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Measures Against the Spread of COVID-19: Simultaneous International Action and Lockdown Postponement

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ABSTRACT

This study discusses city lockdowns in response to the outbreak of COVID-19.

It concludes that simultaneous lockdowns are optimal when there is a high number of travelers from abroad and that either independent or simultaneous lockdowns are preferable when there is a high number of people traveling internally from rural to urban areas.

When the number of infected people is low, the government should respond by requesting self-restraint. Generally, however, policymakers have the incentive to postpone lockdown measures.

If there is significant inward travel from abroad, leaders may hesitate to implement a lockdown because there is a chance that infection is already spreading due to the fact that infected people from other countries have already flown in; this means that lockdown measures of that kind, even if done in a hurry, would not accomplish very much. If there is significant migration from rural to urban areas, leaders may hesitate to implement a lockdown because these kinds of measures in urban areas hinder local employment and destroy domestic supply chains.

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Introduction

National governments have been unable to stop the spread of COVID-19 and the resultant economic losses since the outbreak began in late 2019. As of April 5, 2020, the WHO has identified more than 900,000 cases (from 700,000 on March 30, 2020) and about 45,000 associated deaths (from 35,000 on March 30, 2020). The highest number of infected people is in Europe and the Eastern Mediterranean at about 450,000, followed by the Americas at about 150,000 and the Western Pacific at about 100,000. There are 204 infected countries/regions.

Reporting similarly dire figures, Johns Hopkins University's health center, as of April 5, has reported more than 1.2 million cases, over 65,000 deaths, and about 230,000 having already recovered.

Early government efforts to combat the spread include city closures (lockdown). These closures involve restricting the activities residents in the target area can engage in; generally, all but essential activities are prohibited.

The first of these kinds of closures was in Wuhan. China declared a city-wide lockdown on January 23. Italy began city lockdowns on February 22; all commercial services and activities were gradually banned nationwide between March 12 and March 25. After the WHO formally declared the spread a pandemic on March 11, borders have been closed, access to infected areas has been restricted, and cities have been shut down. In Japan, schools have been closed nationwide and the government has banned the use of public transport; people from 73 countries are being refused entry. The response in the United States has varied from state to state. In New York, all non-essential businesses have been ordered to close. In Texas, Hawaii, and New Mexico, citizens have been asked to stay at home unless there is a serious emergency. In Peru, all borders—land, sea, and air—have been closed. Citizens in Chile were banned from leaving home at night. Non-essential Brazilian businesses were all forced to close. Everyone in Colombia has been required to stay at home around the clock. On March 16, the EU issued a 30-day ban on all unnecessary travel while the UK banned all non-essential workers from working outside of their homes. India has shut down public transportation entirely. Thailand has banned the elderly and children from going out for any reason. The only businesses allowed to remain open in South Africa are hospitals and catering services. Egypt has eliminated movement at night and closed all retail stores. New Zealand has restricted non-emergency outings. Spain closed its borders after declaring an emergency. The metropolitan area around Manila in the Philippines has been closed.

As of April 3, the incubation period for COVID-19 is unknown. However, the WHO has suggested that it is likely about 14 days. As demonstrated above, the substance of lockdowns varies by country. Some countries are more strict than others, handing down fines or even jail time for disobeying. There are partial lockdowns, such as with night curfews, that restrict some activities. Full lockdowns restrict almost all activities. It is said that even a full lockdown,

however, will not disrupt basic social infrastructure. In the context of this study, lockdown means full lockdown, including travel prohibition.

Several studies have estimated the economic impacts of the pandemic. For example, the OECD (2020) predicted in early March that if outbreaks of COVID-19 spread widely in Asia and advanced countries in the northern hemisphere, the global real GDP growth rate for 2020 would be 1.4%, significantly lower than the 2.9% estimated before the pandemic began. McKibbin and Fernando (2020) indicate that in their worst scenario, in which all countries are hit, the spread of COVID-19 would reduce the GDP of China, Japan, the United Kingdom, and the United States by 6.2%, 9.9%, 6.0%, and 8.4%, respectively. However, these two studies used macroeconomic econometric modeling at the national level; they do not incorporate complex inter-firm linkages. This could mean that, according to Inoue and Todo (2019), the estimates of these two studies may be significantly undervalued.

According to the Asian Development Bank (2020), GDP growth will be 2.2% in 2020 (compared to 5.2% in 2019). The ADB now predicts, as a result of the pandemic, a $4.1 trillion loss to the global economy and a negative 5% impact on global economic growth.

It is worthwhile, for context, to evaluate some past pandemics. Between 1976 and 2019, there were more than 30 Ebola outbreaks (Huber, 2018). The SARS outbreak began in January 2002 and was contained by July 2003; SARS had a relatively short incubation period, so through strict patient isolation, the spread was quickly stopped. MERS, which was first identified in September 2012, is still around, though it is far less severe than SARS was. The spread of COVID-19 can be cut short through the isolation of infected individuals (World Health Organisation, 2020). The WHO declares the termination of an outbreak when there has not been a viral case after twice the incubation period.

It is widely agreed upon now that COVID-19 constitutes a global pandemic and that the global infection rate is still rising, though there is some disagreement over how severe it will ultimately be. Marc Lipsitch argues that by 2021, between 40% and 70% of the global population will have been infected. However, many infected individuals have been only mildly symptomatic or subclinical (Hamblin, 2020).

Model

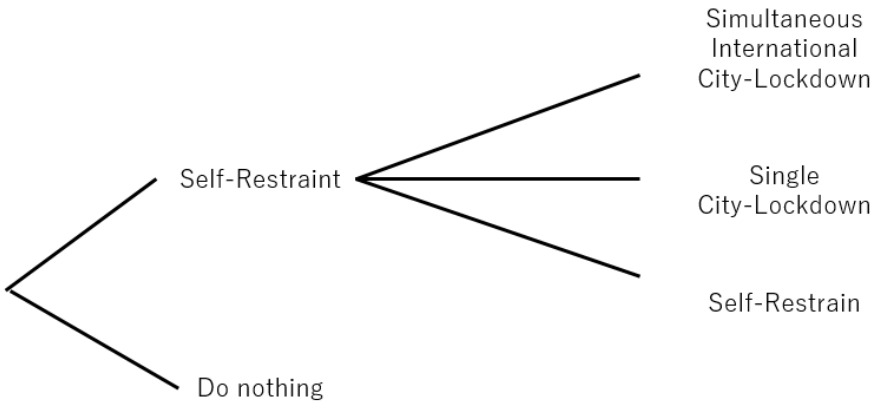
This study examines the decision-making process of policymakers for full lockdowns. Policymakers decide whether to implement a lockdown by comparing long-term disadvantages of economic damage and reduced utility of infected people with the long-term advantages of resuming early economic activity by suppressing the spread of the virus.

Both independent lockdowns and international simultaneous lockdowns are assumed to be implemented in urban areas. Independent lockdown is when a particular city locks down for a

period of time without coordinating with outside actors. International simultaneous lockdown aims to control the global spread of infection worldwide by coordinating with outside actors. Generally, lockdown reduces the number of infected people.

Independent lockdowns stop internal consumption in urban areas. Urban areas can still consume through importing, even if nearby rural areas do not produce the product. Simultaneous international lockdown, however, makes it difficult to import, so consumption in urban areas is greatly reduced. Therefore, a simultaneous international lockdown has a greater economic impact than an independent lockdown. In self-restraint, lock-out alone, and simultaneous lockdown in international cooperation, the negative economic impact of lockdown is as follows: domestic self-restraint with the smallest effect, international simultaneous lockdown with the greatest effect, and independent lockdown in between them.

Policymakers make two-stage decisions. In the first stage, governments choose between "requesting self-restraint" and "doing nothing." In the next stage, they select either "independent lockdown" or "international simultaneous lockdown." It is assumed that Country A has two areas—urban areas and rural areas—while Country B has its own imports/exports through the travel of infected persons, and vice versa. It is also assumed that decision-makers know the rate of infection is rising.



Policymakers solve long-term optimization problems to maximize the utility of the people. Policymakers implement a lockdown if they are convinced of the prolonged internal spread of the virus (i.e., if it is difficult to end the outbreak with current policies). It is also assumed that the likelihood of a lockdown rises alongside the number of infected people, the level of internal migration, and the number of travelers from abroad.

This means that policymakers' expectations, attitudes, and optimism about the natural end of the infection affect whether the lockdown is implemented. Even if lockdowns result in significant economic damage, policymakers predict that the long-run economic impacts are better with a lockdown in place.

The decision maker's model changes from a finite repetition game to an infinite repetition game. It is well-known that changing to an infinitely repetitive game leads to coordination (Pedro & Guillaume, 2016; Engle-Warnick & Slonim, 2006; Dal Bó & Frechette, 2017). Postponing lockdowns can lead to more severe situations and further affect policymakers' expectations and decisions. Lockdown can also be triggered by a rising belief in prolonged infection.

The first stage has two early decisions, "requesting self-restraint" and "doing nothing," when the magnitude of the crisis is small. The impact on the domestic economy after requesting self-restraint is smaller than the impact of a lockdown without the early request.

In the second stage, policymakers are assumed to make a decision on lockdowns every day. It is considered a super game. That is, the first-stage decision is a one-time decision while the second-stage decision assumes the possibility of a finite or infinite repetition game.

If the timing of the lockdown is incorrect, it affects future election results; therefore, policymakers aim to execute the lockdown at the optimal time. However, policymakers want to avoid prolonged lockdowns, as they reduce the utility of the people.

As a result, according to the model used in this study, implementing a large-scale lockdown is difficult for policymakers in any country; they generally procrastinate. Lockdown postponement may result in a more severe global spread.

$$max \sum_{t=1}^{\infty}\{\frac{L_{ui}}{N_u}[u_{ui}(w_u - h(e)) - u_{Dui}] + \left(1 - \frac{L_{ui}}{N_u}\right)\underline{u}\} + \sum_{t=1}^{\infty}\{\frac{L_{ri}}{N_r}[u_{ri}(w_r - h(e)) - u_{Dri}] + \left(1 - \frac{L_{ri}}{N_r}\right)\underline{u}\} \quad (1)$$

$$(R_{ui}(eL_{ui}) - w_u L_{ui}) + \mu(R_{ri}(eL_{ri}) - w_r L_{ri}) \geq 0 \quad (2)$$

$$L_{ui} = L_{ui}(\theta_{ui}(\rho_{Dui}, \rho_{Fui}), \gamma_k), \quad L_{ri} = L_{ri}(\theta_{ri}(\rho_{Dri}, \rho_{Fri}), \gamma_k)$$

$$u_{Dui} = u_{Dui}(\theta_{ui}(\rho_{Dui}, \rho_{Fui})), \quad u_{Dri} = u_{Dri}(\theta_{ri}(\rho_{Dri}, \rho_{Fri}))$$

Equation (1) is a function of the policymaker and the utility of the people as workers. The objective function of the decision-maker is to maximize the utility of urban and rural people. The index u represents an urban area; r represents a region; N is a worker; L is a worker who is not infected with the coronavirus; the worker receives wages w for work and determines their level of effort e; h is the monetary value of effort; $\underline{u}$ is the utility of infected workers; the worker L is a decreasing function of the number of infected persons in the country θ; θ is an increasing function of the number ρ_D of people migrating from rural areas to urban areas in the country; θ is also an increasing function of the number of travelers ρ_F from abroad.

A lockdown not only harms employment but also worsens the standard of living. γ_k is a type of policy decision, such as requesting self-restraint or lockdown. Policies such as service suspension have a direct impact on employment during the policy implementation period.

$u - u_D$ is individual utility after the policy is implemented. Suppose an additive utility function is obtained by subtracting u_D from the utility u of each individual due to economic deterioration stemming from government policies. The decrease in utility u_D resulting from the policy is an increasing function of the number of infected people in the country θ.

Equation (2) is a function of a company, where *R (eL)* is the income from each worker's effort, and the company's profit is the company's income minus wage payments to employees. μ is the degree of connection between urban and rural supply chains. The larger μ is, the more rural areas are affected by economic fluctuations in urban areas. Equation (2) is the sum of the profits of urban and local enterprises.

Policymakers solve the optimization problem of equations (1) and (2). The lower the number of COVID-19 infections, the greater L increases the utility of the population and the profits of the company. The reduction in utility associated with infection is a function of the number of people infected and the number of domestic and international migrants. By solving equation (4) below, policymakers can maximize the utility of the people in the long run.

$$U_{ij}(h^{\infty}) = U_{ij}\big(\alpha(1)\big) + \delta(\tau, t_r)U_{ij}\big(\alpha(2)\big) + \delta^2(\tau, t_r)U_{ij}\big(\alpha(3)\big) + \delta(\tau, t_r)^{t-1}U_{ij}\big(\alpha(t)\big) = \sum_{t=1}^{\infty}\delta^{t-1}U_{ij}(q(t)) \quad (3)$$

δ is the discount factor; τ is the degree of belief that policymakers will prolong the spread of infection; δ is a decreasing function of τ—the stronger the belief, the smaller the discount factor. t_r is a variable that determines the status of COVID-19 as a pandemic, according to the WHO.

Index *j* means country A and country B. Strategy C means that a lockdown is in place. Strategy D means that a lockdown is not in place. If Country A, the home country, locks down, and Country B, the other country, does the same, the number of infected people θ and u_D will decrease through a decrease in the number of travelers ρ_F from abroad. Individual utility increases in both Country A and Country B.

In other words, if both Country A and Country B choose lockdown and engage in international simultaneous lockdown, the infection will be suppressed and both will have high utility. If countries A and B lock down simultaneously in a way that bans travel, intentionally or otherwise, it is highly effective in preventing the spread. If only one country locks down, the utility will be lower. The utility is low if both countries choose only the request to refrain from going out, as they cannot decisively control the spread.

As the discount factor becomes smaller, the Nash equilibrium changes from "do not lockdown," which is the previous Nash equilibrium, to "lockdown."

Causes of Lockdown Postponement

1) Decision-maker's optimism: Change of game from finite to infinite repetition and increase in belief τ for the prolonged increase in discount factor δ.

Early decision-makers are optimistic about the end of the spread of infection and have no reason to lock down. They expect that a request for self-restraint can control the spread. However, as the outbreak becomes more severe even after requests for self-restraint and the spread of infection to rural areas through domestic migration increases, the spread of infection

cannot be stopped by just measures in the urban area. It becomes also necessary to take measures in all regions, causing national issues. Daily life activities such as school and work are threatened and economic activity slows to a crawl—a large-scale policy is required.

A study that simulates the effects of lockdown (Inoue & Todo, 2020) shows that the lack of a lockdown can lead to the virus spreading to rural areas. However, a lockdown can have a significant negative economic impact on rural areas through the domestic supply chain.

This study predicts that a two-week lockdown would have economic consequences more severe than those of the Lehman Shock, which pushed economic growth down to negative 5%. A two-week lockdown in Tokyo would reduce the GDP in Tokyo by 2.2 trillion yen and, outside Tokyo, by 1.6 trillion yen. If the lockdown lasts one month, Tokyo will lose 9.3 trillion yen while the area around Tokyo will lose 18.5 trillion yen. As the lockdowns lengthen, the impact on rural areas exceeds the impact on urban areas.

According to a Cabinet Office report (2020), the effects of a two-week lockdown would result in the same economic loss as the Great East Japan Earthquake (for more information on the economic impact of the Great East Japan Earthquake, see: Tokui et al., 2012). The report states that the earthquake reduced real GDP by 1.25% to 2.25%.

Excessive optimism among policymakers has largely disappeared. It is assumed that the outbreak will not be stopped in the short term. Policymakers will begin to make decisions based on a long-term perspective. Lockdowns were postponed largely as a result of short-term optimism. With a long-term perspective, the game changes from the expectation that the game will converge a finite number of times to the perception that the game will continue indefinitely. Lockdowns are implemented when the game changes to an infinitely repeated game.

2) The number of travelers from abroad: ρ_F

Policymakers believe that if the inflow of people from abroad remains high, the effect of lockdown alone in their own country is small. In other words, even if an independent lockdown reduced the spread to some degree, there would be further outbreaks on account of the influx of infected people from abroad. Thus, they hesitate to lockdown, as the benefits of revitalizing economic activity through controlling the spread are, under these circumstances, less than the disadvantages of the economic impact of locking down.

3) The number of domestic migrants from rural to urban areas: ρ_D

If there is significant travel from rural to urban areas, in addition to shutting down public transport, the prohibition of automobile travel into cities becomes an issue. This is necessary for lockdown methods in countries where there is significant travel between cities and rural areas. These methods can seriously harm rural workers. Additionally, the inflow of food and

other goods into the city is reduced, seriously impacting local companies that rely on urban consumption. The method seriously harms the domestic supply chain network.

Lockdowns in urban areas are important when there is significant travel between rural and urban areas. Reducing contact between urban and rural people is important for controlling the spread nationally, meaning lockdown is a valid method even in small urban areas. Importantly, since urban areas are dense and have the potential for rapid spread, locking down urban areas is more important than locking down rural areas for reducing the spread on a national level.

Postponing lockdown may result in a far more severe global spread.

International Simultaneous Lockdown

If a country accepts foreign travelers on a large scale, it is possible that despite an independent lockdown, the outbreak would continue. Thus, independent lockdowns are significantly less effective at entirely eliminating the threat. Policymakers only implement lockdowns when infection can be reliably suppressed; they aim to end the outbreak with a single lockdown.

For this reason, international coordination and simultaneous lockdown are important for countries with significant travel from abroad and a high domestic infection rate.

In countries with little domestic migration and a low rate of infection, there is little need to lock down at the same time as other countries. In countries with an infection rate small enough to prevent the spread through simple stay-at-home measures, such a request is sufficient. These countries are generally small countries with few overseas travelers for which the long-term economic benefits of not locking down exceed the benefits of locking down.

Discussion

This study presented a model in which policymakers use a two-stage repetitive game to choose from three options based on the current extent of the spread: not locking down, locking down independently, and locking down simultaneously with other countries.

This study concluded that the greater the number of travelers from abroad, the more important simultaneous lockdown is. The greater the number of domestic rural-to-urban migrants, the more the country should be locked down, even independently. If the number of infected people is small, requesting self-restraint is sufficient.

If there is significant travel from overseas, policymakers are hesitant to implement a lockdown because even if an independent lockdown is performed, the outbreak could simply emerge again through infected travelers coming from abroad. Policymakers are also hesitant if there is significant travel from rural to urban areas, as urban lockdowns deprive rural workers and

seriously harm the domestic supply chain. If policymakers are optimistic about the spread, lockdown is postponed.

The increase in the number of infected people, θ, and the WHO's formal pandemic declaration have broken policymakers' optimism. This changed the game structure from a finite repetition game to an infinite repetition game. Thus, we believe that policymakers are more inclined to make long-term decisions about lockdown and are more eager to engage in cooperative actions with policymakers in other countries (i.e., agree on simultaneous international lockdown).

In the future, it is necessary to identify which cities require international simultaneous lockdown and which require independent lockdown based on the number of infected people in urban areas, the supply chain, and the level of migration between rural and urban areas. As the situation worsens, global border closures and lockdowns are needed to limit migration. Travel between large cities and rural areas must be curbed. After locking down large cities, policymakers must move to lock down small cities. Large cities must remain locked down until the end of the outbreak to limit the number of people spreading the virus from them to other, smaller areas. Decisions on the exact duration should be made based on a balance between the risk of rural transmission and the national economic loss.

Even if lockdowns are implemented in urban areas after the virus was spread to rural areas, the economic issues in rural areas were inevitable. Additionally, it is likely that rising unemployment in urban areas will result in a population outflow to rural areas, leading to an increase in the rural unemployment rate. Finally, supply chain disruptions stemming from lockdowns in urban areas will significantly impact rural areas.

References

[1] Asian Development Bank. *Asian Development Outlook 2020: What Drives Innovation in Asia?* 2020.

[2] Coronavirus Resource Center. "Coronavirus COVID-19 Global Cases by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University." http://coronavirus.jhu.edu/map.html.

[3] Engle-Warnick, J., and R. L. Slonim. "Inferring Repeated Game Strategies from Actions: Evidence from Trust Game Experiments." *Economic Theory* 28, (2006): 603– 632.

[4] Huber, C., L. Finelli, and W. Stevens. "The Economic and Social Burden of the 2014 Ebola Outbreak inWest Africa." *Journal of Infectious Diseases* (2018).

[5] Inoue, Hiroyasu, and Yasuyuki Todo. "Firm-Level Propagation of Shocks Through Supply-Chain Networks. *Nature Sustainability*, 2, (2019): 841–847.

[6] Inoue, Hiroyasu, and Yasuyuki Todo. "The Propagation of the Economic Impact Through Supply Chains: The Case of a Mega-City Lockdown Against the Spread of COVID-19." (March 2020). https://ssrn.com/abstract=3564898.

[7] Hamblin, James. "You're Likely to Get the Coronavirus." *The Atlantic*, February 24, 2020. https://www.theatlantic.com/health/archive/2020/02/covid-vaccine/607000/.

[8] OECD. *Coronavirus: The World Economy at Risk* (Interim Report). Paris: OECD, 2020.

[9] Dal Bó, P., and G. R. Frechette. "On the Determinants of Cooperation in Infinitely Repeated Games: A Survey." *Journal of Economic Literature* (2017).

[10] Dal Bó, P. "Cooperation under the Shadow of the Future: Experimental Evidence from Infinitely Repeated Games." *The American Economic Review* 95, no. 5 (2005): 1591–1604.

[11] McKibbin, Warwick J., and Roshen Fernando. *The Global Macroeconomic Impacts of COVID-19: Seven Scenarios*. 2020.

[12] World Health Organization. *Coronavirus Disease (COVID-19) Situation Report*. 2020. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports.