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COVID-19 and Suicide in Japan

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Abstract

We quantify the effects of the COVID-19 crisis on suicides in Japan using a time-series model relating the number of suicides to the unemployment rate as well as private-sector forecasts of the unemployment rate before the crisis. We find that (i) the COVID-19 crisis increased suicides in Japan by about 7,000 from March 2020 to April 2022, (ii) the increase in the unemployment rate can only account for one third of the excess suicides, (iii) the excess suicides are skewed towards younger generations and female, and (iv) lost years of life expectancy associated with the excess suicides are almost as large as those associated with COVID-19 deaths.

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COVID-19 and Suicide in Japan*

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June 30, 2022

Abstract

We quantify the effects of the COVID-19 crisis on suicides in Japan using a time-series model relating the number of suicides to the unemployment rate as well as private-sector forecasts of the unemployment rate before the crisis. We find that (i) the COVID-19 crisis increased suicides in Japan by about 7,000 from March 2020 to April 2022, (ii) the increase in the unemployment rate can only account for one third of the excess suicides, (iii) the excess suicides are skewed towards younger generations and female, and (iv) lost years of life expectancy associated with the excess suicides are almost as large as those associated with COVID-19 deaths.

Keywords: COVID-19, Suicides, Unemployment, Forecasting
JEL Codes: C53, I10, J11

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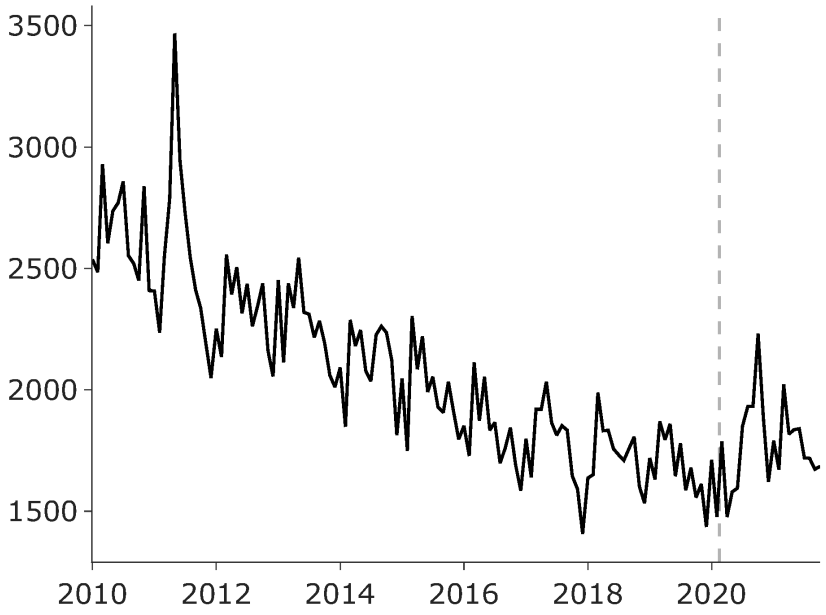
1 Introduction

The COVID-19 crisis has not only led to a large number of deaths from the disease itself, but also generated another set of tragedies in Japan—a surge in suicides. As shown in Figure 1, the number of suicides was on a steady path of decline for more than a decade before the COVID-19 crisis intensified in March 2020. However, as the number of COVID-19 cases started to increase in the spring of 2020 and as various non-pharmaceutical interventions started to affect our lives, the number of suicides started to deviate from its downward trend of previous years.

Figure 1: The number of suicides in Japan



Source: Ministry of Health, Labor, and Welfare; Statistics Bureau, Ministry of Internal Affairs and Communications

In this paper, we present an estimate of the effect of the COVID-19 crisis on the number of suicides in Japan. Utilizing the fact that the number of suicides is strongly correlated with the unemployment rate, we use private-sector forecasts of the unemployment rate before the COVID-19 crisis began to estimate the hypothetical path of suicides that would have prevailed in the absence of the COVID-19 crisis. We then interpret the difference between the actual and hypothetical numbers of suicides as the effect of the COVID-19 crisis on suicides.

We find that the cumulative effect of the COVID-19 crisis on suicides since March 2020 is 6,993 as of April 2022, representing about 15 percent of the total number of suicides during

the same period.[1] As a reference, the cumulative number of COVID-19 deaths is 30,771 up to April 2022. We find that 1,216 of 6,993 excess suicides can be explained by the increase in the unemployment rate; the remaining 5,777 excess suicides cannot be explained by the economic hardship associated with a typical recession.[2]

We also find that female suicides account for more than half of the 6,993 excess suicides. In contrast, female suicides accounted for only about 30% of suicides between 2009 and 2019. The distribution of excess suicides is skewed towards younger generations, with the group most affected being female in their 20s followed by male in their 20s. The distribution of excess suicides stands in stark contrast to that of COVID-19 deaths. Reflecting the fact that the infection fatality rate increases with age, the distribution of COVID-19 deaths are concentrated on older generations. Of 30,771 cumulative COVID 19 deaths, about 19,800 are individuals over age 80 and 7,000 are individuals in their 70s. Reflecting this opposite pattern in distribution, the expected years of lives lost associated with excess suicides are higher than those from COVID-19 deaths.

Commentators list a number of reasons for this increase in suicide during the COVID-19 crisis. Those reasons include, but are not limited to, economic hardship, loneliness associated with reduced in-person interactions, suicides triggered by suicides of celebrities, and domestic violence cases that are likely caused by sudden adjustments in how families live together.[3] It is outside the scope of our paper to investigate these causes and discuss remedies. However, it is crucial for the government and citizens to take various measures to prevent further increases in excess suicides until the COVID-19 crisis is fully behind us and for the government to take note of the fact that well-intended policies to control infection could contribute to excess suicides in future pandemics in the absence of appropriate measures.

There are several research papers on suicides during the COVID-19 crisis in Japan. Anzai, Fukui, Ito, Ito, and Takahashi (2021), Tanaka and Okamoto (2021), Eguchi, Nomura, Gilmourd, Harada, Sakamoto, Ueda, Yoneoka, Tanoue, Kawashima, Hayashii, Arima, Suzuki, and Hashizume (2021), Nomura, Kawashima, Yoneoka, Tanoue, Gilmour, Kawa-

[1] We also estimate the number of excess suicides using three other models besides the model described in Section 2. The estimates of those alternative models range from 5,860 to 7,400.

[2] We began our analysis in July 2021 to help draw public's attention to the rise of suicides, which we perceived as an important—yet often neglected—factor in the discussion of how to manage COVID-19 pandemic in Japan. We have updated our analysis every month since then. Our suicide analysis has been featured in various newspapers and TV programs. Examples are Yomiuri Shimbun (2021), Asahi Shimbun (2021), Nikkei Shimbun (2021), and NHK (2021), among others. We also submitted our analysis to the Advisory Committee on the Basic Action Policy on March 17, 2022 (Chiba, Fujii, Nakata, Ohtake, and Sunakawa (2022a)) and the Subcommittee on Novel Coronavirus Disease Control on April 27, 2022 (Chiba, Fujii, Nakata, Ohtake, and Sunakawa (2022b)).

[3] Anecdotal evidence suggests that suicides of a few prominent actors and actresses nontrivially contributed to the rise of suicides in the fall of 2020.

mura, Harada, and Hashizume (2021), Sakamoto, Ishikane, Ghaznavi, and Ueda (2021), and Ueda, Nordstrom, and Matsubayashi (2021) document either the initial decline in suicides in spring 2020 or the increase in suicides in the second half of 2020 in Japan. Horita and Moriguchi (2022) analyze the suicide trend in a longer sample through September 2021 and note that a surge in the number of suicides is associated with the rise in the unemployment rate. Ando and Furuichi (2022) use regional variation in the unemployment rate and the number of suicides to estimate the elasticity of suicides to fluctuations in the unemployment rate in the first six months of the COVID-19 crisis. Our paper differs from these papers because we quantify the effects of the crisis on suicides using private-sector forecasts of the unemployment rate and because we analyze data through April 2022.

This analysis is also related to various studies investigating social and economic impacts of the COVID-19 crisis in Japan. Kikuchi, Kitao, and Mikoshiba (2021), Hoshi, Kasahara, Makioka, Suzuki, and Tanaka (2021), and Fukui, Kikuchi, and Goalist Co (2020) examine how the COVID-19 crisis affected labor markets, whereas Morikawa (2021), Kawaguchi, Kitao, and Nose (2021), and Kawaguchi and Motegi (2021) study various issues related to remote-work during the COVID-19 crisis. Kikuchi, Nagao, and Nakazono (2021), Watanabe and Omori (2021), and Asai, Fujii, Nakata, Sunakawa, and Takakura (2022) study consumption or output during the COVID-19 crisis, whereas Fujii and Natata (2021) analyze the joint dynamics of COVID-19 infection and the economy using an estimated macro-SIR model. Takaku and Yokoyama (2021) and Ikeda and Yamaguchi (2021), and Yamamura and Tsustsui (2021), Asakawa and Ohtake (2021) study how school closures during the COVID-19 crisis affected children, whereas Naito and Ogawa (2021) and Chiba and Nakata (2022) study how the COVID-19 crisis has affected pregnancy, marriage, and births.

Finally, our work is related to macroeconomics literature that uses private-sector or financial market forecasts to extract exogenous shocks. Examples are Engen, Laubach, and Reifschneider (2015), Gertler and Karadi (2015), Kim, Laubach, and Wei (2020), and Gurkaynak, Sack, and Swanson (2005), among many others.

This paper is organized as follows. Section 2 describes our framework. Section 3 describes data. Sectio 4 presents the results. Section 5 concludes.

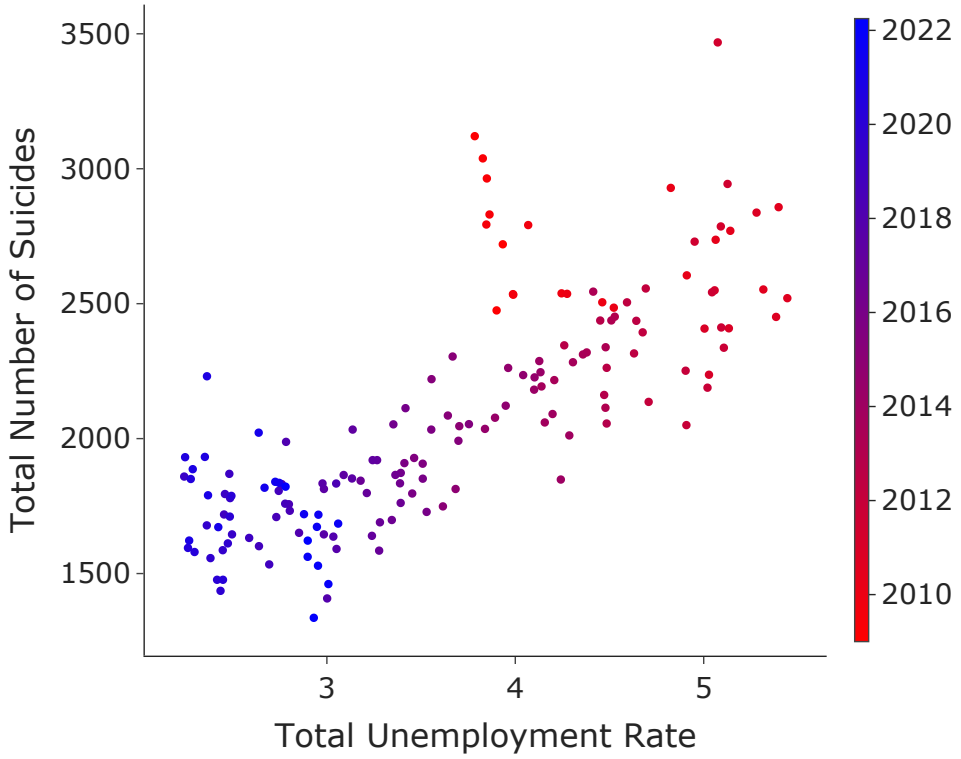
2 Framework

2.1 Idea

In estimating the hypothetical number of suicides in the absence of COVID-19, we use the fact that the number of suicides and the unemployment rate are strongly correlated in Japan.

Figure 2 plots suicides against the unemployment rate in monthly frequency since 2010. This correlation is robust to different sample periods and is well-known.[4]

Figure 2: Suicides and the unemployment rate



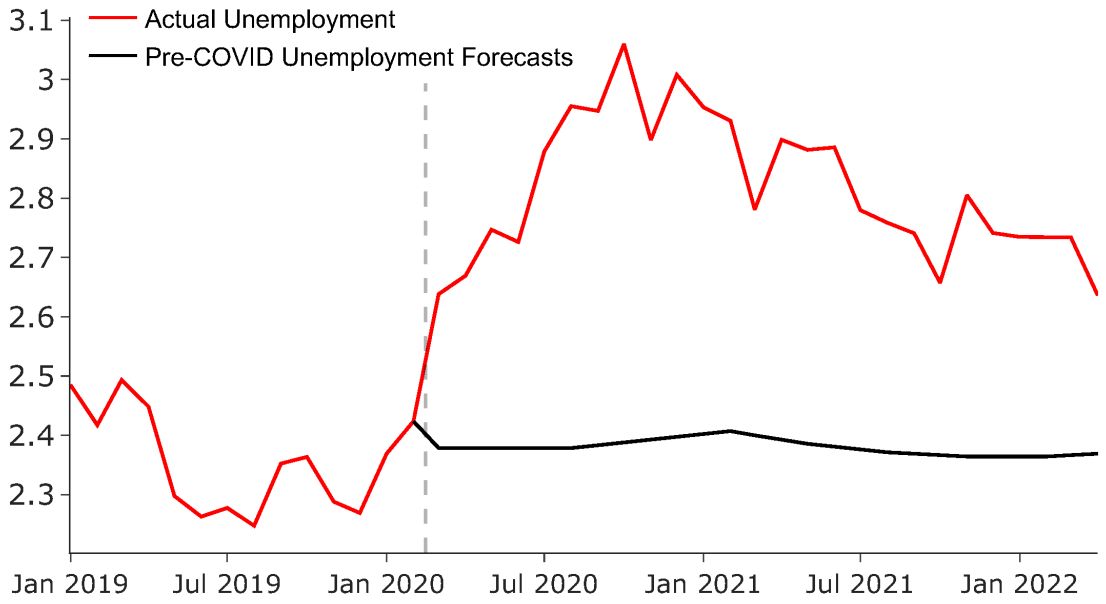
Source: Ministry of Health, Labor, and Welfare; Statistics Bureau, Ministry of Internal Affairs and Communications

Thus, if we knew the path of the unemployment rate that would have prevailed in the absence of the COVID-19 crisis, we could use this relationship between suicides and the unemployment rate to estimate the hypothetical number of suicides that would have prevailed in the absence of COVID-19 crisis. We use the pre-COVID private-sector forecasts of the unemployment rate as an approximation of such a hypothetical path of the unemployment rate.

As shown in Figure 3, and as discussed in detail in Section 3, prior to the COVID-19 crisis, private-sector analysts predicted that the unemployment would hover slightly below 2.4 percent in 2020 and 2021. The actual unemployment rate has been on average 0.45 percentage points above the projection.

[4]See Chen, Choi, and Sawada (2009).

Figure 3: Pre-COVID unemployment rate projections



Source: Statistics Bureau, Ministry of Internal Affairs and Communications; Pre-COVID projections are based on the authors' calculation using the private-sector forecasts of the unemployment rate. (See Table 1 for details.)

2.2 Model

We use a monthly time interval. We specify our model at the following disaggregate level: two genders (male and female) and eight age groups (age of 0-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-70, and 80-). For each age and gender group, we assume the following relationship between the number of suicides and the unemployment rate:

$$S_{a,g,t} = \sum_{m=1}^{12} \left(\alpha_{a,g,m} + \beta_{a,g,m} t\right) \delta_m + \gamma_{a,g} U_{a,g,t} + \varepsilon_{a,g,t} \tag{1}$$

where $S_{a,g,t}$ is the total number of suicides for individuals in age group a of gender g at time t. $U_{a,g,t}$ is the unemployment rate for individuals in age group a of gender g at time t. $\delta_{m,t}$ is a month m dummy variable at time t. That is, $\delta_{m,t} = 1$ if time t is at month $m \in \{\text{January}, \text{February}, ..., \text{December}\}$ of any year, and $\delta_{m,t} = 0$ otherwise. $\alpha_{a,g,m} + \beta_{a,g,m} t$ is an age, gender, and month specific intercept and time trend.

$\varepsilon_{a,g,t}$ is an i.i.d. error term. We estimate the model parameters for each group of age and gender equation-by-equation using Ordinary Least Squares. We use data in the pre-COVID period from January 2010 to February 2020 for the estimation.

With the estimated parameters $\{(\hat{\alpha}_{a,g,m})_{m=1}^{12}, \left(\hat{\beta}_{a,g,m}\right)_{m=1}^{12}, \hat{\gamma}_{a,g}\}$ from the pre-COVID period at hand, we compute the hypothetical number of suicides during the COVID-19 crisis using pre-COVID unemployment forecasts. Specifically, we compute *the number of suicides consistent with pre-COVID unemployment forecasts*,

$$\hat{S}^F_{a,g,t} = \sum_{m=1}^{12} \left(\hat{\alpha}_{a,g,m} + \hat{\beta}_{a,g,m} t\right) \delta_m + \hat{\gamma}_{a,g} U^F_{a,g,t} \tag{2}$$

by using the projected unemployment rate $U^F_{a,g,t}$ for each group of age a and gender g at time t. We attribute the difference between the actual number of suicides and the hypothetical number of suicides, $S_{a,g,t} - \hat{S}^F_{a,g,t}$, to the COVID-19 crisis. We also compute *the number of suicides consistent with the actual unemployment rate*,

$$\hat{S}_{a,g,t} = \sum_{m=1}^{12} \left(\hat{\alpha}_{a,g,m} + \hat{\beta}_{a,g,m} t\right) \delta_m + \hat{\gamma}_{a,g} U_{a,g,t} \tag{3}$$

by using the actual unemployment rate $U_{a,g,t}$ at time t. Then $\hat{S}_{a,g,t} - \hat{S}^F_{a,g,t}$ is the number of suicides that can be explained by the increase in the unemployment rate. $S_{a,g,t} - \hat{S}_{a,g,t} = \hat{\varepsilon}_{a,g,t}$ is an estimate of the residual of Equation (1) and the number of suicides that cannot be explained by the economic hardship associated with a typical recession.

3 Data

In this section, we briefly describe the suicide and unemployment data we use. See Table 1 for the source of the original data (Panel A) and the list of institutions publishing unemployment forecasts (Panel B). Also see the appendix for more details.

Table 1: Data list

Panel A: Actual data

Data	Frequency	Description	source
Suicides	monthly	Number of suicides for different gender and age groups	MHLW
Unemployment	monthly	Unemployment rates for different gender and age groups	Statistics Bureau
COVID-19 infection deaths	weekly	Number of deaths due to COVID-19 for different gender and age groups	National Institute of Population and Social Security Research
Life expectancy	—	Life expectancy for different gender and age groups	MHLW

Panel B: Pre-COVID Unemployment Forecasts

Name of institution	Release date	Frequency
Nomura Holdings	November 11, 2019	quarterly
Sumitomo Mitsui Trust Bank	November 22, 2019	semi-annual
Nisseikiso Research Institute	December 8, 2019	quarterly
SMBC Nikko Securities	December 9, 2019	quarterly
Daiichi Seimeikeizai Research Institute	December 9, 2019	annual
Japan Center for Economic Research	December 9, 2019	quarterly
Mitsubishi UFJ Research & Consulting Co., Ltd.	December 9, 2019	quarterly
Daiwa Institute of Research Ltd.	December 9, 2019	quarterly
Mizuho Information & Research Institute	December 9, 2019	quarterly
Shinkin Central Bank Research Institute	December 11, 2019	annual
Shinsei Bank	December 24, 2019	semi-annual
Teikoku Databank	January 8, 2020	annual
Japan Research Institute, Limited	February 4, 2020	quarterly

Notes: We collect the latest forecast by each institution before February 15, 2020. Some institutes release only semi-annual or annual forecasts. We interpolate these forecasts to make quarterly forecasts. Also, some institutes release no forecasts for 2022. We use the same value of the forecast for the fourth quarter of 2021 to make 2022 forecasts.

Suicides We collect monthly suicide data from the Ministry of Health, Labor, and Welfare (MHLW) for different genders and age groups. We make the following two adjustments to the original data. First, only provisional values of suicide data are available at monthly frequency, whereas confirmed values are available at annual frequency. Given that we observe a significant difference between provisional and confirmed values (see Figure **??** in the appendix), we make an adjustment to the provisional values to bridge this gap. Second, the age of some suicide victims is not available. Therefore, when we have some data points for gender g in month m with unknown age, we divide these data points into each age group by using the proportion of provisional suicides for gender g and known age group a in month m.

Actual unemployment We collect monthly unemployment data from the Statistics Bureau of Japan for different genders and age groups. The age groups that are available for unemployment do not match those available for suicide data. We use a simple weighting

scheme described in the Appendix to construct unemployment rate series for the suicide age groups.[5]

Pre-COVID unemployment forecasts We collect forecasts for the aggregate unemployment rate published by various institutions. Panel B of Table 1 shows the frequency, the institution name, and the release date of forecasts. We use the latest forecast by each institution in the pre-COVID period at a quarterly frequency.[6] Then we compute the mean of all the quarterly forecasts. Finally we use some interpolation techniques to construct our monthly measures, which is denoted by U_t^F and shown by black line in Figure 2 above.[7]

While we wish we had age-gender specific unemployment forecasts $U_{a,g,t}^F$ for the COVID-19 period to estimate the hypothetical number of suicides $\hat{S}_{a,g,t}^F$ using Equation (2), forecasts for the aggregate unemployment rate are only available in data. We construct age-gender specific unemployment forecasts as out-of-sample predictions of an estimated regression of age-gender specific unemployment on aggregate unemployment. Specifically, we estimate

$$U_{a,g,t} = c_{a,g,0} + c_{a,g,1}t + c_{a,g,2}U_t + e_{a,g,t} \tag{4}$$

to obtain age-gender specific parameters $\{\hat{c}_{a,g,0}, \hat{c}_{a,g,1}, \hat{c}_{a,g,2}\}$ by using the age-gender specific unemployment rate $U_{a,g,t}$ and the aggregate unemployment rate U_t in the pre-COVID period from January 2010 to February 2020. $e_{a,g,t}$ is an i.i.d. error term. Then we compute

$$U_{a,g,t}^F = \hat{c}_{a,g,0} + \hat{c}_{a,g,1}t + \hat{c}_{a,g,2}U_t^F \tag{5}$$

by using the mean forecast for the aggregate unemployment rate U_t^F for the COVID-19 period.

4 Results

Figure 4 shows the actual and hypothetical numbers of suicides. The red dots show the actual number of suicides, while the solid black line shows the hypothetical number of suicides consistent with pre-COVID unemployment forecasts. The shadow area around the solid black line is the one-standard deviation confidence interval of the estimate.

[5]We assume that the unemployment rate is zero for individuals younger than 15 and older than 70.

[6]Some institutes release only semi-annual or annual forecasts. We interpolate these forecasts to make quarterly forecasts. Also, some institutes release no forecasts for 2022. We use the same value of the forecast for the fourth quarter of 2021 to make 2022 forecasts.

[7]We attribute the quarterly forecast to the middle month for each quarter, and use continuous piece-wise linear interpolation.

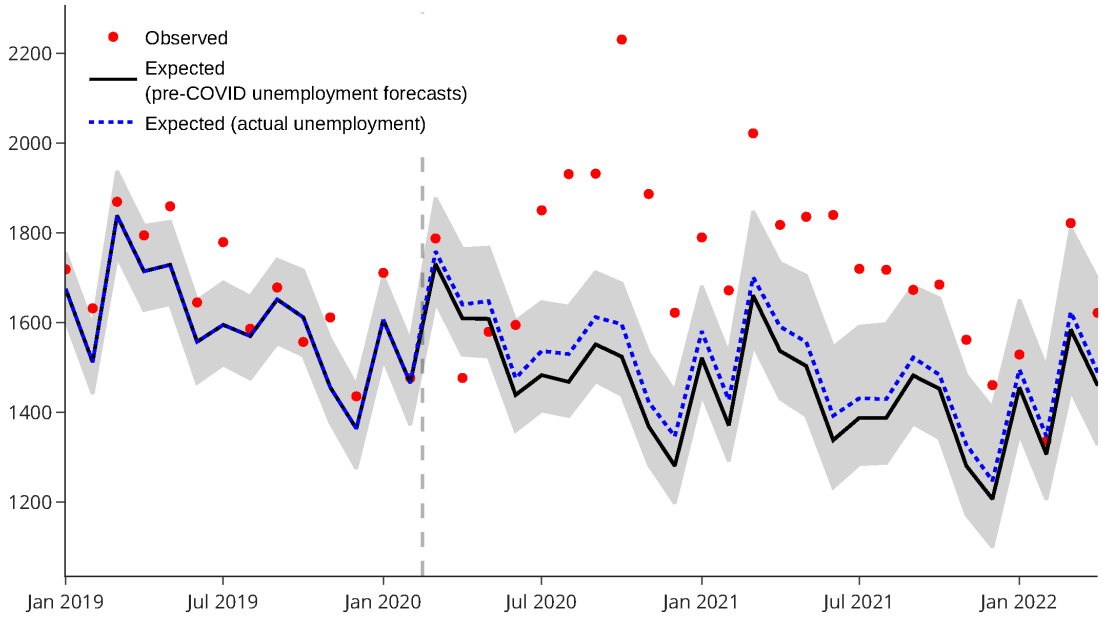
The actual number of suicides exceeds the hypothetical number of suicides, except for April and May 2020. The number of actual suicides observed in data is outside of the confidence interval during most of the COVID-19 crisis, whereas it is inside of the confidence interval in the pre-COVID period. In particular, the number of excess suicides was large in the second half of 2020. The total number of excess suicides is 6,993 from March 2020 to April 2022.[8]

The dashed blue line shows the number of suicides consistent with what the model would predict with the actual evolution of the unemployment rate. The dashed blue line is somewhat above the solid black line, indicating that the increase in the unemployment rate during the COVID-19 crisis can account for some of excess suicides, but a large portion of excess suicides is left unexplained. We find that 1,216 of 6,993 excess suicides can be explained by the increase in the unemployment rate; the remaining 5,777 excess suicides cannot be explained by the economic hardship associated with a typical recession.[9]

[8]We also estimate the number of excess suicides using three other models: Model A abstracts from gender heterogeneity, Model B abstracts from age heterogeneity, and Model C abstracts from both types of heterogeneity. The estimates of excess suicides from these alternative models are 7,400 (Model A), 6960 (Model B), and 5,860 (Model C).

[9]Our decomposition is based on the assumption that the past relationship between the unemployment rate and suicides did not significantly change during the COVID-19 crisis. Thus, our estimate of "excess suicides that cannot be explained by the rise in the unemployment rate" includes excess suicides that might have been related to the rise in the unemployment rate during the COVID-19 crisis, but would not have occurred in other episodes with a similar rise in the unemployment rate. In other words, we classify the effect of a possible change in the elasticity of suicides to the unemployment fluctuation as the effect that cannot be explained by "normal" unemployment fluctuations.

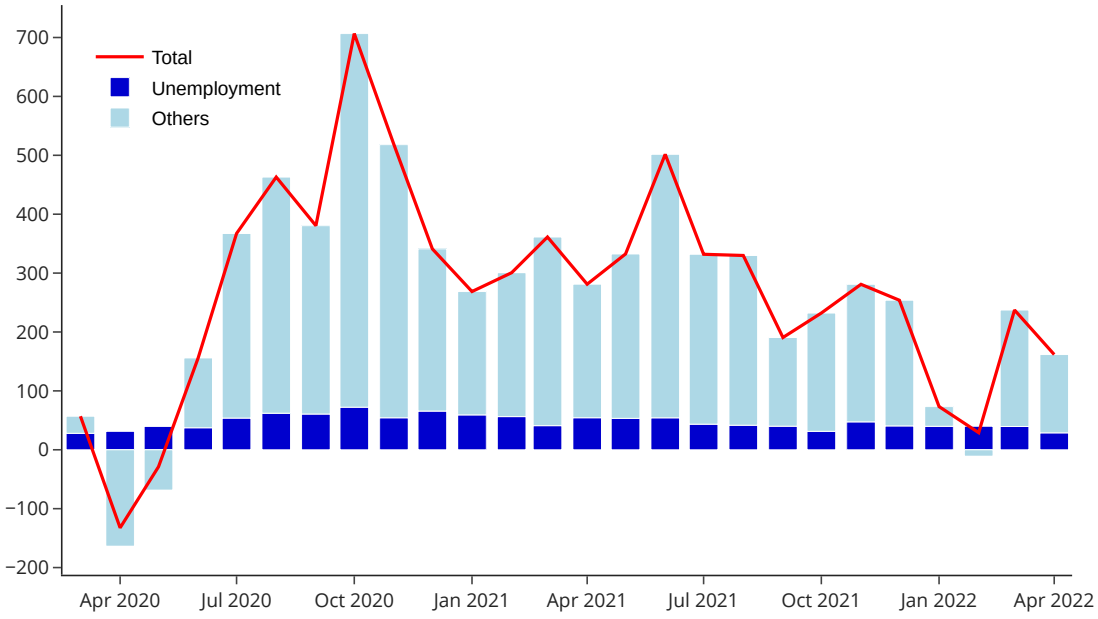
Figure 4: Actual and hypothetical suicides



Source: Ministry of Health, Labor, and Welfare; the expected number of suicides (-COVID and Pre-COVID) are based on the authors' calculation.

As an alternative visualization, the red line in Figure 5 shows excess suicides—the difference between the actual number of suicides shown by the red dots in Figure 4 and the hypothetical number of suicides shown by the black line in Figure 4. Light and thick blue bars show contributions to excess suicides from (i) the part that be explained by the increase in the actual unemployment rate—the difference between the expected number of suicides consistent unemployment forecasts in the pre-COVID period (the black solid line in Figure 4) and the expected number of suicides using the actual unemployment during the COVID-19 crisis (the blue dashed line in Figure 4) —and (ii) the part that cannot be explained by the increase in the unemployment rate.

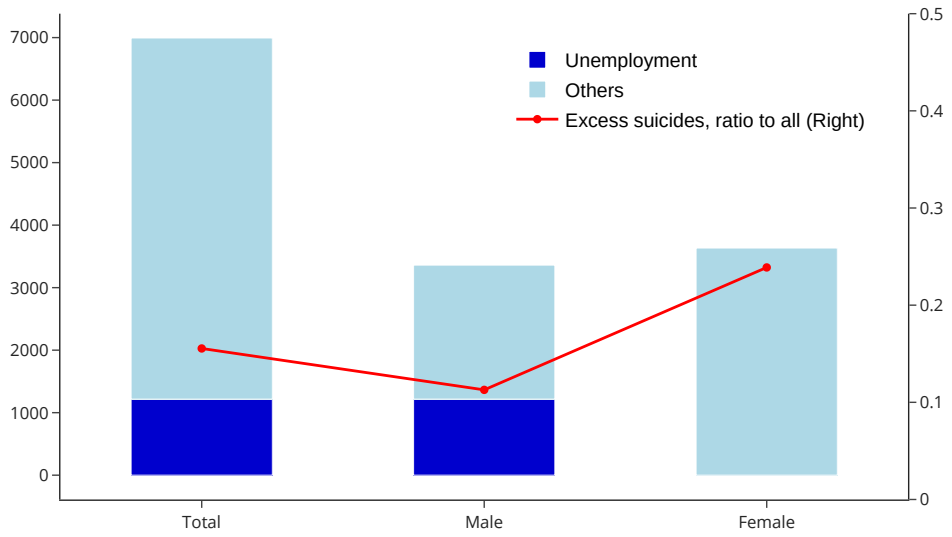
Figure 5: Excess suicides



Source: The authors' calculation

Figure 6 shows the distribution of excess suicides from March 2020 to April 2022 by gender. There are more female excess suicides than male excess suicides. This result is striking because the number of suicides had been consistently lower for female than for male in Japan prior to the COVID-19 crisis. The red line shows the ratio of excess suicides to overall suicides—including those not associated with the COVID-19 crisis according to our model—reinforcing the sense in which the crisis affected excess suicides for female more than those for male. Finally, according to the dark blue bars, about half of excess suicides can be explained by the increase in the unemployment rate for male, while almost all of excess suicides cannot be explained by the increase in the unemployment rate for female.

Figure 6: Distribution of excess suicides: Gender

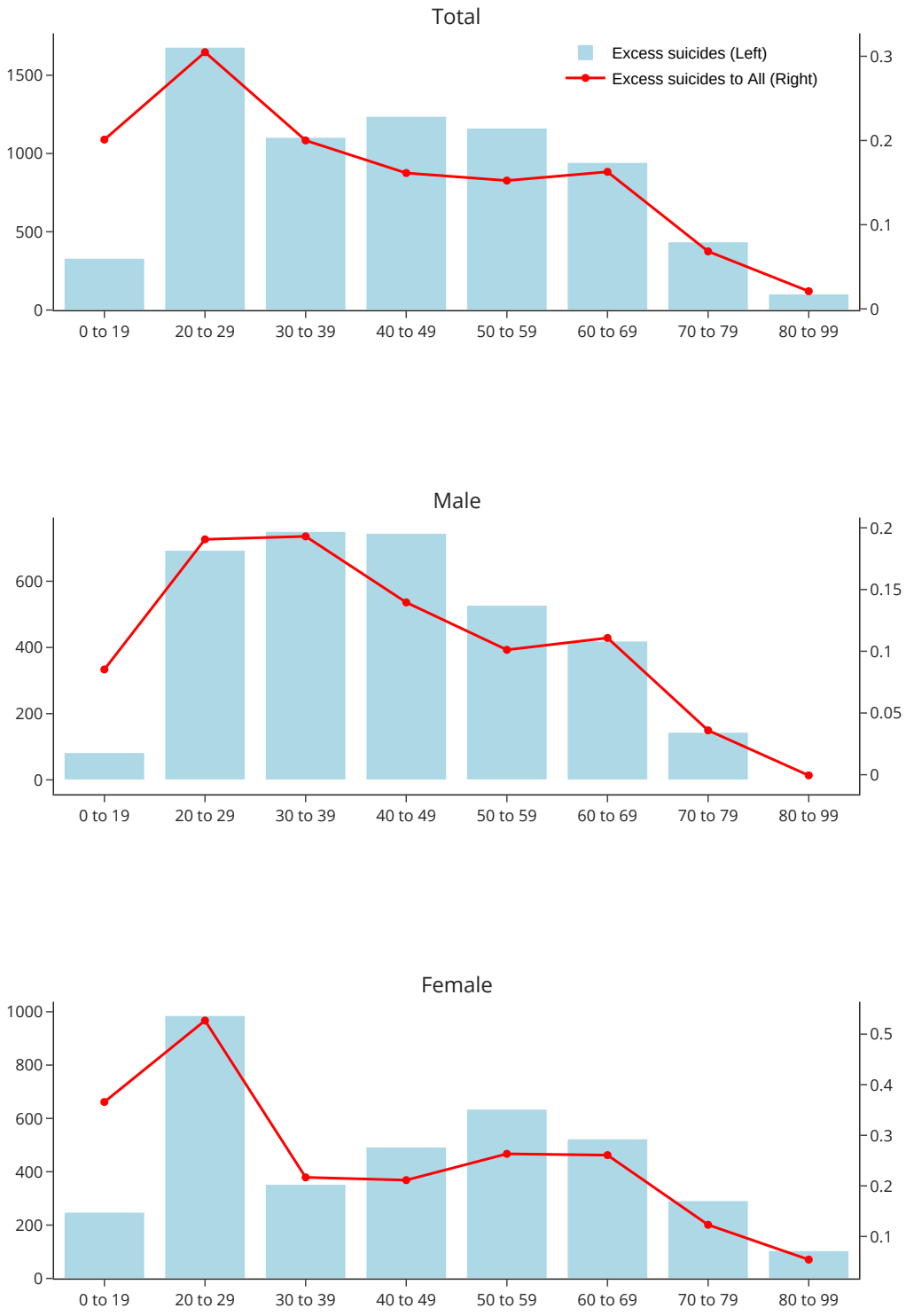


Source: The authors' calculation

Figure 7 shows the distribution of excess suicides from March 2020 to April 2022 across ages: The top panel is for the sum of male and female, the middle panel is for male only, and the bottom panel is for female only. In all three panels, the distribution is skewed to younger generations. The group of age 20-29 has the largest number of excess suicides, with the largest being female in their 20s followed by male in their 20s. As age decreases, the number of excess suicides tend to increase except for the group of age 0-19.

The red line shows the ratio of the number of excess suicides to the total number of suicides for different ages and genders. The distribution of the ratios across ages is broadly in line with that of the numbers of excess suicides across ages. A notable exception is that the group of age 0-19 has a less number of excess suicides, but its ratio to the total number of suicides is are higher than most other age groups. In all three panels, the number of excess suicides of age 0-19 is the second lowest in absolute values across age groups, next to that of age 80 and over. However, in the top and bottom panels, the excess suicides of age 0-19 is the second highest in ratios across age groups, next to that of age 20-29 .

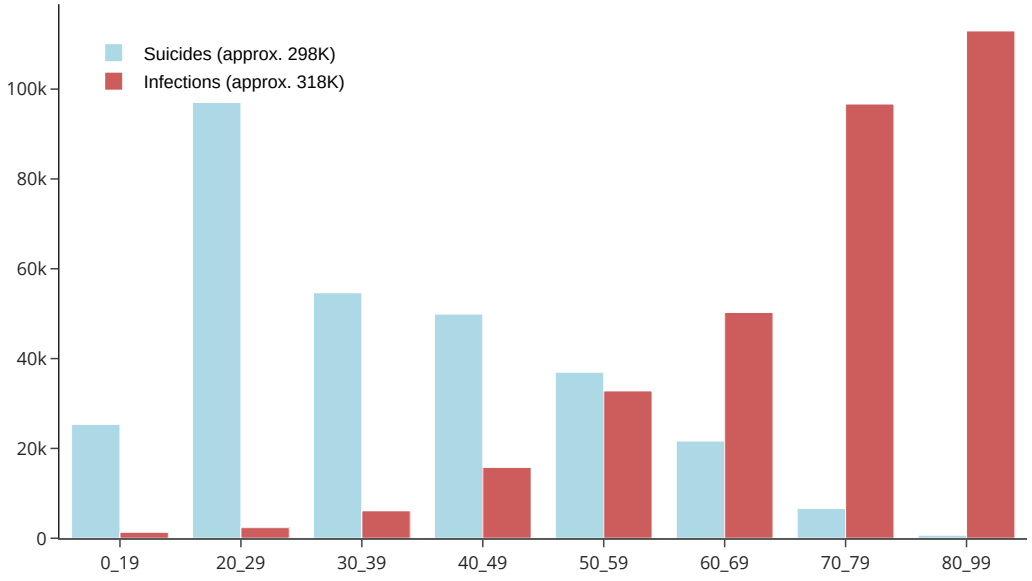
Figure 7: Distribution of excess suicides: Age



Finally, Figure 8 shows the distribution of excess suicides and COVID-19 deaths in terms

of the expected years of lives lost across ages. We calculate the years of life expectancy for each age-gender group, multiply them with the number of excess suicides or the number of COVID-19 deaths for each age-gender group, and aggregate across genders. Reflecting the fact that the infection fatality rate increases with age, the distribution of COVID-19 deaths are concentrated on older generations. Of 30,771 cumulative COVID-19 deaths, about 19,800 are over age 80 and 7,000 are in their 70s. Reflecting this opposite pattern in distribution, the expected years of lives lost associated with excess suicides (approximately 298 thousand years) are similar to those from COVID-19 deaths (approximately 318 thousand years).

Figure 8: Distribution of excess suicides and COVID-19 deaths: Years of lives lost



Source: The authors' calculation

5 Conclusion

In this paper, we quantified the effects of the COVID-19 crisis on suicides in Japan using a time-series model relating the number of suicides to the unemployment rate as well as private-sector forecasts of the unemployment rates before the COVID-19 crisis. We find that (i) the COVID-19 crisis increased suicides in Japan by about 7,000 from March 2020 to April 2022, (ii) the increase in the unemployment rate can only account for one third of the excess suicides, (iii) the excess suicides are skewed towards younger generations and female, and (iv) lost years of life expectancy associated with the excess suicides are almost as large as those associated with COVID-19 deaths.

We focused on quantifying the effect of the COVID-19 on suicides. A natural next step

would be to investigate why the COVID-19 has led to a surge in suicides and what could have been done to mitigate the surge. Such investigation is likely to be useful for policymakers fighting the next pandemic.

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