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Economic Impacts of SARS/MERS/COVID-19 in Asian Countries

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Economic Impacts of SARS/MERS/COVID-19 in Asian Countries

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Abstract

This paper surveys the recent literature on the economic impacts of SARS, MERS, and COVID-19, which Asian countries have experienced in the past two decades. In particular, this paper provides a detailed summary of how each of the past infectious diseases has impacted the Asian economies and to what extent. This paper also studies how the governments of the Asian countries have responded to the COVID-19 shocks with their economic policies. Lastly, this paper discusses the effectiveness of these economic policies to mitigate the COVID-19 shocks on the economy.

JEL Classification: E00, I14, I15, I18
Keywords: COVID-19, Coronavirus, Asia, SIR, SIR-Macro, Work-from-Home

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1 Introduction

Starting in 2019, a new coronavirus originated in Wuhan, Hubei Province, China, has quickly spread around the world. Almost all the countries in the world were severely affected, and are still managing to contain the virus until the distribution of the vaccine is completed. strong interventions such as lockdowns have been implemented, at the expense of economic activities. For Asian economies, however, the coronavirus is not the first infectious disease that challenges their economies. Asian countries have already experienced SARS and MERS and have overcome the damage caused to their economies by these infectious diseases.

The purpose of this paper is to summarize the economic impact of SARS, MERS, and COVID-19 that Asian countries have experienced, based on the existing literature. In particular, this paper provides a detailed summary of how each of the past infectious diseases has impacted the Asian economies and to what extent. This paper then discusses how the governments of the Asian countries have responded to COVID-19 through their economic policies, and which of the policies were effective.

In this paper, we particularly focus on why COVID-19 caused more serious economic damage than SARS and MERS. To provide an answer, we first divide shocks caused by a pandemic into two types: demand shocks and supply shocks. Then, we visit the fact that COVID-19 caused a serious supply shock due to non-pharmaceutical interventions such as lockdowns.

How can we interpret such non-pharmaceutical interventions in economics? To answer this question, this paper introduces, so-called, SIR-macro model, which combines epidemiological and macroeconomic models. With this model, we study the trade-off between the economy and public health. We then review the latest papers that apply this model to Asian economies. Some of these papers are indeed helping countries to plan their infectious disease control measures.

In the last two sections of this paper, we visit empirical studies of how the COVID-19 shock affected the economy through the supply and demand channels described above and

Table 1: Numbers of infections, and deaths for SARS/MERS/COVID-19 in Asia

	SARS	MERS	COVID-19
Number of cases	7,777	2,517	25,801,995
Number of deaths	729	876	406,651
Time period	2002–2003	2012–	2019–
Affected countries	China, Hong Kong, Macao, Taiwan, Kuwait, Malaysia, Mongolia, Philippines, Republic of Korea, Russia, Singapore, Thailand, Viet Nam	Bahrain, China, Egypt, Iran, Jordan, Kuwait, Lebanon, Malaysia, Oman, Philippines, Qatar, Saudi Arabia, South Korea, Tunisia, Thailand, Turkey, United Arab Emirates, Yemen	Almost all countries in Asia

Note: For the data sources, see World Health Organization (2003) for SARs, World Health Organization (2020) for MERS, and Worldometer (2021) for COVID-19 as of July 31, 2021.

then examine the economic policies that were effective in response to the COVID-19 shocks, as well as the economic policies which were taken by Asian countries.

There are already several good reviews in the literature on COVID-19 and its impact on the economy. Baldwin and Di Mauro (2020) is an excellent introduction to the literature, with a comprehensive collection of 14 papers on various topics on COVID-19 and economies. Brodeur et al. (2020) also have recent papers in this literature. Unlike these two references, this paper is a survey of COVID-19 and economies, with a particular focus on Asia.

2 History

SARS

The first case of SARS (Severe Acute Respiratory Syndrome) was reported in Guangdong Province, People's Republic of China, in November 2002, and an epidemic broke out in the province in the same month. The Chinese government did not officially report the outbreak to the WHO until February 2003. This delay in information disclosure led to delays in infectious disease control, and as a result, the Chinese government received a lot of international criticism.

In March 2003, the WHO issued a global alert, followed by the U.S. Centers for Disease Control and Prevention (CDC). A couple of days later, the WHO took the unusual step of is-

suing an advisory to refrain from travel to Guangdong Province and Hong Kong. The spread of SARS was seen in Toronto, Ottawa, San Francisco, Ulaanbaatar, Manila, Singapore, Taiwan, Hanoi, Hong Kong, and China. The WHO announced the successful containment of SARS in July 2003. The numbers of cases, deaths, time period and affected countries are summarized in Table 1.

MERS

MERS (Middle East Respiratory Syndrome) was first identified in September 2012 in a Saudi Arabian male patient who died of acute pneumonia and kidney failure. Later, in May 2015, a Korean man who had stayed in Bahrain returned to the Republic of Korea without knowing he had been infected with MERS, developed the disease, and was confirmed to have MERS. After that, a major outbreak occurred, mainly in hospitals, and the infection spread throughout Korea. More and more schools in South Korea had to close temporarily, and in June, the number exceeded 1,000 schools. In December 2015, the South Korean government declared an end to the MERS coronavirus based on WHO standards. The numbers of cases, deaths, time period and affected countries are summarized in Table 1.

COVID-19

COVID-19 was first identified in Wuhan, Hubei Province, the People's Republic of China in November 2019. In January 2020, the World Health Organization (WHO) declared a Public Health Emergency of International Concern (PHEIC). In January 2020, the World Health Organization (WHO) declared a Public Health Emergency of International Concern (PHEIC). Although countries around the world have imposed entry restrictions to prevent the influx of the new coronavirus, the high latency of the new coronavirus has resulted in an epidemic that has affected more than 180 countries and regions, including China, South Korea, Italy, Spain, Europe, Japan, and the United States. The numbers of cases, deaths, time period and affected countries are summarized in Table 1.

3 Understanding pandemic shocks

There is a broad agreement in the literature that SARS, MARS, and COVID-19 had significant impacts on the Asian economies. On the other hand, channels of their economic impacts seem to have been not the same. In this section, therefore, we examine how infectious diseases can affect the economy using the past examples of SARS, MERS, and COVID-19.

3.1 Supply or demand shocks?

We pay particular attention to whether a pandemic affects the supply side or the demand side of an economy. A demand-side shock is such that people's fear of infection reduces the demand for consumption in goods and services, and results in a decrease in firm's sales. A supply-side shock is such that non-pharmaceutical interventions such as lockdowns and self-restraint requests restrict the labor supply of workers, and thus decrease the total production of an economy.[1] Distinction of the two types of shocks is important because they could have different implications for economic policies.[2]

SARS

Keogh-Brown and Smith (2008) construct cross-country panel data analysis for the set of countries affect by SARS, and examine how SARS affects several economic measures of the countries. They find that there were significant economic impacts of SARS due to reductions in consumer spending in hotels, and restaurants. In the case of SARS, thus, the shock seems to be more related to the demand side. Also, Fernandes and Tang (2020) use transaction-level trade data of Chinese firms and find that firms in regions with local transmission of SARS experienced lower import and export growth. The vast majority of losses were experienced

[1] Kumar and Nataraj (2020) show that after the imposition of the national government's lockdown policy, time spent in residence increased significantly in India. In Japan, Watanabe and Yabu (2020) show that, in Japan, the government's announcements reinforced awareness and that people voluntarily refrained from going out.

[2] Guerrieri et al. (2020) shows that in a model with two goods as in this paper, a negative supply shock has an impact on the economy analogous to a negative demand shock when they are complementary.

in China and Hong Kong, with more minor effects in Canada and Singapore.

MERS

The impact of MERS on Asia was limited to South Korea. Similarly to SARS, the shock seems to be more related to the demand side. The shocks mainly hit the tourism industry including accommodation, food and beverage, and transportation sectors, because of the decrease of visitors (Joo et al. (2019)). In addition, consumer spending in retail, restaurants, and food services that require traditional, face-to-face shopping decreased dramatically, while there was an increase in e-commerce spending (Jung et al. (2016)).

COVID-19

In contrast to SARS and MERS, the supply shock seems to have played a major role as well as the demand shock in the case of COVID-19. It is empirically supported in the U.S., that this supply shock had a significant impact on the economy. Brinca et al. (2020) and Bekaert et al. (2020) report that roughly two-thirds of the decline in total hours worked in the U.S. in March and April 2020 can be explained by supply-side factors. While the analysis for Asian countries is limited, Watanabe (2020) study on whether the economic shock caused by the spread of a new coronavirus was caused by demand-side or supply-side factors. He reports that the demand shock had a relatively larger effect in Japan, unlike the U.S. nor the U.K.

Aum et al. (2020) estimate the causal effect of the outbreak on the labor market using difference-in-differences using the fact that Korea did not implement a lockdown. They find that a one per thousand increase in infections causes a 2 to 3 percent drop in local employment, suggesting that at most half of the job losses in the US and UK can be attributed to lockdowns and the rest of the job losses are due to people's fear of infections.[3]

[3]Kim et al. (2020) use monthly credit card data at the level of metropolitan cities and provinces to study changes in consumption patterns following the outbreak of COVID-19 in South Korea.

3.2 Modeling supply shocks

In the case of COVID-19, the supply-side is the key to understand the economic impacts of a pandemic. In particular, non-pharmaceutical interventions such as lockdowns and self-restraint requests by the government play a significant role to restrict the labor supply of households. Is there any rationale for such a government policy? In this section, we study the economic framework to understand non-pharmaceutical interventions.

During the COVID-19 crisis, there has been a great advancement in the economics literature on the so-called, *SIR-macro model*. The SIR-macro model introduces an epidemic model into a macroeconomic framework and describes the trade-off between the number of deaths due to infectious diseases and economic losses. The government's non-pharmaceutical interventions such as a containment policy improve the social welfare in this model because they internalize the externalities of the spread of the disease due to economic activity.[4]

We introduce one of the most popular baseline models, created by Eichenbaum et al. (2020). The core part is called the *SIR* created by Kermack and McKendrick (1927). It is to analyze the dynamics of infectious diseases. Eichenbaum et al. (2020) combine it with a macroeconomic model with no capital accumulation and individuals with different histories of viral infections.[5]

Consider an infinite period economy. In period t, people are divided into four groups according to their viral infection history: the susceptible S_t, the infected I_t, the recovered R_t, and the deceased D_t. We assume that the total population is $S_t + I_t + R_t + D_t = 1$. Each individual belonging to the group $i \in \{S_t, I_t, R_t\}$ is assumed to obtain the following utility

[4]Using the panel data of 152 countries, Goldstein et al. (2021) find that lockdowns tend to significantly reduce the spread of the virus and the number of related deaths. Ghosh (2020) documents similar evidence with Indian data.

[5]Atkeson (2020) is probably the first paper to use a SIR-type model to analyze economic losses after a new coronavirus outbreak. Other studies that use SIR models to analyze economic losses include Alvarez et al. (2020) and Hall et al. (2020).

from consumption C_t^i and labor N_t^i,

$$U = \sum_{t=0}^{\infty} \beta^t u(C_{t,}^i N_t^i). \tag{1}$$

The budget constraint faced by each individual is as follows

$$(1 + \mu_t) C_t^i = w_t N_t^i + \Gamma_t \tag{2}$$

Here, w_t represents wages as in the standard macro model, and μ_t represents the strength of the containment policy that restricts economic activities.

The government manipulates this containment policy μ_t to control economic activity and prevent the spread of the infectious virus, which is a particularly important aspect of this model. The containment policy μ_t is a form of taxation that suppresses economic activity in society, for example, the larger the value of μ_t, the more people will refrain from consuming, and as a result, production in the economy will be suppressed. For simplicity of the model, we assume that the government revenue collected by μ_t is equally transferred to each individual by Γ_t in the form of a lump-sum income transfer.

An essential part of this model is the part that describes the infectious dynamics of the population, called SIR, described below.

$$\text{(Susceptible)} \quad S_{t+1} = S_t - T_t \tag{3}$$

$$\text{(Infected)} \quad I_{t+1} = I_t + T_t - (\pi_r + \pi_d) I_t \tag{4}$$

$$\text{(Recovered)} \quad R_{t+1} = R_t + \pi_r I_t \tag{5}$$

$$\text{(Deceased)} \quad D_{t+1} = D_t + \pi_d I_t \tag{6}$$

In the above equation (3), the number of susceptible persons in $t+1$ period S_{t+1} is expressed as the number of susceptible persons in t period S_t minus the number of new infected persons T_t. In (4), the number of infected persons I_{t+1} in period $t+1$ is expressed as the number

of infected persons I_t in period t plus the number of newly infected persons T_t and then subtracting the number of newly recovered persons $\pi_r I_t$ and deceased persons $\pi_d I_t$. and the new deaths $\pi_d I_t$ are subtracted, where π_r and π_d are the probability that an infected person will recover and die, respectively. The equation (5) (or (6)) is then expressed as the number of recovered R_{t+1} (number of deaths D_{t+1}) in period $t+1$ is equal to the number of recovered R_t (number of deaths D_t) in period t plus the number of new recovered $\pi_r I_t$ (number of deaths $\pi_d I_t$) added together.

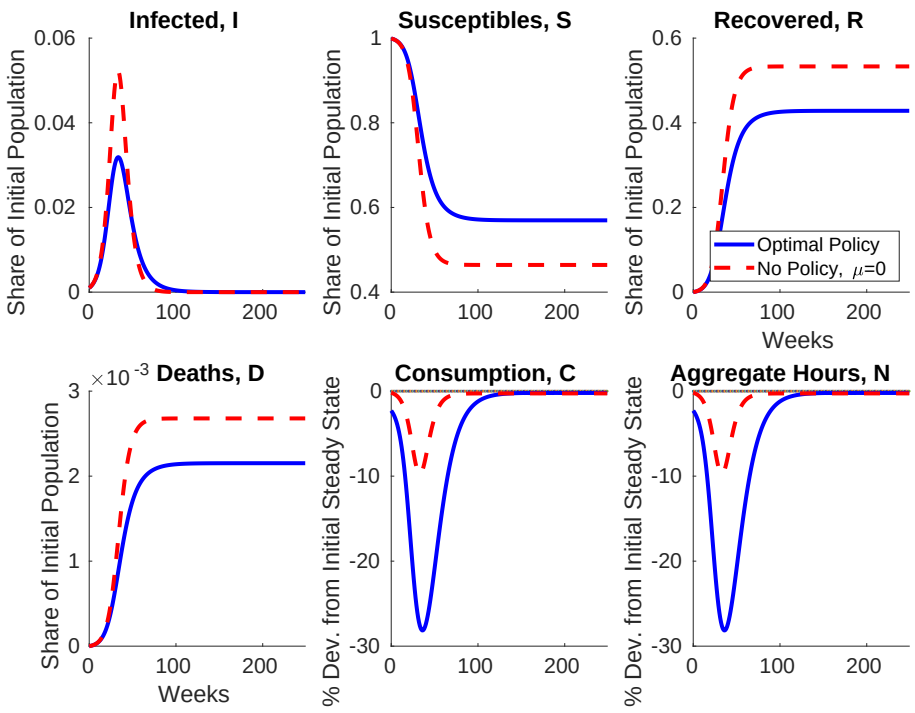
Furthermore, the key here is the movement of the number of newly infected people. The number of newly infected T_t depends on three terms the cross term of total consumption between susceptible and infected $(S_t C_t^S)(I_t C_t^I)$, the cross term of total working hours between susceptible and infected $(S_t N_t^S)(I_t N_t^I)$, and the cross term of the total number of susceptible and infected $(S_t)(I_t)$, which depends on three terms. The terms π_1, π_2 and π_3 are parameters that determine the impact of each term on the determination of the number of new infections.

$$T_t = \underbrace{\pi_1 (S_t C_t^S)(I_t C_t^I)}_{\text{infection by consumption activities}} + \underbrace{\pi_2 (S_t N_t^S)(I_t N_t^I)}_{\text{infection by labor}} + \underbrace{\pi_3 (S_t)(I_t)}_{\text{usual SIR part}} \tag{7}$$

In the standard SIR model, $\pi_1 = \pi_2 = 0$ in the above equation (7): The number of newly infected T_t depends only on the cross term $(S_t)(I_t)$ of the total number of uninfected and infected. However, in the *SIR-macro* model, the cross term of total consumption of susceptible and infected $(S_t C_t^S)(I_t C_t^I)$ and the cross term of total working hours $(S_t N_t^S)(I_t N_t^I)$ affect the number of newly infected. In other words, the SIR macro model assumes that infectious diseases spread through people's consumption behavior and labor market activities.

The assumption that infectious diseases spread through consumption and labor supply also defines negative externalities in individuals' economic activities, which are particularly important for the governments to determine containment policies. That is, economic activities such as consumption and labor supply that involve close contact with others may increase the utility of each individual, but they also have the potential to spread infection.

Figure 1: The evolution of a pandemic and its economic impacts



Note: This figure is created based on the code provided by Eichenbaum et al. (2020)

Therefore, in order to mitigate this negative externality, the government's interventions are justified, which restrain people's consumption and labor. Here, μ_t in equation (2) serves as a so-called Pigouvian tax to internalize the externality, making people pay higher prices for consumption and labor that spread the infection.

In this model, how should the government change its containment policy μ_t in order to maximize social welfare as the infectious disease spreads? The dynamics of infection and the optimal government containment policy in the SIR macroeconomic model of Eichenbaum et al. (2020) is illustrated by Figure 1. First, the upper left panel shows the number of infected people in the model. As in the usual SIR model, the number of infected people increases with time, peaks when a certain number of people become immune, and then decreases.

The difference between the solid (optimal policy) and dashed (no containment) shows that the number of infected people and the number of deaths move more slowly with the

optimal containment policy than with no containment policy. The cost of reducing the number of infections and deaths is a decline in aggregate consumption and working hours. In other words, in this SIR macro model, the optimal policy is to sacrifice economic activity in order to maximize social welfare, reducing the damage from infection.[6]

3.3 The trade-off between health and economy

While there are many papers that apply a SIR-macro model to the U.S., there is only a limited number of applications of it to Asian countries, as listed below. A SIR-macro model is particularly useful to determine the timing and duration of a lockdown policy.

China

Using a SIR-macro model, Chudik et al. (2020) simulate the trade-off between the epidemic and recession curves under a number of different social distancing and economic participation scenarios for China. They show that mandating social distancing is very effective at flattening the epidemic curve but is costly in terms of employment loss. They argue that, if targeted towards individuals most likely to spread the infection, the employment loss can be somewhat reduced.

Japan

Using a SIR-macro model, Fujii and Nakata (2021) examine alternative scenarios for ending the state of emergency in Japan. They update their analysis weekly showing the trade-off between the epidemic and the economic loss. Their model is relatively simpler than Eichenbaum et al. (2020), omitting household consumption and labor supply decisions.

With a SIR-macro model similar to Eichenbaum et al. (2020), Kubota (2021) analyzes Japan's second state of emergency policy, starting on January 2021. He derives an impli-

[6]Other studies that have used the SIR macro model to analyze the trade-off between economic activity and infectious damage from non-pharmacological intervention policies include Krueger et al. (2020), Jones et al. (2020), Aum et al. (2021), and Kaplan et al. (2020).

cation, similar to Fujii and Nakata (2021), that the Japanese government should extend this lockdown long enough to avoid another future lockdown, given the country's medical capacity.

Korea

Aum et al. (2021) extend the model of Eichenbaum et al. (2020) to incorporate individuals' occupational choices and work-from-home decisions to maximize income and minimize their fear of infection. In their model, occupations differ by wage, infection risk, and productivity loss when working from home. They calibrate the model to South Korea and the UK to compare South Korea's intensive testing and quarantine policy against UK's lockdown. They argue that South Korea's policies would have worked equally well in the UK, dramatically reducing both deaths and GDP losses.

Other countries in Asia

Atkeson et al. (forthcoming) use a simple SIR-macro model that incorporates feedback from disease prevalence to disease transmission through people's endogenous behavioral responses. They use cross-country data including many Asian countries for their calibration. Their result implies that humans endogenously reduce their interactions with each other in response to rising disease prevalence.

Hsu et al. (2020) extend a SIR-macro model to a multi-country, multi-sector Ricardian model of international trade with input-output linkages across countries. They study an optimal containment policy in such an environment in which containment policies may interact across countries. Their model is calibrated to cross-country data that include Asian countries. They find that the welfare gains under optimal policies are asymmetric across countries once the interactions through the input-output linkages are considered and that the welfare implications of optimal policies in open economies differ significantly from those in closed ones.

Table 2: Economic impacts of SARS and MERS in Asia

	SARS			MERS		
GDP losses	China	-3.00%	in 2003, quarter 2	South Korea	-0.7%	in 2015, whole year
	Hong Kong	-4.75%	in 2003, quarter 2			
	Singapore	-1.00%	in 2003, whole year			

Note: The GDP losses for SARS is based on the estimates in Keogh-Brown and Smith (2008). For MERS, we don't have a reliable estimate. The number for MERS is based on the South Korean government's cut-down of their economic growth forecast for 2015 to 3.1% from the 3.8% projected in the previous year (Jung et al. (2016)).

4 Economic impacts

In this section, we look at the economic impacts of SARS, MERS, and COVID-19 in Asian countries. While all of their impacts are significant, the economic impacts of SARS and MERS are concentrated in a limited number of countries. On the other hand, COVID-19 has given significant economic losses to the whole Asia economies.

4.1 Aggregate impacts of SARS and MERS

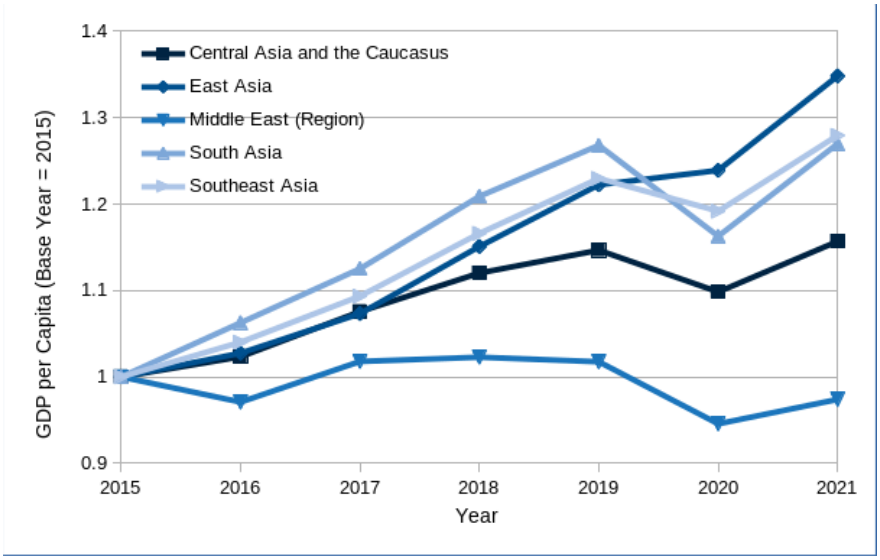
SARS

As documented in Keogh-Brown and Smith (2008), the economic losses of SARS are concentrated in China, Hong Kong, and Singapore as shown in Table 2. China and Hong Kong experienced a significant drop in their GDP in the second quarter of 2003 by 3% and 4.75% respectively. These drops are due to losses in tourism, food, and travel industries, and also a reduction in foreign direct investments (FDI). Hai et al. (2004) report a significant loss in China's tourism revenue due to a decrease in foreign visitors. Singapore's tourism industry was also hit severely by SARS lead to their GDP losses by 1% in 2003.

MERS

Table 2 also shows the economic losses of the MERS, which are mainly concentrated in South Korea. The shocks are on its tourism industry including accommodation, food and

Figure 2: GDP per capita in Asian economies around the pandemic



Note: The data are from the World Economic Outlook, International Monetary Fund (2021c). The numbers for 2021 are the projections.

beverage, and transportation sectors (Joo et al. (2019)), and also on retail, restaurants, and food services due to a drop in consumer spending (Jung et al. (2016)). The losses are amount to 0.7% of GDP in 2015.

4.2 Aggregate impacts of COVID-19

The economic impacts of COVID-19 are large and on the whole of Asia economies. It is evident in Figure 2 that, except for the Middle East region, the Asian economies had been on a steady growth path until 2019. In 2020, the COVID-19 shock had hit almost all the regions in Asia and twisted their growth paths. On the other hand, according to the predictions by International Monetary Fund (2021c), the COVID-19 shock will be short in duration, expecting rapid recoveries in most of the regions in 2021. This is because the distribution of the vaccine will restart a lot of economic activity. Thus, the COVID-19 shock can be looked like large, short-time impacts on Asian economies.

In terms of the prediction of the aggregate impacts of COVID-19 for Asian economies, there are a couple of papers in the earlier stage of the pandemic. McKibbin and Fernando

(2020) have predicted the impacts of different scenarios on macroeconomic outcomes and financial markets in an open-economy computable general equilibrium (CGE) model. Rees (2020) uses a multi-sector DSGE model to estimate the economic forces that explain the decline in economic activity in the United States, the Euro Area, Japan, and China in the first half of 2020. He then uses the model to project the trajectory of economic recovery. He finds that the US, EA, and Japan will each face a '98% economy' if half of the constraints faced by customer-facing service industries in the first half of 2020 persist, while the economic recovery in China is projected to occur more quickly.

4.3 Heterogeneous impacts of COVID-19 across workers

One thing we need to be especially careful about COVID-19 shocks is that their negative effects are not uniform among workers.

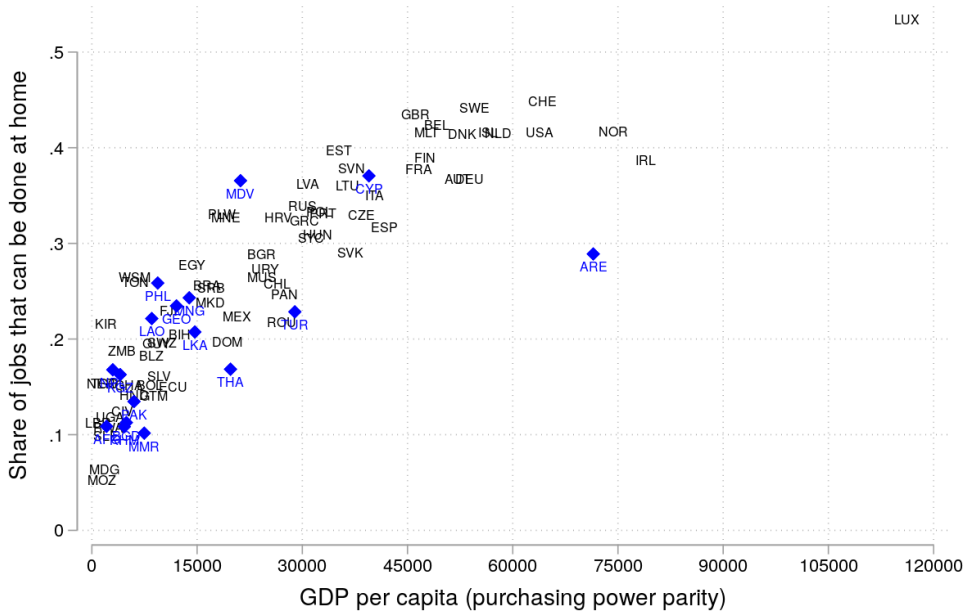
Work-from-home capability

Dingel and Neiman (2020) and Leibovici et al. (2020) recognized the importance of identifying occupations by COVID-19 shocks at the early stage of the pandemic and attempted to identify occupations at risk by applying the *task approach* developed in the field of labor economics.[7] Their method is to classify jobs into those that can be capable to work from home (WFH) and those that cannot, based on the nature of their task. They use O*NET, a data set containing task information for each job in the U.S. They predicted that occupations such as construction workers, restaurant workers, and janitors are more exposed to risk.

Applying their work-from-home analysis to cross-country data, Dingel and Neiman (2020) study how the share of jobs that can be done at home is correlated with GDP per capita adjusted for purchasing power parity (PPP). They find that the share is positively correlated with GDP per capita across countries as shown in Figure 3. This implies that the fractions of occupations that can be performed at home are larger in the developed country and that

[7]The task approach was established in the field of labor economics by Autor et al. (2003) et al.

Figure 3: GDP per capital and Dingel and the teleworkability index



Note: The figure is created using the code in Dingel and Neiman (2020). The blue diamonds indicate Asian countries, which include Afghanistan, Bangladesh, Cambodia, Cyprus, Georgia, Kyrgyzstan, Lao People's Democratic Republic, Maldives, Mongolia, Nepal, Myanmar, Pakistan, Philippines, Sri Lanka, Thailand, Turkey, and United Arab Emirates.

developing economies and emerging markets may face an even greater challenge in continuing to work during periods of stringent social distancing. The developing countries in Asia are indicated by the blue diamonds in the Figure 3 that also exhibit a relatively low share of work-from-home jobs.[8]

Okubo (2020) uses unique survey data in Japan and shows which occupations are suited to work-from-home. He reports that the use of telework increased from 6% in January to 10% in March and reached 17% in June 2020. He also notes that the level is still remarkably lower in Japan than that of other developed countries (e.g. 37% in Europe).

Morikawa (2020) uses data from his original survey in Japan conducted in June 2020. He studies the prevalence, frequency, and productivity of working-from-home practices during the COVID-19 pandemic in Japan. His result shows that the mean work-from-home produc-

[8]Saltiel (2020) extend Dingel and Neiman (2020)'s analysis to cover more developing countries. In the study, Armenia, China, Georgia, Laos, and Vietnam are included from Asia.

tivity relative to working at the usual workplace was about 60% to 70%, and it was lower for employees who started work-from-home practices only after the spread of the COVID-19 pandemic.

Heterogeneous impacts across workers

Mongey et al. (2020) took the analysis in Dingel and Neiman (2020) one step further and found that the types of jobs affected by the lockdown are concentrated in less-educated and lower-income groups, using the data from the Current Population Survey (CPS) and the Panel Study of Income Dynamics (PSID) in the U.S. They have also shown that the classification of affected jobs predicted by Dingel and Neiman (2020) was actually correct in the data by using CPS hours of work data in March 2020.

A number of studies find the results for Asian countries which are similar to those in Mongey et al. (2020). Kikuchi et al. (2021) is one of the earlier papers that documents heterogeneous changes in employment and earnings in response to the COVID-19 shocks, observed in various data sources during the initial months after the onset of the pandemic in Japan. They find that the most severely hurt by the COVID-19 shocks has been a group of female, contingent, low-skilled workers, engaged in social and non-flexible jobs and without a spouse of a different group. Lekfuangfu et al. (2020) apply work-from-home indices to the labor force survey of Thailand. They find that low-income families tend to face a disproportionately larger risk of income/job loss from lockdown measures. Lee et al. (2020) use microdata on mostly poor and non-migrant workers in Delhi, India, and find that weekly income and days worked fell by 86.2 and 72.2 percent, respectively, by mid-May 2020.

The effects of COVID-19 are not just on individuals' economic status. Several studies find the effects have also changed individuals' risk attitudes and behaviors in Asian countries. Bu et al. (2020) use variation in exposure across different Chinese cities and provinces to measure the impact of the COVID-19 pandemic on subjects' willingness to take the risk. They find that subjects' allocations of wealth to hypothetical risky investments decrease

monotonically based on the strength of their exposure to the pandemic. Mehrotra (2020) conduct an event study analysis that indicates a sustained decline in conflict after the first COVID-19 case is reported, driven by a decrease in religious conflict and public protests. Poblete-Cazenave (2020) analyzes the effect of lockdowns on criminal activity in the state of Bihar, India, and finds that that lockdown decreases aggregate crime by 44 percent.

4.4 Firms, production networks, and international trades

The decline in demand caused by the COVID-19 shocks makes the survival of businesses, especially small and medium-sized businesses, significantly more challenging. The negative shocks are possibly further amplified through domestic and international production networks.

Firms facing COVID-19 shocks

At the early stage of the pandemic, Chetty et al. (2020) use transaction data of small and medium-sized businesses in the U.S. to show that the decline in consumption associated with the spread of COVID-19 had a significant negative impact on the continuation of small and medium-sized businesses and the employment of their employees.

There are a couple of studies that document the effects of COVID-19 shocks on firms in Japan during the pandemic. Kawaguchi et al. (2020) use differences in the timing of self-restraint requests by prefectures to show that the declaration of a state of emergency and the accompanying requests for self-restraint reduced the expectations of small business owners for the survival of their businesses. Also, Miyakawa et al. (2021) similarly use data from Japan to show that the reduction in people's mobility associated with the spread of COVID-19 increased firms' exits by 20%.

In addition, a couple of studies from Japan confirms that firms are changing their behaviors to adjust to COVID-19 shocks. Honda and Uesugi (2021), using quarterly data on publicly-traded firms in Japan, find that the COVID-19 crisis has had a substantial impact

on corporate cash management strategies and the results are consistent with the precautionary motive theory for cash holdings. Yamori and Aizawa (2021) investigate credit guarantee trends in relation to the first wave of the COVID-19 crisis and find that the spread of COVID-19 led to increased use of credit guarantees. In terms of individual business types, there was a particularly marked rise in the usage of credit guarantees by companies in the restaurant industry, which has been catastrophically affected by the pandemic.

Production networks

The recent advancement in the production network literature is helpful to understand the spread of COVID-19 economic shocks across firms. Baqaee and Farhi (2020) provide a neoclassical model of non-linear production networks and show how nonlinearities associated with complementarities in consumption and production amplify the effect of negative supply and demand shocks. Their quantitative results suggest that nonlinearities may amplify the impact of the COVID-19 shock by between 20% – 100%, depending on the horizon of analysis and the size of the underlying shocks.

There are a couple of empirical studies in Japan in the context of production networks. Inoue and Todo (2020) simulate an agent-based model to the actual supply chains of nearly 1.6 million firms in Japan and find that, when Tokyo is locked down for a month, the indirect effect on other regions, through production networks, would be twice as large as the direct effect on Tokyo, leading to a loss of 5.3% of its annual GDP. Inoue et al. (2020) further investigate this network effect by studying the role of upstreams and loops by decomposing supply-chain flows into potential and circular flow components.

In a somewhat different context, Murakami et al. (2020) explore the potential impacts of the COVID-19 pandemic on the welfare of remittance-dependent households using a dataset collected in heavily remittance-dependent regions in the Philippines prior to the outbreak. These studies show that people's networks through family relationships could be a passthrough of economic shocks.

International trade

International trade is a channel that possibly spread COVID-19 shocks across firms in different regions. At the early stage of the pandemic, Baldwin and Tomiura (2020) summarize possible negative impacts of COVID-19 on the world economy through the international trade system.

Hayakawa and Mukunoki (2021) use monthly data on worldwide trade from January to August in 2019 and 2020 and estimate the gravity equation by employing various variables as a proxy for the COVID-19 damage. They find significant negative effects of COVID-19 on the international trade of both exporting and importing countries. They also find that heterogeneous effects across industries: The negative effects on non-essential, durable products persist for a long time, whereas positive effects in industries providing medical products were observed.

In Asian countries, Friedt and Zhang (2020) investigate three different channels that affect Chinese exports: the domestic supply shock; the international demand shock; and the effects of the global value chain (GVC) contagion. They find that Chinese exports declined in response to the Coronavirus outbreaks mainly through the impact of GVC contagion.

The COVID-19 economic shocks can be spread also through multi-national firms. Zhang (2021) uses aggregate-level data on Japanese multinational corporations in major host countries and regions and finds that lockdown and containment policies in host countries had large negative impacts on the sales and employment of Japanese multinational corporations.

5 The economic policy response to COVID-19 shocks

In response to the sheer magnitude of COVID-19 shocks, countries are implementing a variety of policy responses. These policy responses include a) employment subsidies, b) extension/increase in unemployment benefits, c) increase in welfare payments/coverage, d) unconditional/conditional cash transfers to workers/households, and e) subsidies/loan-guarantees

to (small) firms.

5.1 Theoretical backgrounds

The optimal policy response to supply shocks

Guerrieri et al. (2020) is one of the earlier papers that provides a theoretical framework to understand supply shocks in a multi-sector New-Keynesian model. They argue that standard fiscal stimulus can be less effective than usual because the fact that some sectors are shut down mutes the Keynesian multiplier feedback. The optimal policy in their framework is closing down contact-intensive sectors and providing full insurance payments to affected workers can achieve the first-best allocation, despite the lower per-dollar potency of fiscal policy.

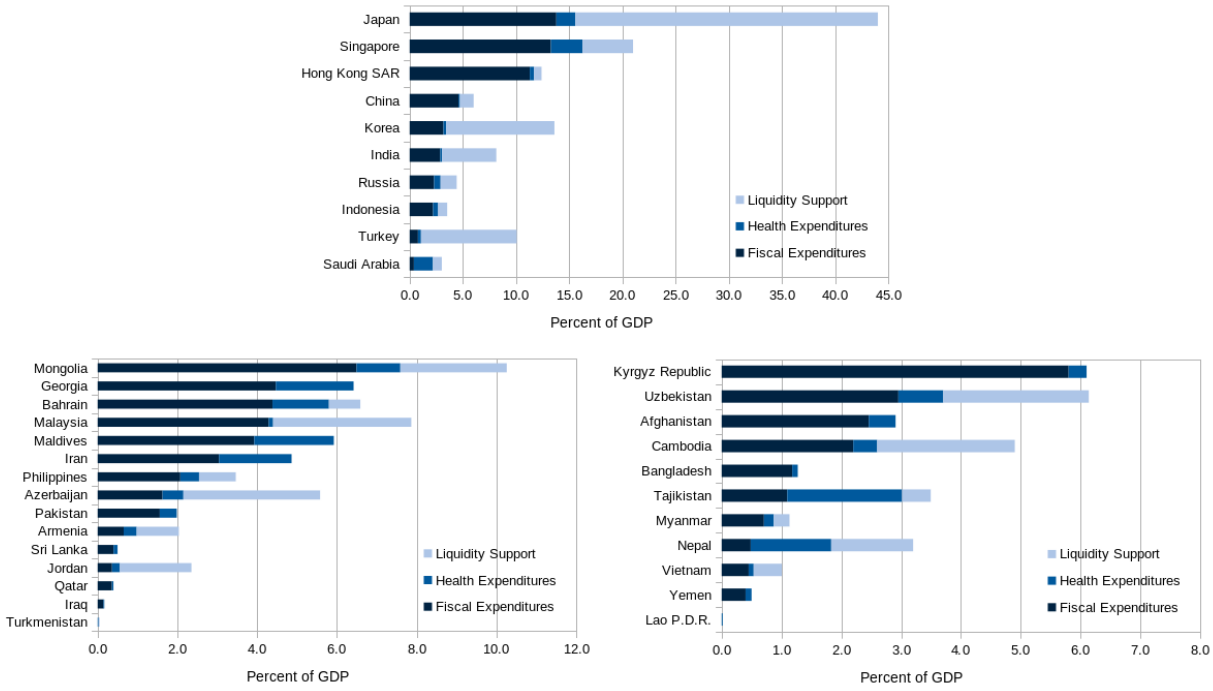
Lockdown and fiscal policies

Since the non-pharmaceutical interventions are one of the sources of the supply shocks, there is an optimal combination of containment and fiscal policies. Kaplan et al. (2020) explore this path by integrating an expanded SIR model into a macroeconomic model with occupational and sectoral heterogeneity. They evaluate the U.S. fiscal policy response implemented in the Spring of 2020 (CARES Act) and find that it succeeded in mitigating economic welfare losses by around 20% on average while leaving the cumulative death count effectively unchanged. They also find that the stimulus package made the economic consequences of the pandemic more unequal. This is because middle-income households gained little from the stimulus package but will face a higher future tax burden.

Employment subsidies or unemployment insurance?

There was a debate on which the government should rely on, employment subsidies or unemployment insurance, in order to mitigate COVID-19 shocks. Noting that the shocks caused

Figure 4: The fiscal expenditures relative to GDP in Asian countries



Note: The data are from the Policy Responses to COVID-19, International Monetary Fund (2021b).

by the current recession are temporary, Fujita et al. (2020) proposes that employment subsidy policies should be used to maintain the employment relationship between firms and workers in order to avoid damaging the firm-specific human capital in the economy. On the contrary, if shocks to specific occupations are prolonged or permanent, excessive employment subsidies may prevent workers from moving between occupations, leading to misallocation in the labor market. In fact, Giupponi and Landais (2018) use data from Italy to show that employment subsidies prevent workers from reallocating when shocks are prolonged.

5.2 Economic policy responses in Asian countries

Responding to COVID-19 shocks, governments in Asian countries greatly increased their fiscal expenditure. On the other hand, the amount of fiscal expenditures varies across countries.

Variations the fiscal response of governments

Figure 4 shows the amount of a) (general) fiscal expenditures, b) health expenditures, and c) liquidity support to firms, relative to GDP, for each country. As shown, there is a great extent of variations across countries: Developed countries seem to spend more, and developing/emerging countries spend less. These variations potentially widen the inequality in the world, because those in poor countries are not likely to be supported by their government even if they are hit by COVID-19 shocks

So, what are the determinants of the fiscal response of governments? Balajee et al. (2020) study the fiscal response of governments from around the world including Asian countries and its main determinants. They find that sovereign credit rating is one of the most critical factors determining their choice. Thus, living in a wealthier country that has a higher credit rating indeed helps the residents to ensure against COVID-19 shocks.

Evaluations of economic policies

There are still only a few research in Asia that evaluate the effectiveness of the government's policies during the pandemic.

Kubota et al. (2020) is one of the few studies that documents households' spending responses to a stimulus payment in Japan during the COVID-19 pandemic. The Japanese Government launched a universal cash entitlement program offering a sizable lump sum of money to all residents to alleviate the financial burden of the pandemic on households. Using a unique panel of 2.8 million bank accounts, they find an immediate jump in spending during the week of payments, followed by moderately elevated levels of spending that persist for more than a month.[9]

Kim and Lee (2020) analyze a South Korean program, which provided vouchers redeemable only at small local businesses. They find that, due to the program, over 30%

[9]Kaneda et al. (2021) use the data of personal finance management software and estimate households' spending responses to a stimulus payment in Japan during the COVID-19 pandemic.

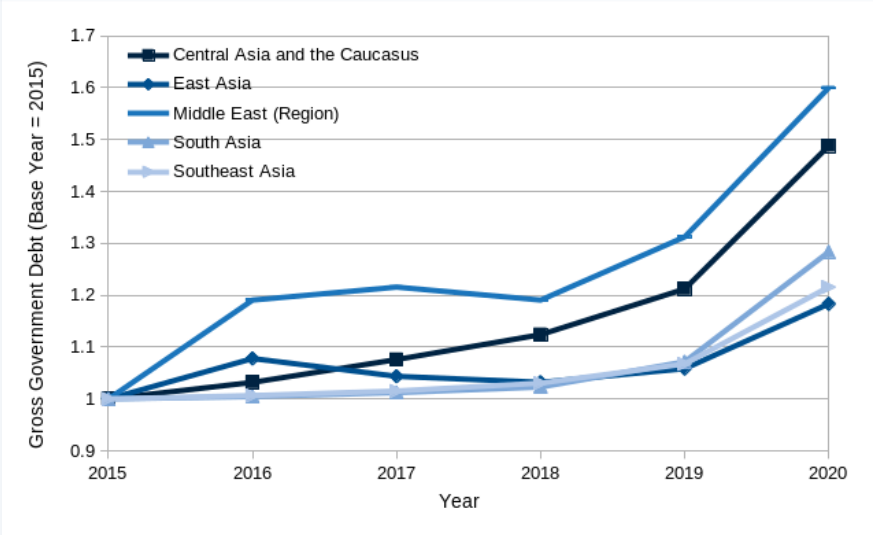
of households across all income groups increased their food and overall household spending, but the usage restriction may have affected consumer choice as well as competition among businesses. They argue that, while the employment and sales of small businesses improved, the program's fiscal sustainability is in question because of the large tax exemption.

Hoseini and Beck (2020) use monthly and daily transaction data from Iran, disaggregated by provinces, good and service categories, and retail store segments to gauge the impact of government emergency loans on consumption patterns. They find that emergency loans are positively related to higher consumption of non-durable and semi-durable goods, suggesting that the emergency loans were predominantly used for their intended purpose.

In Japan, Kawaguchi et al. (2020) has been studying the impact of sustainability benefits and employment adjustment subsidies on the business survival expectations of small and medium firms.

5.3 Debts accumulations

Figure 5: Gross government debt in Asian economies



Note: The data are from the Global Debt Database, International Monetary Fund (2021a).

Finally, as a consequence of a significant increase in the fiscal expenditures of governments, Asian countries have started accumulating government debts without exception. As shown in Figure 5, the increases are large, which even amount to more than a 20% increase in gross government debt, becoming a huge burden in some countries. By integrating a standard epidemiology model into a sovereign default model, Arellano et al. (2020) study how default risk impacts the ability of these countries to respond to the epidemic. They find that the possibility of lockdown-induced debt crises, in turn, results in less aggressive lockdowns and a more severe health crisis. They argue that the social value of debt relief can be substantial because it can prevent the debt crisis and can save lives.

6 Conclusion

In this paper, we study the economic impacts of SARS, MERS, and COVID-19 that Asian countries have experienced, based on the existing literature. We find that a supply shock plays an important role during the COVID-19 pandemic, which generated significant impacts on Asian economies. We also find that many Asian countries have significantly increased their fiscal expenditures during the pandemic. Some of them potentially had been effective to mitigate the COVID-19 shocks. Evaluations of the economic policies implemented in Asian countries during the pandemic are still left for future work.

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