Economic Agents’ Behaviors During the Coronavirus Pandemic: Theoretical Overview and Prospective Approach

Rim JEMLI1,2 · Nouri CHTOUROU2

Received: 12 February 2021 / Accepted: 23 March 2022 / Published online: 7 April 2022
© The Author(s), under exclusive licence to Springer Science+Business Media, LLC, part of Springer Nature 2022

Abstract
In economics, several theories have focused on the study of decisions made by economic agents. Recent branches in economics have even revealed some controversies with the theoretical findings of the basic neoclassical model. Indeed, the growing uncertainty characterizing certain contemporary risks leads to various biases in the economic agents’ behaviors. The relevance of decisions under uncertainty calls into question the assumption of absolute rationality of the neoclassical economics. In this context, the COVID-19 pandemic is causing an unprecedented human crisis. This paper aims to provide a theoretical examination of the behaviors of economic agents faced with uncertainty and catastrophic situations. In its first contribution, this study provides a theoretical overview of behaviors under uncertainty. In its second contribution, the paper highlights the need for a prospective approach in the face of the coronavirus pandemic. Hence, we delve into the theoretical foundations of a prospective approach to health. All around the world, the COVID-19 pandemic approved the need for rethinking the preparation of “public health” systems to deal with pandemics. A good response to the present and a better preparation for the future require a revision of behaviors in terms of international cooperation and monitoring of Sustainable Development Goals.

Keywords Behaviors economics · Uncertainty · Knowledge and decision-making · COVID-19 Crisis · Health · International cooperation

JEL Classification D91 · D81 · D87 · H12 · I12 · F55

Highlights
• The Covid-19 pandemic is characterized by a high degree of uncertainty and requires improving knowledge about contamination.
• Uncertainty leads to several biases and risky health behaviors. So, it is fundamental to strengthen knowledge management in healthcare sector.
• The pandemic revealed the need for rethinking the preparedness of public health systems.
• The new Coronavirus’ vaccine development requires greater international cooperation.
• Health prospective approach is crucial to deal with future pandemics.

* Rim JEMLI
rimjemli@yahoo.fr

Extended author information available on the last page of the article
Introduction

The increasing complexities of human activities and the accumulation of extreme events have rapidly moved the society into a “growing risk universe.” These changes result from the modification of both the nature and the context of risks. They lead to a new universe of risks in which the repetition of past experiences is extremely rare. In fact, the new risks, anywhere natural or man-made, become “total social facts.” No single discipline can fully account for them. These new risks are characterized by a double uncertainty due to their low probability and high consequence. In that, the traditional approach of risk is becoming unsuitable. New tools for prevention, insurance, and crisis management are required. Thus, it is very useful improving the learning and prevention of these risks. In the same regard, the “risk society” that Beck announced as early as the 1980s has profoundly transformed the perception of the risks we face. Indeed, technical progress and globalization have changed the notion of “risk.” Ambiguities about risk likelihood and damage are higher. Hence, the challenge of the scientific uncertainty inherent in this “new risk” is learning to “live with it” and to become aware of the potential exposure of each one. Individuals will have a common destiny, and they must be aware that they have all something to lose. This will probably lead to promoting new forms of solidarity and decision-making (Beck, 1992).

According to the Organization for Economic Co-operation and Development (2003), the major risks of the twenty-first century are natural disasters, technological accidents, infectious diseases, terrorism, and food safety. In this context, this paper focuses on the global crisis caused by the coronavirus pandemic. A more recent literature studied the pathways to improve the decision-making in crisis. In this field, several studies recommended to reinforce knowledge of new risks (Battineni et al., 2020; López et al., 2021; Milani, 2021) and to support cooperation and participation of diverse actors (Erić et al., 2021; Glenn et al., 2021; Goutte et al., 2020; Kandel et al., 2020; Rasul, 2021). However, the gap of these previous studies was their failure to well establish the interconnectivities between the behaviors of economic agents and the good governance of major risks like pandemics. Indeed, they do not stress the direct repercussions of the biased behaviors on the performance of healthcare systems and therefore on the management of crisis triggered by pandemics.

The paper’s originality is to study, at the macroeconomic level, the behaviors of economic agents (i.e., individuals, institutions/organizations, and even nations) during the COVID-19 crisis. The study establishes the repercussion of biased behaviors on pandemic management and especially on the performance of “public health” systems. Some lessons may be withdrawn from the coronavirus pandemic. They demonstrate that the lack of awareness, the non-respect of barrier gestures, and the delayed decision-making have led to the collapse of health systems even in rich and developed countries. These irrational behaviors have disrupted the containment strategy. Biased behaviors of both individuals and organizations have affected the relevance of public decision-making. All these factors have caused the outbreak of the second and third waves of pandemic in many countries.
The COVID-19 pandemic has several socio-economic consequences around the world. However, the key and common consequence is the lack of “public health” systems’ preparedness. In several countries, biased behaviors and ambiguity surrounding the new coronavirus disease have undermined the preparation of “public health” systems. In fact, the coronavirus pandemic is unpredictable and unprecedented event. This paper aims at delving into the theoretical literature for explaining and mitigating economic agents’ behaviors faced with uncertainty. Hence, the issue of our study is: What are the pathways for mitigating the behavioral biases of economic agents and optimizing decision-making in the fight against the coronavirus pandemic?

To respond to the paper’s issue, at a first step, we have referred to the description and explanation of the agents’ behaviors as given by psychological analysis. So, we used at this step the positive approach (or inductive reasoning) that starts from the reality by describing the facts during the pandemic. Then, at a second step, we have analyzed the theoretical foundations of economic agents’ behaviors under uncertainty. Thus, in this normative approach (or deductive reasoning) stemming from theory, we demonstrated that theoretical hypotheses strongly support the real facts and the explanations of the psychology. This result reinforces the findings of experimental economics that recommend bringing psychology and economics together for better understanding economic behaviors under uncertainty. So, in the context of the pandemic, the biased behaviors are both approved by the real facts (the positive approach) and by the theoretical findings (the normative approach).

This paper is the first study in economics that has questioned the links between economic agents’ behaviors and the relevance of responses in the governance of the COVID-19 crisis. In that, our paper has two major contributions. On the one hand, this study can be distinguished because it is the first one that explores theoretical foundations in order to argument economic agents’ behaviors face to coronavirus pandemic. By this primary contribution, this study helps researchers in understanding and explaining the biased behaviors during this unprecedented and large-scale event. On the other hand, the second contribution of our study is identifying and recommending solutions which allow improving pandemics’ preparedness and response in the future. Our study underlines that the better preparation of health systems requires improving knowledge management and boosting cooperation among countries and even between all actors. Good knowledge of the contamination is useful for optimizing decision-making. Reducing the uncertainty and well understanding the virus propagation are crucial for rising awareness and strengthening preparation. In addition, this paper highlights the need for implementing more international cooperation for better exchange and share of knowledge about contamination and responses. The international cooperation matters to accelerate vaccine development and guarantee their access for all people. The theoretical foundation of these solutions is the prospective approach to health. Indeed, the foresight attitude postulates the adoption of a synthetic view that allows protecting lives of both present and future generations. Implementing a large-scale cooperation is very required to deal with the COVID-19 crisis and especially for achieving the Sustainable Development Goals of health. Hence, a wide cooperation must be implemented between diverse actors (e.g., public/private, and individuals/organizations) and at all the levels (i.e.,
local, national, regional and international). This paper is structured in six parts: introduction; state of the art of behaviors during the coronavirus pandemic; theoretical overview of economic agents’ behaviors under uncertainty; foundations of a prospective approach in pandemic situations; discussion of our paper’s recommendations; and conclusion.

State of the Art of Behaviors During the Coronavirus Pandemic

In the first body part of this paper, we present the state of the art of behaviors during the pandemic. This part aims to describe and explain the real facts. It consists in the positive approach of our study. At the beginning, we give an insight on the emergence of COVID-19 pandemic and on the associated biased behaviors of economic agents. Then, for more scientific basis, we present the psychiatrist’s opinion about these behaviors. Indeed, during the coronavirus pandemic, psychology has deeply analyzed the behaviors of individuals. This discipline has given the main scientific reasons that explain the biased behaviors in the earlier periods of COVID-19 pandemic. Next, we point out the convergence between the psychology arguments and the theoretical findings in economics. Finally, we underline the lack but also the need for focusing researches on the link between behaviors and pandemics governance.

The emergence of the coronavirus pandemic dates back to the end of 2019. On 30 December 2019, Dr. Li Wenliang from Wuhan Central Hospital was the first to warn of an unknown new virus and a potential epidemic. On 31 December 2019, the World Health Organization (WHO) alerted about several cases of pneumonia registered in Wuhan, the metropolis of the center China. As a matter of urgency, the Chinese government has taken severe confining and disinfection measures for nearly 60 million people. Nevertheless, the virus has spread to other countries. Many disease cases have been detected in people who have not visited Wuhan. The new virus, which is part of the coronavirus family, has quickly spread to countries around the world (Larquier, 2020). However, only on 11 March 2020, the World Health Organization announced that the new coronavirus (COVID-19 or SARS-CoV-2) has become a pandemic. According to the WHO’s definition: “A pandemic is defined as the global spread of a new disease” (World Health Organization, 2010; Thiébaux, 2020).

The French Ministry of Solidarity and Health (2020) considers that a country’s health response strategy to deal with COVID-19 virus goes through four stages: slowing down the entrance of the virus into the territory (stage 1); slowing down its spread within the territory (stage 2); mitigating the effects of the epidemiological wave. This stage is characterized by the epidemic’s peak (stage 3); and returning to the previous situation (stage 4). Stages 1 and 2 are part of a “containment strategy,” while stage 3 corresponds to a “mitigation strategy” (Thiébaux, 2020).

In the context of the pandemic, people live and feel the cataclysm. Indeed, the “new virus” is progressing rapidly in countries around the world. Every day, there is an acute intensification in the number of deaths and infected cases. The global crisis, triggered by the pandemic of the new coronavirus (COVID-19), has highlighted the strong inter-connectivity among the world (Erić et al., 2021). In addition, this global
health crisis revealed many biases in the behaviors of various economic agents (mainly the “common citizen” but even the “public agent”) such as:

- Consumers who have opted instead for excessive behavior and irrational consumption decisions. In all countries, the pandemic crisis was marked by the overconsumption of certain food, medical, and paramedical products. These deviant behaviors at the demand side will have deep repercussions on the supply in the goods market. Among direct consequences, the market equilibrium is disestablished by the soaring prices, the shortage of raw materials, the stock-out of masks, and the unfair trade practices.

- People returning and/or repatriated from an affected country by the new virus and who do not respect the imposed sanitary confining. Such irresponsible behavior has increased the number of infected cases and modified also the pandemic’s epicenter. Globally, many lives were threatened and “public health” expenditures increased.

- Young people who have not taken seriously the rapid spread of the pandemic. They behave as “They are not a potential target of the virus” or as “They will be healthy carriers; they have no risk on their lives.” This behavioral bias is mainly due to the high level of uncertainty that characterizes this new disease. The high level of unawareness among young people, around the world, compelled the head of the World Health Organization, Tedros Adhanom Ghebreyesus, to address them online. Dr Tedros said: “Today I have a message for young people. You are not invincible. This virus can put you in the hospital for weeks and even kill you. Even if you don’t get sick, the choices you make in your travels can be a matter of life and death for someone else” (Franceinfo, 2020).

- Public authorities, in some countries, have taken belatedly preventive measures such as the isolation of sick people, the closure of educational institutions, the curfew, or even the general health confining.

In this paper, the main types of decisions that are explored in context of uncertainty, particularly in the case of the COVID-19 pandemic, are those that can affect pandemic containment efforts. Indeed, we have highlighted some irrational decisions such as the overconsumption of primary products by households but especially the non-respect of preventive measures (e.g., social distancing, sanitary confining, barrier gestures, and health protocols). In fact, it is difficult for economic agents to grasp the great uncertainty of this unique and unprecedented phenomenon. For the “new” or “unproven” risk, neither probability nor magnitude is known. In reality, many behavioral and cognitive biases have marked the COVID-19 pandemic’s period. For giving objective and scientific arguments, we refer here to the testimony provided by the psychiatrist Jerome Palazzolo on March 17, 2020, for the HuffPost website. Palazzolo is the author of the book Clinical Case in Behavioral and Cognitive Therapy. The psychiatrist’s intervention deals with the behaviors of confined citizens and their confining respect. He explained the difficulty for people to change their habits even in times of health crisis. According to the psychiatrist, remaining confined belongs to the impossible realm for some ones. Thus, he cited five reasons for people’s behavior of resistance and non-obedience:
– Reason n° 1: “People do not understand what is at stake.” Perhaps, they are not aware of the problem and things are not well explained. When they are told not to go out and make contact, they fear that “it is useless” and “it is not too serious, because it is like other viruses.” Perhaps, “the information did not go down well.” In fact, forbidding the person to go out is not simply to protect him or her, but rather to avoid a global contamination. This avoids therefore overwhelming the emergency services. So, this is more a dynamic of civic gestures than of protecting oneself.

– Reason n° 2: “People understand but are unable to link causal effects.” People who say: they are worried about their parents but this does not prevent them from contacting potentially sick or contaminated people (i.e., healthy carriers). The objective here is to try to inform as much as possible while avoiding being alarmist.

– Reason n° 3: “People are governed by their emotions.” There is the emotional impact. Some people feel that there is no force that can prevent them from visiting people who are dependent on them at the difficult time of pandemic. They visit always their family even they may be source of danger to their relatives. The problem here is often due to the lack of information.

– Reason n° 4: “People are in denial.” This is natural because before the imposition of confining, people were not too stressed. Nevertheless, as soon as there was the obligation, people start to worry and say that things do not work well.

– Reason n° 5: “People who question the authority.” Some people do not obey the rules and always choose the opposite. Systematically, the problem must be explained differently to convince these people. Thus, if they do not respect the rules for themselves, they have to do it for their family (Degbe, 2020).

Hence, the psychiatrist fixed five groups of people that have deviant behaviors in respect to the confining. Arguments he given will be stressed by the theoretical hypotheses in the next section. In that, lack of information, neglect of danger, and emotions are explanations provided already by several economic theories that have focused on the behaviors under uncertainty.

On the same line of thought, Hamel (2020) highlights the link between behaviors and pandemic episodes through history. The historian considers that limited scientific knowledge and human behaviors have intensified the spread of various infectious diseases. He recommends a greater focus on studying the bilateral links between people’s behaviors and infections. On the one hand, he postulates that good behavioral practices are effective in reducing the spread of infections. On the other hand, he warns that if response measures to deal with pandemic are ineffective, the high mortality may cause panic and irrational reactions. Furthermore, Hamel (2020) underlines the lack of studies that have addressed the impact of psychological factors on the spread of pandemics and on the performance of the “public health” systems. He supports the consideration of human behavior and psychological factors in pandemic planning. Indeed, the COVID-19 pandemic illustrates that the lack of respect for hygiene measures, panic, emotions, psychological vulnerabilities, and defensive reactions had great repercussions on the management of the crisis and mainly on “public health” systems.
Theoretical Overview of Economic Agents’ Behaviors Under Uncertainty

The second body part of the paper represents the normative approach of our study. In this theoretical overview, we deliver the main branches and theories in economics that have focused on the economic agents’ behaviors in uncertain or catastrophic situations.

The Economics of Uncertainty

In economics, the emergence of the uncertainty notion goes back to the works of Keynes (1921) and Knight (1921). They adopted the Bernoulli’s distinction between “an uncertain” and “a risky” situations. In the first case, risk is not an independent and identically distributed (i.i.d) random variable. Risk is single; therefore, it cannot be considered as a set of similar cases. Consequently in the uncertain situation, the risk is rather said non-probabilizable. However, in the risky situation, risk is proven and it is an independent and identically distributed random variable. This risk follows an objective probability distribution; therefore, it is a probabilizable risk. In the sequel, we will explain more the two concepts of “risk” and “uncertainty.”

The Concept of “Risk”

According to Keynes (1921) and Knight (1921), in a risky situation, the agent has partial information about possible events. Thus, he is able to express them in probability laws. Risk refers to the situation in which the consequences are not certain, but their probabilities are known or can be estimated. Nevertheless, there are different types of risks. The European Environment Agency (2001) distinguished between three types:

- Known risks or hazards: are those whose impacts can be associated with probabilities.
- Potential risks: those that correspond to known consequences with unknown probability of occurrence. They require an approach of “prevention by precaution.”
- Surprises: are those for which both impacts and probabilities of occurrence are unknown. Surprises require precautionary measures to anticipate, identify, and reduce their impacts.

In the same way, Godard et al. (2002) mentioned different types of risks. Hence, in their Treatise on New risks, they classified risks into two categories:

- Proven risks: for which the phenomena underlying the hazard are scientifically well understood and their probability is known. The frequency of occurrence of this type of risks is random, but their existence is admitted. They require therefore a prevention approach, based on the construction of statistical databases.
Unproven or hypothetical risks: for which there is a lack of knowledge about the basic phenomena and even the existence of the hazard. For these risks, the probability of occurrence is ignored. Nevertheless, they cannot be neglected. The precautionary principle therefore comes into play.

The Concept of “Uncertainty”

In the “marginal utility theory,” Bernoulli distinguished between “a certain” and “an uncertain” universes. In the certain universe, each possible action has a single consequence; rather, in uncertain universe, the consequence is not unique. According to the states of nature, the action’s consequence may differ. Each action is likely to give several consequences.

In the same line of thought, Keynes (1921) and Knight (1921) consider that in an uncertain situation, economic agent cannot express his partial knowledge about events in the form of probability laws. Hence, uncertainty means that consequences cannot be assessed in terms of probabilities. This is a key characteristic of catastrophic risks such as natural disasters and pandemics. These major risks have a high level of uncertainty. Therefore, the law of large numbers and statistical forecasting are not applicable. Since causal links are not available or are controversial, these risks can be seen as unique events without known history. This uniqueness classes them as highly uncertain events in the sense of Keynes and Knight. So, these events are qualified as non probabilizable.

The major risks’ unpredictability recalls the Keynes’ innovation of future anticipation in his “general theory” (1936). Keynes considered that future anticipation is a major source of uncertainty. Obviously, this is linked to the information asymmetry and the limited rationality of individuals in their forecast of the future. Nevertheless, only with Arrow (1953) has been established the “school of uncertainty.” The latter focused on the study of low-probability and high-consequence risks. Its main contribution is the rejection of the “expected utility theory” of Von Neumann and Morgenstern (1944) in the context of major risks.

The Behavioral Economics

At this level, we recall the various theories that have been developed to understand the behaviors and decisions of economic agents under uncertainty. In this field, we present the psychological theory and the prospect theory. Through these theoretical underpinnings, we try to explain the causes of behavioral biases in the context of uncertainty.

The Psychological Theory

Tversky was the pioneer who introduced psychological research’s findings, like judgments and decisions under uncertainty, into economics. The emergence of the “psychological theory” is linked to Tversky and Kahneman’s work of (1974). Psychological theory has focused on the study of the way in which the individuals
judge the probability of events. This study demonstrated that individuals tend to assign a high probability to the most frequent events (i.e., events with a high recurrence).

In the same vein, Kunreuther (1979) tried to examine the psychology guiding people’s decisions to purchase insurance coverage. His research aimed explaining the lack of coverage for catastrophic events. He found that people refused to buy coverage for low-probability events even if the consequences are very severe. People consider that these rare events do not occur to them even if the disaster occurs. Moreover, the state will help them regardless of whether they are insured or not (Goes & Skees, 2003). These behaviors, face to catastrophic situations, reflect that the individuals find it difficult to interpret low probabilities. Indeed, behaviors were highly deviant because many agents do not purchase insurance coverage for catastrophic risks. However, the same agents insure themselves against more frequent risks. These problems related to the risk perception stem from the difficulty of interpreting small probabilities for making individual decisions. This idea became more famous with the “prospect theory” which highlighted the behavioral biases associated with uncertainty.

### The Prospect Theory

The “prospect theory” was an extension of the 1974’s psychological theory. This theory which appeared in 1979 was the second theory of Kahneman and Tversky. The prospect theory had a stronger impact on economists. Kahneman and Tversky argued that individuals evaluate situations relatively to a reference point that may be subjective. This hypothesis is in contrast with the “classical economic theory” which postulates that individuals evaluate the different states of the world in an absolute and objective way (the assumption of absolute rationality). Thus, prospect theory is a new approach for decision-making in an uncertain universe. It assumes that individuals under uncertainty no longer rely on the computational principles but rather on a mental construction of their environment, mainly based on their perceptions, psychological posture, emotions, and intrinsic motivations. The major contributions of this theory have shown that decision-making under uncertainty can systematically deviate from the predictions of the classical theory. Prospect theory highlighted that judgments under uncertainty deviate considerably from the basic principles of the “theory of probability” (Kahneman & Tversky, 1979).

Catastrophic risks such as natural disasters and/or pandemics are characterized by increasing uncertainty. These risks are a turning point in the field of economic analysis. They are distinguished because of the extent of their human and material losses as well as the large number of affected sectors (Chemarin & Henry, 2005). The catastrophic risks are designed as major or large-scale risks. In that, they affect the ability of agents to understand and to manage them effectively. These risks have a low probability but heavy consequences. They are source of two kinds of bias affecting the decisions of economic agents.

- Behavioral Biases in Relation to Catastrophic Risks

 Springer
These biases appeared in 1982 with the work of Kahneman, Slovic, and Tversky. The most famous and important of them is the “availability bias.” According to which, people refuse any probabilistic reasoning under uncertainty. They adopt extreme behaviors that have strong repercussions on their decision-making. According to the “availability bias,” individuals rely on their most recent history (i.e., the occurrence of past events) for the estimation of the likelihood of a new event. This deviation from probabilistic reasoning leads individuals to adopt extreme behaviors such as: supra-optimist “it will never happen” or supra-pessimistic “it can only happen” (Kahneman et al., 1982). As a result, the prospect theory assumes an overestimation of events that occurred in the near past. On the contrary, there is an underestimation of events that have occurred in the distant past. This difficulty in interpreting the low probability of catastrophic risks affects the decisions of both individuals and organizations. Indeed, insurers are usually very averse to ambiguity. They may charge much high premiums if potential losses are not well estimated, comparatively to those for well-foreseen risks (Kunreuther et al., 1995).

A study published in 1997 in Acta Psychologica consists of confronting individuals with decision-making in an uncertain universe while forcing them to seek information themselves. The results showed the difficulty for individuals to interpret the probability notion (the likelihood). In fact, only 22% of people asked for information in terms of probability and only 20% of them used the expressions “probability” or “likelihood.” Thus, there is often an under-use of the probability concepts. Matters for the low likelihood of losses caused by a rare event, individuals do not give importance to it occurrence. They consider that the probability of losses is zero or very close to zero. Everyone considers that such an event does not happen to him (Kunreuther et al., 2001). These findings were supported by experimental studies by Weber and Zuchel in (2001). These studies revealed that an individual’s past influences largely his perception of the situation. In turn, this perception affects his choices mainly those relating to the purchase of insurance coverage.

- Cognitive Biases in the Context of Uncertainty

In the cause of the ambiguity about the occurrence of event, individuals and institutions deviate from rational reasoning. Indeed, the occurrence of a catastrophic event raises awareness of the threat potentiality. However, return to periods without disasters leads to the threat’s oblivion. Several previous studies highlighted the increasing demand for protection by individuals following a disaster. At the opposite, there is a phenomenon of forgetting just few months later (Organization for Economic Co-operation and Development, 2003; Commissariat général du Plan, 2003; Rosenthal et al., 2004). Moreover, studies on cognitive biases have pointed out that under uncertainty both individuals and institutions choose to neglect the available information about the potential hazards to face. This neglect can cause a kind of collective blinding at the societal level (Chemarin et al., 2005).

The increasing ambiguity intensifies cognitive biases and affects therefore the decision-making by individuals who find big difficulty to grasp uncertainties. Thus, the extreme event uncertainty may be exacerbated by the deviant behaviors of economic agents. In the context of uncertainty, it is impossible to set the criterion for
the socially efficient choice. In this regard, Gollier et al. (2003) postulate that: “Current behaviors are largely determined by treatment patterns that deviate significantly from classical norms of rationality. Uncertainty reinforces this trend and raises in new terms the question of the relevance of a normative approach in such context.” Thus, the experimental economics is emerging as a novel branch.

**The Experimental Economics**

Kahneman and Smith were awarded the 2002 Nobel Prize in Economics for their innovative ideas that view economics as an experimental science. The two researchers succeeded in bringing psychology and economics together. In fact, their research has focused on Kahneman’s integration of psychology and Smith’s development of experimental methods. For example, they tried to model data in the laboratory for about 20 years. Then, the laboratory data were used in their research (De Filippis, 2002).

This Nobel Prize rewarded their contribution consisting in the insertion of the results of psychological research in economics, especially judgments and decisions under uncertainty. According to Kahneman, man is not rational and selfish in his decision-making. This result contradicts the “neoclassical theory” which is based on the homo economicus hypothesis (i.e., all decisions are governed by self-interest and absolute rationality). Indeed, under uncertainty, individuals judge and decide in violation of the probabilistic calculation rules and the probability laws (i.e., the law of large numbers or the principle of events independency). In uncertain situations, individuals decide according to their prejudices and emotions. Keynes is the pioneer who pointed out that economic decisions made under uncertainty are opposed to the Pareto-Walrasian analysis. Kahneman’s main contributions concerning decision-making under uncertainty lead to taking into account an “irrationality variable” in economic calculations. This idea inspired Smith, his co-laureate who proposed the use of experiments in economic analysis, especially for studying the different structures of market. This line of thought gave rise to the experimental economics as a new form of empirical analysis in economics. Indeed, Smith and Kahneman’s work has led to the emergence of new researches including experimental economics and behavioral finance. They have also contributed to renewing the dialogue between economics and cognitive science by highlighting the need to integrate an “irrationality variable” (De Filippis, 2002).

A more recent study in the field of the experimental economics, by Iandolo et al. (2020), is consisting in the new technologies ‘exploitation. This study highlights the potential role of new technologies mainly big data and artificial intelligence for knowledge management and decision-making improvement in unpredictable environments. The study refers to the Chinese governmental approach for managing COVID-19 spread in which Iandolo et al. (2020) underline the usefulness of technology for managing knowledge and reducing uncertainty. Indeed, the Chinese approach provides several evidences about the role of new technologies in improving knowledge about contamination and for facing collective issues in the pandemic situation. This approach was so efficient in managing unpredictable dynamics of
pandemic. The collection of data from several hundred million of smartphones helped in containing COVID-19 spread. Data from all smartphones with enabled Global Positioning System (GPS) have been used to track the user’s itinerary. They are therefore used for estimating the individual’s probability to be exposed to COVID-19 by matching its position to the infected subjects’ location. These data allowed the authorities to optimize the use of limited medical resources. Thus, tests for COVID-19 have been directed to high-risk subjects identified by the artificial intelligence algorithm. Moreover, the gathered data served for controlling individuals who may have attempted to flee quarantine (Iandolo et al., 2020).

**Foundations of a Prospective Approach in Pandemic Situations**

In the sequel, this part consists in analyzing the solutions and outlooks for dealing with pandemics and boosting the preparation of “public health” systems. These solutions are founded by the prospective approach.

**The Prospective (Foresight) Attitude**

The philosopher Gaston Berger is the inventor of the “foresight” or the “prospective” attitude. Through a rational and holistic approach, Berger’s foresight attitude is a science that aims to make decisions for improving the future of human beings. The basic idea of this discipline is that: “The future is not what comes after the present, but what is different from it.” So, the famous quote of Berger is: “Tomorrow will not be like yesterday. It will be new and will depend on us. It is less to discover than to invent” (Berger et al., 2007).

In 1957, the prospective attitude was the subject of the work of the “International Centre for Foresight.” This group focused on the study of the technical, economic, and social causes which accelerate the evolution of the modern world; and the forecasting of situations which might arise from their combined influences (Prévost, 1965). As a new philosophy, foresight is mainly understood as an attitude for action. It favors knowledge and economic action, especially in a modern world where economic agents are increasingly forced to reason in the long term. As a result, they are usually constrained to adopt a forward-looking attitude. Moreover, the prospective attitude has enriched knowledge in several theoretical fields. In economics, a prospective approach is a requirement for successful long-term forecasting. According to the foresight’s logic, it is impossible to forecast by extrapolation in the long term. New methods are required, including forecasting by anticipation. This forecasting requires an orientation towards the future (Prévost, 1965). Three fundamental features distinguish the prospective attitude:

- Looking ahead: Studies should not be limited to the direct and immediate consequences of present actions. Indeed, the perpetual and rapid evolution of the modern world requires a distant vision.
Rethinking ends: The forward-looking attitude focuses on the human being in the whole world. It recommends considering the complex entanglement of means and ends. The foresight foresees therefore the need for a “will of synthesis.”

- Adopting a synthetic view to apprehend uncertainty and risk: Foresight requires a synthetic view because the future involves the lives of everyone (present and future generations). However, foresight also insists on the limited rationality of people. It postulates that economists must consider the future “not as something decided and that, little by little, would be discovered to us, but as something to be done whose nature will depends at the same time on our strength, skill, courage and a number of circumstances which we can never foresee them in all their details.” Foresight recommends future and long-term horizons for analyzing economic problems. It takes into account uncertainties and risks. It admits that rationality is not absolute (Prévost, 1965).

As a future-oriented way of knowledge, foresight aims to better inform action. It seeks to guide social activity towards ends that serve to improve human well-being and life (Prévost, 1965). In economics, foresight is well founded by theoretical approaches which emphasize the need for inter-temporal management of major economic problems. Economic foresight also finds its basis in the logic of sustainable development.

Theoretical Approaches of Prospective to Deal with the New Coronavirus

As a “new risk,” the action and response to the coronavirus pandemic are well within the scope of economic prospective. The current situation approved that the present is different from the past and the future will certainly be different from the present. On the one hand, measures of response find their theoretical underpinnings in the common and universal heritage approach. On the other hand, the United Nations guidelines for achieving the Sustainable Development process provide a roadmap for preparation and action.

The Common and Universal Heritage Approach

The concept of “global public good” (by analogy “global public bad”) is the international version of the “public good” notion. In economics, academic usage of the “global public good” concept began in the 1990s. First, we recall the main characteristics of this relatively recent concept. Then, we highlight why the maximalist vision of international cooperation matters to health improvement (as a global public good) and pandemic mitigation (as a global public bad).

- The Main Characteristics of the “Global Public Good”

Charles Kindleberger was the pioneer who introduced the notion of the “global public good” into economics. Kindleberger (1986)’s definition is: “Global Public Goods are the set of goods accessible to all States that do not necessarily have an
individual interest in producing them.” Kindleberger added two new dimensions to the traditional criteria (i.e., non-rivalry and non-excludability) of collective goods:

- **An international dimension:** On the one hand, this dimension emphasizes on the universal character of these goods (their utilities or costs go beyond national borders). In fact, the positive externalities in the case of a global public good (respectively negative externalities in the case of global public bad) affect several countries. On the other hand, the international dimension highlights the problem of their production. The global public goods cannot be produced by a single country. Consequently, international coordination and cooperation between states are very required.

- **An intergenerational dimension:** Global public goods can affect the interests of several generations of citizens. In this context, the management of major risks (e.g., global warming, biodiversity destruction, pandemics) aims at protecting the interests of both the present and future generations. This intergenerational equity is well supported by the Sustainable Development logic.

**• The Maximalist Vision of International Cooperation: Global Health Case**

The maximalist vision recommends a large-scale international cooperation to manage common heritage. This vision is derived from the international political economy. It is therefore a positive conception of political economy. The maximalist international cooperation is based on the mobilization of public actors, civil society, and private sector. According to this vision, states must come together to manage global public goods. In the absence of a world government, the resort to supranational institutions is constantly necessary. The key roles of these institutions are to raise awareness and create a harmonized framework of negotiation. These roles are crucial for boosting the management of the goods that are considered as common and universal heritage (Gabas & Hugon, 2001; Kindleberger, 1986; Senate, 2012; Thoyer, 2011). Furthermore, the holistic conception of the rights approach recognizes some global public goods like has a “basic human right.” Thus, if health is accepted as a “fundamental human right,” then access to health for all is an “eternal and priority right” (Boidin, 2014). This idea rallied the international community and institutions to protect human health. In this framework, international cooperation matters to the development of treatments and vaccines against new diseases and epidemics.

According to the both theoretical foundations, the maximalist vision and the holistic conception, health is admitted as well as a common-universal heritage and a fundamental human right. Its management therefore requires large-scale collective action. Even non-public actors (e.g., non-governmental organizations, civil society associations, parliaments, and big companies) have a crucial role to play in this cooperation. For example, diseases such as AIDS will only be solved through cooperation that is not limited to agreements or negotiations between states. So, they require the intervention of different stakeholders such as states, non-governmental organizations, political parties, and private companies (Gabas & Hugon, 2001).
The management of these global public goods represents a “global general interest.” International cooperation is the only alternative to ensure the interest of nations (Cossart, 2015; Dalode, 2006; Thoyer, 2002).

At the beginning of the twenty-first century, the Center for Development Studies of the United Nations Development Programme published its book Global Public Goods, International Cooperation in the 21st Century. This book has enriched the debate on global public goods, and health was cited among them. Similarly, in its book Effective Use of Development Finance for International Public Goods, the World Bank mentioned “health” as a global public good of high priority. Health is ranked second after the environment. The common point of these two books is emphasizing on the importance of international cooperation for optimizing the management of global public goods (Barkat, 2008).

Currently, the COVID-19 pandemic is conceived by the international community as a calamity. Thus, like any disaster, it is highly ambiguous. It represents a double uncertainty about its probability of occurrence and its severity. This ambiguity presupposes multi-level management and broader international cooperation; without them, countries cannot withstand the crisis (Jemli et al., 2010). In this field, international institutions have played a leadership role. The World Health Organization intervenes frequently to guide countries for taking strict and early measures to circumvent the spread of the new coronavirus. The organization warms and addresses the social categories that neglect the danger of this new virus. After the declaration of the pandemic state, the United Nations Educational, Scientific and Cultural Organization (UNESCO) gave its recommendations for the closure of schools and educational institutions. Surely, several other forms of intervention will be required from international financial institutions. These interventions are required to absorb the economic and financial shocks during and after the global crisis triggered by the pandemic. According to Mr. Antonio Guterres, the Secretary-General of the United Nations (UN), “Coronavirus is the worst global crisis since the Second World War. It is the combination of a disease threatening everyone and an economic impact leading to an unprecedented recession in the recent past.” Mr. Guterres predicts that there will be the risks of increased instability, violence, and conflicts. He considers that these consequences will make the COVID-19 crisis “the greatest challenge for us since the Second World War.” In this regard, the UN official emphasized the need for a stronger and more effective response. The latter is conditioned by “solidarity and the gathering of all, abandoning political games and understanding that humanity is at stake” (20Minutes and AFP news Agency, 2020). In the same line of thought, the Director-General of the World Health Organization pointed out that: “It is very rare that a single serious problem mobilizes the world’s attention. Countries and communities are coming together to stop the outbreak of the new Coronavirus.” He considers that the emergence of a new virus is always subject to many uncertainties (e.g., its spread, diseases it causes, and its potential impacts). In this context, the WHO is working daily with affected countries and a global network of partners to mitigate the uncertainties. For curving this unprecedented pandemic, the WHO supports solidarity and global collaboration to learn from early interventions and evidence-based measures. Indeed, the WHO acts as a coordinator between countries and health sector partners. The WHO efforts focus on the following: the epicenter in China; the other affected countries for preventing the virus spread; and preparing fragile states to react in the case of possible transmission.
Furthermore, to accelerate the discovery of treatment and vaccine for COVID-19, the World Health Organization is launching the “Solidarity Trial.” In fact, the first vaccine trial began only 60 days after that China has shared the genetic sequence of the virus (United Nations, 2020a). The WHO and its partners are testing and comparing treatments in many countries. Researchers around the world are attempting to systematically evaluate clinical therapies. This large-scale international cooperation aims to generate more reliable data that is essential for science and medicine in order to specify the most effective treatments. Hence, the WHO launched a program to exchange data on different COVID-19 treatments around the world. Several countries have already confirmed their participation in these solidarity tests such as Argentina, Bahrain, Canada, France, Iran, Norway, South Africa, Spain, Switzerland, and Thailand. Nevertheless, the WHO head emphasized on the participation of other countries in the trials. He pointed out that the new coronavirus is “the enemy of humanity” (i.e., it is a global public bad). So, the collective efforts are needed to defeat it (United Nations, 2020a).

The Sustainable Development Approach: “Goal 3: Good Health and Well-Being”

The third Sustainable Development Goal (SDG 3) “Good Health and Well-Being” is one among seventeen global objectives that are set by the United Nations for the period 2015–2030. This goal aims to “To ensure healthy lives and promote well-being for all at all ages” (World Health Organization, 2020). The SDG 3 reflects well the Sustainable Development logic. The goal highlights explicitly the international dimension “for all” and the intergenerational dimension of health “at all ages.” Among the priority targets of this objective are the reduction of major communicable, non-communicable, environmental, and mental diseases. In that, combating the spread of infectious and communicable diseases within and across regions of the world requires great efforts. Synergies are therefore important in determining the origin of diseases and mitigating their consequences. In addition, more efficient health systems and better access to health professionals are also strongly recommended to save people’s lives. These major health threats require the establishment of prevention systems that are crucial for circumventing deviant behaviors. Preventive measures include universal access to medical care and health services. Hence, better risk management presupposes more support for research and development of vaccines and drugs (United Nations, 2020b).

Moreover, health is the most fundamental human right. It is one of the basic indicators to evaluate country’s Sustainable Development achievement. Beyond that, health is now an increasing international phenomenon. For example, communicable and infectious represent a global problem (i.e., global public bad). No single country can therefore respond and solve them alone. In fact, the SDG 3 has set nine targets to be achieved by 2030. Communicable diseases are included in target 3.3 which states that: “By 2030, end the AIDS epidemic, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, waterborne and other communicable diseases” (United Nations, 2020b; World Health Organization, 2020). According to the United Nations, several achievements have been made in the fight against HIV/AIDS, malaria and other diseases, including:
– From 2000 to 2015, more than 6.2 million malaria deaths were averted. These results were primarily due to saving the lives of many children under the age of five in Sub-Saharan Africa. Globally, malaria-affected cases have decreased by about 37% and the mortality rate by 58%.

– In 2017, a total of 21.7 million individuals had access to antiretroviral therapy in the worldwide. However, 77.3 million people have been infected with HIV since the beginning of the epidemic. The death rate is still high with 35.4 million people dying from AIDS-related illnesses since the start of the epidemic. Tuberculosis remains the leading cause of death among these people, accounting for about one-third of deaths (United Nations, 2020c).

These advances are the result of the efforts of several organizations and institutions affiliated to the United Nations. These international institutions are constantly working to achieve the goal of “good health” around the world. The World Health Organization is leading these efforts. The United Nations Children’s Fund (UNICEF), another UN agency, is involved in supporting the health situation of children and pregnant women. However, new diseases are constantly emerging and even old diseases can mutate. The spread of a disease from one country to others leads to the transition from an epidemic to a pandemic. The strong inter-connectivity among countries accelerates the pandemic’s emergence and spread (United Nations, 2020c). Furthermore, biased behaviors frequently observed during the coronavirus pandemic, become major threat to “public health” systems. On the one hand, despite the strict instructions during the general confining, people still go out for any reason. In several countries, these deviant behaviors have intensified spreading the disease with several cases of horizontal contamination. On the other hand, the strict instructions to inform the relevant authorities without going directly to the health facilities were not respected. Hence, these biased behaviors are great threats to health facilities and staff. They have led to the isolation of these facilities and the restriction of access to their healthcare services. As highlighted by Hamel (2020), the proactive measures are the key solutions for improving pandemics governance. This orientation fits well into the framework of a prospective approach by relying on the boost of international and inter-organizational cooperation. Indeed, improving pandemic prevention and response requires cooperation at multiple levels (i.e., local, national, regional, and international) and among diverse stakeholders (e.g., food producers, medical product suppliers, healthcare providers; law enforcement, emergency managers). Thus, the coronavirus pandemic highlights the need for a global and coordinated management of this major risk. The health crisis that it triggered is thus bringing the issue of global health to the forefront of the international agenda.

Discussion of Our Paper’s Recommendations

In this last body part, we aim at substantiating our study’s findings as well as opening up further prospects for research. Hence, we discuss here the solutions/recommendations ensuing from our analysis comparatively to the most recent publications on the issue of the COVID-19 pandemic and its direct and/or indirect spillovers on “public health” systems.
At the outset, we would remind and underline that the issue of our paper (i.e., the pathways for mitigating behavioral biases and optimizing decision-making for COVID-19 management, especially the relevance of “public health” systems) has not yet been fully studied, even by these recent references. Furthermore, we discuss our paper’s findings comparatively to these works for two principal reasons. Firstly, these publications belong to diverse disciplines (computing and informatics, medicine, public health, economics, environment, telecommunication, demography, and sociology) and so valorize the interdisciplinarity as per our findings. Indeed, for its better management as a very complex and an unprecedented risk, the COVID-19 requires the contribution of many sciences and specialties. Secondly, as mentioned above, these new published works have in common of analyzing direct and/or indirect relationships between COVID-19 management and “public health” systems.

In accordance with our study, all these works admit the COVID-19 as a global pandemic and they hence strongly support the key recommendations of our paper about the recourse to a prospective approach to health. The main guidelines of the approach which we propose in our current paper are strengthening the knowledge of COVID-19, boosting cooperation and coordination at several levels and among various actors, and admitting health as a fundamental and universal human right. In this framework, health improvement and therefore “public health” preparedness are so required for the fight against ongoing and further pandemics according to the sustainable logic. As a matter of fact, all the researches referred here that are made at regional, international, or national levels give a push for better understanding and explaining as well causes and consequences of the new coronavirus.

In this context, Battineni et al. (2020) point out the fast-spreading of the new COVID-19. By affecting all world nations, COVID-19 may be the top deadly disease of the twenty-first century. Battineni et al. (2020) highlight the complementarities between health services improvement, governmental interventions, public’s alerts, and all preventive measures. They underline the importance of recent research studies on the topic of COVID-19 predictions. These studies are useful for better understanding the new virus longevity. The better knowledge of COVID-19 is very required for better managing healthcare systems and improving responses and decision-making in the fight against pandemic. Battineni et al. (2020) support the use of forecasting models for improving healthcare systems management, mainly intensive care units (ICU) in highly affected countries. By studying the four highly hit nations (USA, Brazil, India, and Russia), they proposed a model that can significantly predict the number of infections. It can therefore better guide national authorities for planning their health policy and to deal with the next waves. The work of Battineni et al. (2020) approves our paper’s findings about the need for boosting knowledge and prevention of pandemics. In fact, international and inter-temporal management of new pandemic will be useful for improving good health, well-being, and so sustainability.

In the same line, López et al. (2021) consider COVID-19 as a global pandemic in cause of its quickly climbed number of cases (that increase according to an exponential growth trend). In that, the ongoing pandemic caused by the new
coronavirus represents the most global pandemic in the last decades. The COVID-19 spreading cannot be limited to neighboring cities or cross-border regions, but it attends the most far-board countries and continents. López et al. (2021) highlight the utility of forecasting models for understanding the disease behavior and therefore alleviating uncertainty about future waves. Even if the current understanding is mainly about the short term, nevertheless it is very required for implementing adaptive responses. The model of López et al. (2021) shows that in Spain and more generally when there are not yet effective vaccines, drugs, and treatments for the COVID-19 disease, the next wave is more likely inevitable. A new wave is almost triggered few days after the government has ended the confining and lockdowns measures. In addition, they point out that any delay in the implementation of strict interventions at the beginning of the new wave may exacerbate the disease cases. This global crisis reveals the interconnected world and the common destine of diverse actors and/or countries that have to act together to contain the COVID-19 and to strengthen the “public health” preparedness and its resistance to potential next pandemics. On the first hand, the work of López et al. (2021) supports our findings about the big spillovers of biased economic behaviors and delayed or ineffective responses on the pandemic containment. On the other hand, their study highlights the need for a better uncertainty reduction, knowledge improvement, and vaccine development and sharing, in order to ameliorate “public health” preparedness and hence COVID-19 crisis management.

Based on Erić et al. (2021), the COVID-19 disease rapidly spread from China to Europe, USA, and the whole world, and therefore, it illustrates well the high interconnectivity of the actual world. In addition to its big human consequences (enormous deaths and infections), COVID-19 triggered a global pandemic that brought the world on the brink of economic catastrophe (e.g., gross domestic product and investments are falling, unemployment and indebtedness are rising, expenditures for healthcare are increasing). As a consequence, diverse sectors and economic agents have been drastically afflicted (e.g., profits of several companies jeopardized, incomes of households, and individual agents declined). The wider economic and social spillovers of the COVID-19 pandemic will be felt in the world for many years to come. In that, it will affect also the future generations (Erić et al., 2021). Furthermore, by the strong interconnectivity of countries, sectors, and economic agents, COVID-19 crisis management requires strengthening the cooperation and rethinking the public policy. Erić et al. (2021) study a sample of 31 European countries, and their analysis show that the state of democracy has a significant and positive effects on the “public health” policy during the COVID-19 pandemic (i.e., democracy stimulates health expenditures and hospital beds rate). The results and conclusions of Erić et al. (2021) approve our findings mainly about the huge and catastrophic impacts of COVID-19. The socio-economic spillovers of pandemic can last over time and threaten diverse generations. For these reasons, wide cooperation among multiple economic agents is recommended for enhancing “public health” response and country’s resilience to COVID-19’s shock. In this vision, we support the role of democracy to stimulate “public health” responses in the fight against the COVID-19 pandemic. Democracy may be a determinant for authorizing and facilitating the
participation and the cooperation of several actors and sectors, even those outside
the field of health, in pandemic management.

By the same, for better understanding the virus transmission and especially the
morbidity factors, Goutte et al. (2020) recommend undertaking more territorial
comparative analyses (i.e., at the level of departments or territorial units that have
the same human and climatic characteristics). They consider that the comparative
studies made at more wide levels (e.g., continental, regional, and national) may be
limited by giving some biased results about the contamination and transmission
rates. Indeed, in Sub-Saharan Africa transmission is extremely lower versus in
the North and West of the Globe. Goutte et al. (2020) analyze the effect of socio-
economic factors on the death rate of COVID-19 in some similar (densely populated)
territories in France. Their findings approve the significant effect of socio-economic
factors on the death rates caused by COVID-19. Among these factors, they set the
unemployment, poverty, lack of formal education, and unsuitable housing (i.e.,
unworthy, narrow, and/or overcrowded). The departments with the high-level factors
have accounted the highest death rates despite their younger populations. In that,
the link between old population (over the age of 75) and the excess mortality cannot
be absolute. Thus, COVID-19 threatens all individuals at all ages. In accordance
with our findings, to better understand the COVID-19 pandemic and as a result to
improve the management of the global crisis that it caused, it matters to control
various structural socio-economic factors. Hence, it is required to widen the
implication and participation of several actors and sectors, with a sustainable vision.

According to Kandel et al. (2020), the COVID-19 is quickly announced by the
WHO as a “public health” emergency of international concern (i.e., as a global pan-
demic). In that, the “public health” measures for managing this new pandemic rely
on national and regional preparedness capacities to prevent, detect, verify, assess,
and respond to this disease. All the measures must be in accordance with the Inter-
national Health Regulations (IHR). Indeed, Kandel et al. (2020) emphasize on the
priority of capacity building in all regions and countries. It is therefore very required
enhancing countries preparedness through the implementation and the control of
IHR national capacities for strengthening “public health” systems against ongoing
and potential pandemic. They study the health security capacities for a sample of
182 countries based on the five following indices of capacities: prevention, detec-
tion, response, enabling functions (i.e., resources and coordination capacity), and
operational readiness. Their study’s results show wide differences between countries
in terms of the studied capacities. For example, about half of the sample postponed
the operational readiness in the profit of health emergencies response. In addition,
the study points out the importance of prevention by public awareness that leads to
more responsible behaviors (e.g., hygiene measures, barrier gestures, local commu-
nities’ engagement, effective “public health” response measures). Moreover, Kandel
et al. (2020) underline the role of the early detection of the new coronavirus (due to
the development of laboratory for testing and genetically sequencing) for support-
ing early responses worldwide. However, they consider that pandemic’s effective
management is not only linked to the availability of human and financial resources.
Indeed, they emphasize on the country’s ability to manage the emergency logistics
(i.e., its capacity in handling supply chains for essential products during pandemic).
Furthermore, they suggest extending the participation to other disciplines as anthropologists, data scientists, communicators, educationists, and economists, for enhancing the control of pandemics. Thus, for strengthening the global health security and controlling the pandemics, they highlight the need for more inter-sectoral coordination and international collaboration. In fact, more than half of countries analyzed are characterized by weak enabling functions, meaning insufficient coordination and collaboration on them. On the contrary, the COVID-19 pandemic showed the countries’ needs of robust mechanisms of collaboration and coordination at several levels (e.g., global, national, and sub-national), according to an all-hazard and holistic approach. Hence, COVID-19 pandemic may be an opportunity for all countries for rethinking their “public health” preparedness and emergencies for dealing with future health crises. In accordance with the results of Kandel et al. (2020), the foresight attitude to health, proposed by our paper, suggests building “public health” capacities against pandemics. Indeed, all countries need to be more active in strengthening their preventive measures, stimulating international cooperation and involving multiple stakeholders, in order to improve the response to the current pandemic but also to be better prepared for future ones.

Across a large sample of countries, Milani (2021) studies the relevance of social and economic responses to the COVID-19 pandemic. He admits that the new coronavirus illustrated the strong interdependencies across all the regions of the globe and so the virus capacity to move cross-borders. Milani (2021) points out the delayed perceptions of the crisis triggered by COVID-19 in various countries and therefore the existence of delay in social behavior. Nevertheless, these perceptions and social responses have been learned later from others countries’ experiences (i.e., learning from the others’ more or less effective social measures in containing the disease). On the basis of social networks data, Milani (2021) analyzes the interdependencies between the numbers of confirmed cases, the citizens’ perceptions of risk, and their social responses. He demonstrates that the responses of people differ according to their risk perceptions, but at the same social responses can depend on the experience and the risk perceptions of the others individuals in their social networks, even those residing abroad. Indeed, people who are hyper-connected to countries with peaks of COVID-19 cases and where are early social responses learned from their social network in a matter of social distancing. In that, the social networks have improved their perceptions of risk and social behaviors. By studying a sample of 41 countries during the first months of the COVID-19 pandemic, Milani (2021) indicates that the majority of countries progressively (gradually) learn from each others’ social distancing measures. On the one hand, he highlights that the learning from the critical situations of some countries cannot lead to an instantaneous (a real-time) change in risk’ perception and behavior in others countries. On the other hand, he emphasizes on the importance of interconnections to understand both the virus’ spreading and the behaviors of gradual adaptation according to the others’ experiences and responses. In this field, the social connections (measured by Facebook’s Social Connectedness data) participated in sharing several data that are useful for the COVID-19 containment (e.g., health shocks, risk’s perceptions, merit of social distancing). Milani (2021) stresses that the shocks from Italy, the USA, Spain, and the UK affected individuals’ risk perceptions in several countries in the world. As
a result, many people reduced their social mobility and showed a gradually adaptive behavioral (i.e., their habits have not changed immediately, but they change progressively over time). Nevertheless, some countries that did not apply enough social distancing to deal with the global or domestic health shocks; they do not achieve a significant decrease in the rate of COVID-19 cases. In line with our findings, Milani (2021) confirms the large-scale risk of COVID-19. At the early period of pandemic in particular, he highlights that the new coronavirus affected the crisis perceptions and the behaviors of economic agents in cause of its huge uncertainty. Paradoxically, the experiences of some countries and their social adjustments allowed improving later, due to the learning effects, the responses in others countries.

In the same vein, Glenn et al. (2021) point out the crucial need for an effective public leadership in managing the COVID-19 crisis. They suggest a collective leadership form that is based on wide collaboration for generating a common good “health.” Indeed, COVID-19 is a “public health” crisis which requires various technical knowledge and practice and so the involvement of diverse disciplines. As a global threat, COVID-19 poses a common problem to different countries even if they have different contexts (i.e., it is a mega problem and major risk). The COVID-19 crisis leads to several spillovers (health, social, and economic) that are unique compared to previous pandemics. Glenn et al. (2021) analyze and compare the public leadership approaches in three countries (Chile, France, and the USA). These countries differ widely in their political institutions, health system design, and beliefs about the role of “public health”. Glenn et al. (2021) focus on the three dimensions of crisis’ management: sense-making, decision-making, and meaning-making. First, the dimension of sense-making (i.e., acknowledging the “public health” crisis) involves the attitude of leaders for recognizing the existence of a crisis and to realize both what and why is happening. This supposes knowing several data about the crisis (e.g., recognizing its timing, the magnitude of risk, and also the nature of its challenges—health versus economy). According to Glenn et al. (2021), leaders may face significant challenges and biases in crisis (e.g., cognitive biases, egocentric motives, and affiliations to particular groups or values). This finding is consistent with our paper especially about the limited capacities of individuals and organizations to quickly identify and fully understand threats under uncertainty. While delays in recognizing threats occurred in the three countries, Glenn et al. (2021) show some differences regarding the dimension of sense-making. They stress that the crisis denial was most marked in the USA because political leaders acknowledged with big lags the real danger of virus to their country. In France, the authorities quickly acknowledged the high severity of the new virus especially as a global crisis (by linking all primer cases only to international travels). Nevertheless, they were slow to recognize it as a domestic crisis. On the contrary, Chile quickly recognized that the virus triggered both global and domestic crises. Next, the dimension of decision-making (i.e., the role of institutions and the administrative versus political leaders) includes making critical choices and coordinating the actors involved in the response to the crisis. In the context of COVID-19 crisis, Glenn et al. (2021) highlight the heterogeneity across countries according to the decision-making processes. The particular institutional system of the USA led to decentralized responses in the fight against the COVID-19 pandemic. In fact, decision-making are made at a local level by each
state government (leading to various responses and differences in terms of effectiveness). Contrary to France and Chile, centralized management is implemented by imposing confining in all the country. In addition, Glenn et al. (2021) point out the differences of the three countries in matters of the role of administrative (i.e., scientific or technical expertise) versus political leaders. Indeed, in the USA, huge tensions appeared between “public health” administrators and politicians. These conflicts both at state and local levels have negatively affected the virus containment. In contrast to France and Chile, administrative leaders, especially the health experts, have contributed in legitimizing the political leaders’ decisions. In these two countries, the scientific committee guided the government’s decisions. Then, the dimension of meaning-making (relayed on trust and narratives) consists in managing the crisis as a political communication. Hence, this dimension focuses on the attitude of leaders in enhancing the awareness of crisis by public. The key challenge of this dimension is to communicate and persuade in a context of high uncertainty, but at the same preserving credibility and building trust. Glenn et al. (2021) stress the importance but also the difficulty of this task for all the countries. In fact, citizens who have trust on their public leaders respond more effectively with governmental measures in the fight against the COVID-19 crisis (by a collective compliance with “public health” guidelines). According to Glenn et al. (2021), trust issues were exacerbated in Chile, few months after the beginning of crisis, in the cause of weakness and controversy in communicating and interpreting data (e.g., number of recovered people and number of deaths). In the USA, the “public health” crisis deepened even the division of the political parties which led to more conflicts between Republicans and Democrats, especially during the presidential elections. This division exacerbated the crisis because it undermined the “public health” efforts in containing the virus and even accelerated the tension between politicians and health leaders. On the contrary, in France, crisis served in building more trust in policy-makers and scientific expertise. Overall, Glenn et al. (2021) recommend rethinking “public health” policies by moving the considerations of the “public health” at the center of the public arena. They consider that, in the COVID-19 crisis, the “public health” professionals are not seen only as actors within their specific discipline, but they become leaders for wide and diverse others fields. This idea supports our findings regarding the importance of collaborating between diverse sectors and multiple stakeholders during pandemic. Moreover, they consider that the crisis management relies on three key dimensions (sense-making, decision-making and meaning-making). The findings of Glenn et al. (2021) are consistent in great part with our paper that highlights the repercussions of biased behaviors on the relevance of decision-making during the COVID-19 pandemic. Nevertheless, we consider that the issue of our paper has gotten ahead of the work of Glenn et al. (2021) who studied the three dimensions of crisis management. Indeed, in our paper, we not only focus on the complementarities between the three dimensions; however, we go further by stressing their interactions. We analyze the repercussions of sense-making dimension (i.e., the risk understanding and the cognitive biases of economic agents under uncertainty) on the relevance of decision-making (i.e., responses to deal with the pandemic), and beyond this scope the feedback effects between them. In fact, by recommending a prospective approach to health, we attempt at highlighting that biased behaviors of
economic agents can, on one side, lag good choices and decision-making. On the other side, the ineffectiveness in response measures may mismanage the ongoing and also the further waves of pandemic.

Additionally, Rasul (2021) highlights the similarities and connections between the COVID-19 pandemic and climate change, as they are both global risks. In his study of South Asia region, he points out the disruption of agricultural activities and supply chains caused while by climate change and COVID-19. In this region, farmers are facing twin global challenges of climate change and COVID-19 pandemic. Rasul (2021) stresses the existence of direct and indirect causality relationships between agriculture or food security, climate change, “public health,” and COVID-19 pandemic (and so between several Sustainable Development Goals—SDGs). On one side, he underlines that the unsustainable practices in agriculture (e.g., use of agrochemicals, unsustainable use of water, and intensive use of fossil fuel energy) have a direct effect on climate change (e.g., greenhouse emissions, water pollution and scarcity, loss of biodiversity). The degradations of environmental conditions may intensify health risks (e.g., heart, asthma, and lung diseases), affecting therefore “public health” interventions (more chronic diseases) and indirectly increasing the occurrence of COVID-19 (i.e., increasing the possibility of being a risk factor). On the other side, Rasul (2021) emphasizes on the direct effect of both COVID-19 and climate change on agricultural activities and supply chains disruption in South Asia. He admits that these two global risks contributed in increasing people’s vulnerabilities by compounding the challenges of food security and sustaining livelihoods. Indeed, climate change has a direct effect on crop yields and land productivity. At the same manner, because of some measures for dealing with COVID-19 (e.g., lockdowns and cross-border closures), farmers are exposed to the uncertainty and perturbation in production, marketing, transportation, and income coming from agriculture and fresh products. Although the COVID-19 is a global risk, South Asian countries are very vulnerable for many reasons (e.g., big population, weak health facilities, high poverty, less access to water and sanitation, and inadequate living space which hinder social distancing). Furthermore, Rasul (2021) highlights the role of food and nutrition in supporting the immune system of COVID-19 patients as recommended by several nutritional and antiviral literatures and specialists. In addition, it is right that global air pollution has been significantly decreased during the lockdowns and movement restrictions caused by COVID-19. Nevertheless, this pandemic has also negative environmental effects by increasing medical wastes (e.g., hand gloves and surgical masks). In that, COVID-19 intensifies environmental risks and indirectly climate change (contamination of water, land, and air) and ultimately may aggravate health risks and food security. In accordance with our recommendations of a prospective approach, Rasul (2021) highlights the need for an integrated action and a holistic approach for addressing the interconnected challenges (i.e., COVID-19 pandemic, food security, health issues, and climate change). He and we too suggest strengthening regional and global cooperation for addressing the ripple effects of both COVID-19 and climate change on the health. In that, the associated policies for recovery may accelerate and facilitate the transition to more sustainable and resilient societies. These suggestions are consistent with our paper in which we recommend a global and synthetic vision to deal with the pandemic.
Indeed, we support collaboration and cooperation among various levels/countries and multiple stakeholders. Moreover, the recommendations of Rasul (2021) fit well with the sustainable approach supported by our paper. In fact, one important stake of the COVID-19 pandemic consists in taking a broad look at factoring sustainability (by its three pillars: economic, social, and environmental) into policy choices in order to create more resilient societies and sustainable development.

To summarize, the recommendations of our article are strongly underpinned by the recent published works. To strengthen pandemic response and preparedness, it is important to move toward a foresight attitude to health that posits enhancing knowledge and reducing uncertainty (Battineni et al., 2020; López et al., 2021; Milani, 2021); boosting cooperation and strengthening coordination among different actors (Erić et al., 2021; Glenn et al., 2021; Goutte et al., 2020; Kandel et al., 2020; Rasul, 2021); rethinking health (Erić et al., 2021; Kandel et al., 2020); and reasoning according to a more sustainable approach (Goutte et al., 2020; Rasul, 2021). These solutions trace the pathways for alleviating and addressing biased behaviors and so irrelevant measures during a global pandemic. Finally, the main implications of the findings of our paper, as well as recent works on the COVID-19 pandemic, are the opening of new research perspectives. For example, in future studies, it will be timely to analyze the broad range and cointegration of multiple exogenous variables to better explain how they influence decision-making and thus “public health” preparedness for pandemics.

**Conclusion**

Since 1921, Keynes and Knight have described the situations of uncertainty as non-probabilistic events. This category includes exceptional events with catastrophic consequences such as pandemics. This paper is inspired by the global crisis linked to the coronavirus pandemic. Our work delves into the theoretical underpinnings of the explanation and response to the biased economic behaviors in pandemic situations. In fact, the state of the art of behaviors during the COVID-19 pandemic illustrates the existence of several behavioral biases. People adopt deviant behaviors or fail often to respond rationally.

The first purpose of our paper is to provide a theoretical overview of economic behaviors in situations of uncertainty. In this respect, we have presented the various branches and theories that have studied the effects of uncertainty and psychological factors on the decisions made by the economic agents. These studies approve the existence of irrational and biased behaviors in the context of uncertainty. These theoretical findings are the main contributions of the economics of uncertainty, behavioral economics and experimental economics. The second purpose of our article is to highlight the need for a prospective approach in pandemic situations. Hence, the foresight attitude to health is founded, on the one hand, by the approach of “common and universal heritage.” This approach treats global health as a “global public good.” Therefore, any violation or threat to health, as a fundamental human right, is conceived as a “global public bad.” The common and universal heritage approach recommends maximalist and large-scale international cooperation for pandemic
preparedness and response. On the other hand, the prospective approach to health is already strongly solicited by the “Sustainable Development Approach” of the United Nations. Indeed, the third Sustainable Development Goal (SDG 3) is entitled “Good Health and Well-Being.” By one of its targets, this objective focuses on the control and mitigation of the communicable diseases in the world.

In the period of the coronavirus pandemic, themes at the forefront of political and media discourse are: awareness, discipline of people, and the importance of cooperation. Around the world, there have been efforts by the media, psychiatrists, and influential people (artists, players, writers) to raise awareness of precautionary measures and especially respect for general confining. These attempts again endorse how biased and irresponsible behaviors can exacerbate the problem and hinder prevention and response measures. For this reason, a prospective approach is a requirement. Moreover, the COVID-19 pandemic is classified as a “major” or “new” risk. In this respect, the prevention and the fight against this large-scale risk need the mobilization of diverse actors (political decision-makers, trade unions, private actors, civil society, international organizations, and communities). This intervention is multi-level (local, regional, national, and international) and multidisciplinary. It implies therefore the involvement of different ministries such as health, defense, interior, transport, trade, external affairs, social affairs, and religious affairs.

In closing, we can say that previous studies of economic behaviors under uncertainty have revealed the existence of several biases. These findings led to the rejection of the neoclassical assumption of “absolute rationality.” Furthermore, the COVID-19 pandemic has uncovered several unfair practices in international relations and trade. Some countries have failed to help their economic partner, as in the case of Italy which was left to its fate by the other members of the European Union. Large economic forces have practiced price wars and piracy and have even banned on the export of medical products and equipment. These practices invite us to rethink the prospects of the international cooperation if the pandemic lasts for longer. In fact, selfish economic practices call into question Adam Smith’s invisible hand which postulates that the individual interest lead to the collective one. Thus, unfair country practices can threaten the international cooperation and efforts to circumvent the virus. In the future, these practices may increase conflicts and wars, as advertised by the United Nations.

Our paper raises a highly topical issue by referring to the reality and lived experience during the coronavirus crisis. The paper highlights the immediate effects of economic agents’ behaviors on risk management, especially on “public health” preparedness. Indeed, the biased behaviors of some individuals can become a source of threat for the whole group. Country experiences have revealed that biased behaviors of individuals and organizations (e.g., failure to follow barrier gestures and sloppy application of health protocols) have led to the resurgence of infected cases, resulting in a second and even a third wave of infection in several countries around the world. The lessons to be learned from these experiences support the main recommendations of this paper. Thus, it is crucial to understand and better regulate biased behaviors. Additionally, it is important to boost the international cooperation in the health sector. These orientations fit well within the framework of a prospective
approach to health that requires more vigilance and preparation to ensure a better response to pandemics.

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

**Declarations**

**Conflict of Interest/Competing Interests** None.

**References**

Adhanom Ghebreyesus, T. (2020). Nouveau coronavirus: solidarité, collaboration et mesures d’urgence au niveau mondial s’imposent. Organisation Mondiale de la Santé. https://www.who.int/fr/news-room/commentaries/detail/global-solidarity-collaboration-and-urgent-action-needed-to-defeat-the-new-coronavirus-outbreak. Accessed 10 Mar 2020.

Arrow, K. J. (1953). Le rôle des valeurs boursières pour une meilleure répartition des risques. Cowles Commission for Research in Economics.

Barkat, K. (2008). Les biens publics mondiaux et l’aide publique au développement: un cruel dilemme. Faculté d’Économie Appliquée, Centre d’Analyse Economique, Aix-en-Provence. http://ged.u-bordeaux4.fr/BienPublicMondiaux_APD.pdf. Accessed 26 Mar 2020.

Battineni, G., Chintalapudi, N., & Amenta, F. (2020). Forecasting of COVID-19 epidemic size in four high hitting nations (USA, Brazil, India and Russia) by Fb-Prophet machine learning model. *Applied Computing and Informatics*. https://doi.org/10.1108/ACI-09-2020-0059

Beck, U. (1992). *Risk Society: Towards a new modernity*. Sage Publications.

Berger, G., Massé, P., & De Bourbon-Busset, J. (2007). *L’ouvrage de la prospective – Textes fondamentaux de la prospective française 1955–1966*. Paris: l’Harmattan Collection.

Boidin, B. (2014). *La santé : bien public mondial ou bien marchand ? Réflexions à partir des expériences africaines*. Villeneuve d’Ascq: Presses Universitaires du Septentrion.

Chemarin, S., & Henry, C. (2005). Vers une théorie économique de l’assurabilité en incertitude. EDF-Ecole Polytechnique, Laboratoire d’Econométrie de l’Ecole Polytechnique, Chaire Développement Durable, Cahier n° 2005–005.

Commissariat général du Plan. (2003). *La décision publique face au risque. Rapport du Séminaire Risques, La Documentation Française, Paris.*

Cossart, J. (2015). *Les biens publics mondiaux, sauvetage du capitalisme ou révolution ? Les Possibles*, (5).

Dalode, J. (2006). Présentations des Biens publics mondiaux: définitions, études de cas. Conférence: Solidarités Internationales et Droits Fondamentaux: vers les biens publics mondiaux. Forum permanent de la Société civile européenne, 21 février, Bruxelles. https://survie.org/topics/economie/biens-publics-a-l-echelle-mondiale/article/presentations-des-biens-publics. Accessed 25 Mar 2020.

De Filippis, V. (2002). L’irrationalité économique obtient le prix Nobel. Libération. https://www.liberation.fr/futurs/2002/10/10/l-irrationnalite-economique-obtient-le-prix-nobel_418001. Accessed 07 Mar 2020.

Degbe, E. (2020). Du mal à respecter le confinement? Un psychiatre vous explique pourquoi. Interview avec Jérôme Palazzolo sur HuffPost. https://www.huffingtonpost.fr/entry/du-mal-a-respecter-le-confinement-un-psychiatre-vous-explique-pourquoi_fr_5e73a228c5b6f5b7c54009f16. Accessed 19 Mar 2020.

Erić, O., Popović, G., & Bjelić, J. (2021). Economic Response of the European Countries to the First Wave of COVID-19. *Economy and Market Communication Review*. https://doi.org/10.7251/EMC2101063E

European Environment Agency. (2001). *Signaux précoces et leçons tardives : le principe de précaution, 1896–2000*. Environmental Issue Report N°22/2001, Copenhagen.
Franceinfo. (2020). L’OMS lance un message aux jeunes: Vous n’êtes pas invincibles face à l’épidémie de coronavirus. Conférence de presse en ligne de Tedros Adhanom Ghebreyesus. https://www.francetvinfo.fr/sante/maladie/coronavirus/l-oms-lance-un-message-aux-jeunes-vous-n-etes-pas-invincibles-face-a-l-epidemie-de-coronavirus_3877241.html. Accessed 21 Mar 2020.

French Ministry of Solidarity and Health. (2020). Préparation au Risque Epidémique Covid-19. Guide Méthodologique, France. https://solidarites-sante.gouv.fr/IMG/pdf/guide_methodologique_covid-19-2.pdf. Accessed 15 Mar 2020.

Gabas, J. J., & Hugon, P. (2001). Les biens publics mondiaux et la coopération internationale. L’économie Politique. https://doi.org/10.3917/leco.012.0019

Glenn, J., Chaumont, C., & Villalobos Dintrans, P. (2021). Public health leadership in the times of COVID-19: A comparative case study of three countries. International Journal of Public Leadership. https://doi.org/10.1108/IJPL-08-2020-0082

Godard, O., Henry, C., Lagadec, P., & Michel-Kerjan, E. (2002). Traité des nouveaux risques. Précaution, Crise, Assurance. Collection Folio-Actuel, Paris: Gallimard.

Goes, A., & Skees, J. R. (2003). Financing natural disaster risk using charity contributions and ex ante index insurance. American Agricultural Economics Association, Annual Meeting, July 27–30, Montreal, Canada.

Gollier, C., Hilton, D. J., & Raufaste, E. (2003). Daniel Kahneman et l’analyse de la décision face au risque. Revue D’économie Politique. https://doi.org/10.3917/repd.133.0295

Goutte, S., Péran, T., & Porcher, T. (2020). The role of economic structural factors in determining pandemic mortality rates: Evidence from the COVID-19 outbreak in France. Research in International Business and Finance. https://doi.org/10.1016/j.ribaf.2020.101281

Hamel, T. (2020). Pandémie COVID-19: Leçons pour le Bioterrorisme. Revue Sécurité Globale, 4(24), 5–42.

Iandolo, F., Loia, F., Fulco, I., Nespoli, C., & Caputo, F. (2020). Combining big data and artificial intelligence for managing collective knowledge in unpredictable environment - Insights from the Chinese Case in Facing COVID-19. Journal of the Knowledge Economy, Open Access. https://doi.org/10.1007/s13132-020-00703-8

Jemli, R., Chitourou, N., & Feki, R. (2010). Insurability challenges under uncertainty: An Attempt to Use the Artificial Neural Network for the Prediction of Losses from Natural Disasters. Panoeconomicus. https://doi.org/10.2298/PAN1001043J

Kahneman, D., & Tversky, A. (1979). Prospect theory: An Analysis of Decision under Risk. Econometrica, 47(2), 263–291.

Kahneman, D., Slovic, P., & Tversky, A. (1982). Judgment under uncertainty: Heuristics and biases. Cambridge University Press.

Kindleberger, C. P. (1986). International public goods without international government. American Economic Review, 76(1), 1–13.

Knight, F. H. (1921). Risk, Uncertainty and Profit. Houghton Mifflin Company.

Kunreuther, H. C. (1979). Why aren’t they insured?. Journal of Insurance, XL(5), 15–39.

Kunreuther, H. C., Meszaros, J., Hogarth, R. M., & Spranca, M. (1995). Ambiguity and underwriter decision processes. Journal of Economic Behaviour and Organization. https://doi.org/10.1016/0167-2681(94)00041-C

Kunreuther, H. C., Meyer, R., Zeckhauser, R., Slovic, P., Schwartz, B., Schade, C., Luce, M. F., Lippman, S., Krantz, D., Kahn, B., & Hogarth, R. (2001). High stakes decision making: Normative, Descriptive and Prescriptive Consideration. Marketing Letters. https://doi.org/10.1023/A:1020287225409

Larquier, P. (2020). Coronavirus: l’épidémie en 13 dates clés. Journal La Croix, Bayard Presse. https://www.la-croix.com/Monde/Asie-et-Oceanie/Coronavirus-epidemie-10-dates-clles-2020-02-07-1201077010. Accessed 07 Apr 2020.

López, M., Peinado, A., & Ortiz, A. (2021). Characterizing two outbreak waves of COVID-19 in Spain using phenomenological epidemic modelling. PLoS ONE. https://doi.org/10.1371/journal.pone.0253004

Milani, F. (2021). COVID-19 outbreak, social response, and early economic effects: A global VAR analysis of cross-country interdependencies. Journal of Population Economics. https://doi.org/10.1007/s00148-020-00792-4
Organization for Economic Co-operation and Development. (2003). Les risques émergents au 21ème Siècle, Vers un programme d’action. Les rapports de l’OCDE, Risk Report, Paris.
Prevéost, R. (1965). La prospective économique. Revue Économique. https://doi.org/10.3406/reco.1965.407653
Rasul, G. (2021). Twin challenges of COVID-19 pandemic and climate change for agriculture and food security in South Asia. Environmental Challenges. https://doi.org/10.1016/j.envc.2021.100027
Rosenthal, I., Kleindorfer, P., Kunreuther, H., Michel-Kerjan, E. O., & Schneider, P. (2004). Lessons learned from chemical accidents and incidents. OCDE Workshop, 21–23 Sep, Karlskoga, Sweden.
Senate. (2012). L’application du concept de bien public à l’échelle internationale. Rapports d’information, 12 Mars, Paris. Disponible sur: http://www.senat.fr/rap/r03-23/r03-23320.html. Accessed 20 Mar 2020.
Thiébaux, A. (2020). Pandémie: définition, différence avec une épidémie, exemples. Le Journal des Femmes, Santé. https://sante.journaldesfemmes.fr/maladies/2619795-pandemie-coronavirus-covid-19-definition-signification-difference-epidemie-exemple-historique/. Accessed 21 Mar 2020.
Thoyer, S. (2002). Biens publics mondiaux. Policy Brief Paper, Conclusions du Séminaire Sustra Global public goods and trade, 13–14 Mai, ENSA Montpellier, France.
Thoyer, S. (2011). La montée en puissance de la notion du bien public mondial. L’Encyclopédie du Développement Durable, n°135, 26 Janvier, Paris.
Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and Biases. Science, 185(4157), 1124–1131.
United Nations. (2020a). L’OMS annonce le début des premiers essais d’un vaccin contre le Covid-19. ONU Info. https://news.un.org/fr/story/2020a/03/1064362. Accessed 18 Mar 2020.
United Nations. (2020b). ODD3 - Donner aux individus les moyens de vivre une vie saine et promouvoir le bien-être à tous les âges. Agenda 2030. https://wwwagenda-2030.fr/odd/odd3-donner-aux-individus-les-moyens-de-vivre-une-vie-saine-et-promouvoir-le-bien-etre-tous-les. Accessed 26 Mar 2020.
United Nations. (2020c). Objectif 3: Permettre à tous de vivre en bonne santé et promouvoir le bien-être de tous à tout âge. Objectifs du Développement Durable. https://www.un.org/sustainabledevelopment/fr/health/. Accessed 26 Mar 2020.
20Minutes and AFP news Agency. (2020). Coronavirus: La pandémie est la pire crise mondiale depuis 1945, selon l’OMS. https://www.20minutes.fr/monde/2752275-20200401-coronavirus-pandemie-pire-crise-mondiale-depuis-1945-selon-chef-ons&utm_term=Autofeed&xtrref=twitter.com&utm_medium=Social&utm_source=Twitter&fclid=IwAR2aEZUYULjWqS44wvnyHpvGOHNRUGcric1U44wGfoGRwvoq30XH5oU0YE#Echobox=1585712434. Accessed 01 Apr 2020.
Von Neumann, J., & Morgenstern, O. (1944). Theory of games and economic behaviour. Princeton University Press.
Weber, M., & Zuchel, H. (2001). How do prior outcomes affect risky choices?. Further evidence on the house-money effect and escalation commitment. Universität Mannheim.https://pdfs.semanticscholar.org/15f7/087a7230ac3525b55ee0f13ae412044a0a35.pdf. Accessed 01 Mar 2020.
World Health Organization. (2010). Qu’est-ce qu’une pandémie ?. Document d’orientation de l’OMS : préparation et action en cas de grippe pandémique. Alerte et action au niveau mondial (GAR). https://www.who.int/csr/disease/swineflu/frequently_asked_questions/pandemic/fr/. Accessed 21 Mar 2020.
World Health Organization. (2020). La santé et le bien-être: objectif 3 de développement durable. https://www.who.int/topics/sustainable-development-goals/targets/fr/. Accessed 26 Mar 2020.

Publisher’s Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Authors and Affiliations

Rim JEMLI1,2 · Nouri CHTOOUROU2

1 Department of Economics and Quantitative Methods, Graduate School of Commerce, University of Sfax, Route de l’Aéroport Km 4.5, Box n° 1081, 3018 Sfax, Tunisia
2 Faculty of Economics and Management, University of Sfax, Route de l’Aéroport Km 4, Box n° 1088, 3018 Sfax, Tunisia