The struggling post-COVID Chinese economy underscores the significant future challenges faced by Chinese policymakers.

3. Taiwan

3.1 Introduction

Despite its exclusion from the WHO, Taiwan managed to overcome the challenge of this COVID-19 pandemic with a mild negative impact on its economy compared to other economies. Several key factors, such as the timely establishment of the epidemic command center, quick border control, strict quarantine policy, face mask policy, utilization of medical facilities and national health insurance, transparent information, technology use, and public education and cooperation, led to the successful prevention of the virus from spreading in its early stages (Kuo, 2021). The Taiwan Center for Disease Control's (CDC) white paper on Taiwan's epidemic prevention policy summarizes some of Taiwan's key actions that helped combat the pandemic, such as 253-day no new-infected domestic cases from 2020 April 13th

to 2020 December 31st, no lockdown implanted, a 93.8% vaccine coverage rate, and injection of an 840 billion special budget with 83% aimed at industries and individuals.

Based on the different threat levels of COVID-19, Taiwan experienced three phases. Phase One occurred from December 2019 to April 2021, Phase Two from May 2021 to March 2022, and Phase Three covered April 2022 to May 2023. Taiwan successfully controlled the virus through border control and strict quarantine measures. With no lockdown restriction and few new infections, Taiwan's economy and people's lives were mildly affected to near normal in Phase One. Taiwan launched an online electronic Entry Healthy Declaration system on February 16, 2020, which included QR code scanning, tracing, and an electronic fence warning system. Taiwan extended its vaccine coverage to 93.8%, and students were transferred from campuses to online learning from May 19, 2021, to July 2, 2021, to cope with the rising level-three virus alert in Phase Two. Taiwan reopened its borders and relaxed its quarantine restrictions as the virus threat diminished in Phase Three. People's lives and economic activities have gradually resumed a new normal since Phase Three.

3.2 Overall economic impacts

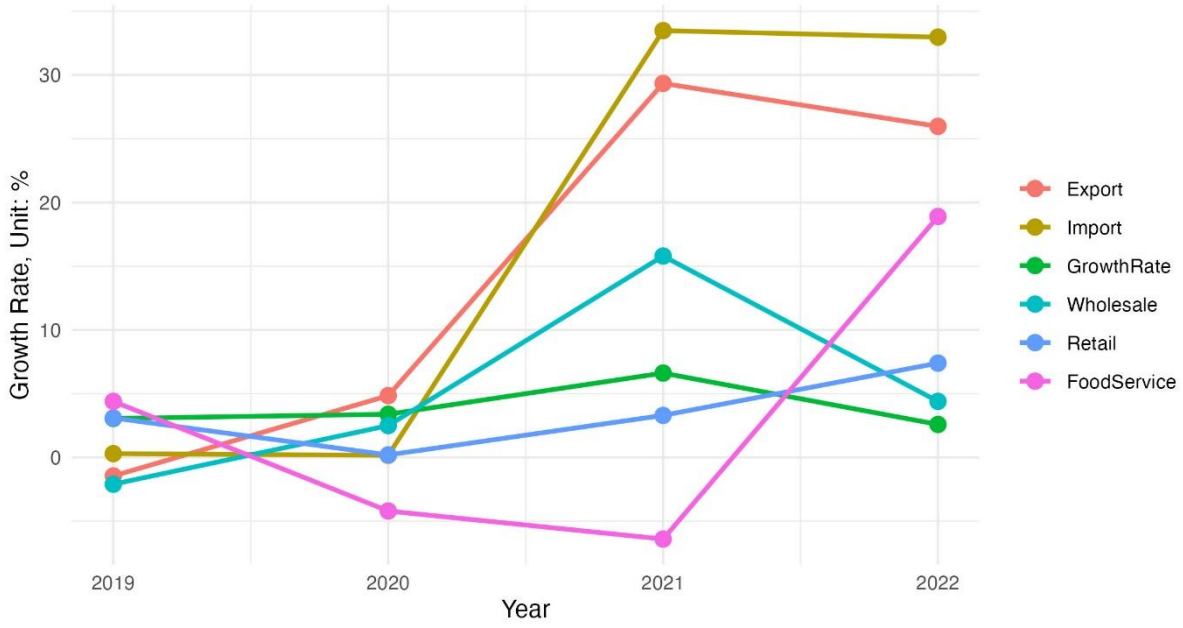
As a trade-dependent economy, Taiwan is vulnerable to reduced global trade flows and recessions caused by lockdowns worldwide during this pandemic. Weak external demand and disruption of supply chains inevitably hurt Taiwan's economy. However, benefiting from its strong exports of information and communication technology and semiconductor products during the early stages, Taiwan is one of the few economies with a positive economic growth rate in the 2020-2021 period and experienced no lockdowns during this pandemic.[11]

[11] Taiwan had recorded a 3.39 percent and 6.62 percent economic growth rate in 2020 and 2021, respectively, as Figure 3 shows.

Taiwan's exports were impeded in the early stages but strongly rebounded during the pandemic. Figure 3 shows that the export growth rate declined by -1.45 percent in 2019 and rebounded strongly with a 4.85 percent increase in 2020 and over 20 percent in 2021 and 2022. Similarly, the import growth rate was only 0.3% in 2019 and 0.17% in 2020 but increased greatly to 33.48% in 2021 and 32.97% in 2022. Although impeded by the negative impacts in the early stages, Taiwan's exports and imports rebounded and later grew substantially. The total export volume had increased from 329.2 billion US$ in 2019 to 479.4 billion US$ in 2022, a 45.63% increase during this pandemic period. However, exports declined to 432.4 billion US $ in 2023 due to Russia's invasion of Ukraine and rising tension in the Taiwan Strait.[12] Most of Taiwan's exports declined in 2023, except for information and audio-video products. Kuo (2023) mentions that the rising rivalry between the US and China in the new Cold War and the Taiwan Strait tension will harm Taiwan's economy since these two superpowers are Taiwan's top two trade partners. China's possible termination of the Cross-Strait Economic Cooperation Framework Agreement would further impede cross-strait trade.

[12] Taiwan Strait tension rose substantially since the Speaker of the United States House of Representatives Nancy Pelosi's visit to Taiwan in August 2022.

Figure 3 Exports, Imports, GDP, Sales Revenue (YOY) Growth Rate, Unit: %

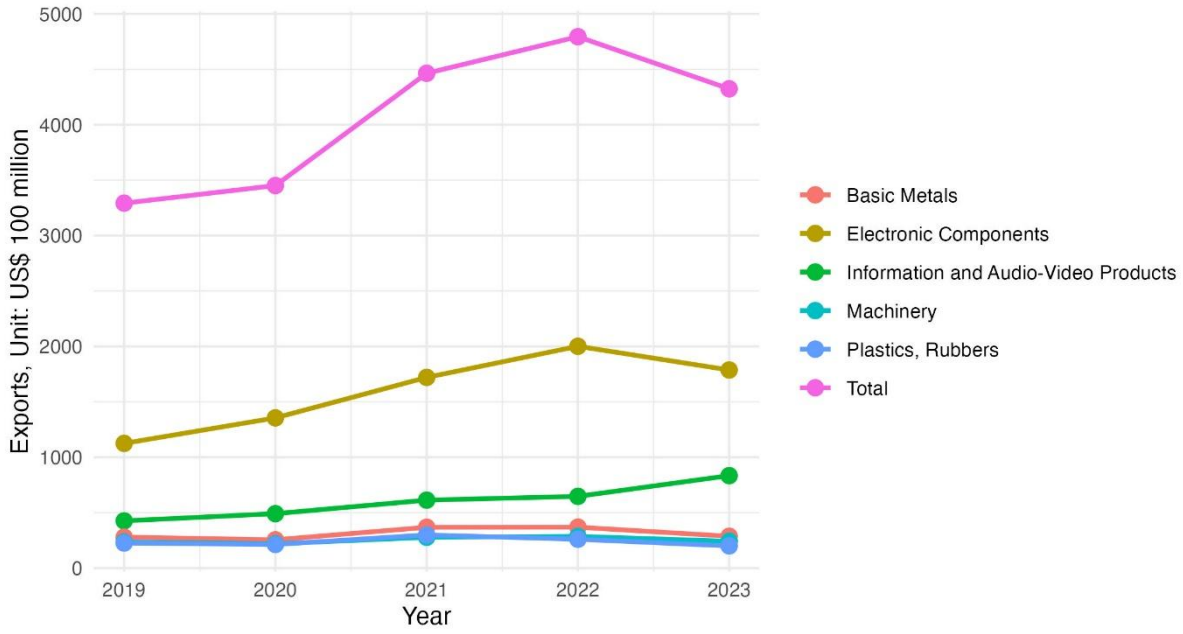


Source: Ministry of Economic Affairs, Taiwan.

Taiwan's exports mainly benefited from an increase in electronic components, information, and audio-video products during the pandemic. These exports were boosted by the rising global demand for hardware equipment for working from home, distance learning, and meetings during the pandemic. Electronic component exports are expected to increase from 111 billion US $ in 2019 to 200 billion US $ in 2022. Similarly, the information and audio-video products exports also increased from 35.3 billion US $ in 2019 to 64.7 billion US $ in 2022, as shown in Figure 4. The exports of electronic products, information, and audio-video products increased by 78% and 52% from 2019 to 2022 respectively, compared to 46% of total exports. Since Taiwan's exports contributed to its economic growth by almost 60%, these rising exports contributed significantly to Taiwan's positive economic growth during the pandemic.

Figure 3 lists Taiwan's wholesale, retail, and food service sales revenue growth rates from 2019 to 2022. Wholesale sales revenue did not drop in the early stage of the pandemic; on the contrary, it expanded in the middle and continued to grow at the end, as its revenue growth rate increased by 2.5% in 2020, 15.8% in 2021, and 4.4% in 2022. On the other hand, the retail sales revenue growth rate increased by 0.2% in 2020, 3.3% in 2021, and 7.4% in 2022. Unlike wholesale and retail, the food service sales revenue growth rate dropped by 4.2% in 2020 and continued to drop by 6.4% in 2021, but rebounded strongly with a positive 18.9% in 2022. Overall, wholesale and retail sales were minimally affected in the first half of this pandemic and were able to recover in the second half, while food service sales were severely impacted in 2020 and 2021, but also recovered in 2022 when restrictions were eased in Phase Three.

Figure 4 Taiwan Exports by Commodity, Unit: US$ 100 million



Source: Ministry of Economic Affairs, Taiwan

How did the pandemic affect Taiwan's internal demands? Table 3 lists the selected inner demand indices for Taiwan from 2019 to 2023. Taiwan's service industry was hurt the most in the early stages of the pandemic, especially in hotels, restaurants, and transportation. Both hotel rooms and food revenue declined substantially in 2020 and 2021 but gradually increased in 2022 and 2023 in the later stages. The overall food industry growth rate also declined greatly in 2020 and 2021 but rebounded strongly in 2022 due to increasing food deliveries and the mitigated virus threat in Phase Three. The airline and travel industries were also drastically impacted by the pandemic, with a sharp drop in the demand for air travel. Table 3 shows that the number of foreign tourists in Taiwan declined dramatically from 11.86 million in 2019 to 1.38 million in 2020 and 0.14 million in 2021; this number slowly recovered to 0.90 in 2022 and 6.48 million in 2023. Facing a sudden drop in demand at the early stage of this pandemic, the two leading airlines, China Airlines, and EVA Airlines, adjusted their business strategy to transporting packages instead of passengers or redirecting international flights to domestic flights. These adjustments can reduce sudden revenue losses. Airlines can readjust their strategy when the demand gradually returns by switching transporting packages to passengers. Taiwan's airlines' flexibility strategies reflect their efforts to gain resilience during the pandemic.

Taiwan's stock market index grew more than 50% and the average trading volume almost doubled from 2019 to 2022. The TAIEX grew from 10,790 in 2019 to 15,623, and the average trading volume increased from 109.4 billion US $ in 2019 to 228 billion US $ in 2022. Taiwan's Stock market continued to prosper during the pandemic.

Table 3 Taiwan's Selective Inner Demand Indexes

	2019	2020	2021	2022	2023
Foreign Tourists (Thousands)	11864	1378	140	896	6487
TAIEX Index	10790	12074	16938	15623	16386
TAIEX Volume (bn)	109	186	378	228	264
Hotel Room Revenue (bn)	268	145	134	198	273
Hotel Food Revenue (bn)	264	209	177	212	257

Source: Department of Statistics, Ministry of Finance

3.3 Production impacts

The pandemic has caused several unexpected disruptions in consumption, production, and economy. Firms faced short-run challenges from the pandemic, such as the deterioration of their revenues and profits, supply chain disruption, and difficulty in labour mobility. Unstable market demand, uncertainty, new supply chain changes, and deglobalization pose tough long-run challenges for producers. Resilience and digitalization are the two main directions that producers have adopted to cope with this pandemic. Because there was no lockdown, Taiwan's producers did not need to shut down factories for production, as happened elsewhere during the pandemic. However, some production was forcibly ended or postponed owing to the supply chain disruption that resulted in a shortage of parts and components from abroad. Shortening or localizing supply chains is an option for Taiwan's producers to counter the negative impacts of a sudden break or shortage in the supply chain. In addition, some labourers were unable to work because of quarantine restrictions. Some producers, especially manufacturers, adjusted their production to cope with remote work, but others could not. Meanwhile, to meet the rising demand for electronic devices for remote work and distance

learning, both domestically and internationally, Taiwan's production and export of electronic products and audio-video information products increased during the pandemic.

Digitalization is another strategy that has emerged to cope with the need for remote work under quarantine and to mitigate the negative impacts for producers during this pandemic. Taiwan's manufacturers have made significant efforts toward digitalization during the pandemic. The 2022 Taiwan Small and Medium Enterprise Transformation and Demand Survey shows that 91.6% of the small and medium enterprises in Taiwan's manufacturing industry adopted digitalization (5% adopted digital optimization and 28.7% adopted digital transformation). The pandemic has made the transformation towards production digitalization in Taiwan quicker and more widespread, especially in manufacturing.

Face masks and semiconductor production were Taiwan's two most noticeable cases of production during this pandemic. Facemask production demonstrates the Taiwan government's quick coordination of production resources to boost a sufficient supply of facemasks to meet urgent demands and soothe people's shortage fears in the pandemic's early stage.[13] Taiwan's semiconductor industry illustrates its strength and resilience through its unique semiconductor agglomeration advantage of a complete supply chain within 400 km. Taiwan's semiconductor industry continued to grow and prosper, especially in chip production, during this pandemic. Taiwan's leading chip producer, Taiwan Semiconductor Manufacturing Company, has become increasingly important worldwide.

[13] Under the government's coordination, a face mask national team of producers was established to increase total production capacity in a short period of time.

3.4 Impacts on consumption patterns and lives

People's lives and consumption behaviours are inevitably affected by the pandemic. Consumers tend to stay at home longer and avoid eating or shopping in public because of fear of infection. Lockdowns and quarantines prevent consumers from engaging in in-person shopping. Under these circumstances, consumers have changed their consumption patterns from physical stores to contactless e-commerce stores, thereby enhancing the growth of e-commerce in Taiwan. Taiwan's retail sales growth rate declined to only 0.2% in 2020 and slowly increased to 7.4% by 2022. On the other hand, the e-commerce sales growth rate doubled to 26.7% in 2020, and remained at 22.1% by 2021, dropping to 10.9% by 2022. The proportion of e-commerce to total retail sales continued to grow from 7.5% in 2019 to 11% in 2022, as shown in Table 4. The e-commerce retail sales increased from 287.3 billion NT$ in 2019 to 503.5 billion NT$ by 2023, a 75.25% increase from 2019 to 2023. Total e-commerce retail sales in Taiwan continued to grow throughout the pandemic, indicating that more consumers were inclined to make purchases on the Internet.

Table 4. Retail Sales, E-commerce Sales (YOY) Growth Rate and Percentage, Unit: %

Year	Retail	E-Commerce	E-Commerce/Retail Percentage
2019	3.1	14.1	7.5
2020	0.2	26.7	9.4
2021	3.3	22.1	11.1
2022	7.4	10.9	11.0

Source: Ministry of Economic Affairs, Taiwan

Cashless payments continued to grow during this pandemic as consumers avoided using cash. Taiwan's coverage of mobile payment has grown from 50.3% in 2018 to 70.6% in

2022[14]. Taiwan's consumer willingness to use mobile payments has continued to increase from 5.1 percent in 2020 to 6.8 percent in 2021, and 9.3 percent in 2022. In addition to existing government promotions, the extension of mobile payments was indirectly induced by this pandemic.

The restaurant business was severely impacted in the early stages of the COVID-19 outbreak in 2020 owing to people's fear of infection from others while eating at restaurants. An increasing number of consumers prefer to cook by themselves or order food. Food delivery had grown by 293.78%, almost tripling, in the first half of 2020 compared with 2019 in Taiwan. The Market Intelligence & Consulting (MIC) Institute food delivery survey 2021 indicates that 53.3% of consumers use food delivery, among which 10.9% are first-time users and 22.1% increased their frequency of food delivery orders. Almost 80% of consumers revealed a willingness to continue using food delivery, and 60.4% of new users were willing to continue using food delivery even after the pandemic. The Market Intelligence & Consulting Institute's consecutive-year surveys show an increasing trend in food delivery usage for Taiwanese consumers since this pandemic. This percentage has increased from 53.3% in 2018 to 73.3% by 2022. Additionally, the types of food delivery payments changed from 31.4% mobile payments and 68.8 % credit cards in 2022 to 46.5% mobile payments and 55.9 % credit cards in 2023. Mobile payments were also substantially boosted by the pandemic in Taiwan.

According to Digital 2020-2024 Taiwan reports, the number of Internet users in Taiwan increased from 20.51 million in January 2020 to 21.68 million in January 2023. The Internet penetration rate also increased from 86% in 2020 to 90.7% in 2023. Increased

[14] The mobile payment coverage increased to 60.3% in 2020 and 69% in 2021 during the pandemic according to the MIC's mobile payments surveys.

Internet usage and penetration enhanced the development and extension of e-commerce in Taiwan during this pandemic.

Taiwan's consumer behaviour shifted to e-commerce, food delivery, and cashless payments, particularly mobile payments. These new patterns continued to grow throughout the pandemic.

3.5 Looking ahead

The COVID-19 pandemic brought several unexpected challenges and impacts on Taiwan's economy. The Taiwanese government's quick response effectively reduced its negative impact in the early stages of the pandemic. The overall negative impacts were relatively mild; however, some industries, such as the food and tourism industries, were severely affected during the pandemic. Taiwan can learn and utilize lessons from this pandemic in the future. First, in addition to a quick response, Taiwan's government should maintain keen awareness of possible changes by keeping information transparent and maintaining close international cooperation in public health. Taiwan should put great effort into creating and extending its cooperation with other nations, given its current exclusion from the WHO. Second, the pandemic has magnified the international importance of Taiwan's information and communications technology industry, especially its semiconductor industry. However, this also creates challenges and pressure for other industries in Taiwan. This pandemic has not only accelerated the need for digitalization of production but has also nourished the new trend of adopting digitalization for consumption in Taiwan. This provides challenges and opportunities for producers to enhance their resilience in the future by adopting digitalization. Resilience and flexibility have proven crucial for future production during the pandemic. Third, the COVID-19 pandemic highlights the importance of key medical supplies, vaccines,

and medicines. Taiwan should expand its production and maintain supply chain linkages for these important materials to avoid possible future shortages.

3.6 Conclusion

The negative impact of the pandemic on Taiwan's economy was relatively mild compared to that of other economies. Taiwan benefits from its increasing exports of electronic products and information audio-video products to offset the negative impacts of this pandemic. Taiwan has experienced positive economic growth during the pandemic. Taiwan's economy was only mildly affected by adjustments that made it more resilient during the pandemic. Consumers, producers, and governments have learned to adopt new risk-mitigation strategies during the COVID-19 pandemic in Taiwan. Taiwan's government also plays a vital role in enhancing Taiwan's resilience in fighting the COVID-19 pandemic with a quick response and by utilizing technologies, such as a mobile mask map app, QR code scanning, and artificial intelligence assistance with distance medical diagnosis[15]. The government's promotion and producers' willingness to adopt digitalization accelerated digitalization during this pandemic in Taiwan. Taiwan's consumers have adjusted their consumption patterns to increase e-commerce, food delivery, and cashless payments, especially mobile ones. Producers in Taiwan have adopted strategies to enhance their resilience and move their production toward digitalization. Short-chain, near-chain, and the development of domestic production are the strategies that Taiwan's producers have learned from this pandemic.

[15] See Kuo (2021) section 3.3 Face mask policy and section 3.6 Technology use.

4. Japan

This section summarizes Japan's COVID-19 infection, economic damage, and government policies on various topics, such as the medical system, consumption, labour, and firms. [16] Japan's situation was relatively good in terms of both infection and economy. However, there remains discussion about containment and economic policies, such as mild lockdowns, inflexible medical systems, generous economic support, accumulated government debt, and the Tokyo Olympic Games. We summarize the policy evaluations for future lessons. Moreover, this section emphasizes what economists could promptly provide academic research on and how they contributed to actual policy decisions during the COVID-19 pandemic periods. Notably, economists started to utilize new tools, such as big data from private companies and real-time forecasting models. The pandemic was also an academic exercise for economists regarding future economic and social crises.

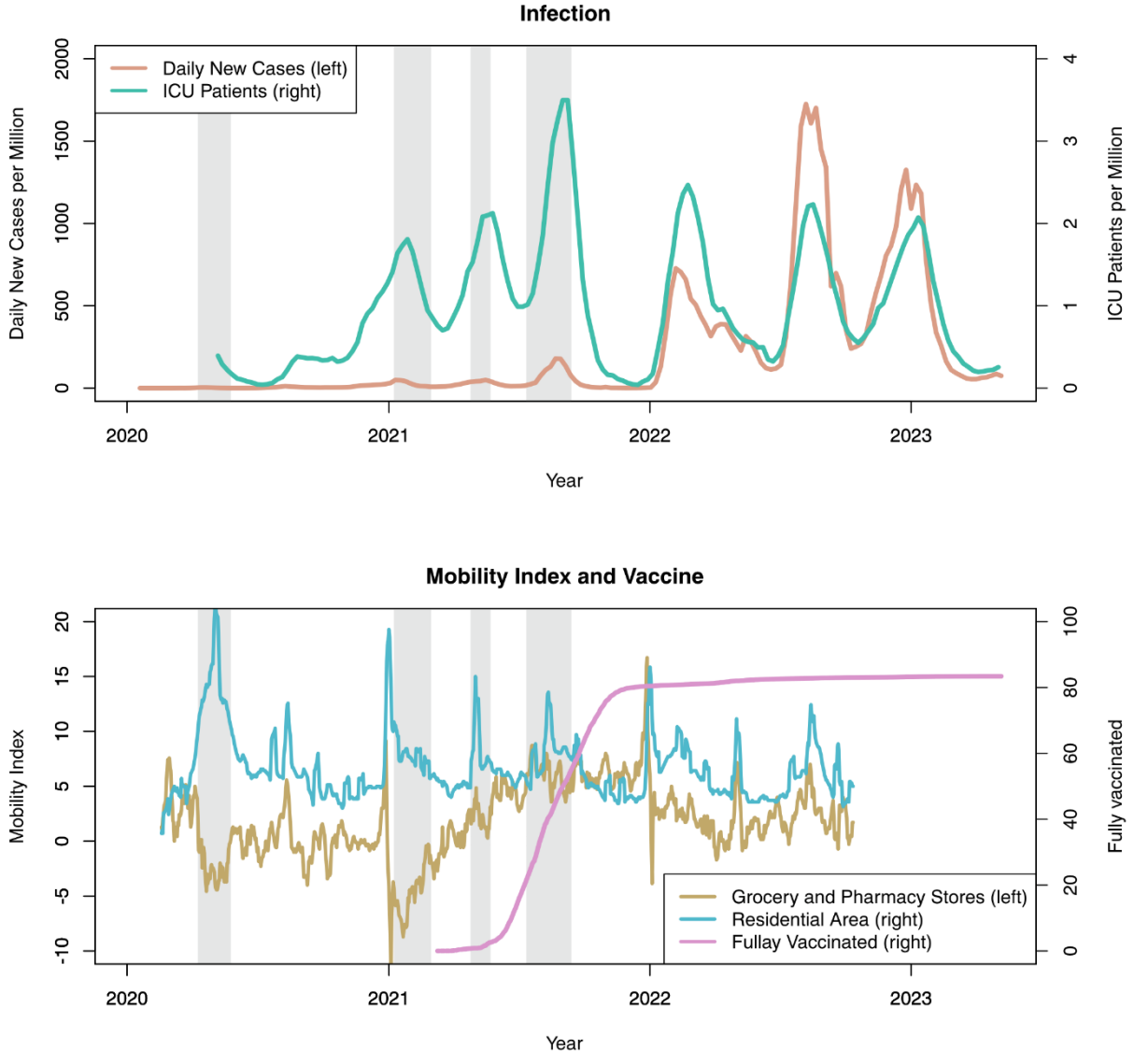
4.1 Infection and lockdowns

Similar to other countries, Japan experienced several waves of COVID-19. In the first wave of spring 2020, the infection was quite mild; only 15,156 cases (120 cases per million people) were reported, with 2190 severe cases and 136 deaths. The Japanese government implemented a partial lock down, a so-called state of emergency, which caused about a 10% decline in real GDP in the second quarter of 2020. This emergency declaration was later repeated in January, April, and July 2021 in response to subsequent waves (grey-shaded areas

[16] We thank Daisuke Fujii and Taisuke Nakata for their helpful comments and Yuki Nakamura for excellent research assistance for this section. The selection of citations partly depends on the Japanese Economic Association's COVID-19 literature database. (https://COVID19.jeaweb.org/). Due to page limitations, we omit some important economic studies that overlap with other disciplines, for example, education (Takaku and Yokoyama, 2021; Ikeda and Yamaguchi, 2021; Nishihata and Kobayashi, 2024; Asakawa and Ohtake, 2021), family issues (Komura and Ogawa, 2022; Sugawara and Nakamura, 2021), and mental health (Yamamura and Tsutsui, 2022; Batista et al., 2022; Yamamura et al., 2023; Takaku et al., 2024).

in Figure 5). In 2022, the government ended its emergency statis, although the infection had spread substantially. This is because, as shown in the top panel of Figure 5, the number of patients in critical condition was limited compared to the previous waves. Overall, Japan was more successful in avoiding the harmful impacts of the pandemic.

Figure 5. Infection and Mobility



Notes: The infection data are from Our World in Data (Max Roser and Hasell, 2020) and the mobility index is from the COVID-19 Community Mobility Reports of Google.

However, it was paradoxical. First, the low infection rate and high economic costs appear to imply that Japan imposed a severe and efficient containment policy. However,

Japan's declaration of a state of emergency was mild, being simply a 'request', and interpreted as a 'voluntary' lockdown (Watanabe and Yabu, 2021a, b). There were almost no legal penalties for going outside during this emergency. This situation also differs from the efficient Trace-Test-Quarantine (TTQ) strategies conducted in South Korea and Taiwan because of the insufficient supply of PCR tests.[17]

Interestingly, this simple request policy was sufficiently powerful. The mobility index in the bottom panel of Figure 5 substantially dropped down reacting to the state of emergency. Watanabe and Yabu (2021a,b) argue that rather than direct intervention, the information people infer from government announcements matters more, using regional timing differences in policies. Similarly, Rui et al. (2022) reported that newspaper coverage stimulated the purchase of masks. The importance of voluntary behaviours has also been emphasized by epidemic-macroeconomic model simulations (Hosono, 2021; Kubota, 2021). Japan's request-based policy may also work well for cultural reasons. Fujii et al. (2023) found that Japanese people revealed a preference for health over the economy from a cross-country comparison of pandemic frontiers. Kuroda et al. (2022) emphasized the role of social capital in preventing behaviours.

Epidemic-Macro models and policy decisions

Epidemic–macro models were applied to policy decisions in Japan, with Fujii and Nakata (2021) conducting the most influential study. The structure of their Susceptible-Infected-Recovered (SIR) model is substantially simple, eliminating agents' decisions, market equilibrium, and optimal policies. Instead, this model incorporates detailed data and policy scenarios to answer policy topics practically and promptly. The authors organized a weekly press conference that received considerable attention from mass audiences and governments.

[17] As of May 31 2020, 2.16 people out of a population of 1000 took PCR tests in Japan, while the numbers were 17.55 in South Korea, 49.63 in the UK, and 57.16 in the US. https://ourworldindata.org/coronavirus-testing

In January 2021, their model predicted that an extension of the state of emergency could prevent future repeated lockdowns and improve both health and the economy. The authors presented their analysis to public health advisors and key policymakers, including Japan's prime minister, who are likely to influence the government's decisions on when to issue or lift a state of emergency. They are also known to project the effects of the Tokyo Olympic Games on infections, as summarized in Chiba et al. (2022). The authors projected that foreign visitors themselves would have almost negligible impacts on infection but that the increased human flow of Japanese residents associated with the Olympic Games could be substantial. This type of simple SIR model has also been studied by Shibata and Kosaka (2021), Beppu et al. (2023), Fukao and Shioji (2021), and Inoue and Okimoto (2023). In contrast, Hosono (2021) and Kubota (2021) use DSGE-based models to capture endogenous economic reactions. Chiba (2021a) and Chiba (2021b) applied agent-based models in various applications. Time-series studies (Tomura, 2022; Shibamoto et al., 2022) are also useful. However, national-level simulations suffer from endogeneity. Hoshi et al. (2021) combined an SIR simulation with regional difference-in-difference (DID) estimation to avoid this problem. Another unique and insightful study is that of Hirokawa et al. (2023), which evaluates a regional government's certification policy for food providers caring for infection prevention and finds positive effects on both infection reduction and business sales.

Medical system and vaccine

Japanese hospitals struggled to accommodate COVID-19 patients, as in other countries, but this is puzzling given the low infection rate. Part of the reason for this is the scarce supply of intensive care beds, although Japan has the largest number of beds per person among the OECD countries.

Moreover, Japan has allocated only a small number of intensive care beds for COVID-19 patients.[18] Economists have criticized the ignorance of economic incentives in medical systems. Like the voluntary lockdown, the Japanese government only provided guidelines for hospitals; that is, hospitals were free to reject COVID-19 patients. Takaku and Yokoyama (2022) found that the acceptance of COVID-19 patients imposed substantial financial burdens on hospitals through a decline in other patient visits.

In contrast, Japan succeeded in increasing vaccine intake by more than 80%, although its introduction was delayed. For an efficient distribution, Wang et al. (2022) and Kuniya et al. (2024) considered optimal vaccine allocation policies using age-dependent SIR models. The University of Tokyo Market Design Center provides vaccine distribution consulting services for local governments based on the matching theory. Moreover, Sasaki et al. (2022) experimented with nudge-based messages to increase the intention to receive the COVID-19 vaccine; however, the effects were limited, similar to findings on infection-prevention behaviours (Sasaki et al., 2021; Kurokawa et al., 2024).

4.2 Economic reactions and policies

Next, we focus on the economic reactions to the pandemic on consumption, jobs, families, and firms. Unlike the mild spread of the infection and voluntary lockdowns, the economic reactions were substantial and comparable to those of other countries. The government

[18] According to OECD (2020), Japan had 5.2 intensive care beds per 100,000 people, compared to the OECD average of 12.0. In Japan, as of May 2020, 2356 intensive care beds were prepared for COVID-19 patients (according to the Ministry of Health, Labor and Welfare) out of 7109 total (according to the Japanese Society of Intensive Care Medicine). In contrast, Berger et al. (2022) report 925 out of 1242 in Denmark, 1900 out of 2400 in the Netherlands, and 925 out of 1200 in Norway.

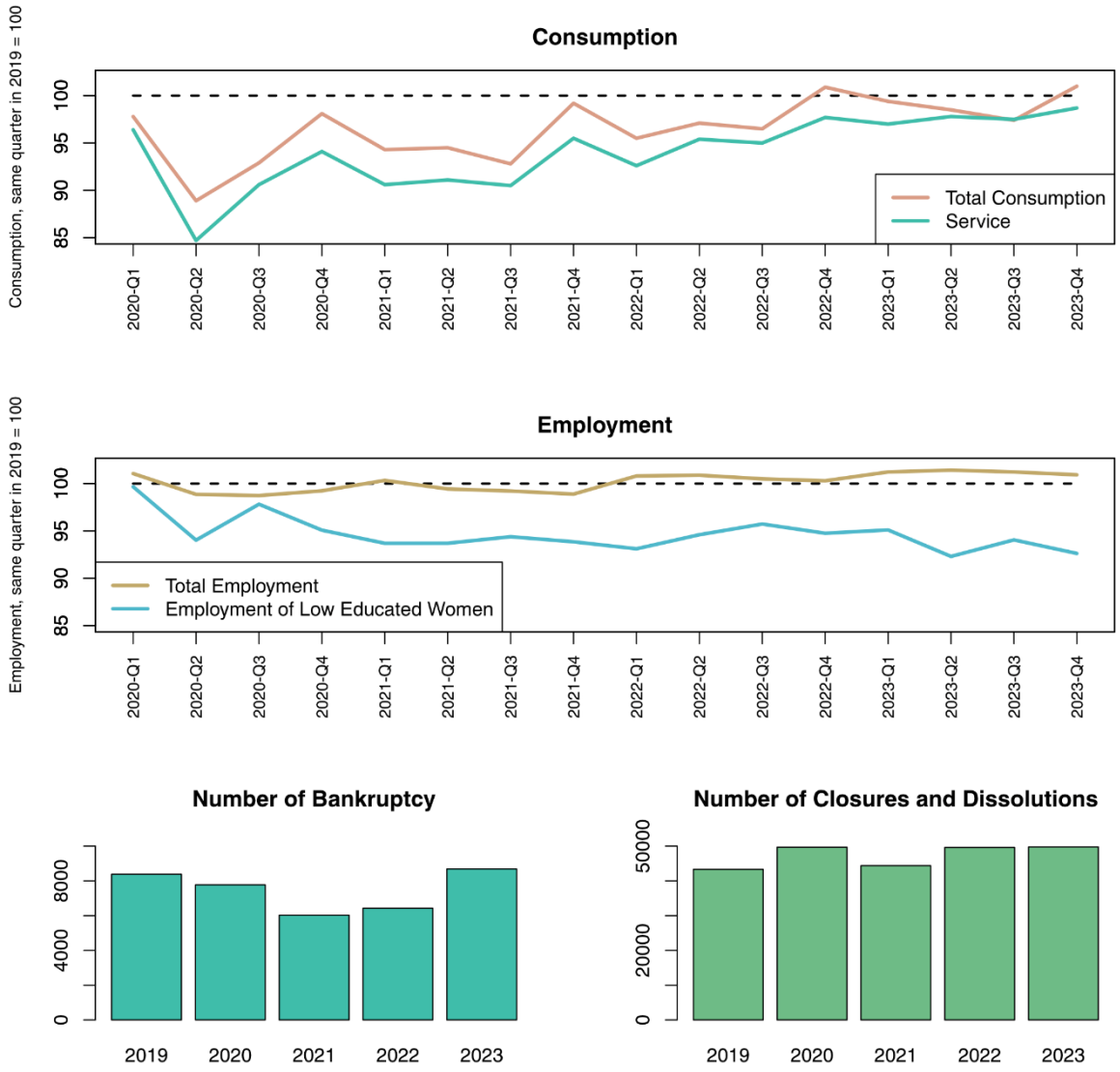
provided generous economic support, and its efficiency subsequently led to key policy debates.[19]

Consumption Trend

Figure 6 shows an 11% decrease in total consumption and a 15% decrease in service consumption in the second quarter of 2020. Subsequently, these economic measures gradually returned. Given rapid and short-term changes in economic conditions, alternative data held by private companies have gained attention as faster economic measures than public data. Watanabe (2020) was the first study to appear surprisingly early in late March 2020. This study shows a large decline in service consumption using credit card records and an increase in stockpiling consumption in supermarket sales from point-of-sale (POS) data. The Ministry of Economy, Trade, and Industry (METI) reported real-time sales indices using POS data for various items. Using raw data, Konishi et al. (2021) reported dramatic sales changes in detailed item categories such as masks and web cameras. On the household side, Kikuchi et al. (2023) studied age differences in consumption swings using home scanner data. A few studies have focused on the persistence of this change in consumption patterns. Watanabe and Omori (2021) suggest that this is temporary because the online shopping shift did not expand to inexperienced consumers. However, Nakajima et al. (2022) found that consumers who newly started online shopping continued to make online purchases. While these two studies examined consumer-side data, Inoue and Todo (2023) studied online shopping site data and found that sales reverted to the old trend after the state of emergency.

[19] Ando et al. (2020) summarize the Japanese government's fiscal policies in the early stage of the COVID-19 pandemic.

Figure 6. Economic Trends



Notes: Consumption data are from the National Account reported by the Cabinet Office, and employment data are from the Labor Force Survey provided by the Statistics Bureau. Tokyo Shoko Research published the number of bankruptcy units, closures, and dissolutions. Here, bankruptcy refers to the suspension of a business under the law or by banks and creditors. Closures and dissolutions are suspensions other than bankruptcy. Among them, more than half have no problems with assets or business profits.

Consumption stimulus

One of the most popular policy topics during the pandemic was the Special Cash Payment (SCP) program. In the summer of 2020, the government transferred a fixed and sizable

amount of cash (100,000 Japanese Yen or approximately US $ 950 in 2020) to every individual in Japan regardless of age, income, family size, or employment. Interestingly, the timing of bank transfers was unexpectedly and randomly delayed due to undercapacity in local offices, which allowed a natural experimental design for policy evaluations.[20] Kubota et al. (2021) analyse 2.8 million personal bank accounts data and find that 31% of transfers were withdrawn as cash. Kaneda et al. (2021) used financial management application data and reported slightly lower consumption responses. Many critics suggest targeting transfers depending on labour income instead of universal transfers; however, these studies find negligible differences conditional on labour income. Instead, both studies find that liquidity constraints play a critical role. Hattori et al. (2021) followed the same identification strategy using regional-level public data. Ueda (2023a) and Ueda (2023b) extend Kubota et al. 's (2021) study on bank account data. Kuroda and Onishi (2023) used the same bank account data to capture the financial conditions of food delivery gig workers, who became popular during COVID-19.

Travel supports

Another arguable economic stimulus policy is the Go to Travel campaign, which was implemented between July and December 2020. To recover the hugely damaged tourism industry, the government subsidized 35% of travel expenditure and distributed vouchers to 15% of purchases at the destinations. Indeed, there was great concern regarding the spread of COVID-19 through activated travel. This campaign excluded Tokyo because of its high risk of infection, and allowed researchers to use DID approaches for policy evaluation. Matsuura and Saito (2022) found a substantial increase in the number of overnight hotel stays and their (gross) prices, while Funashima and Hiraga (2023) suggested similar effects on hotel guests.

[20] There still remains an endogeneity problem. Bessho (2023) shows that the speed of the local office's payment process depends on mayor's characteristics.

Tamura et al. (2022) compared the areas inside and outside the Tokyo border and found a significant but short-term increase in the number of COVID-19 cases.

Labor market

The Japanese labour market remained relatively stable. The unemployment rate was 2.5% in January 2020 and hit its highest rate of 3.3% in October 2020. As the middle panel of Figure 6 shows, the total employment remained almost unchanged. This might be partly because of the Japanese labour law's protection of workers. Inaba and Matsuo (2023) emphasized the effects of the Employment Adjustment Subsidy (EAS). To allow firms to offer official leave to workers rather than lay them off, the government covered approximately 80% of the leave payments for small and medium-sized enterprises (SMEs).

However, these policies failed to help the most critical people in Japan: part-time and non-tenured workers, called contingent workers. This issue was also related to 'She-Cession', because these contingent workers tended to be low-income women employed in the service industry. As Figure 6 shows, the employment of low-educated women dropped substantially and never returned. Kikuchi et al.'s (2020) relatively early study appeared in April 2020, estimating the concentration of damage to specific workers inferred by the consumption drop observed in credit card data. Kikuchi et al. (2021) explored these implications of using a public labour force survey and a structural model. Fukai et al. (2021) report individual-level differences in employment loss by industry, occupation, age, and sex. Kotera and Schmittmann (2022) conduct a panel survey of a human resource management companies and suggest that She-Cession effects were mainly attributed to industry differences. Fukai et al. (2023) found a larger decline in employment among married women with children, possibly because of the childcare responsibilities placed on mothers.

The availability of teleworking or working from home (WFH) also affects resilience to pandemic shocks. Studies suggest that high-income and educated workers engaging in nonroutine tasks can switch to teleworking more flexibly (Kawaguchi and Motegi, 2021; Okubo, 2022). WFH productivity is relatively lower than that of usual office work (Kitagawa et al., 2021; Morikawa, 2022, 2023), while mitigating sales loss in business (Kawaguchi et al., 2022). WFH is beneficial for mental health (Kitagawa et al., 2021), although its effect is questionable for working mothers (Sugano, 2021). Moreover, WFH encourages husbands to do housework and pay more attention to their families (Hara and Kawaguchi, 2022; Inoue et al., 2023a).

4.3 Firms

At the beginning of the pandemic, economists were worried about the damage to firm activities. Miyakawa et al. (2021) predicted substantial firm exits in the early period of the pandemic based on a model estimated using pre-pandemic data. However, the number of bankruptcies decreased during the pandemic, as shown in the lower panel of Figure 6. By contrast, the number of closures and dissolutions, interpreted as voluntary exits, increased. This is possibly due to the substantially expanded business support. In addition to EAS, the government provided direct grants (Business Continuity (BC) Grants) and partial reimbursement for Office Rent (Office Rent (OR) Grant) for small and medium-sized enterprises whose sales had significantly declined. Furthermore, the government initiated zero-interest zero-collateral loans provided directly by public financial institutions and indirectly through subsidies to private banks and credit unions. This benevolent support may help rescue unfortunate and potentially productive businesses. However, it may also support unproductive firms (sometimes called zombies), which should otherwise exit.

Kawaguchi et al. (2021) conducted the earliest studies on this topic. Through a unique survey of firm managers, they found substantial sales damage caused by COVID-19 and its containment policies. Moreover, they asked managers about their expectations of business performance and showed that receiving BC Grants improved the subjective probability of business survival. Subsequent studies used realized data and focused on the downside of weakening Schumpeterian-style cleansing mechanisms. Hoshi et al. (2023) and Honda et al. (2023) showed that firms with low performance before the pandemic tended to apply for more support. Furthermore, Honda et al. (2023) find that although the programs successfully targeted substantially damaged companies, those firms used subsidies mainly to accumulate cash holdings, and their profit performance worsened. In line with that, Hong et al. (2022) found a substantial increase in zombie firms in 2020. Indeed, there are things to be aware of. For example, markets during the COVID-19 pandemic were highly uncertain and risky (Chen et al., 2021; Morita and Ono, 2024; Saxegaard et al., 2022); hence, firms' precautionary cash savings might be reasonable. In addition, prompt and massive support may prevent the potential propagation of damage through supply chain networks. During the pandemic, the structure of the business network mattered more because of the heterogeneity of the COVID-19 shocks in the business sector and region. This importance was first emphasized by Inoue and Todo (2020) in April 2020. They simulated how the lockdown in Tokyo would propagate to production in other regions. Business networks were also studied by Inoue et al. (2021), Inoue et al. (2023b), and Arata and Miyakawa (2024).

4.4 Looking ahead

The COVID-19 era was a historically rare period in which governments directly utilized scientific evidence for important policy decisions. In Japan, the Subcommittee on Novel Coronavirus Disease Control, a counterpart to the Scientific Advisory Group for Emergencies

(SAGE) in the UK, played a crucial role in policy decisions. The subcommittee succeeded in providing scientific evidence for containment policies; however, members struggled to communicate with the government and participate in the policymaking process. Furthermore, the pandemic has revealed a difficulty in interdisciplinary cooperation. The subcommittee consisted of 16 members, mainly medical experts; however, two of them were economists. Economic analyses tend to focus on costs and benefits, for example, by using the value of statistical life; however, these concepts are rarely accepted by medical experts. To prepare for a future pandemic, we need to reconsider how to integrate real-time scientific evidence into the political decision process and make agreements on value judgments, such as health versus economy.

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