The Coronavirus Through the Eyes of an Economist

“Eventually we will have some digital certificates to show who has recovered or been tested recently, or when we have a vaccine, who has received it “. Bill Gates, March 19, 2020.¹

- From the viewpoint of an economist, the coronavirus epidemic causes substantial market failures: the infection of one person by another, the lack of information about whether an individual is infected (either because he is asymptomatic or there is a lack of testing), the uncertainty regarding the duration of the epidemic and its extent, the tendency to overreact among individuals and public authorities, and moral hazard. In the absence of public intervention, all of these factors lead to a substantial decline in economic activity and an increase in the rate of infection and mortality.

- Public policy today can be implemented according to three options: a) full containment including limitations on activity (“full containment”); b) a policy of achieving herd immunity among the population; and c) selective containment that relies on precise information and mass testing (“smart containment”).

- Economic research based on US data, which combines an epidemiological model (SIR) with a macroeconomic model, found that selective containment reduces the loss in GDP by 5 percentage points and the number of deaths by half relative to full containment. The cost of saving a life in selective containment is still high but is only about one-third of the accepted value of a life in the US. Therefore, the recommended public policy is selective containment.

- The experience of Taiwan, South Korea, Singapore and China, which combined selective containment with the possibility of short-term full containment, shows an improvement in the number of infections and mortality and, in particular, less economic damage.

- In Israel, the number of confirmed infections per million inhabitants is higher than in the OECD countries, but the number of serious cases and the ratio of deaths to the number of infected patients are particularly low. It appears that while the policy of full containment was no more effective than the policy of countries that did not implement this extreme measure, the risk of mortality from coronavirus in Israel is low. Therefore, a policy that takes the economy into greater account will not lead to a collapse of the medical system.

- In conclusion, it appears that the immediate adoption of a selective containment policy as in the case of Southeast Asia and which is similar to that being considered in Europe will be of benefit to the economy in Israel. Such an approach depends on a program that contains the following key components: (1) the widespread proliferation of testing in order to identify infected and immune individuals (2) the integration of health funds’ health information systems, which would allow for faster information sharing with workers in essential enterprises and in high-productivity industries, and (3) the creation of an option for selective containment using digital applications. In parallel, it would be worthwhile to maintain the option of full containment in areas characterized by a particularly high rate of infection and a low contribution to GDP.

¹ This note has been originally published in Hebrew at mid-April. While some details are not up to date, the main thrust of the paper is as valid today as it has originally been.

¹ https://www.gatesnotes.com/Health/How-to-respond-to-COVID-19
1. Introduction

This article focuses on an economic approach to the debate about quarantine policies in the face of an epidemic. Epidemics have been experienced by mankind throughout its history and have resulted in major health and economic costs. The main characteristics of an epidemic are its rapid spread by means of one individual infecting another, while the public has only partial information. In the absence of an intervention, the number of infections rises each day at a fixed, high rate (exponential growth), such that the number of infected individuals doubles every few days. Without intervention, and in the case of Corona, the rate of doubling in the worst case is 3 days and in the best case is 8 days. As a result of the rapid rate of infection, the proportion of severely ill patients—and therefore the mortality rate—rises to high levels. Without a major intervention, the number of patients who require intensive intervention (ventilators and intensive care facilities) is expected to reach levels at which the healthcare system cannot provide care at a level expected in a developed country. In such a situation, the high mortality has a tremendous socioeconomic cost.

In most advanced countries, public health policy has focused on controlling the epidemic by means of quarantines. This helps prevent the accumulation of severely ill patients to a level that exceeds the capability of the health system to provide appropriate care, with the goal of “flattening the curve” to less than a critical level, and it buys time until a vaccine and/or treatments are found. The professional and public discourse centers on the choice between different quarantine policy options, and based on their effect on society and the economy, when there is clearly a high level of uncertainty with respect to their effect on the course of the epidemic and on the economy.

From the perspective of an economist, the infection of one individual by another is a market failure that requires government intervention since, in general, individuals do take into account the chance that they themselves will be infected when they go to work or go shopping, but do not take into account the chance that they will infect others. Moreover, in the case of Corona there is a period of time in which the individual is unaware that he is infected, particularly if he is asymptomatic and/or if there is insufficient testing, as is the case in Israel, or no testing at all. Additionally, the medical and biological information on the new virus’ channels of infection and its damage have the characteristics of a public good. All of the aforementioned considerations are identified by an economist as major market failures.

The sudden appearance of a significant risk creates uncertainty as to the scope and duration of the source of the risk and leads to an immediate and dramatic drop in economic activity, particularly tourism and leisure. The wave of terror that Israel experienced in the Second Intifada led to a halt in tourism and a situation in which people did not want to frequent crowded places, use public transportation, etc. The effect of the Coronavirus is much worse since it also causes damage to business and public sector activity when workers refrain from coming to work out of fear of being infected by their colleagues. This fear is intensified due to the phenomenon of moral hazard which occurs because individuals who themselves know whether they are infected are liable not to reveal this information, thus increasing the fear of other individuals and reducing any activity that requires people to be in close proximity with one another. This phenomenon of only partial information taken together with the fear of moral hazard may also lead to an overreaction due to the behavioral tendency to overestimate risk. Finally, since the epidemic is worldwide, it is causing significant harm to Israel’s markets.

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2 A classic example is smoking: a smoker does not take into account the harm to others due to second-hand smoke.
In view of the market failures resulting from an epidemic on the scale of Covid-19, a unique public health policy is required that has a particularly high personal and economic cost on the individual level in order to successfully minimize the economic, health and social costs on the aggregate level. The question that therefore arises is the price that society is willing to pay in order to reduce the mortality rate.

The tradeoff between the rates of infection and mortality on the one hand and the economic price on the other is dependent on the public policy chosen to prevent the spread of the epidemic. In principle, there are three ways to respond to the epidemic: a) the imposition of full containment on the entire population apart from essential services (full containment); b) the imposition of a quarantine on high-risk groups (the elderly and those with underlying conditions) and freedom of movement for the rest of the population (herd immunity for the strong); and c) the imposition of restrictions on those individuals who are infected and on those who have been in close contact with them (smart containment).

The first model, namely of full containment, substantially reduces the initial rate of infection ("flattening of the curve") and thus lessens the burden on the health system enabling it to serve severely ill patients. This is the model adopted by many countries when they found themselves unprepared for the virus, including Israel. However, there is a heavy economic price to such a policy. On the release from full containment, secondary waves of infection occur, and the epidemic is essentially halted only when the majority of the population has been infected and become immune (herd immunity) or when a vaccine/anti-viral drug has been found. In comparison to countries that adopted a policy of "sit and do nothing," the imposing of a full containment delays the process of herd immunization and thus lengthens the duration of the economic crisis.

The second model, namely of herd immunization for the strong, is based on identifying the healthy population, such that even at the peak of the infection, the number of severely ill patients does not exceed the system’s capability. The model makes it possible to maintain the economic activity of the strong population even if a certain percentage of them become ill. However, the model does not solve the problems of personal risk and moral hazard mentioned above for those who have freedom of movement, thus lowering the level of economic activity. Furthermore, the quarantining of the weak population (the elderly and those with underlying health conditions) reduces their ability to support the working-age population by providing childcare services, reduces demand and leads to additional economic harm. In the end, the release of the entire economy from restrictions is again dependent on the achievement of herd immunity and/or the finding of a vaccine or antiviral drug.

The third model, namely smart containment, involves a partial quarantine that delays the spread of the virus and flattens the curve. Even if it lengthens the crisis it also reduces its intensity. This policy has been implemented with impressive success by Taiwan and to a great extent also by Singapore and South Korea and today, following a difficult and long quarantine, it is being implemented in China. As will be claimed below, a smart containment that restricts only those who can cause significant infection solves the information problem and does not need to achieve herd immunity. Therefore, it minimizes the market failures while maintaining a high level of public health until a vaccine/antiviral drug is found. However, a smart containment policy also maintains the option of returning to a full containment,  

3 This approach is supported by Professor Amnon Shashua on the basis of an article he co-wrote: https://medium.com/amnon-shashua/can-we-contain-covid-19-without-locking-down-the-economy-2a134a71873f
particularly if an outbreak occurs that is dispersed evenly throughout the population. In such a situation, it is not possible to gather reliable information and there is no ability to adopt smart containment.

2. Economic analysis of full containment and smart containment

In a recent article by Professor Martin Eichenbaum of Northwestern University and others, a comparison is made between full containment and a simple version of smart containment. The comparison is based on a model that combines a process in which an epidemic spreads according to the epidemiological calculations of the SIR model, which is widely accepted among experts worldwide, and an economic model of consumer and producer behavior that is calibrated using US economic data. On the assumption that the rate of infection in the US reaches 60 percent of the population and the incidence of mortality is 0.5 percent of those infected, then the basic SIR model, which ignores the response of individuals to risk and any effect of a quarantine policy, predicts the death of one million people and a drop in GDP of 0.3 percent. The economic model without a quarantine policy assumes that individuals know the risk of being infected and immediately identify if they are infected. When the response of individuals to the risk of infection is accounted for in the economic model, GDP drops by about 7 percent while the level of infection in the population drops to 54 percent, and the predicted mortality drops to 880 thousand (a reduction of 120 thousand) relative to the basic SIR model.

The article examines a policy scenario involving full containment. This policy reduces the level of infection in the population and the incidence of mortality by 500 thousand relative to the basic economic scenario, but at the same time GDP falls by 22 percent. According to the GDP in the US, the additional loss amounts to about $6 million per additional life saved. This loss is significantly less than the value of $9.3 million dollars per human life that is used by the US government in order to make cost-benefit calculations in transportation and environmental projects. Another policy scenario is that of smart containment, according to which the government is able to successfully identify the infected individuals and to quarantine only them. In this case, about 700 thousand lives will be saved relative to the situation in which the government does not intervene, and the GDP will drop by about 17 percent. Accordingly, the cost in terms of GDP per life saved drops by 50 percent – to only about $3 million.

Until recently, full containment was the only tool available to a society in the effort to control epidemics. As the model shows, this tool deals successfully with the externalities since it prevents contact between people, but it has a high economic price. Modern information technology provides an additional way to flatten the curve which dramatically reduces—at least in a theoretical model based on numerous assumptions—both the quantity of victims (deaths) and the economic damage. In this way the policy is

4 Professor Eichenbaum is also a member of the Board of Directors of the Aaron Institute for Economic Policy at the Interdisciplinary Center in Herzliya. The article was written by Eichenbaum, Rebelo and Trabandt and can be found at: 
https://sites.google.com/site/mathiastrabandt/home/downloads/EichenbaumRebeloTrabandt_EpidemicsMacro.pdf

A comprehensive survey can be found in the New York Times:

5 Eichenbaum, Rebelo and Trabandt do not take into account the age profile of the infected individuals relative to that of the working population. In any case, the accepted value in the US is much higher than the present value of an average individual’s income over his working life in the US. Accordingly, a calculation that is adjusted for expected income according to age might change the ranking of the policies.

6 In a revised version of the article, the advantage of smart containment increases even more.
Pareto dominant. It is important to mention that smart containment (policy (c)), which is based on the ability to identify infected individuals, is different in nature from policy (b), which refers to a statistically-based selection of the population with the lowest risk of death and serious illness and the creation of herd immunity in its environment.

3. The implications for public health policy

Clearly, we are recommending a policy of smart containment. The necessary basis for implementing it is the collection of reliable information and its dissemination. The gathering of information involves, first and foremost, a major ramp-up in the amount of testing according to order of priority, the implementation of sample testing and repeat testing, the rapid and reliable conveyance of results to those tested by way of the health funds, and the organization of information at the national level. Information on the medical situation of citizens will allow for rapid identification of the sources of risk and will enable pinpoint containment. The revelation of information to a third party should be allowed in order to prevent moral hazard. These steps will reduce an individual’s risk in entering the public domain and the fear of random infection. In this way, economic activity can be maintained at a high level.

As mentioned, some of the smart containment measures have already been adopted to various extents, primarily in Taiwan, Korea, Singapore and more recently China. It is well-known that on discovering the extent of the epidemic, China imposed a complete quarantine on Wuhan, the source city. Over time, the quarantine succeeded in slowing and even preventing infection. However, China continued to isolate individuals suspected of being carriers, particularly those arriving from abroad. One of the main steps (and a controversial one) was adopted in the monitoring of individuals. The citizens of China have an app in their cellular phones which gives them a health “score” of green, orange or red, where green allows them full freedom of movement, orange is an indicator of unproven risk related to trips outside the city and red requires quarantine of 14 days. The Chinese information system also made it possible to monitor those who were meant to be in quarantine and enforce it.

Korea learned the lessons of the SARS epidemic in 2003 and the MERS epidemic in 2015. Its guiding principle was mass testing in order to identify carriers and foci of infection. To this end, testing stations were created in the format of “telephone booths” and “test and ride” centers in areas of high infection. The carriers were required to enter isolation which was monitored by means of an app. Epidemiological information on infected individuals was gathered by cellular phone tracking and the monitoring of credit card transactions and disseminated (anonymously) to the entire population. Like Korea, Taiwan met the epidemic with a policy of smart containment. The Taiwanese government immediately identified the source of the outbreak in Wuhan and forbade flights from the city. Later on, a sophisticated monitoring system was developed that merged information on the travel history of residents with their medical records. Testing and retesting were carried out according to level of risk and anyone found infected was put into quarantine, including electronic tracking to enforce it.

Singapore prepared itself in a similar way to Taiwan by adopting smart containment immediately at the beginning of the event in late December. However, due to a recent second wave, which is apparently the result of many citizens traveling abroad with their children, it became clear that smart containment is no longer practical. Therefore, Singapore returned to full containment, and starting from April 7th it
adopted a quarantine policy similar to that of Israel for a period of one month. In other Asian countries, there was no complete shutdown of economic activity throughout the country as there was in Israel, apart from the recent policy adopted in Singapore (which has a smaller territory than Gush Dan by half and a larger population by 60 percent). It is worth mentioning that in these and other Asian countries, there has long been a tradition of wearing protective masks in the public domain, which became obligatory during the epidemic.

In Europe, there has been vigorous debate over models that include elements of smart containment. The pioneer in this context is Austria, where Chancellor Kurz declared the beginning of the withdrawal from full quarantine a few days ago. The plan requires accurate monitoring of infections and includes random sampling, serological testing, use of tools to predict risk and digital tracking. The Red Cross in Austria is already installing a Bluetooth-based software that sends a warning in case of close contact with someone discovered to be carrier. At this stage, the installation is voluntary but the government is not ruling out making it mandatory and even finding a solution for those who do not own a smartphone.

The adoption of smart containment in Israel is expected to have large economic benefits together with a low risk to public health; furthermore, Israel is not ruling out the possibility of full containment, if necessary, in areas with high infection rates or those that make only a small contribution to economic activity. The disadvantage of the full containment that has been adopted in Israel can be seen in the following graph, which is based on WHO data as of April 8, 2020. A comparison of infection rates shows that despite the scope of the quarantine, Israel’s number of infected individuals was 1086 per million, while the average of the surveyed countries (the OECD countries apart from the small countries of Luxembourg and Iceland, and with the addition of Taiwan and Singapore) was 828 per million. The comparison with the Asiatic countries is particularly illuminating. In Taiwan, which adopted smart containment measures immediately, there were only 15 infected individuals per million and in Japan 23 per million. In Singapore, the number stood at 190 and in South Korea it was 198. In contrast, the mortality rate among the infected was only 0.7 percent in Israel, in comparison to an average of 3.8 percent. Although the Israeli mortality rate is almost twice that of Singapore, it is lower than that of Taiwan (1.3 percent), Japan (1.9 percent) and South Korea (2 percent). These figures indicate the effectiveness of the health system in Israel in maintaining very low mortality rates, despite the relatively...
high rates of infection. It appears, therefore, that the health system and the size of the population at risk (over age 60) provide wide margins of safety and allow for the rapid institution of smart containment.\textsuperscript{12}

Graph


The comparison of Israel’s data to that of other countries indicates that the full containment adopted by Israel so far has only been moderately successful while there have been impressive achievements in minimizing the rate of mortality.

4. The implications for policy in Israel

As mentioned, the economic analysis points to personal risk, externalities and moral hazard as the main barriers causing the slowdown in economic activity. The removal of these barriers requires that individuals, the public and the government receive reliable and accessible information. Accordingly:

1. We believe that the management of testing and information should be transferred to the health funds, while simultaneously greatly increasing the number of tests and their frequency.\textsuperscript{13} The health funds are in continuous contact with their members and should be able to provide them with information quickly and efficiently, exactly as they do in periods of calm.

2. An order of priorities for testing various populations should be decided on and should be based on clear criteria whose goal is to increase economic activity while minimizing health risk. These criteria can reflect the ability for physical monitoring based on the location of the workplace (such as industrial areas that can be closed off so as to check the identity of those entering), as well as the contribution to economic activity.

3. The information to be provided by the health funds should be made available on a designated smartphone app in order to enable tracking by a third party.

4. In addition to the information generated by the testing apparatus, epidemiological information should be accumulating on the movement of individuals and their contacts with diagnosed carriers of the virus. A Bluetooth-based technology should be employed in order to achieve accuracy. The use of this kind of technology is currently being discussed in Germany and is already in use (on a voluntary basis) in Austria. The technology facilitates the recording on a mobile phone of all close physical contacts of the phone owner and their merging with the database of carriers. Every contact of this type requires quarantine.

5. The information that should be gathered by the health funds will be sent to a national center which will merge the database of carriers with the aforementioned personal information accumulated on mobile phones. The national center should be able to identify foci of outbreaks and to impose local quarantines as needed, for the benefit of the affected area and the public as a whole.

\textsuperscript{12} We are aware of the fundamental problem of violation of privacy implicit in smart containment. Nonetheless, an epidemiological investigation in which the patient is asked to provide information on people he has been in contact with is also an invasion of privacy. With appropriate public supervision, the invasion of privacy should be a negligible problem relative to the individual and social benefit obtained from the information acquired.

\textsuperscript{13} The German government is seeking to achieve a level of 200 thousand tests per day. In the Israeli context, this would be equivalent to about 20 thousand tests per day.
The proposed measures are essentially similar to the plan proposed by Minister of Defense Naftali Bennett. They solve the information problem and thus minimize both the “actual” risk and the moral hazard. The information that will be conveyed to individuals will facilitate the identification of those who are at low risk of infecting others. The possibility of this information being monitored by a third party solves the problem of moral hazard. As a result, anyone who is permitted to enter the public domain will know that it is “clean” and that there is no danger there of being infected. Distancing from the public domain will be limited to individuals that endanger it. Thus, smart containment will minimize the disruption of economic activity.

Beyond the clear advantage of these measures with respect to economic activity and output, they will also make it easier for the non-working elderly to be in quarantine. The reduction of the risk of infection in the public domain will make it possible for this population to leave quarantine with only a minimal risk. The specific and precise identification of potential sources of risk will assist in preventing encounters with a high risk of infection.

Looking ahead to the future, it appears that market forces will facilitate the rapid development of the medical technology to deal with the Corona crisis. Efforts are underway to develop testing kits that will simplify the test and provide a quick solution without the need for laboratory services. The British government has already purchased 3.5 million home testing kits (at this stage they are meant only for healthcare workers), and it intends to raise the number of tests to 100 thousand per day by the end of April. The increased level of testing, together with the apps that will enable the presentation of results to a third party, will also constitute the basis for the renewal of international air travel.

Initial drug trials—at this stage on the most severely ill patients—are already in progress. But more importantly, the effort to find a vaccine is proceeding at full speed. The great reward expected for the company that develops it first brings us ever closer to the day the vaccine becomes available. The world will then be able to return to normal.

14 See https://www.bosch.com/stories/vivalytic-rapid-test-for-covid-19/