The Great Influenza Pandemic in Japan
Policy Responses and Socioeconomic Consequences

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Abstract

This paper explores the socioeconomic consequences of the 1918-1920 Great Influenza Pandemic (GIP) in Japan. First, it reviews the chronological and geographical patterns of the disease's spread and policy responses by the government. It then employs panel analyses to test the quantitative effects of the pandemic on socioeconomic indicators such as population growth, factory employment, wage, capital formation, and income. The study finds that 1) Japan was hit by the pandemic twice, once in the winter of 1918-1919 and again in the winter to spring of 1919-1920, with the urban population facing a greater risk to life because of greater exposure to the virus, while the rural population was more likely to succumb to the disease when infected, 2) the pandemic seemed to have a noticeable effect on socioeconomic activities in the short and medium terms, suggesting a trigger of population outflows and substitution of labor by capital without any adverse effect on income, and 3) the government response included medical and public health measures but not economic measures. Though the GIP was similar to COVID-19 in terms of epidemiological patterns, it was very different in terms of human agency and socioeconomic consequences.

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1. Introduction

The outbreak of COVID-19 has shed new light on the Great Influenza Pandemic (GIP), which began in 1918. In this paper, I revisit the GIP in Japan to draw lessons for COVID-19, focusing on the similarities and differences between the two pandemics. To this end, I look at the pattern of the disease's spread and its socioeconomic impact using an underutilized panel dataset compiled by contemporary experts.

According to a contemporary estimate by the Public Health Bureau (PHB) of the Home Ministry of Japan, over forty percent of the Japanese population was infected and almost one percent of the population lost their lives to the disease (PHB 1922). Though Japan was far removed from the main warring nations of Europe and the United States, which became the initial epicenters of the disease toward the end of WWI, its death toll was comparable to those countries (Hayami 2006, Athukorala and Athukorala 2020).

Since the outbreak of COVID-19, many scholars have studied past pandemics. Among various others, the GIP has increasingly been attracting the attention of scholars due to its similarities with COVID-19 in terms of its infectious patterns and its spread across borders. Meanwhile, the socioeconomic impacts of the GIP and COVID-19 seem to have both similarities and differences.

There are two strands of research. The first strand tries to capture the overall picture of socioeconomic consequences by surveying global trends. Athukorala and Athukorala (2020) reviews existing studies on the GIP, shows the global and regional estimates of mortality by the disease, and discusses the demographic and socioeconomic consequences. Arthi and Parman (2021) surveys the literature on the long-term effects of the GIP on health, labor, and human capital, while also touching on the Great Depression in the 1930s, another major event that had adverse global socioeconomic consequences. Using cross-country panel data, Barro et al. (2020) estimates the economic effects of the GIP on GDP and consumption as well as real return on stocks and short-term interest rates. Beach et al. (2020) explores the effects of both the GIP itself and of the policy measures in response to it on health and human capital through mortality, fertility, and economy. Siklos (2022) tests if the GIP led to a reversal in trade and financial globalization trends. Jorda et al. (2021) compares long-term macroeconomic after-effects of pandemics, including the GIP, and major wars, by looking at the natural rate of interest. Bloom et al. (2020) studies five major infectious diseases, including the GIP, and argues that while major epidemics and pandemics can take enormous human tolls and impose staggering economic burdens, early and targeted interventions may mitigate these adverse effects.

The second strand digs deeper into the cases of specific countries to take a more detailed look at the socioeconomic effects of the GIP and policy responses to it. For the United States, Fourie and Norling (2020) tests the effect of the GIP on household income with city level data to find that cities with higher mortalities saw greater declines in real income, while non-pharmaceutical interventions (NPIs) by local governments had little correlation with consumer behavior. Correia et al. (2020) argues that the pandemic caused short- and medium-term economic disruption, while NPIs may have reduce disease transmission without further depressing economic activity. On the other hand, Velde (2020) claims that the impact of the GIP on the U.S. economy, such as on industrial output or manufacturing employment, if any, was short-lived. Chapelle (2020) suggests that NPIs had no significant impact on cities' population, output and employment growth. For regions other than the United States, Basco et al. (2020) argues that the effect of flu-related excess deaths on real wages was large and negative but short-lived in Spain, and that the effect on returns to capital was insignificant. Karlsson et al. (2014) reports that in Sweden, regions with higher incidence rates had rising poorhouse rates and declining capital returns compared with those with lower incidence rates, but no discernible effect on per capita earnings.

Country-specific studies make detailed observations, but in most cases, only death-toll data is available, not data on case numbers. In this regard, Japan is special because the public health authorities[1] maintained data on both case numbers and the death toll. This paper is the first attempt to perform a case study of Japan using the underutilized prefectural panel data on case numbers and death toll to explore the socioeconomic consequences of the GIP. In doing so, this study tries to add some insight to the second strand of research, country-specific case studies, to capture the dynamics of infectious diseases and their socioeconomic outcomes.

The paper finds that 1) Japan was hit twice by the pandemic, once in the winter of 1918-1919 and again in winter to spring 1919-1920, that the urban population was more exposed to the virus and faced a greater risk to life, while the rural population, once infected, was more likely to succumb to the disease, 2) the pandemic seemed to have a noticeable effect on socioeconomic activities in the short and medium terms, suggesting a trigger of population outflows and substitution of labor by capital without any adverse effect on income, and 3) the government response included medical and public health measures but no significant economic measures. Overall, even though the GIP was similar to COVID-19 in terms of epidemiological patterns, it was very different in terms of human agency and socioeconomic consequences.

The rest of this paper is structured as follows: Section 2 reviews the chronological and geographical patterns of the disease's spread, and reviews the policy responses by the

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[1] Another country which had both types of data was Sweden. Karlsson et al. (2014) explores the effects of the GIP on inequality, capital income, and household earnings.

government; Section 3 uses panel analyses to test the quantitative effects of the pandemic on socioeconomic indicators such as population growth, factory employment, wage, capital formation, and income; and Section 4 concludes by interpreting the implications of the empirical results and suggesting potential directions for future research.

2. The Great Influenza Pandemic in Japan

2.1 Chronology of the Pandemic

The GIP emerged in 1918 and spread worldwide through 1920. The mobilization and demobilization of troops for WWI played a crucial role in spreading the disease while other forms of physical contact also contributed (Crosby 1989). The first wave started in army camps in the Midwest of the United States in the spring of 1918, got transmitted to Europe with the U.S. troops, and had spread to North Africa, India, China, and Australia by July of that year. The second wave started in late summer in France and spread across the world. The third wave was reported in many places around the world from winter through spring of 1918-1919. Japan experienced two waves, one in the winter of 1918-1919 and again in winter to spring 1919-1920, later than in the epicenters of North America and Europe, probably because of its remote location. A report titled *Ryūkōsei Kanbō* (Influenza) published by the PHB stated that "with the busy traffic of ships and frequent communications of commerce, it was inevitable for this country to escape the pandemic. The pandemic showed signs of prevalence from late August through early September 1918, three to four months later than in Western Europe, and immediately spread nationwide." (PHB 1922: 84)[2]

According to Athukorala and Athukorala (2020), the global death toll of the GIP was 37-46 million, with a mortality rate of 2.0-2.5 percent of the world population, four to five times the casualty rate of WWI. Japan recorded 453-517 thousand deaths, with a mortality rate of 0.8-0.9 percent of the population. The mortality rate in Japan was slightly higher than in Europe and Anglo America (0.5-0.7 percent) and lower than in most of other parts of the world.[3]

Table 1 shows three estimates of identified cases and/or deaths due to the GIP in Japan during 1918-1920. The first is (case numbers and deaths) from PHB (1922), the second

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[2] PHB (1922) contains an extensive analysis of the disease's spread and the social and policy responses to counter it in Japan and other countries with a wealth of data.

[3] British India was reported to have suffered 16,700-18,500 thousand deaths (a mortality rate of 5.5-6.1 percent of the population), Africa 2,207-2,268 thousand (3.5-3.6 percent), and Latin America 900-1,053 thousand (1.1-1.5 percent). China's death toll was uncertain, with various estimates putting it between 4,000 and 9,500 thousand (0.8-2.0 percent).

is (deaths) from Hayami (2006), and the third is (deaths) from Richard et al. (2009).[4]

Table 1. Estimates of case numbers and deaths in Japan due to the Great Influenza Pandemic

			Case* (a)	Death* (b)	Incidence rate**	Case fatality rate (a/b)**	Population mortality rate***
PHB (1922)							
		Aug. 1918-July 1919	21,168.4	257.4	37.58	1.22	0.46
		Oct. 1919-July 1920	2,412.1	127.7	4.28	5.29	0.23
		Total	23,580.5	385.0	41.86	1.63	0.68
Hayami (2006)							
		Oct. 1918-May 1919	n.a.	266.5	n.a.	n.a.	0.47
		Dec. 1919-May 1920	n.a.	186.7	n.a.	n.a.	0.33
		Total	n.a.	453.2	n.a.	n.a.	0.80
Richard et al. (2009)							
	Monthly estimate	Oct. 1918-May 1919	n.a.	299.7	n.a.	n.a.	0.54
		Dec. 1919-May 1920	n.a.	181.8	n.a.	n.a.	0.33
		Total	n.a.	481.5	n.a.	n.a.	0.87
	Annual estimate	1918-1920	n.a.	532.1	n.a.	n.a.	0.97

Sources: PHB (1922); Hayami (2006); Richard et al. (2009)

Footnote 1: Case numbers and deaths are in thousands.

Footnote 2: The incidence rate is per 100 population at the end of 1917, and the case mortality rate is per 100 cases.

Footnote 3: The population mortality rate is per 10,000 population at the end of 1917.

The three estimates show a similar trend but different levels. PHB (1922) estimates that the number of cases amounted to around 24 million, or 42 percent of Japan's population, at the end of 1917, while the number of deaths amounted to 385 thousand, or 0.8 percent of the population. It states that the first wave began in August 1918 and lasted until July 1919, and that the second wave lasted from October 1919 to July 1920.[5] These estimates are based on reports from individual prefectures. Hayami (2006) estimates a death toll of 453 thousand, or 0.8 percent of the national population. Richard et al. (2009) estimates a death toll of 482

[4] Athukorala and Athukorala (2020) takes data from Hayami (2006) and Richard et al. (2009).

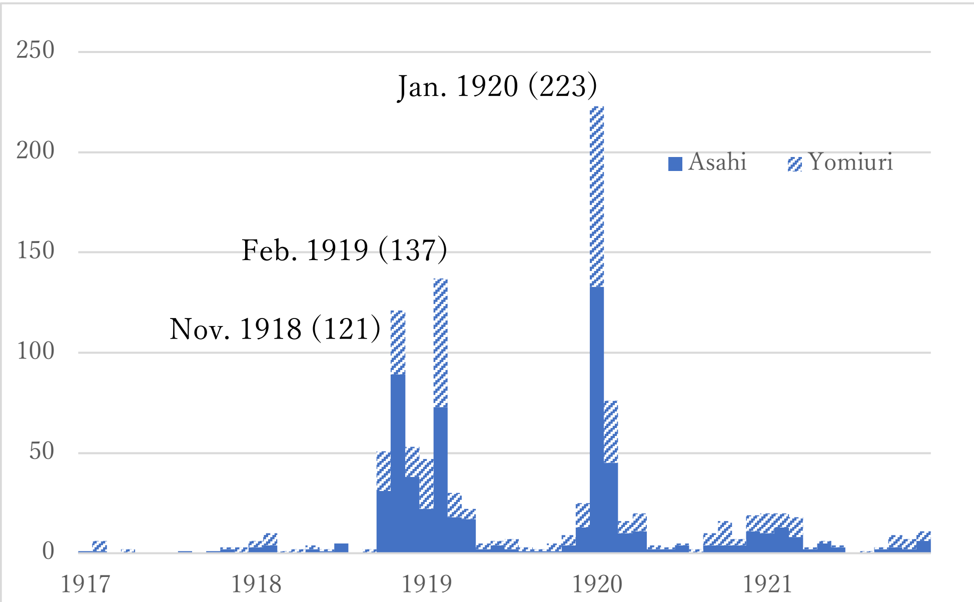
[5] While the report also suggests another wave from August 1920 to July 2021, this paper excludes it from the GIP because of its small magnitude. Hayami (2006) and Richard et al. (2009) similarly exclude it from the GIP.

thousand, or 0.9 percent of the population, based on monthly data, and 532 thousand, or 1.0 percent of the population, based on annual data. Hayami and Richard et al. base their calculations on excess mortality and do not estimate case numbers.[6]

Both Hayami (2006) and Richard et al. (2009) claim that the first wave lasted from October 1918 to May 1919, while the second wave lasted from December 1919 to May 1920. Both estimate that the peak of the first wave was in November 1918, followed by a smaller peak in February 1919, and that of the second wave was in January 1920.

While Hayami (2006: 235-236) notes a possibility of underestimation[7] with regard to the PHB estimates, a distinctive feature of the latter is the availability of not just the death toll, which is commonly available also for other countries, but also case numbers by prefecture. This enables the study of the dynamics of infection with and death from the disease. A quantitative analysis using the PHB data is provided later in this section.

Figure 1. Number of articles in national newspapers



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[6] While Hayami (2006) counts excess mortality due only to respiratory diseases, Richard et al. (2009) counts excess mortality due to all diseases. As a result, the death toll of the latter exceeds the former, suggesting greater vulnerability to and risk of mortality from influenza for patients with various types of underlying diseases.

[7] Hayami (2006: 234-236) guesses that the PHB may have excluded figures that were counted as deaths due to reasons other than influenza or classified as deaths due to unknown reasons, and that case number and death surveys in some prefectures may have been incomplete.

Sources: Asahi Shimbun Database *Kikuzo II Visual*; Yomiuri Shimbun Database *Yomidasu Rekishi-Kan*

Articles in the national newspapers, Asahi Shimbun and Yomiuri Shimbun, confirm that people were well informed of the situation (Figure 1). During the first wave, the number of articles mentioning "*kanbō*," "*ryūkan*,"[8] or "influenza" peaked once in November 1918 and rebounded in February 1919. As early as July 1918, newspapers were reporting on the spread of the GIP overseas. Starting October that year, they reported clusters in domestic military camps and schools. During the second wave, the number of articles mentioning the GIP peaked in January 1920.[9].

2.2 Policy Responses

Acknowledging the need for preventing the spread of the disease and minimizing casualties, the Japanese government tried to take various measures to counter the pandemic based on the latest developments in public health and medicine research and measures taken by other governments. Measures included quarantining the infected, nationwide campaigns to encourage people to wear masks, gargle regularly, and avoid large gatherings, and the facilitation of medical treatments and trials for the development of vaccines (PHB 1922: 110). In January 1919, the Home Ministry printed 50 thousand copies of guidelines for the prevention and treatment of influenza and distributed them as a part of a national campaign. The protocols in these guidelines are applicable even in the 21st century. They stipulated:

To prevent infection:

1) Do not get close to a patient, suspected patient, or persons who are coughing
2) Avoid places with large gatherings of people
3) Always wear a mask in crowded spaces, such as train carriages; if you do not have a mask, cover your nose and mouth with a handkerchief, towel, or some other cloth
4) Gargle regularly with salted water or warm water; or better yet with a gargle

If infected:

1) If you feel a cold coming on, go to bed immediately and call a doctor
2) Isolate from other people as far as possible except to receive nursing care
3) Do not go out without the permission of your doctor even if you feel recovered

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[8] "*Kanbō*" and "*ryūkan*" (an abbreviation of *ryūkōsei-kanbō*) are Japanese words for influenza.

[9] Hayami (2006) provides samples of individual articles.

For your safety:

1) Keep your home and surroundings clean and open up doors and windows on sunny days
2) Sun your bedding and bedclothes on all sunny days
3) Be cautious even when you feel healthy
4) For the sake of public health, make sure to cover your nose and mouth with a handkerchief, towel, or other cloth when coughing or sneezing
5) Sanitize the materials such as dishes, cloth, and bedding attached by spits or snotters of a patient by burning, boiling, or with a disinfectant

A major difference between the GIP and COVID-19 in terms of policy measures is that there were no lockdowns, social distancing mandates, or other major non-pharmaceutical measures to curb socioeconomic activities during the former. As PHB (1922: 186-187) reflects, "Although we noticed that gatherings of large numbers of people were the most dangerous, and that counter measures against them were critical, it was the most difficult to take such actions." Also, effective vaccines were unable to be developed during this pandemic (PHB 1922: 341)[10].

Accordingly, people commuted and traveled as usual even during the pandemic. The number of passengers of the National Railway (NR) remained on an upward trend through the pandemic seasons, only temporary dropping during the initial stages, in the fall 1918 (Figure 2).

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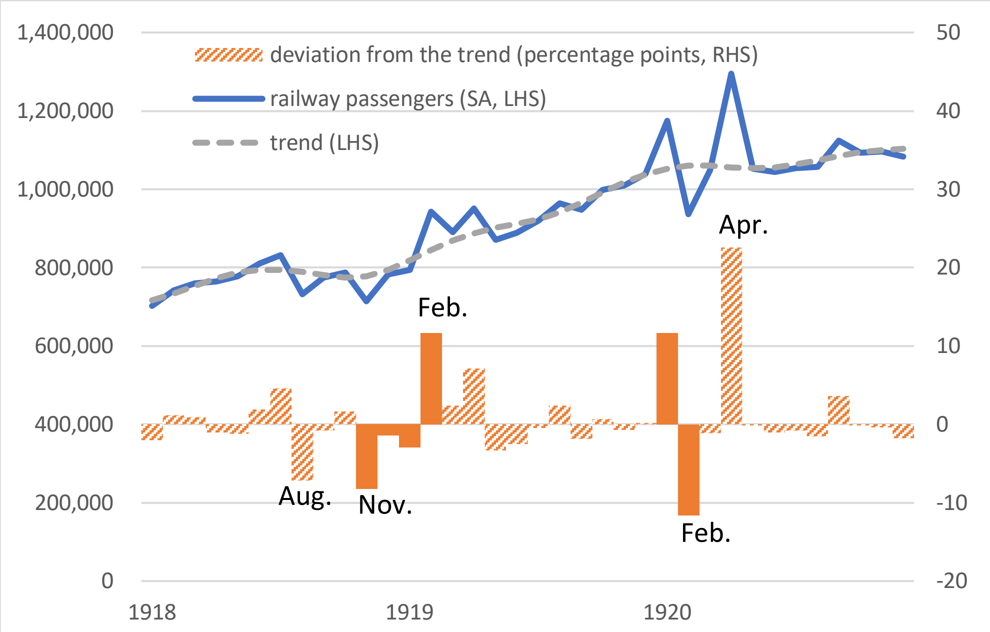
[10] Against the backdrop of rapid and widespread infections, medical research laboratories competed to develop vaccines, and some laboratories, claiming to have successfully developed a feasible vaccine, began immunization programs. However, in the event, these efforts proved ineffective as the virus had not yet been discovered and the cause of the disease was only discovered in the 1930s. PHB concluded, "At the present time, we are still in the experimental stages of developing a vaccine for influenza" (PHB 1922: 389).

Figure 2. Number of railway passengers per day (the National Rail)



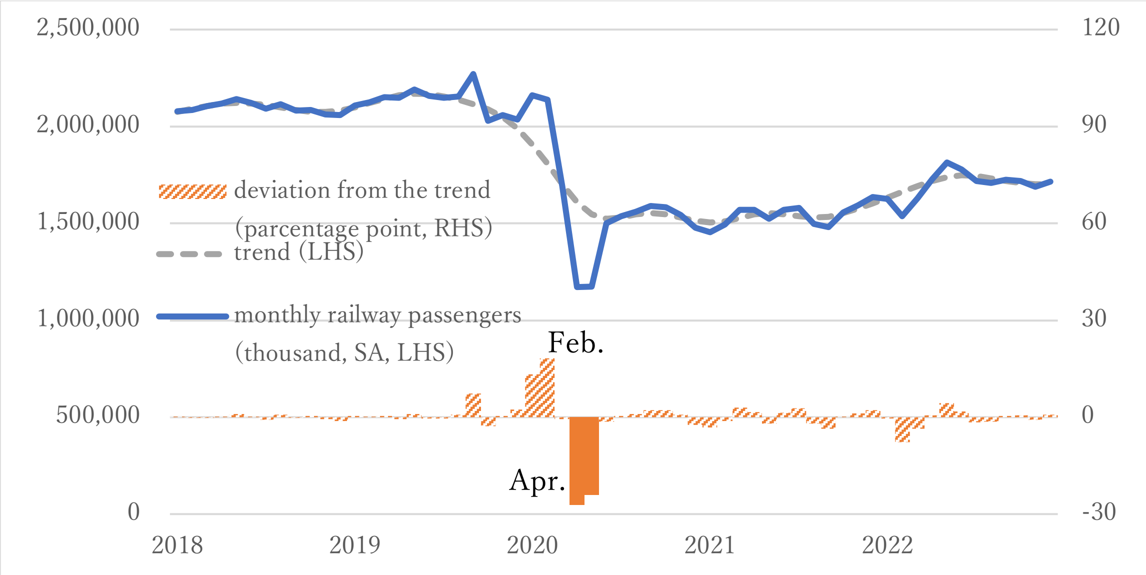
Source: *Railroad Statistics*, Railroad Authority, various issues

Footnote: Seasonally adjusted and trend data were obtained using the X-12ARIMA method.

The Ministry of Railways 1918 annual report (MOR 1920: 2-3) stated that "in November 1918, people took into account the influenza outbreak and refrained from traveling to some extent, but following news of the ceasefire of the Great War, people were tempted to travel near and far, and to both urban and rural destinations." The following year's annual report (MOR 1922: 1) noted that the boom continued in 1919 and early 1920 without mentioning the effect of the pandemic.

Passenger trends in 1918-1920 are sharply contrasted with those during COVID-19. The number of passengers, which declined by a fourth in spring 2020, had not yet fully rebounded as of June 2022.

Figure 3. Number of railway passengers per month

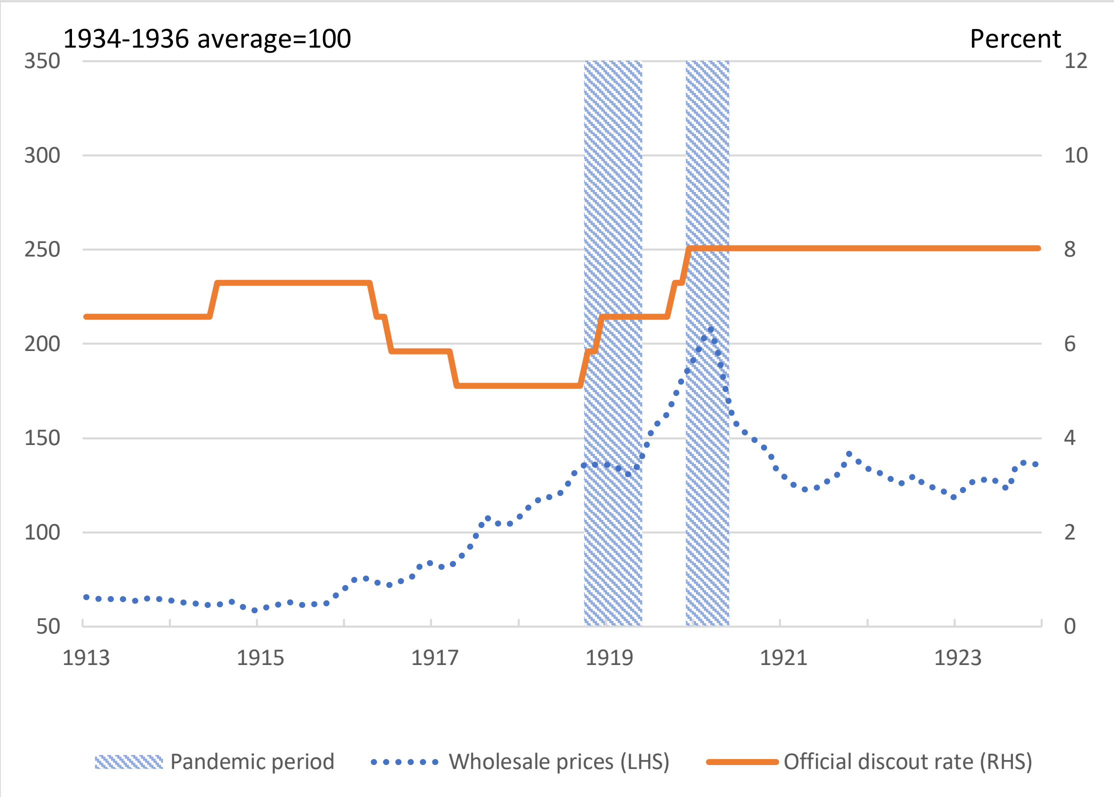


Source: *Railroad Transport Statistics*, Ministry of Land, Infrastructure, Transport and Tourism, various issues

Footnote: Seasonally adjusted and trend data were obtained using the X-12ARIMA method.

Another big difference compared with COVID-19 is that the government did not take on the responsibility of introducing economic stimulus policies. This is conceivably because the government had taken virtually no action to restrict economic activity in the first place. Expenditure toward infectious diseases increased from JPY 1.0 million in fiscal 1917 to JPY 3.2 million in fiscal 1919, i.e., from 0.14 percent to 0.27 percent of the total expenditure of the general account of the national government. This pattern of government expenditure was in sharp contrast to that toward rehabilitation and reconstruction following the Great Kanto Earthquake of 1923, which totaled JPY 1.4 billion in the eight years from fiscal 1923 to fiscal 1930, averaging JPY 181 million per year, or 13 percent of the total expenditure of the national government. In fact, responding to the domestic economic boom following WWI, the Bank of Japan tightened its monetary policy and raised its official discount rate four times, from 5.11 percent in October 1918 to 8.03 percent in December 1919, to cool off the economy (Figure 4).

Figure 4. Wholesale prices and the Bank of Japan's official discount rate



Sources: The Bank of Japan (1986, 1987)

2.3 Quantitative Analysis of the Pandemic

2.3.1 Factors Affecting the Spread of the Disease

This subsection uses a quantitative analysis of the pandemic's pattern to explore factors that affected the spread of the disease. The standard formula is:

$$X_i = \alpha_0 + \alpha_1 Density_i + \alpha_2 StartDate_i + \varepsilon_i \quad (1),$$

where X_i is a dependent variable denoting the status of infection in prefecture i (deaths/10,000 population, cases/100 population, and deaths/100 cases), $Density_i$ is the population density of prefecture i, and $StartDate_i$ is the date of the start of the pandemic in prefecture i. Table 2 reports descriptive statistics for the variables in the equation.

Table 2. Descriptive statistics for variables in Equation (1)

	Mean	Max	Min	SD	# of obs.
Deaths/10,000 population in 1918-1919	46.15	85.39	13.67	14.41	47
Deaths/10,000 population in 1919-1920	20.90	41.44	4.07	8.94	47
Cases/100 population in 1918-1919	39.05	61.04	18.27	12.61	47
Cases/100 population in 1919-1920	3.55	20.59	0.45	3.65	47
Deaths/100 cases in 1918-1919	1.26	2.70	0.63	0.45	47
Deaths/100 cases in 1918-1920	7.95	18.51	0.82	3.20	47
Population density in 1918*	3.83	26.76	0.39	4.73	47
Start date in 1918	Oct. 4	Nov. 5	Aug. 5	16.03	43
Start date in 1919	Nov. 14	Dec. 15	Sept. 15	18.84	40

Footnote: Population density is given in terms of thousand population per square *ri*, as of October 1918. One square *ri* is the equivalent of 15.42 square kilometers.
Sources: PHB (1922); Statistical Yearbook of the Empire of Japan, various issues

Table 3. Regression results on the influenza's spread in 1918-1919

Dependent variable		a) Deaths/pop.			b) Cases/pop.			c) Deaths/cases	
		1918-1919			1918-1919			1918-1919	
Coefficients of independent variables									
Constant		1333.492	*		1551.365	**		-25.539	
	(	781.585	)	(	731.857	)	(	24.219	)
Pop. density in 1918		-0.1480			-0.3090			0.0154	
(thousands)	(	0.1656	)	(	0.4174	)	(	0.0228	)
Start date in 1918		-0.1880			-0.2208	**		0.0039	
	(	0.1141	)	(	0.1069	)	(	0.0035	)
F-statistic		2.18			2.83			0.98	
R-squared		0.0628			0.1251			0.0567	
# of observations		44			44			44	

Footnote 1: Figures in parenthesis are robust standard errors.
Footnote 2: * denotes significance at 10 percent; ** denotes significance at 5 percent.

Table 3 shows the results of OLS regressions for the first wave, during the 1918-1919 season. The start date coefficient is negative and statistically significant on cases/population at the five percent level, indicating that the infection was more widespread where the first infection happened sooner. This suggests that the areas that were hit early faced the disease unprepared, e.g., the Home Ministry's national campaign not yet having arrived in the prefecture.

The population density coefficients were not statistically significant in all the regressions. This may be interpreted to mean that there was no significant difference between urban and rural areas, with high infection rates nationwide. As noted in PHB (1922: 86), "in most prefectures, the disease broke out in the cities first and then spread to the surrounding villages."

Table 4. Regression results on the influenza's spread in 1919-1920

Dependent variable	a) Deaths/pop.	b) Cases/pop.	c) Deaths/cases	d) Deaths/pop.	e) Cases/pop.
	1919-1920	1919-1920	1919-1920	1919-1920	1919-1920
Coefficients of independent variables					
Constant	72.619	107.045	-183.086	69.960	134.592
	(479.254)	(113.550)	(147.195)	(481.769)	(122.753)
Pop. density in 1918	0.6731 ***	0.3988 ***	-0.2753 ***	0.6760 ***	0.3693 ***
(thousands)	(0.1065)	(0.0568)	(0.0464)	(0.1224)	(0.0564)
Start date in 1919	-0.0075	-0.0145	0.0265	-0.0072	-0.0180
	(0.0660)	(0.0156)	(0.0202)	(0.0664)	(0.0167)
Cases/pop. In 1918	-	-	-	0.0054	-0.0558
				(0.0988)	(0.0337)
F-statistic	20.17	31.82	25.47	12.84	46.1
R-squared	0.1917	0.3514	0.2202	0.1918	0.3818
# of obs.	40	40	40	40	40

Footnote 1: Figures in parentheses are robust standard errors.
Footnote 2: *** denotes significance at 1 percent.

Table 4 shows the results of OLS regressions for the second wave, during the 1919-1920 season. The population density coefficients are statistically significant at one percent level in all the regressions. Interestingly, the sign of the coefficient on cases/population is positive, and that on deaths/cases is negative. This suggests that people had a higher risk of infection in the urban areas but, once infected, were more likely to receive better medical care than in the rural areas. The population density coefficient on deaths/population is positive and statistically significant at the one percent level, indicating that urban residents were more vulnerable to contracting the disease with a higher risk of infection (although, of course, with chances of receiving better medical care).

The start date coefficients in 1919 were not statistically significant in all the regressions, suggesting that people were prepared for the disease by the time the second wave began. Also, the coefficient on cases/population during the previous wave (1918-1919 season) was not statistically significant, suggesting that herd immunity did not work, presumably due to the virus mutating.

Table 5. Regression results on influenza's spread in 1918-1920

Dependent variable	a) Deaths/pop.		b) Cases/pop.		c) Deaths/cases	
	1918-1920		1918-1920		1918-1920	
Coefficients of independent variables						
Constant	2215.046	***	1745.979	**	-32.027	
	(643.621)		(731.167)		(30.096)	
Pop. density in 1918	0.6828	***	0.1080		0.0141	
(thousands)	(0.2017)		(0.3808)		(0.0187)	
Start date in 1918	-0.3143	***	-0.2489	**	0.0049	
	(0.0940)		(0.1068)		(0.0044)	
F-statistic	9.49		2.73		1.03	
R-squared	0.1372		0.1244		0.0524	
# of obs.	44		44		44	

Footnote 1: Figures in parentheses are robust standard errors.

Footnote 2: ** denotes significance at 5 percent; ***denotes significance at 1 percent.

Table 5 shows the results of OLS regressions for the entire pandemic, spanning 1918-1920 and including both the aforementioned waves. As in the case of the second wave during 1919-1920, the population density coefficient is statistically significant at the one percent level in all the regressions. The sign of the coefficient on cases/population is positive, and that on deaths/cases is negative. The population density coefficient on deaths/population ratio is positive and statistically significant at the one percent level, indicating that urban residents were more at risk of contracting the disease and dying of it than rural residents despite being more likely to receive better medical care.

The state date coefficients in 1918 are negative and statistically significant on deaths/population and cases/population at the one percent and five percent levels, respectively. This indicates that the people and the government were unprepared when the pandemic first broke out, which resulted in a higher number of infections and deaths through the two waves.

3. Socioeconomic effects of the pandemic

This section explores the socioeconomic effects of the pandemic based on a quantitative analysis using panel data. The standard formula is:

$$Y_{i,t} = \beta_0 + \beta_1 X_{i,1920} + \beta_2 X_{i,1922} + FE_i + \varepsilon_{i,t} \quad (2),$$

where dependent variable $Y_{i,t}$ is the socioeconomic outcome for prefecture i during time t, independent variable $X_{i,1920}$ and $X_{i,1922}$ represent the treatment effect of disease severity in prefecture i during the pandemic period on outcomes in 1919-1920 and 1921-1922 respectively, FE_i is the fixed effect for prefecture i. The dependent variables used are the annualized total population growth, the annualized natural population growth, the annualized social population growth, the annualized growth in factory employment, and the annualized growth in paid-in capital.[11] The independent variables used are the deaths/population, cases/population, and deaths/cases ratios, which are the dependent variables in equation (1). The data is in a balanced panel including 44 prefectural levels and three periods – pre-pandemic (1914-1918), pandemic (1919-1920), and post-pandemic (1921-1922) – giving 132 observations. The main focus of interest is to see whether the severity of the pandemic as an external shock affected regional economic activities during and after the GIP. Growth during 1921-1922 is used for the post-pandemic period to exclude the effect of another big external shock, the Great Kanto Earthquake of 1923.

Considering the endogeneity problem in 1919-1920, that is the possibility that the dependent variable $Y_{i,t}$ and independent variable $X_{i,1920}$ might have been affected by some common factors, I employ instrument-variable (IV) regressions instead of OLS. By doing so, I intend to control such hidden factors and isolate the effect of the independent variable. Having observed that the spread of the disease had been affected by the start date of the pandemic in 1918, and assuming that the start date of the pandemic may not have affected the dependent variables, I use the start date of the pandemic in 1918 as IV for $X_{i,1920}$. When employing IV regressions, I exclude the three prefectures (nine observations) for which the start date was missing from the panel, thereby getting 132 observations[12].

Table 6 reports descriptive statistics of socioeconomic outcomes at the prefectural level. It shows that the average natural population growth was stable at the 1.0-1.1 level across prefectures through the sample period, while the average social population growth fluctuated, starting at slightly under zero percent during 1914-1918, shrinking to minus one percent during 1919-1920, and returning to around zero percent during 1921-1922.[13] The average

[11] Natural population growth is calculated by subtracting the number of deaths from the number of births. Social population growth is extrapolated by subtracting the natural population growth from the total population growth. Conceptually, social population growth could be also obtained by subtracting outflow from inflow, but data limitations do not allow a direct calculation.

[12] I exclude Gunma, Chiba and Tokushima Prefectures.

[13] While this paper does not go into the details of social population growth, fluctuations in social population growth were caused by migrations from one prefecture to another, as well

factory employment growth was over 10 percent during 1914-1918, thanks to the WWI boom, fell to three percent during 1919-1920, and rebounded to six percent during 1921-1922. The average real wage for laborers and carpenters declined in 1914-1918, recovered over 20 percent in 1919-1920, and continued to grow at a reduced pace in 1921-1922. The average paid-in capital growth started at 13 percent during 1914-1918, surged to 38 percent during 1919-1920, and fell to 8 percent during 1921-1922. The average real income shrank by one percent in 1914-1918 and showed double-digit growth afterward.

Table 6. Descriptive statistics of socioeconomic outcomes

	Average	Min.	Max.	Std. Dev.	# of obs.
Population growth, 1914-1918	0.0073	-0.0123	0.0361	0.0100	47
Population growth, 1919-1920	-0.0022	-0.0534	0.0319	0.0158	47
Population growth, 1921-1922	0.0111	-0.0035	0.0484	0.0097	47
Natural population growth, 1914-1918	0.0105	0.0038	0.0203	0.0032	47
Natural population growth, 1919-1920	0.0102	0.0034	0.0328	0.0051	47
Natural population growth, 1921-1922	0.0111	-0.0035	0.0484	0.0097	47
Social population growth, 1914-1918	-0.0034	-0.0251	0.0287	0.0103	47
Social population growth, 1919-1920	-0.0128	-0.0589	0.0233	0.0162	47
Social population growth, 1921-1922	-0.0011	-0.0139	0.0315	0.0096	47
Factory employment growth, 1914-1918	0.1025	0.0214	0.2818	0.0562	47
Factory employment growth, 1919-1920	0.0265	-0.7754	0.1936	0.1434	47
Factory employment growth, 1921-1922	0.0568	-0.0538	0.2753	0.0581	47
Real laborer wage growth, 1914-1918	-0.0049	-0.0853	0.0588	0.0374	13
Real laborer real wage growth, 1919-1920	0.2230	0.0229	0.3839	0.0877	13
Real laborer real wage growth, 1921-1922	0.0275	-0.1008	0.1210	0.0674	13
Real carpenter real wage growth, 1914-1918	-0.0335	-0.0680	-0.0007	0.0219	13
Real carpenter real wage growth, 1919-1920	0.2071	0.0818	0.3221	0.0610	13
Real carpenter real wage growth, 1921-1922	0.0428	-0.0118	0.1596	0.0519	13
Paid-in capital growth, 1914-1918	0.1185	-0.1960	0.4518	0.0956	47
Paid-in capital growth, 1919-1920	0.3235	-0.3359	1.0536	0.2110	47
Paid-in capital growth, 1921-1922	0.0725	-0.8004	0.3807	0.1527	47
Real income growth, 1914-1918	-0.0119	-0.1007	0.1442	0.0527	47
Real income growth, 1919-1920	0.2532	0.0438	0.3835	0.0744	47
Real income growth, 1921-1922	0.1940	-0.0024	0.3390	0.0772	47

Footnote 1: All figures are expressed as annualized changes in logs.

Footnote 2: Data used for calculating total population growth during 1914-1920, natural population growth during 1914-1922, and paid-in capital growth during 1914-1922 is as of the end of year; data used for calculating total population growth during 1921-1922 is as of

as by emigration from Japan to other parts of the world, including colonies.

October 31 1920 and September 1 1923; social population growth during 1921-1922 is extrapolated using the above total population growth and natural population growth figures for 1921-1922; data used for calculating factory employment growth during 1914-1922 is the average of daily data within the year. For population data, the source underwent a base change in 1920, using data from the first national census on October 1, 1920, and compiling the population as of September 1, 1923, the day of the Great Kanto Earthquake.
Source: Statistical Yearbook of the Empire of Japan, various issues

Table 7. IV regression results on annualized total population growth

Independent variable	a) Deaths/pop.		b) Cases/pop.		c) Deaths/cases	
Coefficient of independent Variables						
Constant	0.00763	***	0.00828	***	0.00754	***
	(0.00077)		(0.00089)		(0.00081)	
Deaths/population ratio	-0.00015	***				
to 1919-1920 growth	(0.00003)					
Deaths/population ratio	0.00006	***				
to 1921-1922 growth	(0.00001)					
Cases/population ratio			-0.00025	***		
to 1919-1920 growth			(0.00006)			
Cases/population ratio			0.00006	***		
to 1921-1922 growth			(0.00001)			
Deaths/cases ratio					-0.00594	***
to 1919-1920 growth					(0.00133)	
Deaths/cases ratio					0.00234	***
to 1921-1922 growth					(0.00044)	
Wald chi^2 Statistics	168.80		147.73		57.75	
R squared	0.1946		0.1440		0.2062	
# of obs.	132		132		132	

Footnote 1: Figures in parentheses are robust standard errors.
Footnote 2: ***denotes significance at 1 percent.
Footnote 3: Prefecture-level fixed effects are not reported.

Table 7 shows the results of IV regressions on annualized total population growth. Our main interest is in the treatment effect of the infection, which is described in three forms, namely deaths/population ratio, cases/population ratio, and deaths/cases ratio, on total population growth. All the treatment variables had a statistically significant negative effect on total population growth during the pandemic and a positive effect in the post-pandemic years.

Although statistically significant, the aforementioned effects were small. When the deaths/population ratio in a prefecture rose by one over 100 population, the total population grew by -0.015 percentage points fewer annually in the 1919-1920 period and by 0.006 percentage points more annually in 1921-1922 period. When the cases/population ratio rose by one over 100 population, the population grew by -0.025 percentage points fewer in 1919-1920 and by 0.006 percentage points more in 1921-1922. When the deaths/cases ratio rose by one over 10,000 population, the population grew by -0.594 percentage points fewer in 1919-1920 and by 0.234 percentage points more in 1921-1922.

Table 8. IV regression results on annualized natural population growth

Table 8. IV regression results on annualized natural population growth

Independent variable	a) Deaths/pop.	b) Cases/pop.	c) Deaths/cases
Coefficient of independent Variables			
Constant	0.01057 ***	0.01111 ***	0.00996 ***
	(0.00062)	(0.00047)	(0.00070)
Deaths/population ratio	0.00000		
to 1919-1920 growth	(0.00001)		
Deaths/population ratio	0.00001		
to 1921-1922 growth	(0.00002)		
Cases/population ratio		-0.00002	
to 1919-1920 growth		(0.00002)	
Cases/population ratio		-0.00001	
to 1921-1922 growth		(0.00003)	
Deaths/cases ratio			0.00022
to 1919-1920 growth			(0.00042)
Deaths/cases ratio			0.00120
to 1921-1922 growth			(0.00106)
Wald chi^2 Statistics	2419	2160.22	1.31
R squared	0.0025	0.0017	0.0124
# of obs.	132	132	132

Footnote 1: Figures in parentheses are robust standard errors.

Footnote 2: ***denotes significance at 1 percent.

Footnote 3: Prefecture-level fixed effects are not reported.

Total population growth is resolved into two components – natural population growth and social population growth. The natural population growth refers to the number of births less that of deaths. The social population growth refers to the number of immigrants from other regions less that of emigrants to other regions.

Table 8 shows the results of IV regressions on annualized natural population growth.

None of the treatment variables had statistically significant effects on natural population growth during or after the pandemic period.

Table 9. IV regression results on annualized social population growth

Independent variable		a) Deaths/pop.			b) Cases/pop.			c) Deaths/cases	
Coefficient of independent Variables									
Constant		-0.00306	***		-0.00253	***		-0.00316	***
	(	0.00086	)	(	0.00096	)	(	0.00092	)
Deaths/population ratio		-0.00015	***						
to 1919-1920 growth	(	0.00004	)						
Deaths/population ratio		0.00003	***						
to 1921-1922 growth	(	0.00001	)						
Cases/population ratio					-0.00024	***			
to 1919-1920 growth				(	0.00006	)			
Cases/population ratio					0.00002				
to 1921-1922 growth				(	0.00001	)			
Deaths/cases ratio								-0.00590	***
to 1919-1920 growth							(	0.00149	)
Deaths/cases ratio								0.00138	***
to 1921-1922 growth							(	0.00046	)
Wald chi^2 Statistics		18.95			7.4			31.90	
R squared		0.1509			0.1206			0.1529	
# of obs.		132			132			132	

Footnote 1: Figures in parentheses are robust standard errors.

Footnote 2: *** denotes significance at 1 percent.

Footnote 3: Prefecture- and year-level fixed effects are not reported.

Table 9 shows the results of IV regressions on annualized social population growth. All the treatment variables had statistically significant negative effects on social population growth during the pandemic; the deaths/population ratio and deaths/cases ratio had positive effects on it after the pandemic. When the deaths/population ratio rose by one over 100 population during the pandemic, the social population growth decreased by -0.015 percentage points annually in 1919-1920, and increased by 0.003 percentage points annually in 1921-1922. When the cases/population ratio rose by one over 100 population, the social population growth decreased by -0.024 percentage points annually in 1919-1920. The effect in 1921-1922 was not statistically significant. When the deaths/population ratio rose by one over 10,000 population, the social population growth decreased by -0.590 percentage points annually in 1919-1920 and increased by 0.138 percentage points annually in 1921-1922. As a whole, the effect of the spread of infections on regional differences in population growth was statistically significant but small. The negative effect during the pandemic was larger than the recovery following the pandemic. The regional differences in effect were mainly driven by social factors, namely people moving from one region to another, not by natural factors, namely changes in the birth or mortality rates.

Table 10. IV regression results on annualized growth of factory employment

Independent variable		a) Deaths/pop.			b) Cases/pop.			c) Deaths/cases	
Coefficient of independent Variables									
Constant		0.10387	***		0.10372	***		0.10539	***
	(	0.01407	)	(	0.01460	)	(	0.01224	)
Deaths/population ratio		-0.00122	***						
to 1919-1920 growth	(	0.00044	)						
Deaths/population ratio		-0.00069	***						
to 1921-1922 growth	(	0.00023	)						
Cases/population ratio					-0.00191	***			
to 1919-1920 growth				(	0.00070	)			
Cases/population ratio					-0.00107	***			
to 1921-1922 growth				(	0.00039	)			
Deaths/cases ratio								-0.05032	***
to 1919-1920 growth							(	0.01666	)
Deaths/cases ratio								-0.02965	***
to 1921-1922 growth							(	0.00729	)
Wald chi^2 Statistics		114.05			116.74			16.74	
R squared		0.0729			0.0586			0.1134	
# of obs.		132			132			132	

Footnote 1: Figures in parentheses are robust standard errors.

Footnote 2: *** denotes significance at 1 percent.

Footnote 3: Prefecture-level fixed effects are not reported.

Next, I look into the impact of the pandemic on the labor market. GIP-induced cross-prefectural migrations could have affected the labor supply in the prefectures in question. My hypothesis here is that a prefecture hit more severely would see greater outflows of population, resulting in labor shortages, a relative decline in employment, and higher wages. To test this hypothesis, I run two set of regressions; the first one uses growth in factory employment as the dependent variable and pandemic severity as the treatment variable, and the second one uses wage growth as the dependent variable and pandemic severity as the treatment variable.

Table 10 shows the results of IV regressions on annualized growth of factory employment. In all regressions, the treatment variables representing the severity of the pandemic had significant negative effects on the growth of factory employment during and after the pandemic. When the deaths/population ratio rose by one over 100 population, factory employment grew by -0.122 percentage points fewer in 1919-1920 and by -0.069 percentage points fewer in 1921-1922. When the cases/population ratio rose by one over 100 population, it grew by -0.191 percentage points fewer in 1919-1920 and by -0.107 percentage points fewer in 1921-1922. When the deaths/cases ratio rose by one over 10,000 population, it grew by -5.032 percentage points fewer in 1919-1920 and by -2.965 percentage points fewer in 1921-1922. These results suggest persistent negative effects of the pandemic on the factory employment.

Tables 11 and 12 present the results of IV regressions on annualized wage growth for laborers (unskilled workers) and carpenters (skilled workers), respectively.[14]

In all regressions in Table 11, the treatment variable representing pandemic severity had significant positive effects on the growth of unskilled worker wages during the pandemic and significant negative effects after the pandemic. The absolute magnitude of these effects was larger during the pandemic than after it. Where the deaths/population ratio rose by one over 100 population, laborer wage growth increased by 0.392 percentage points in 1919-1920 and decreased by 0.117 percentage points in 1921-1922. Where the cases/population ratio rose by one over 100 population, it increased by 0.707 percentage points in 1919-1920 and decreased by 0.248 percentage points in 1922-1922. Where the deaths/cases ratio rose by one over 10,000 population, it increased by 13.201 percentage points in 1919-1920 and decreased by 3.323 percentage points in 1921-1922.

In all regressions in Table 12, the results are qualitatively similar to those in Table 11, but the magnitude is smaller and the statistical significance is lower. The treatment variable representing pandemic severity had significant positive effects on the growth of skilled worker wages during the pandemic, and negative effects in general after the pandemic, while the effect of the deaths/cases ratio was statistically insignificant. This may reflect the sectoral segmentation of labor markets between skilled and unskilled workers with laborers being more closely attached to factories than carpenters.

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[14] Wage data is given for 13 cities and has been obtained from the Statistical Yearbook of the Empire of Japan and deflated by the GNP deflator taken from Ohkawa and Shinohara (1979).

Table 11. IV regression results on annualized growth of real laborer wages

Independent variable	a) Deaths/pop.		b) Cases/pop.		c) Deaths/cases	
Coefficient of independent Variables						
Constant	0.09354	***	0.09902	***	0.08832	***
	(0.01659)		(0.01641)		(0.01777)	
Deaths/population ratio	0.00392	***				
to 1919-1920 growth	(0.00070)					
Deaths/population ratio	-0.00117	***				
to 1921-1922 growth	(0.00036)					
Cases/population ratio			0.00707	***		
to 1919-1920 growth			(0.00115)			
Cases/population ratio			-0.00248	***		
to 1921-1922 growth			(0.00071)			
Deaths/cases ratio					0.13201	***
to 1919-1920 growth					(0.02416)	
Deaths/cases ratio					-0.03323	***
to 1921-1922 growth					(0.01148)	
Wald chi^2 Statistics	32.48		36.41		40.85	
R squared	0.7066		0.7648		0.6896	
# of obs.	39		39		39	

Footnote 1: Figures in parentheses are robust standard errors.

Footnote 2: *** denotes significance at 1 percent.

Footnote 3: Prefecture-level fixed effects are not reported.

Table 12. IV regression results on annualized growth of real carpenter wages

Independent variable		a) Deaths/pop.			b) Cases/pop.			c) Deaths/cases	
Coefficient of independent Variables									
Constant		0.06428	***		0.06951	***		0.06477	***
	(	0.01164	)	(	0.01088	)	(	0.01664	)
Deaths/population ratio		0.00412	***						
to 1919-1920 growth	(	0.00054	)						
Deaths/population ratio		-0.00046	*						
to 1921-1922 growth	(	0.00027	)						
Cases/population ratio					0.00746	***			
to 1919-1920 growth				(	0.00080	)			
Cases/population ratio					-0.00116	**			
to 1921-1922 growth				(	0.00050	)			
Deaths/cases ratio								0.13593	***
to 1919-1920 growth							(	0.02092	)
Deaths/cases ratio								-0.01578	
to 1921-1922 growth							(	0.01005	)
Wald chi^2 Statistics		30.56			42.42			55.81	
R squared		0.7711			0.8486			0.7485	
# of obs.		39			39			39	

Footnote 1: Figures in parentheses are robust standard errors.

Footnote 2: * denotes significance at 10 percent; ** denotes significance at 5 percent; *** denotes significance at 1 percent.

Footnote 3: Prefecture-level fixed effects are not reported.

Interestingly, after the pandemic, the more severely affected prefectures saw a relative increase in social population growth (Table 9), a continued relative decline in factory employment (Table 10), and a drop in wages (Table 11), suggesting the loosening of the labor market in the post-pandemic period.

My hypothesis, based on the above findings and the behavior of factory owners, is that factory owners may have been forced by the pandemic to substitute labor with capital; i.e., faced with labor shortages for two consecutive years (1919-1920), they may have installed new machines to take the place of unskilled labor, and this may have had a lasting impact on labor market.

Table 13. IV regression results on annualized growth of real paid-in capital

Independent variable	a) Deaths/pop.		b) Cases/pop.		c) Deaths/cases	
Coefficient of independent Variables						
Constant	-0.00585		-0.00672		0.00584	
	(0.01987)		(0.02077)		(0.01941)	
Deaths/population ratio	0.00323	***				
to 1919-1920 growth	(0.00074)					
Deaths/population ratio	0.00176	***				
to 1921-1922 growth	(0.00026)					
Cases/population ratio			0.00510	***		
to 1919-1920 growth			(0.00118)			
Cases/population ratio			0.00280	***		
to 1921-1922 growth			(0.00039)			
Deaths/cases ratio					0.12405	***
to 1919-1920 growth					(0.02791)	
Deaths/cases ratio					0.05717	***
to 1921-1922 growth					(0.01732)	
Wald chi^2 Statistics	81.75		117.01		26.55	
R squared	0.2009		0.2341		0.1502	
# of obs.	132		132		132	

Footnote 1: Figures in parentheses are robust standard errors.

Footnote 2: *** denotes significance at 1 percent.

Footnote 3: Prefecture-level fixed effects are not reported.

In this section, I test my substitution hypothesis by looking at capital formation. Table 13 shows the results of IV regressions on annualized growth in real paid-in capital. All the treatment variables had statistically significant positive effects on growth in real paid-in capital in 1919-1920 and 1921-1922. When the deaths/population ratio rose by one over 100 population, the capital grew more by 0.323 percentage points more annually in 1919-1920 and 0.176 percentage points more in 1921-1922. When the cases/population ratio rose by one over 100 population, it grew by 0.510 percentage points and 0.118 percentage points more annually in the same period. When the deaths/cases ratio rose by one over 10,000 population, it grew by 12.405 percentage points and 5.717 percentage points more annually in the same period.

Although we need a careful interpretation because we only have employment figures for factories, while capital figures are for all industries, and because we haven't dug into causality figures, the results above suggest some substitution effect between labor and capital.[15]

Table 14. IV regression results on annualized growth of real taxable income

Independent variable	a) Deaths/pop.		b) Cases/pop.		c) Deaths/cases	
Coefficient of independent Variables						
Constant	-0.00527		-0.00318		-0.00813	
	(0.01180)		(0.00997)		(0.01496)	
Deaths/population ratio	0.00383	***				
to 1919-1920 growth	(0.00030)					
Deaths/population ratio	0.00288	***				
to 1921-1922 growth	(0.00029)					
Cases/population ratio			0.00596	***		
to 1919-1920 growth			(0.00040)			
Cases/population ratio			0.00443	***		
to 1921-1922 growth			(0.00039)			
Deaths/cases ratio					0.15781	***
to 1919-1920 growth					(0.01534)	
Deaths/cases ratio					0.11954	***
to 1921-1922 growth					(0.01388)	
Wald chi^2 Statistics	468.25		538.08		109.98	
R squared	0.6476		0.6790		0.5010	
# of obs.	131		131		131	

Footnote 1: Figures in parentheses are robust standard errors.

Footnote 2: *** denotes significance at 1 percent.

Footnote 3: Prefecture-level fixed effects are not reported.

Next, I look at the pandemic's effect on income. To do so, I have compiled taxable income data from the Statistical Yearbooks of the Empire of Japan and deflated it by the GNP deflator taken from Ohkawa and Shinohara (1979). Table 14 shows the results of IV regressions on annualized growth in taxable income. All the treatment variables had statistically significant positive effects on income growth during and after the pandemic. Where the deaths/population ratio rose by one over 100 population, annual income growth increased by 0.383 percentage points in 1919-1920 and by 0.288 percent points in 1921-1922. Where the cases/population ratio rose by one over 100 population, it increased by

[15] In the panel regressions above, I omit time dummies as time dummies are statistically insignificant in all cases.

0.596 percentage points and 0.443 percentage points in the respective periods. Where the deaths/cases ratio rose by one over 10,000 population, it increased by 15.781 percentage points and 11.954 percentage points in the respective periods.[16] These results do not imply that the pandemic promoted income growth. Rather, they may imply that prefectures with the potential for rigorous growth grew more despite the pandemic. In other words, the GIP did not encumber regional economic growth.

4. Conclusions

This paper finds that 1) Japan was hit twice by the pandemic, once in the winter of 1918-1919 and again in winter-spring 1919-1920, that the urban population was more exposed to the virus and faced a greater risk to life, while the rural population, once infected, was more likely to succumb to the disease, 2) the pandemic seemed to have a noticeable effect on socioeconomic activities in the short and medium terms, suggesting a trigger of population outflows and substitution of labor by capital without any adverse effect on income, and 3) the government response included medical and public health measures but not economic measures.

Though the GIP was similar to COVID-19 in terms of epidemiological patterns, it was very different in terms of human agency and socioeconomic consequences. Quantitative analysis indicates that a) non-pharmaceutical interventions were minimal at best, and b) the pandemic had a negative impact on population growth through the direct effect of excess mortality and the indirect effect of reduced chances of pregnancy.

These results are largely in line with the findings of Velde (2020) and Chapelle (2020) for the United States, namely that, unlike in the case of COVID-19, the people and the government responded calmly to the GIP and incorporated very few behavioral changes, and that the socioeconomic effects of the GIP were temporal and small. While some studies attempt to derive direct socioeconomic implications, including the effect of non-pharmaceutical intervention during the GIP (e.g., Correia et al. 2020), one must exercise caution in extrapolating such direct implications from GIP to COVID-19.[17]

At the same time, there are indications of capital-labor substitution triggered by the

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[16] In panel regressions here, time dummies are statistically insignificant in the cases of deaths/population and cases/population ratios. In the case of deaths/cases ratio, time dummies are significant at the 10 percent level, and the coefficient on income growth in 1919-1920 and in 1921-1922 are insignificant.

[17] According to Markel et al. (2007), non-pharmaceutical interventions during the GIP were short and temporal compared to those during COVID-19.

pandemic. Also, one must not dismiss the negative demographic impacts of the GIP. Ogasawara (2017) finds that children born during 1919-1920 were shorter than those in surrounding cohorts in Japan. As for other parts of the world, Almond (2006) finds that in the United States, cohorts in utero during the pandemic displayed lower profiles of human capital development with reduced educational attainment, increased rates of physical disability, lower income, lower socioeconomic status, and higher transfer payments compared with other birth cohorts. Aassve at al. (2020) finds that lower social trust was passed on to the descendants of GIP survivors who migrated to the United States after the pandemic. In the case of Brazil, Guimbeau et al. (2020) finds that the GIP had significant negative impacts on infant mortality and sex ratios at birth in the short-run and persistent effects on health, educational attainment, and productivity more than twenty years later. Although the impact on demographics and long-term effects on human capital are beyond the scope of its study, the present paper suggests the possibility of a rise in case fatality serving as a trigger of population outflows and a change in the capital/labor ratio. The topic is a potential area for future research, given the protracted and extensive non-pharmaceutical interventions underway in COVID-19.

Another potential extension of historical research with relevance to COVID-19 would be on other major external socioeconomic shocks. Arthi and Parman (2021) focuses on the GIP and the Great Depression of the 1930s, arguing that these two global crises were comparable to COVID-19 in scale and scope. For Japan, Shizume (2021) puts forward post-WWII reforms in the late 1940s and the two oil crises of the 1970s as appropriate cases to compare with the current situation in terms of a massive qualitative shift in demand structure and social norms.

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