



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Recent trends in economic research

Economic, social and political issues raised by the COVID-19 pandemic

Clement A. Tisdell

School of Economics, The University of Queensland, Brisbane 4072 QLD, Australia



ARTICLE INFO

Article history:

Received 29 July 2020

Received in revised form 19 August 2020

Accepted 19 August 2020

Available online 20 August 2020

JEL classification:

I

E4

F01

O01

Q00

Keywords:

Economic activity and COVID-19

History of pandemics

Liberty and COVID-19

Quality of life years (QALYS) and COVID-19

Social choice and COVID-19

Triage and COVID-19

Value of human life and COVID-19

ABSTRACT

This article contributes to the assessment of public policies to control the incidence of COVID-19 in several ways. (1) It contains a brief historical and comparative overview of selected pandemics, particularly in relation to the COVID-19 pandemic; (2) It provides a simple original model which could be used to prioritize the admission of COVID-19 sufferers to hospital (taking into account available hospital capacity) and (3) it specifies a second model to evaluate desired social choices involving the trade-off between the severity of social restrictions (taking into account their impact on the incidence of COVID-19) and the level of economic activity. Bergson-type welfare functions are utilized in the second model. It also critically examines the proposition that the isolation (lockdown) of social groups is a desirable method of limiting the incidence of COVID-19. This leads onto the consideration of the extent to which personal freedom of choice (liberty) ought to be restricted in response to the COVID-19 pandemic. A brief outline follows illustrating the factors that are likely to hinder economic recovery from COVID-19. Particular attention is paid to the moral and ethical questions raised by policies to control COVID-19. These appear to have received little attention in the relevant economic literature.

© 2020 Economic Society of Australia, Queensland. Published by Elsevier B.V. All rights reserved.

1. Introduction

The presence of highly infectious diseases which have become pandemics, such as COVID-19, create serious health and economic problems because of various global social and environmental transformations which have occurred as a result of economic development. As a consequence of economic development, the world's population has become increasingly urbanized and concentrated in large cities and as well, the global level of human population has risen manifold since the beginning of the Industrial Revolution. The density of human populations is greater than ever. In addition, the mobility of humans in all geographical dimensions has increased tremendously. These factors facilitate the outbreak of new infectious diseases and their spread. This is especially evident in the case of the corona viruses, such as different strains of influenza and more recently, COVID-19. The incidence of COVID-19 basically involves an environmental health issue because its occurrence depends on the state of the surrounds of individuals.

Developments in the nature of economic activity exacerbate the problem of controlling new infectious diseases which are transmitted as a result of human contact and presence. Increased economic specialization and greater division of labour accompanied by the expansion of markets and growing economic globalization increase the risk that individuals will come into contact with sources that facilitate the occurrence of highly contagious diseases such as influenza and

E-mail address: ctisdell@uq.edu.au.

COVID-19. The adverse economic consequences of new forms or types of these diseases can be severe given the high degree of interdependence in economic activity in modern economies. For example, the absence of workers from work due to such infections, or the risks of these infections, can disrupt production at the workplace level. As well, supply chains are liable to be broken or disrupted by these pandemics, and in addition, they usually have negative effects on the aggregate demand for commodities. This is evident from the COVID-19 outbreak which has resulted in a major worldwide economic depression. A useful coverage of the worldwide economic effects of COVID-19 is available in [Fernandes \(2020\)](#).

There is now a very large volume of literature on the economics of COVID-19 and it is growing at a rapid rate. A relatively comprehensive review of this literature (as at June 2020) is available in [Brodeur et al. \(2020\)](#) and a very useful overview of the economic issues raised at an early stage by COVID-19 is available in [Baldwin and Weder di Mauro \(2020\)](#). So this literature will not be reviewed here again.

The objective of this article is to provide my own insights into economic issues raised by COVID-19. It is important to assess the COVID-19 pandemic in relation to the historical context, impact and nature of previous pandemics. Therefore, initially, this article provides a selected brief overview of the history and nature of a variety of pandemics and compares these to the COVID-19 pandemic. Subsequently, choice problems involving available hospital capacity and the prioritization of admissions of those with COVID-19 are considered. Then attention turns to considering social choice and economic trade-offs between the incidence of COVID-19 infections and the level of economic activity. This is followed up by a critical discussion of the desirability of isolating social groups in order to control the incidence of COVID-19 and possibly reduce economic losses from the pandemic. Particular attention is paid to the views of [Acemoglu et al. \(2020\)](#) in that regard. The important issue of the extent to which individuals should be permitted freedom in relation to the control of COVID-19 is investigated and brief notes follow on the factors that are likely to hinder economic recovery from COVID-19.

2. A selective and brief history of pandemics and their COVID-19 relevance

2.1. *The coverage of this section*

The occurrence of pandemics is by no means new. Although communicable diseases were present when humankind relied on hunting and gathering for subsistence, the shift to agriculture, which began some 10,000 years ago and the subsequent growth of urban centres, increased the incidence of epidemics ([History.com Editors, 2020](#)). Urbanization (facilitated by the Agricultural Revolution) provided a fertile environment for pandemics to take hold. [Huremović \(2019, p. 7\)](#) states:

“In a long succession throughout history, pandemic outbreaks have decimated societies, determined outcomes of wars, wiped out entire populations but also paradoxically cleared the way for innovation and advances in sciences (including medicine and public health), economy, and political systems.”

[Huremović \(2019\)](#) provides a well referenced coverage of pandemics both before, including, and following the Black Death but excluding COVID-19. [History.com Editors \(2020\)](#) also presents a short overview of pandemics of historical significance. Further relevant information on pandemics is available in Wikipedia ([Anon, 2020](#)) and this article is also well referenced. I will just give a brief coverage of the Black Death (1348–1400 AD), the ‘Spanish’ flu (1918–1920), HIV/AIDS, SARS, ‘Swine flu’. Avian flu, Ebola and Zika. Where appropriate, I will provide comparisons with COVID-19.

2.2. *The black death (1348–1400 AD)*

The Black Death (also known as the bubonic plague) ravaged Eurasia in the second half of the 14th century. It arrived in the western part of Eurasia and parts of North Africa via the Silk Road trade routes ([Frankopan, 2016](#)). This disease was spread from oriental rats (which were infected by fleas which hosted the bacteria, *Yersinia pestis*) to humans (bubonic plague) and it was also transmitted from human to human by droplets from those infected (pneumonia plague). The death rates for these two forms of infection were high (approximately 70% in the former case and around 95% in the latter case) and death usually occurred within 8 days. Some scholars believe that the Black Death may have reduced the European population by up to 60%. The death rates were especially high in urban areas.

The economic and social consequences of this pandemic were severe.

“Entire neighbourhoods, sometimes entire towns were wiped out or settlements abandoned. Crops could not be harvested, travelling and trade became curtailed, and food and manufactured goods became short. The plague broke down the normal division between the upper and lower classes and led to the emergences of a new middle class” ([Huremović, 2019, p. 16](#)).

[Scheidel \(2017, Ch. 10\)](#) has argued that due to labour shortages caused by the Black Death, it resulted in the long run in the development of labour-saving technologies and consequently, higher productivity. [Frankopan \(2016, pp. 191–195\)](#) points out that significant economic development and social change occurred in Europe after the Black Death subsided. Several scholars have argued that changes wrought by the Black Death subsequently brought about positive long-term social and economic development (see, for example, the references provided by [Frankopan \(2016, Ch. 10\)](#)).

The Black Death was undoubtedly more catastrophic than COVID-19 has been so far. The economic suffering caused by it appears to have been much worse. Furthermore, it resulted in a considerably higher death rate than COVID-19 and unlike COVID-19, the mortality rate from it bore little relationship to the age of victims, their socio-economic status, or their healthiness prior to contracting the disease. Like COVID-19, it led to a shortage of doctors, quacks peddling ineffective cures, and fake news about its causes and those racial groups said to be responsible for spreading the disease (Huremović, 2019). In some areas, quarantine of visitors from outside of regions was adopted as a measure to reduce its incidence. For instance, the city of Dubrovnik quarantined visitors on a nearby island for a number of days. Quarantine is also one of the methods used today to limit the geographic spread of COVID-19.

2.3. *The 'spanish' flu pandemic, 1918–1920*

This is considered to be the first truly global pandemic and the method of transmission of the disease was similar to that for COVID-19. In the absence of a vaccine, similar methods to those used to limit the occurrence of COVID-19 were adopted such as quarantining those with the disease or those coming from infected areas. Universities and schools were closed in some countries (Hobbins, 2020) and economic production was well below attainable levels during the pandemic. Unlike COVID-19, it was mostly fatal to younger persons – the elderly seem to have been resistant to the disease. It was thought that this was so because they may have been exposed to a similar virus earlier in their lives. It has been estimated that around 500 million people contracted the disease, and that as many as 50 million died as a result of it. This suggests a 10% mortality rate, a significantly higher rate than in the case of COVID-19. It began in August 1918 and petered out in 1920.

Nevertheless, in the case of children in the womb of mothers who contracted this disease, they appear to have suffered long-term adverse effects. A study by Almond (2006) published in the *Journal of Political Economy* reported that these children compared to other cohorts experienced life-long disadvantages. They had lower incomes and socio-economic status, and also were much more dependent on transfer payments than comparable cohorts. Whether or not similar delayed effects will occur in the case of COVID-19 remains to be seen.

2.4. *The HIV/AIDS pandemic*

This pandemic began in the early 1980s and it now infects about 40 million people worldwide. While around two million died annually from this disease in 2005, this number has now declined to about one million (Wang et al., 2016) due, in part to more effective treatments for this disease and increased knowledge of preventative measures. Although it is a major economic and social burden on some sub-Saharan African countries, globally it is much less so. Overall, its annual adverse economic effects are much lower than are those being currently experienced with COVID-19.

2.5. *SARS and the 'swine' flu*

The outbreak of Severe Acute Respiratory Syndrome (SARS) started early in this millennium in China and had the potential to become a global pandemic. It was, however, quickly contained and was limited mostly to China. It was virtually stamped out by mid-2003.

SARS was of global concern because, it resulted in a mortality rate of about 10%. It was also caused by a coronavirus and resulted in similar symptoms to COVID-19. Similar measures were adopted to contain it. Although it did have some negative global economic effects (mainly on international travel and tourism), these were relatively minor compared to the economic consequences of COVID-19.

The 'Swine' flu began in Mexico in April 2009 and disappeared by May 2010. It spread rapidly. The worldwide death rate from it is uncertain but seems to have been lower than in the case of COVID-19. Huremović (2019, p. 25) states: "Although its death rate was ultimately lower than the regular influenza death rates, at the time it was perceived as very threatening because it disproportionately affected previously healthy young adults, often leading to severe respiratory compromise". By comparison, COVID-19 disproportionately is a threat to the elderly, especially those in old-age care facilities.

2.6. *Avian flu, ebola and zika*

In February 2004, the avian influenza virus was found in poultry in Vietnam and began to infect workers in the poultry industry. Cases were subsequently reported from several other countries. It was feared that it could become a pandemic. However, human to human transmission was low (or possibly did not actually occur) and the death rate was very low. Consequently, Avian flu soon became of little concern.

The Ebola virus is another virus which has the potential to become a global pandemic. So far it has been mostly limited to Africa where an outbreak first appeared in Guinea at the end of 2013. It is very deadly and does not differentiate between age groups.

Zika was first recorded in Micronesia and after that in Brazil in 2015. Subsequently, it became more widespread internationally. It is transmitted by mosquitoes. Zika is of considerable concern because it causes severe deformities (*microcephalus*) in about one percent of the unborn children of infected mothers. It has not yet become established globally, unlike COVID-19.

2.7. COVID-19 in historical context

It is too early now to determine how eventually COVID-19 will compare with previous pandemics. However, like the ‘Spanish’ flu, it has become a global pandemic. It was first reported in Wuhan in November, 2019 and by March 2020, WHO declared it to be a pandemic. It was not long before individuals in most nations were infected.

Like SARS (which is also a closely related coronavirus) and the ‘Spanish’ flu, it is spread mainly by droplets and by sneezing. Although it is less deadly than the ‘Spanish’ flu was (and much less likely to kill younger people), it has already resulted in an alarming number of deaths worldwide. In addition, it has significantly reduced (and disrupted) economic and social activity. Nevertheless, its negative effects have been mitigated (to a notable extent) by the availability of advances in information and communication technology (ICT). This has enabled many individuals (but by no means all) to work from home and has helped to sustain social connectivity.

An interesting question is whether the COVID-19 pandemic will bring about permanent economic, social and political changes and what might they be? Will it change the course of history as the Black Death is believed to have done? It is, of course, too early to say. However, one possibility is that it will permanently lead to an increase in the incidence of working from home and also considerably accelerate and maintain the greater use of the internet. This increased use can, for example, be anticipated for conferencing, seminars, meetings, online learning (for instance, via Zoom and Webinair), for social contacts, for economic trading and for financial transactions. Although these trends were already under way before COVID-19 and were predicted in the 1980s when ICT was in its infancy (Darton and O’Neill, 2018; Hall, 2018; Suchard, 2018; Weston and Williams, 2018), COVID-19 has accelerated these trends. Whether or not all of these trends are socially and psychologically desirable remains an open question (Tisdell, 2017a).

With the above general historical background in mind, let us consider some of the important economic and social problems associated with management of the COVID-19 pandemic, as well as some relevant political aspects. Only selected aspects can be covered in this article.

3. Hospital capacity and the prioritization of admissions of those with COVID-19

Contagious diseases capable of becoming pandemics can take varied forms and therefore, appropriate policies for controlling them often differ. Determining appropriate economic policies to respond to the outbreak and human-to-human spread of COVID-19 has proven to be extremely challenging because major measures to stem the level of infections and death rates from the disease involve a high economic cost in terms of the levels of income and economic production forgone. These control measures have included the isolation of individuals, restrictions on gatherings and on travel. They were seen as necessary (especially in the early stages of mass infections with COVID-19) to flatten the upward trend in the curve of infections and reduce the increase in deaths and to enable hospitals to increase their capacity to provide for patients requiring hospitalization.

While it is not possible in this article to consider all economic aspects of responding to the novel virus, COVID-19, Fig. 1 is helpful for conceptualizing one of the economic problems, namely those involved in flattening the infection curve (Anderson et al., 2020). Although many countries have now sufficient capacity to admit COVID-19 patients, many less developed countries do not. So the problem is still relevant. In Fig. 1, curve JKEH represents the capacity of the hospital system to admit and care for patients requiring hospitalization for COVID-19. It might be of a logistic form because the initial expansion of this capacity takes time and once physical capacity ramps up, increasing scarcity of qualified staff to operate hospitals can become a major constraint. Three different hypothetical functions correspond to the number of persons requiring hospitalization due to COVID-19 infections — the higher the curve, the greater the number needing to be hospitalized. Each also corresponds to different levels of social restrictions imposed by the government to limit the spread of COVID-19. Curves OAB, ODE and OGH correspond respectively to substantial, moderate, and weak social restrictions to limit the spread of this disease. The shape of these curves might differ from those shown. The ones shown are for illustrative purposes only.

It can be seen in Fig. 1 that as a result of the most severe restrictions, the hospital system would be able to accommodate all COVID-19 patients requiring hospitalization. Indeed, in this case hospital over capacity occurs. In the other two cases, hospital capacity is exceeded for a period of time and to a greater extent, the weaker the social restrictions and precautions designed to reduce the transmission of the disease. For example, in the case of moderate restrictions, hospital capacity is exceeded between t_2 and t_3 with the number of COVID-19 patients in need of hospitalization but unable to be admitted is equal to the difference between the segment CDE of the curve of COVID-19 patients requiring hospitalization and the segment CKE of the capacity of the hospital system to accommodate these patients. If weak restrictions and precautions are taken to limit the occurrence of COVID-19, then the period for which hospital capacity is exceeded increases to $t_4 - t_1$. Consequently, the number of needy cases unable to be hospitalized rises from an amount indicated by the eye-shaped hatched area bounded by CKED in Fig. 1 to that enclosed by FKHG. This raises the question of how should COVID-19 sufferers be prioritized for admission if the capacity of hospitals to accommodate them is exceeded?

One possibility is to give priority to admitting those COVID-19 sufferers to hospital who have the largest increase in the expected value of their lives if they recover from COVID-19 as a result of being hospitalized. This can be formally analysed as follows: Let

V_i = the expected value of the life of the i th sufferer from COVID-19 if this patient does not die;

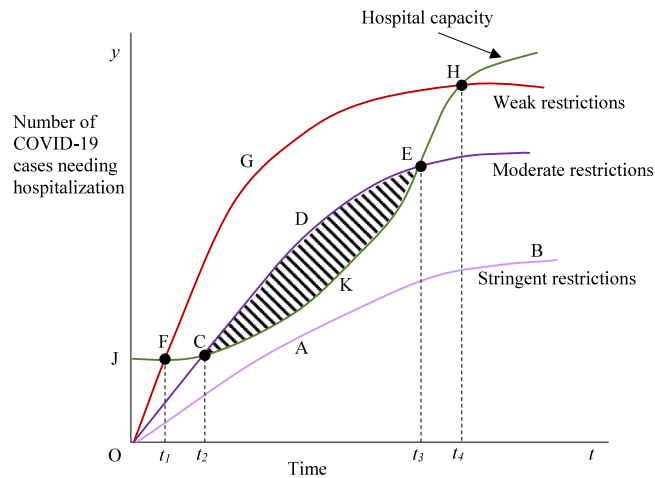


Fig. 1. This figure is used to illustrate a choice problem involving COVID-19 patients needing hospitalization.

PH_i = the probability of the i th COVID-19 sufferer recovering from the virus if admitted to hospital; and

PNH_i = the probability of the i th COVID-19 sufferer's recovery if not admitted to hospital.

Then the expected increase in the value of admitting the i th COVID-19 sufferer to hospital is

$$\Delta E[V_i] = (PH_i - PNH_i)V_i \quad (1)$$

A challenging moral and valuation issue is how to determine V_i . Also, in many circumstances, the change in the probability of survival as a result of hospitalization can be uncertain. In some circumstances, hospitalization may actually increase the probability of death. It is, therefore, best avoided in these cases.

Several different possibilities exist for determining V_i . One criterion for prioritizing health (frequently used by health professionals) is based on the quality of life years (QALYS) available to patients. This criterion is discussed in Tisdell (2020, Ch. 15). In order to apply this criterion to prioritizing COVID-19 sufferers for hospitalization (or for treatment of the disease), it is necessary to estimate the quality of life years each sufferer is likely to have left if the individual recovers from the disease. On this basis, other things being equal, the fewer are the number of years a sufferer is predicted to survive for after recovery from the virus, the lower would be the sufferer's V_i -value. This approach gives a reduced priority for hospital admissions to the elderly and to those with chronic conditions which are likely to reduce their life span. In addition, many belonging to these groups have a poor quality of life. Furthermore, they may have a smaller increase in the probability of recovery if admitted to hospital. This approach could discriminate against the elderly and those with chronic health conditions. Chronic health problems are more prevalent in some ethnic minority communities also and so this criterion could also discriminate against these groups.

It is necessary however, to bear in mind that categorizing individuals into broad groups for triage purposes has its limitations. This is because not all individuals in these groups have an equal chance of recovery if they are provided with hospital care and the remaining QALYS of individuals of the same age can be difficult to determine and can vary considerably.

Furthermore, it should be kept in mind that COVID-19 victims belonging to some groups (such as the young) have a high chance of recovery without hospitalization (or treatment) and on average, hospitalization may do little to increase their probability of recovery. Consequently, even though their V_i -values are high, the change in their expected V_i -values could be much lower than for those patients (such as the elderly or those with underlying health problems) who contract COVID-19. This lowers their priority for hospitalization given expression Eq. (1). Therefore, it is probably rational for doctors to monitor individual patients and to be more ready to recommend admission to hospital of those patients who are likely to have the greatest possibility of benefiting from hospitalization. Possibly, elderly patients (and those with underlying health problems) should be admitted early when they contract this disease whereas others could be monitored with admission only being recommended when it becomes evident that they will succumb to this disease in the absence of hospitalization. If, however, hospital capacity is likely to be exceeded by this policy, further discrimination would be needed.

Another approach to prioritizing hospital admissions of those infected by COVID-19 is to make these admissions dependent on their willingness (and ability) to pay. Normally, willingness to pay is limited by the ability to do so. For example Giannadaki et al. (2018), when estimating the value of a statistical life (VSL), provide evidence that the average willingness to pay to avoid premature death from air pollution has an income elasticity of 0.8. Therefore, this approach discriminates against the poor, and other socially disadvantaged groups. Many socially disadvantaged groups are poor or comparatively poor, for example, many of those who are elderly and those belonging to particular ethnic groups. They

are also more likely than the remainder of the population to have chronic health problems. So there is a high probability that this economic criterion (as well as the use of QALYS) will disadvantage the elderly and some ethnic communities, or more generally the poorer members of society in gaining access to medicine and hospital services.

In addition, consideration should be given to the extent to which patients with health conditions (other than COVID-19) requiring hospital treatment should be prioritized for admission to hospital. When hospital capacity is exceeded, a trade-off problem exists between admitting COVID-19 patients and other patients. In principle, the type of formula set out in Eq. (1) could also be applied to all patients seeking hospitalization.

Decisions also need to be made about the economics of expanding hospital capacity and the period for which this extra capacity is likely to be needed. When a quick response is needed, temporary facilities for hospitalization are likely to be economic, such as the tents which were erected in Central Park in New York, the use of train carriages, as was done for holding COVID-19 patients in India and France, and the conversion of convention centres as hospitals as was done in the UK. Once COVID-19 infections fall, then these facilities are easily dismantled or returned to their original use.

As mentioned above, the shape of the curves shown in Fig. 1 of the number of COVID-19 cases which ought to be hospitalized is only adopted for illustrative purposes. In the absence of mitigation measures, it is believed that the number of active cases of COVID-19 rises initially at an exponential rate (as a function of time) but eventually reaches a maximum (once a large proportion of the population has been infected). It can then be expected to decline at a slower rate than in the upsurge of cases (Anderson et al., 2020; Anon, 2020). Consequently, the curve of infections exhibits kurtosis. In the absence of mitigation, the initial exponential growth rate in the incidence of COVID-19 is very high. The doubling time of infections is very short. If containment or mitigation is not started early after an initial outbreak, it is very hard to contain the virus because small numbers of infected persons rapidly infect a very large number of individuals, and tracing active cases becomes difficult. This makes the disease very hard to manage socially.

It is also the case, that early relaxation of mitigation measures can allow a rapid resurgence of the disease (Anderson et al., 2020; Anon, 2020). Control measures need to be kept in place to ensure that the basic reproduction rate of infections is less than unity if the number of infections is to be lowered. An infection rate of unity corresponds to an approximate stationary state. If less than an existing stationary state is desired (because the number of existing infections is deemed to be too high), a hard lockdown may be needed to reduce the numbers infected, that is the adoption of a suppression strategy. The economic and psychiatric costs of this are likely to be high. Let us now consider aspects of the economic cost of the pandemic in relation to the severity of policy measures to control it.

4. Modelling social choice involving trade-offs between COVID-19 restrictions and the level of economic activity

Most global pandemics substantially lower global economic production and increase unemployment. In the case of COVID-19, government measures to stem the spread of this disease and mortality from it significantly reduced worldwide employment and economic activity. Given that unemployment rises and aggregate economic activity falls when social restrictions to reduce the occurrence of COVID-19 are more stringent, governments have been faced with a difficult trade-off problem; namely how much reduction in employment and economic activity to accept as a result of allowing more liberal opportunities for social interaction. This type of choice involves an opportunity cost and a trade-off problem and conceptually can be subjected to economic analysis. However, solving such a problem is difficult because of the uncertainty about many of the dimensions of a new pandemic (Atkeson, 2020), and the problem of devising a widely or universally acceptable social welfare function. Again, our ability to solve the problem from a purely economic point of view, is hampered by the inability to measure (in a universally acceptable way) the significant costs and benefits of adopting alternative measures to control pandemics. A significant bounded rationality problem exists. This limits the scope for applying social cost-benefit analysis to the problem. Despite this, exploring the potential trade-offs and opportunity costs involved in such measures remains important as a basis for rational decision-making.

Social choice is also complicated by the fact that collective responses to new pandemics, such as COVID-19, are significantly influenced by prevailing political systems and by the diverse objectives of rulers. In the case of COVID-19, this (along with the uncertainty about the epidemiology of the virus and its impacts on public health and economic activity) has resulted in noticeable disparities in the methods adopted by different governments to manage the occurrence of COVID-19 infections and in the stringency of their precautionary social restrictions. Furthermore, especially in democratic countries, controls seem to be subject to political see-saw of public opinion. When death rates are high, government action to adopt measures to reduce them become commonplace but once death rates fall, then there are usually strong demands to ease social restrictions. This can set off a new wave of infections with the process repeating itself once again. This process has been evident in several European countries, e.g. Spain and France.

The above discussion can be advanced conceptually by means of some theoretical modelling. Fig. 2 shows a hypothetical relationship between the number of COVID-19 cases and the level of economic activity and supposes that the number of cases rises as the stringency of social controls on the spread of the virus are weakened. *It assumes that a vaccine is unavailable.* The relationship ABCDE represents the assumed relationship between the stringency of controls (Z) as well as the number of COVID-19 cases (X) and the level of economic activity (Y). Stringent controls result in a low level of economic activity due to the closure of many businesses and restrictions on the mobility of individuals. Weak controls are also likely to depress production due to absences from work in those cases where production requires employees to be at a workplace. Crowding in workplaces also tends to increase the risk of COVID-19 infections. The line HJ represents

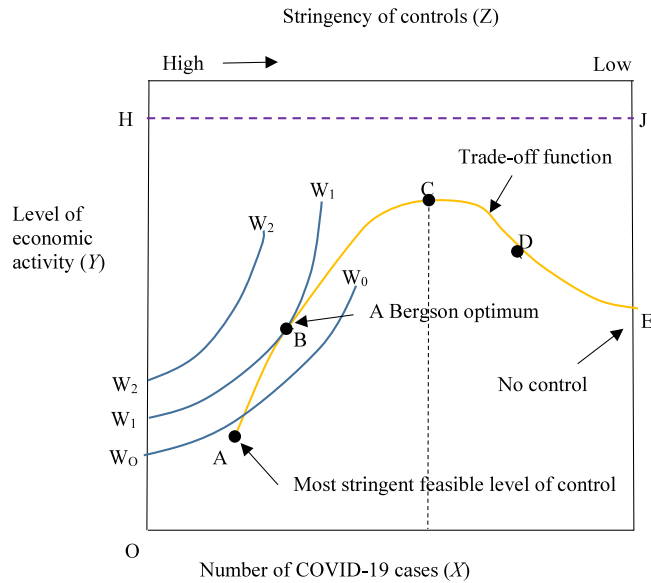


Fig. 2. A theoretical illustration of social choice and the trade-off between a higher number of COVID-19 cases (less stringent social restrictions) and the level of economic activity.

the assumed level of economic activity that would prevail in the absence of COVID-19. The model is a type of snapshot or static model.

The exact nature of the trade-off curve ABCDE, shown in Fig. 2, is not known. However a similar (but not identical relationship) has been independently assumed by a leading group of MIT economists (Acemoglu et al., 2020, Fig. 1). Their frontier relationship represents the trade-off between the loss in output (GDP) and the number of COVID-19 deaths which in turn is related to the severity of social controls designed to limit the occurrence of the disease. I assume, however, that it is not only deaths from COVID-19 that reduce output but also the incidence of the disease. However, I also suppose that the number of deaths are positively related to the number of COVID-19 cases. To be more specific, when m represents mortality from the disease and X indicates the number of COVID-19 cases, it is supposed that

$$m = f(X) \text{ where } f' > 0 \tag{2}$$

This relationship will vary from country to country and by social groups depending on the health care available and the healthiness of the different groups.

The relationship shown in Fig. 2 is easily related to the loss in output due to COVID-19. The loss in output is equal to the difference between line HJ and the trade-off function ABCD. If the relationship ABCDE in Fig. 1 is represented by the function

$$Y = g(X), \tag{3}$$

then the loss in output (L) due to COVID-19 can be represented by

$$L = Y_0 - g(X) \tag{4}$$

where Y_0 represents the level of output in the absence of COVID-19.

Taking into account only the above-mentioned variables, it is rational to suppose that there is a social preference for fewer COVID-19 cases and for a higher level of economic activity. Therefore, given this point of view, it is irrational to choose a combination on the segment CDE of the trade-off function, ABCDE. The optimal choice will depend on the nature of the preference function adopted. Given the Bergson-type of preference function (Bergson, 1938) represented in Fig. 2 by the indifference curve W_0W_0 , W_1W_1 and W_2W_2 , the optimal choice corresponds to point B. The relevant Bergson function will reflect the preferences of a nation's political leaders. This function may alter during the course of the pandemic as political pressures change.

The governments of different states have displayed differences in their relevant preference functions and these have altered as the epidemic has progressed. In extreme cases, their indifference curves are almost horizontal and social restrictions are adjusted solely to maximize the level of predicted economic activity with no regard being given to the number of COVID-19 cases and deaths. At the opposite end of the spectrum, their indifference curves are almost vertical. As a result, a high priority is given to avoiding COVID-19 cases and deaths.

Furthermore, uncertainty exists about the nature of the type of trade-off function shown in Fig. 2. For example, it is not certain when this function reaches its maximum. It might reach its maximum when controls are very lax, but this

appears to be unlikely. However, governments having a high preference for increasing the level of economic activity and a belief that the trade-off curve in Fig. 2 will reach its maximum when social controls on the occurrence of COVID-19 are weak and are unlikely to adopt stringent social restrictions for very long or may not adopt them at all.

5. Comments on the isolation of social groups as a means of controlling the incidence of COVID-19 and reducing economic losses from the virus

Acemoglu et al. (2020) develop a model from which they conclude that the isolation of individuals belonging to particular social groups is an effective means of limiting the number of deaths from and the incidence of COVID-19 and the economic loss from the virus. They claim, on the basis of their modelling that a policy of isolating the elderly from other age groups (which they describe as “group distancing”) is a very efficient means for approaching the trade-off frontier between the incidence of COVID-19 and the loss in output due to the disease.

They investigate the optimal targeted lockdown of social groups. Their modelling focuses on three age groups. These are those aged 20–49 years, 50–64 years and 65 and over which they describe respectively as young, middle-aged and elderly. Why these particular years were chosen for the groupings is unclear. It can be doubted if those aged in the 50–64 group should be appropriately described as middle-aged. They estimate that the corresponding fatality rates for each of these groups is 0.001, 0.01 and 0.06 respectively. These figures are based on Ferguson et al. (2020) and are derived from South Korean data. However, they are influenced by the availability of adequate hospital facilities, especially ICU facilities, for COVID-19 victims requiring hospitalization. The availability and standard of facilities in South Korea is relatively high. A higher death rate is likely in countries with poorer hospital facilities or with shortages of hospital places. Acemoglu et al. (2020) also consider a lower death rate for the elderly based on lower fatality rates for older cohorts of the *Diamond Princess* cruise ship which berthed in Sydney. The modelling of Acemoglu et al. only focuses on the economic impact of fatality rates and does not take specific account of economic losses which occur when individuals are affected by the virus but do not die. This is a limitation of their technical analysis.

Acemoglu et al. (2020) also suggest that in addition to targeting the elderly for lockdown, it would be beneficial to target other social groups that are vulnerable to COVID-19, for lockdown. They state (p.45):

“There is a sense in which our analysis understates the gains from targeting, because we have focused only on targeting by age. The mortality rates of COVID-19 also vary significantly by pre-existing co-morbidities, and targeting lockdown and protection policies to co-morbidities can multiply the benefits from targeting significantly”.

However, the poor are more likely to have co-morbidities that make them more vulnerable to COVID-19 than those that are well-off. Economically, the poor may not be able to survive a lockdown unless provided with financial support by the state. Morbidity tends to increase with poverty and chronic illness is also often a source of poverty.

The possibility of group lockdown policies and the ethical implications of them need to be explicitly considered. Lockdowns of social groups as proposed by Acemoglu et al. (2020) are likely to create serious economic problems for some of the targeted groups. *In the absence of government financial support*, most of the poor have little option but to work (if they can) even if they have COVID-19 or are awaiting the results of testing for it. They are also more likely than the well-off to be employed in occupations where they are unable to work from home, for example, in higher income countries, in cleaning or as taxi and bus drivers. In fact, there is a case for government income support to be given for all those infected by COVID-19 or those awaiting test results if they do not have sick leave entitlements. Otherwise they may fail to remain in isolation or quarantine and spread the virus.

Locking down everyone in particular social groups seems to be a very blunt way of reducing COVID-19 deaths and the incidence of the disease. For example, not everyone of 65 and over is in poor health and highly vulnerable to the disease. Some also hold important positions in societies. Several of the political leaders of nations are well over 65, for example, Mr. Donald Trump, President of the USA. It would be unreasonable to expect these leaders to go into social isolation. Furthermore, many in the vulnerable social groups identified by Acemoglu et al. (2020) can reduce their likelihood of catching COVID-19 by wearing masks, practising appropriate hygiene, and by keeping appropriate distance away from others. As well, they can avoid crowded places. However, special care is needed to avoid infections in aged care facilities given the vulnerability of residents and the closeness of contact, for example, with staff. The same is true in hospitals. Moreover, it is not clear how the elderly living in extended families can be easily isolated.

As for isolating those who have underlying health conditions which make them vulnerable to COVID-19, it is not clear how they are to be identified. Possibilities include isolating those in areas known to have a high incidence of co-morbidity, or to do likewise with those belonging to particular racial groups in which morbidity is high. Such policies are likely to be viewed as blunt and too discriminating.

Although the contribution by Acemoglu et al. (2020) is an interesting and worthwhile contribution to the discussion about how to respond to the COVID-19 pandemic, it only concentrates on comparing targeted and uniform isolation policies as a means of limiting the number of COVID-19 deaths and their economic impacts. It does not take account of alternative policies such as those mentioned above and fails to take account of many of the difficulties that arise when particular social groups are to be isolated. Some of these (such as the costs of imposing isolation and the possibility of breaches of it) are mentioned by Fenichel (2013). Furthermore, lockdowns are a major restriction on liberty. Whether or not that is justified needs consideration.

6. Freedom of choice issues

The theoretical modelling illustrated by Fig. 2 (and that of Acemoglu et al., 2020) does not allow for a value being placed on personal freedom of choice or liberty. If liberty is valued, then a choice to the right of point B and even beyond C (such as that corresponding to point D) might be made. In the latter case, the government is prepared to forgo some economic activity and allow a higher number of COVID-19 infections to occur than otherwise in order for individuals to have more freedom.

There are two aspects to be considered in restricting liberty:

1. The extent to which individuals should be able to decide the degree of risk they want to take in contracting the virus, and
2. The ability of an individual to spread the occurrence of the virus, that is the negative external effects arising from the individual being permitted liberty.

Although some restrictions on liberty may be defensible on social grounds, others could be difficult to defend. The latter include restrictions in cases where the behaviour of individuals poses little or no risk to others, but which heighten the risk of those granted greater liberty being infected with the virus. However, even in these cases, it might be argued that taking this extra risk could pose a burden to society if the individuals involved become infected with the virus. If they need medical care or hospitalization as a result of being infected, this would put extra strain on the medical and hospital system. If the state subsidizes or provides free medical care or hospital services, this will add to the costs that have to be met by taxpayers. In addition, if the contacts of an infected person are quarantined for a time, this adds to external costs as does the cost of tracing their contacts. Furthermore, an extra economic burden can be placed on family members if one of its members is infected by COVID-19. For example, they may be required to quarantine and they may have to meet the extra medical care and other costs incurred by the infected family member.

Every society faces the difficult task of determining how much personal liberty should be afforded to its citizens. Any society which allowed complete personal liberty would be lawless and lacking in order. This lack of law and order would have negative economic repercussions due to individuals being allowed to act (without limitation) in ways which have negative effects on others. The negative effects of lack of law and order on the creation of economic wealth were already stressed by Adam Smith in 1776 (Smith, 1776). 'Excessive' personal liberty including 'too much' consumers' sovereignty (Tisdell, 2017b, Ch. 17) poses a threat to the stability of societies and to the maintenance of social and economic welfare.

A problem is how to determine what is the appropriate amount of personal liberty to allow. This is particularly relevant to measures to control COVID-19. For example, some restrictions on the freedom of individuals involve little cost and loss of freedom, such as the wearing of masks in crowded places but the social benefits may be considerable. These would be defensible. On the other hand, some types of blanket lockdowns involve a considerable restriction on personal freedom and the social gains might be small. These would, therefore be harder to defend from a libertarian perspective.

The costs to individuals of restrictions on their liberty appear to vary with the social structure, nature of economies and the stages of their economic development. Higher income countries are in a better position to provide social safety nets to their citizens to support them if they are restricted in their ability to work as a result of COVID-19. There is little scope for cushioning these effects in low-income countries such as India. In these countries, stringent social measures to control COVID-19 impose a heavy burden on the poor who need to work to earn enough income for their survival.

The choice of government policies to control COVID-19 are significantly influenced by political pressures, the nature of which has altered with the duration of the pandemic. Initially, many governments were slow to impose social restrictions to limit the occurrence of COVID-19. As infections and the death rate rose, political pressure to impose social restrictions to limit the occurrence of the disease mounted. However, political pressure subsequently intensified to ease these restrictions in order to reduce the economic cost of the virus. As a result, many governments responded by altering their Bergson-type preference functions to take account of these political pressures. In addition, with better knowledge about COVID-19 and of the means to treat it, greater hospital capacity and the occurrence of fewer cases, shifts in the trade-off function ABCDE favoured less stringent control measures in some countries.

7. Factors limiting economic recovery from COVID-19

As is well known, the extent of economic recovery from COVID-19 depends upon medical treatments to prevent COVID-19 occurring, for example, the discovery and mass production of an effective vaccine, or finding means to reduce the severity of infections. However, it is unlikely that this disease will be eliminated, and like influenza, it may change its form (mutate) with the passage of time.

The speed and nature of recovery from the pandemic will be hampered both by supply-side and demand-side factors. On the supply-side, many manufacturers and other businesses depend on international supply chains for sustaining their economic activity. This raises a synchronization problem. Nations that are ready to and want to resume production of commodities (but rely on international supply chains for their production) may find that their ability to do so is restricted because their international suppliers cannot meet their demands due to continuing closures or because of their reduced output as a consequence of COVID-19. International deliveries may also be limited by disruption in transport services, e.g., air services. China's recovery is likely to be hampered for example, by the disruption in its supply chains as well

as a lagged recovery in the demand for its exports. In the recent past, China has exhibited a high degree of dependence on imported components used in manufacturing its goods (Tisdell, 2007). It was, therefore, quite exposed to supply-side disruptions. This, together with its high dependence on exports (Tisdell, 2009a,b), created major economic challenges for the Chinese government in responding to COVID-19, not to mention problems created by Trump's 'trade war' with China.

Many nations have international demand and supply-side constraints on their level of economic activity and its recovery given the presence of COVID-19. Australian farmers have, for example, faced delays in the supply of spare parts for agricultural machinery and in the supply of agrochemicals, such as weedicides due to transport delays or supply shortages. The disruption of supply chains, however, appears to have been more severe in the earlier stages of the pandemic than later. Just-in-time international supply chains have had to be replaced by others or by increases in domestic production.

On the demand-side, aggregate consumer expenditure is likely to recover slowly due to lower disposable incomes and because consumers do not purchase commodities that increase their risk of contracting COVID-19 or purchase lots of these commodities. Even when government restrictions on international travel (and even national travel) are lifted, many individuals will not be inclined to undertake this travel especially by means that heighten their chances of contracting COVID-19, such as forms of collective transport, e.g., planes, trains, buses and ships. Similarly, many individuals will continue to avoid activities (for some time) that involve mass gatherings. Demand is only likely to recover slowly for the commodities produced by those industries that sell discretionary commodities and for which their purchasers face increased risks of contracting COVID-19. Consequently, the economic recovery of some industries will be constrained by both of these factors, that is, by reduced discretionary buying and by risk-avoidance in purchasing commodities.

Of course, those industries that recover slowly after the end of the period of socio-economic hibernation designed to control COVID-19 will also retard the recovery of those industries with which they have a high degree of economic interdependence. Inter-industry analysis (e.g. input–output analysis) could be used to help gauge these flow-on effects.

A dangerous international situation now exists. Many nations may begin to adopt protectionist policies to counteract a reduction in their level of economic activity and employment brought about by the COVID-19 pandemic. This could delay global economic recovery. It will disadvantage countries (such as Australia and Germany) which depend heavily on exports to generate their level of economic activity and employment.

8. Concluding comments

8.1. *More on ethics and COVID-19*

The effects of COVID-19 on mortality raise difficult moral and ethical questions about how human life should be valued as well as significant economic dilemmas. Some of these matters have already been mentioned but some additional ones are worth noting, albeit briefly. The modelling by Acemoglu et al. (2020), for instance, supposes that it is reasonable to value the lives of social groups or individuals by how much they contribute to economic production, measured by variations in GDP. This results in the lives of the elderly and those of low-income earners (the poor) being ascribed a low value compared to the lives of others. This approach would also give a low value to the lives of women as a group who on average earn less (market-related) income than do men. It also ignores the value of the unpaid work of women within the household and their usual roles as the main carers in a family (Tisdell, 2019, Ch. 11). Also how should one value the lives of those who do unpaid or under paid charitable work?

It was also found that the QALYS and the willingness to pay approaches tend to assign a lower value of life to the elderly, and possibly to those who are poor and have serious morbidity problems. However, the lives of those individuals may have value for others. Should that be ignored? It is known that individuals are often prepared to pay to save others from death, particularly children. While sometimes this may be because of a material benefit to the donor, it may also be motivated purely or partly by sympathy or altruism. Furthermore, in the case of the elderly, should their earlier contribution to the welfare of others be ignored in considering the value of their lives? By way of example, in George Orwell's *Animal Farm* (Orwell, 2008), did the loyal and hard-working horse that contributed so much to his community deserve to be sent to the knacker at the end of his working life? We must be careful not to smother our economic analysis in technicalities that cause us to lose sight of ethical issues of this kind. I am not suggesting that technical analysis is not of value, but its ethical implications and limitations should be made clear and debated.

8.2. *A brief résumé*

The occurrence and consequences of epidemics and pandemics depend on the nature and stages of economic development. The economic and social structure of contemporary societies facilitates the transmission of those diseases which depend on human contact or presence, especially those that involve air-borne germs or which persist on surfaces that are commonly used. The latter characteristics have facilitated the rapid spread of COVID-19 and left little time to respond to it. Devising appropriate policies to deal with it were also complicated in its early stages by lack of knowledge about its epidemiology and many of its other characteristics.

This article has analysed the types of trade-offs that have required consideration and choices that have to be made at different stages of the COVID-19 pandemic. It has done this by means of some simple economic modelling. In addition, factors that can be expected to hamper economic recovery after the socio-economic hibernation period (designed to limit the incidence of COVID-19) have been identified and discussed. Ethical issues have also received attention.

8.3. Issues requiring further attention and research

The occurrence of COVID-19 has raised many important issues which need more attention and research. These include the following ones.

1. How should we value human life? To what extent are economic valuations of it morally and socially acceptable? In relation to this matter, it would be useful to have further studies of the extent to which individuals would be willing to save the life of others and why. The value placed on the lives of different social groups, e.g. the aged, probably varies in different societies, may alter with the passage of time and could weaken as societies become more individualistic, for instance, due to increased pervasiveness of the market system and the greater geographical mobility of individuals. Family ties may be weakened by such changes.
2. What is the extent of the economic and social costs of locking down schools and educational institutions? To what extent is there a loss in human capital and which social groups are most adversely affected?
3. Can an economic cost be placed on the adverse psychological and psychiatric effects of the pandemic? To what extent have these costs been elevated by the high levels of personal financial indebtedness present prior to the occurrence of the pandemic and due to the continuation of opportunities to obtain 'easy' finance and credit?
4. The impact of policy measures to alleviate higher unemployment and under employment (which have occurred due to the pandemic) needs more consideration.
5. It would also be interesting to have more evidence about which social groups support or do not support different policies for managing the COVID-19 pandemic and why they do so. Which social groups, for instance, support rapid return-to-work policies and why? Probably, it is not only those who rely on work for their survival who support these policies but also a group of capitalists and investors who are concerned about the falling return on their investments as a result of reduced economic activity.
6. A decline in the overall funding of research by universities and similar bodies have occurred (at least in Australia) as a result of financial pressures associated with the occurrence of COVID-19. In many cases, internal recurrent funding by universities for research has been shelved as they try to maintain their financial viability. This is especially evident in subject areas where overseas student enrolments have fallen and less money is therefore, available for cross subsidizing research from this source. There is a need to examine the long-term consequences of these changes.

The above is just a small sample of significant issues raised by the COVID-19 pandemic which require further investigation. As this article has demonstrated, the whole of our economic, social and political framework has been shaken by this pandemic. The pandemic has therefore, resulted in increasing scrutiny of this framework.

Declaration of competing interest

The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

I wish to thank Hemanath Nantha and Valentin Zelenyuk for their useful comments on the initial draft of this article and Evelyn Smart for help with its presentation. I am also grateful to the editor of this journal for encouraging me to submit an article for consideration dealing with COVID-19, as well as to two anonymous referees for their constructive comments on an earlier version of this article.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial or non-profit sectors.

References

- Acemoglu, D., Chernozhukov, V., Werning, I., Whinston, M.D., 2020. Optimal Targeted Lockdowns in a Multi-Group SIR Model. *Economic Fluctuations and Growth, Health Economics, Public Economics*. National Bureau of Economic Research, Cambridge MA, USA, Available from: <https://www.nber.org/papers/w27102>.
- Almond, D., 2006. Is the 1918 influenza pandemic over? Long-term effects of in utero influenza exposure in the post-1940 U.S. population. *J. Polit. Econ.* 114 (4), 672–712. <http://dx.doi.org/10.1086/507154>, Available at: <https://www.journals.uchicago.edu/doi/abs/10.1086/507154>.
- Anderson, R.M., Heesterbeek, H., Klinkenberg, D., Hollingsworth, T.D., 2020. How will country-based mitigation measures influence the course of the COVID-19 epidemic?. *Lancet* 395 (10228), 931–934. [http://dx.doi.org/10.1016/S0140-6736\(20\)30567-5](http://dx.doi.org/10.1016/S0140-6736(20)30567-5).
- Anon, 2020. Pandemic. <https://en.wikipedia.org/wiki/Pandemic>. (Accessed 17 August 2020).
- Atkeson, A., 2020. How Deadly Is COVID-19? Understanding the Difficulties with Estimation of Its Fatality Rate. *Economic Fluctuations and Growth*, National Bureau of Economic Research, Cambridge MA, USA, Available from: <https://www.nber.org/papers/w26965>.
- Baldwin, R., Weder di Mauro, B., 2020. Economics in the Time of COVID-19. CEPR Press, London, Available from: <https://cepr.org/sites/default/files/news/COVID-19.pdf>.

- Bergson, A., 1938. A reformulation of certain aspects of welfare economics. *Q. J. Econ.* 52 (2), 310–334. <http://dx.doi.org/10.2307/1881737>. Available at: www.jstor.org/stable/1881737.
- Brodeur, A., Gray, D.M., Islam, A., Bhuiyan, S., 2020. A Literature Review of the Economics of Covid-19. Institute for the Study of Labor (IZA), Research Paper Series, Bonn, Germany. Available from: <https://ssrn.com/abstract=3636640>.
- Darton, D., O'Neill, G., 2018. The changing role of the household economy in a world of expanding technology. In: Tisdell, C.A., Maitra, P. (Eds.), *Technological Change, Development and the Environment: Socio-Economic Perspectives*, second ed. Routledge, London and New York, pp. 217–238. <http://dx.doi.org/10.4324/9781351106092>.
- Fenichel, E.P., 2013. Economic considerations for social distancing and behavioral based policies during an epidemic. *Health Econ.* 32 (2), 440–451. <http://dx.doi.org/10.1016/j.jhealeco.2013.01.002>, Available at: <http://www.sciencedirect.com/science/article/pii/S0167629613000039>.
- Ferguson, N.M., Laydon, D., Nedjati-Gilani, G., Imai, N., Ainslie, K., Baguelin, M., Bhatia, S., Boonyasiri, A., Cucunubá, Z., Cuomo-Dannenburg, G., Dighe, A., Dorigatti, I., Fu, H., Gaythorpe, K., Green, W., Hamlet, A., Hinsley, W., Okell, L.C., van Elsland, S., Thompson, H., Verity, R., Volz, E., Wang, H., Wang, Y., Walker, P.G.T., Walters, C., Winskill, P., Whittaker, C., Donnelly, C.A., Riley, S., Ghani, A.C., 2020. Impact of Non-Pharmaceutical Interventions (NPIs) to Reduce COVID-19 Mortality and Healthcare Demand. Covid-19 Response Team, Imperial College, London, Available from: <https://www.imperial.ac.uk/media/imperial-college/medicine/sph/ide/gida-fellowships/Imperial-College-COVID19-NPI-modelling-16-03-2020.pdf>.
- Fernandes, N., 2020. Economic Effects of Coronavirus Outbreak (COVID-19) on the World Economy. <https://ssrn.com/abstract=3557504> or <http://dx.doi.org/10.2139/ssrn.3557504>. (Accessed 29 July 2020).
- Frankopan, P., 2016. *The Silk Roads: A New History of the World*. Bloomsbury, London and New York.
- Giannadaki, D., Giannakis, E., Pozzer, A., Lelieveld, J., 2018. Estimating health and economic benefits of reductions in air pollution from agriculture. *Sci. Total Environ.* 622–623, 1304–1316. <http://dx.doi.org/10.1016/j.scitotenv.2017.12.064>.
- Hall, P.H., 2018. Telecommuting, work from home and economic change. In: Tisdell, C.A., Maitra, P. (Eds.), *Technological Change, Development and the Environment: Socio-Economic Perspectives*, second ed. Routledge, London and New York, pp. 239–259. <http://dx.doi.org/10.4324/9781351106092>.
- History.com Editors, 2020. Pandemics that changed history. <https://www.history.com/topics/middle-ages/pandemics-timeline>. (Accessed 17 August 2020).
- Hobbins, P., 2020. 2020 Versus 1919: Is COVID-19 As Bad As the 'Spanish' Flu?. The University of Sydney, Sydney, Australia, Accessed 17 August, 2020, from <https://www.sydney.edu.au/news-opinion/news/2020/05/27/2020-versus-1919--is-covid-19-as-bad-as-the--spanish--flu-.html>.
- Huremović, D., 2019. Brief history of pandemics (pandemics throughout history). In: Huremović, D. (Ed.), *Psychiatry of Pandemics: A Mental Health Response to Infection Outbreak*. Springer International Publishing, Switzerland, pp. 7–35. http://dx.doi.org/10.1007/978-3-030-15346-5_2.
- Orwell, G., 2008. *Animal Farm*. Penguin Books, London and New York.
- Scheidel, W., 2017. *The Great Leveler: Violence and the History of Inequality from the Stone Age to the Twenty-First Century*. Princeton University Press, Princeton.
- Smith, A., 1776. *The Wealth of Nations*. William Strahan, Thomas Cadell, London.
- Suchard, H.T., 2018. Attitudes of bank employees to technological change: a survey of the South African banking industry. In: Tisdell, C.A., Maitra, P. (Eds.), *Technological Change, Development and the Environment: Socio-Economic Perspectives*, second ed. Routledge, London and New York, pp. 260–280. <http://dx.doi.org/10.4324/9781351106092>.
- Tisdell, C.A., 2007. Economics and business relations between Australia and China: insights into China's global footprint. In: Basu, P., O'Neill, G., Travaglione, A. (Eds.), *Engagement and Change: Exploring Management, Economic and Finance Implications of a Globalising Economy*. Australian Academic Press, Brisbane, pp. 11–25.
- Tisdell, C.A., 2009a. Economic reform and openness in China: China's development policies in the last 30 years. *Econ. Anal. Policy* 39 (2), 271–294. [http://dx.doi.org/10.1016/S0313-5926\(09\)50021-5](http://dx.doi.org/10.1016/S0313-5926(09)50021-5), Available at: <http://www.eap-journal.com/>.
- Tisdell, C.A., 2009b. China's economic performance and transition in relation to globalization: from isolation to center-stage. In: Basu, D. (Ed.), *Advances in Development Economics*. World Scientific, Singapore, pp. 211–232.
- Tisdell, C.A., 2017a. Information technology's impacts on productivity and welfare: a review. *Int. J. Soc. Econ.* 44 (3), 400–413. <http://dx.doi.org/10.1108/IJSE-06-2015-0151>.
- Tisdell, C.A., 2017b. *Economics and Environmental Change: The Challenges We Face*. Edward Elgar Publishing Cheltenham, UK and Northampton, MA, USA.
- Tisdell, C.A., 2019. *Gender Inequality. Socioeconomic Analysis and Developing Country Case Studies*. World Scientific Publishing Co. Pte. Ltd., Singapore, New Jersey, London.
- Tisdell, C.A., 2020. *Resource and Environmental Economics: Modern Issues and Applications*, second ed. World Scientific, Hackensack (NJ), London and Singapore, (in press).
- Wang, H., Wolock, T.M., Carter, A., Nguyen, G., Kyu, H.H., Gakidou, E., Hay, S.I., Mills, E.J., Trickey, A., et al., 2016. Estimates of global, regional, and national incidence, prevalence, and mortality of HIV, 1980–2015: the Global Burden of Disease Study 2015. *Lancet HIV* 3 (8), e361–e387. [10.1016/S2352-3018\(16\)30087-X](https://doi.org/10.1016/S2352-3018(16)30087-X).
- Weston, R., Williams, A., 2018. Socioeconomic implications of new technology in banking: Some Australian and new zealand evidence. In: Tisdell, C.A., Maitra, P. (Eds.), *Technological Change, Development and the Environment: Socio-Economic Perspectives*, second ed. Routledge, London and New York, pp. 281–297. <http://dx.doi.org/10.4324/9781351106092>.