

# The “Day After” Covid-19 Pandemic: Logistical Disorders in Perspective

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## Abstract

Half of humanity experienced an unprecedented situation of lockdown during the Covid-19 pandemic of 2020. The sharp slowdown in trade and the shutdown of entire industrial and commercial sectors had major economic consequences, with a historic collapse in household consumption, particularly in Europe. One country after another decided to gradually organize a lockdown exit, taking into account the heavy health constraints involved. This lockdown exit, and the resulting boom of trade, is likely to come up against a major disruption of supply chains, which needs to be evaluated now. The research note proposes an exploratory reflection on a unique situation since the WW II, and the logistical implications of what can be called the “day after” the Covid-19 pandemic. In order to limit serious disorders in product flow monitoring, the question of a moderate rhythm of lockdown exit and economic recovery is raised.

**Keywords:** consumption, Covid-19 pandemic, lockdown exit, supply chains

## 1. Introduction

It is not a sterile polemic to note the lack of preparedness of most European countries, with the exception of Germany, for the Covid-19 pandemic and the difficulties encountered in managing a health crisis of such magnitude. It also highlighted the selfishness of governments when health systems were overwhelmed by the exponential growth in the number of patients in acute respiratory distress, which has led, for example, to the organization of complex patient transfers between public hospitals that are far apart from each other (Paché 2020b). Historians will no doubt remember the theft of protective masks between countries on the tarmac of some airports, in defiance of all ethical and humanitarian considerations. It will also remember, in a more positive way, the self-sacrifice of health professionals in public hospitals in European countries, as well as the courage of the people of the “invisible” (supermarket cashiers, lorry drivers, garbage collectors, etc.), who continued to carry out their tasks at the risk of serious contamination.

After inevitable hesitations, following a state of stunning chock, a radical political decision, unprecedented in History since the great plague epidemics in Europe in the 17<sup>th</sup>, 18<sup>th</sup> and 19<sup>th</sup> centuries (about 15 million deaths), was taken to limit mortality: lockdown. At the time, it was probably impossible to imagine any other solution to stem the pandemic wave, even though European countries, such as Sweden, leaned towards achieving *collective immunity* by allowing it to spread. Clearly, lockdown is a difficult choice with major economic and societal implications, but one that also plunges the most informed observers into abysses of uncertainty about the “day after” Covid-19 pandemic. One of the important questions is undoubtedly about the capacity of supply chains to be reactivated rapidly after operating for several weeks in *degraded mode*.

## 2. Europe Between Lockdown and Lockdown Exit

In mid-March 2020, drastically limiting the arrival of new intensive care patients in European public hospitals became an absolute emergency, at the risk of seeing mortality skyrocket in a few days due to a lack of sufficient capacity in terms of respirators and health professionals (Paché 2020a), as a result of a secular trend to reduce health care expenditures in most European countries (Gradus, 2012). For this purpose, the choice was made to impose a lockdown of the populations at home in order to reduce the number of social contacts, vectors of an accelerated spread of Covid-19. Most European countries, including Italy, Spain, France, Austria, the United Kingdom and Belgium, have followed this strict policy, directly inspired by the Chinese “quarantine” model (Lau *et al.*, 2020), but with exemptions to take into account the fact that a democracy does not function as an authoritarian system (see Figure 1).

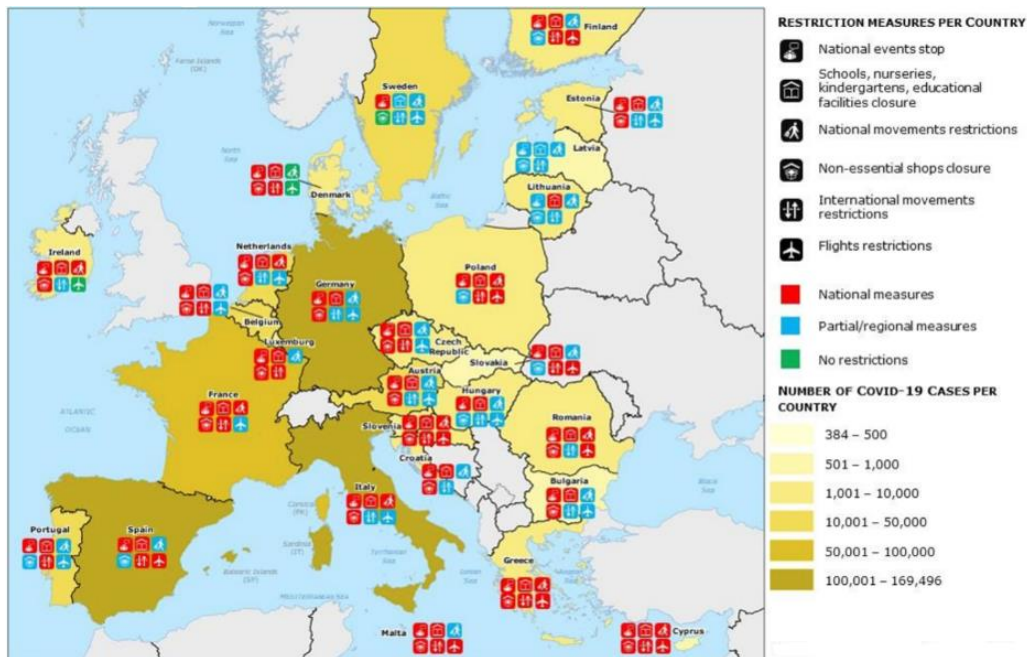


Figure 1. Lockdown policies in the European Union (*Forbes*, April 15, 2020)

At the same time as the freedom of movement of individuals has been impeded, and as a consequence, whole sectors of the economy, considered “non-essential”, have been shut down, again to prevent the multiplication of social contacts through physical distancing. The concept of distancing, which comes from theatre, was theorized by Bertold Brecht, in reference to *verfremdungseffekt*, or creating a “distance” between the performance (show) and the spectator in order to develop his/her critical mind. In medicine, social distancing was applied for the first time during the Spanish flu pandemic in October 1918 by Dr. Max C. Starkloff, in charge of health care for the city of St. Louis, Missouri, which forbade gatherings of more than twenty people. With the lockdown of 2020, while industrial activity has been partly preserved, the activity of services to individuals has been forced to stop overnight, plunging Europe into a deep recession of an intensity not seen since the WW II (Mann, 2020). A brutal recession which, moreover, justified massive intervention by the European Central Bank and the US Federal Reserve to prevent the stock markets from collapsing.

The lockdown exit, between April and May 2020, is the period of all dangers, both health and economic. Indeed, after many debates between scientists, industry decision-makers and political authorities, European countries have decided, one after the other, to take their populations out of lockdown, but in an extremely gradual manner. In other words, after several weeks of drastic reduction of travel possibilities, these same populations are allowed to return to their workplaces, and a significant number of non-food stores are opening again. Of course, freedom of movement is not total, excluding for example many entertainment activities. Nonetheless, the gradual exit from lockdown risks profoundly destabilizing the monitoring of supply chains with a too rapid and poorly controlled recovery of household consumption, although such a hypothesis remains subject to discussion (Mirlicourtois, 2020).

### 3. Towards an Explosion of “Revenge Buying”?

The lockdown strategy has caused a shock of unprecedented violence for European countries, with a collapse in economic activity. The consumption of many products has thus fallen in dizzying proportions, and it is expected, for example, to fall by 30% for motor vehicles and 35% for alcohol and spirits over the whole of 2020. Although one must remain cautious with projections made at the worst moment of a crisis, an article by Giles & Romei (2020) indicates that for the Eurozone, the IHS Markit composite index for services and manufacturing fell from 51.6 in February 2020 to 29.7 in March 2020, the lowest level since the index was introduced in 1998 (a level below 50 indicates that a majority of firms have reduced their activity in the last month). It is not really surprising that lockdown, combined with the business interruption of many commercial activities, has a direct impact on both the consumption of industrial goods (BtoB markets) and the consumption of food and non-food goods (BtoC markets).

Figure 2 clearly illustrates the breakdown in consumption of engineered goods for France during the first month of the lockdown. One of the most illustrative cases of the effects on all value chains is that of catering: the closure of independent restaurants could only impact wholesale intermediaries (and international wholesale markets such as Rungis, in Paris), and by necessity, the farmers and fishermen with whom they usually work (Richards & Rickard, 2020). Services

such as transport, hotels, restaurants and entertainment contribute most to the overall decline in economic activity in 2020. Even if two-thirds of activity is, on average, maintained in these different sectors, they account for almost half of the decline in GNP. Compared with a “normal” situation, the loss of activity for the French economy as a whole is around 35%, but with wide disparities. The construction industry lost 89% of its business because construction sites were suspended at the beginning of the containment period due to a lack of sufficient guarantees for employee safety. The consequence of the decline in activity is massive partial unemployment for 12 million employees in France, i.e. almost one employee in two.



Figure 2. Breakdown of engineered goods consumption in France (INSEE, April 2020)

The whole question is to know how the “day after” will take shape in terms of consumption, especially with its possible boom, in proportions that are not well known. Already, according to the French *Observatoire des Conjonctures* (OFCE), the political decisions linked to the Covid-19 pandemic (lockdown and shutdown of activities) have generated “forced savings” that reached a record amount of 55 billion euros for France at the end of April 2020. This is a significant potential for future consumption. In addition, there is a foreseeable boom in household purchases for two main reasons: on the one hand, it will be possible to make purchases that have been postponed because of the requirement for lockdown; on the other hand, on a more psychological level, the fact of regaining freedom of movement could generate a consumerist frenzy based on the Chinese model of “revenge buying”. During the lockdown exist of Wuhan (China) in April 2020, consumers rushed to buy shoes, household durables and furniture, as if to make up for a momentarily lost time.

#### 4. Major Logistical Risk

As soon as Europe was hit by the Covid-19 pandemic, recognized as such by the WHO on March 11, 2020, the political authorities pointed to the extraordinary vulnerability of the economies of the Old Continent to supplies from Asia, China and India in particular, confirmed by the premonitory article by Haren & Simchi-Levi (2020). The example of European dependence on active principle used in the production of medicines is now well known, even if it had been identified years ago by the French Academy of Pharmacy. More broadly, both President Emmanuel Macron and his Minister of Economy have underlined the danger represented by “global value chains”, whose operation worldwide is made possible, or rather carried by transport/logistics systems of outstanding efficiency. As summarizes by Velychko (2014:135), adequate logistics “have become one of the most significant factors of providing competitiveness of a business and effective satisfaction of consumer needs”.

It is true that almost all Fortune 1000 companies have reported major supply chain disruption risks related to Covid-19 pandemic (Ivanov, 2020a), which is not surprising given the dependence on China in global value chains. An econometric study on the evolution of European countries’ dependence on Chinese inputs between 2000 and 2014, measured by the share of Chinese value added in each country’s gross output, indicates that it has increased sharply (Mejean, Martinez & Gerschel, 2020). In 2014, dependence is still low in Southern European countries as well as Switzerland, France and the United Kingdom, and medium in Germany and a few small countries such as Denmark, Belgium and Finland. On the other hand, it is high in Eastern European countries such as Hungary and Czech Republic (see Figure 3).

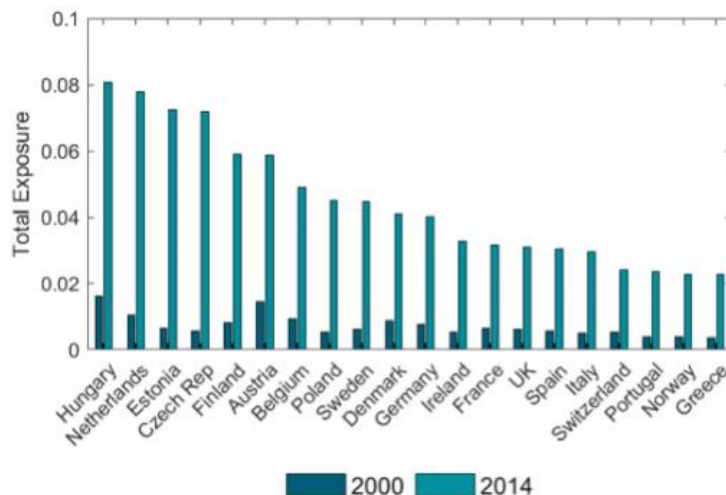


Figure 3. Dependence to Chinese inputs for European countries  
(Mejean, Martinez & Gerschel, 2020)

While the vulnerability of European economies in the context of globalization is now recognized, few analysts have realized that it is a direct threat to the lockdown process. Indeed, a high speed of lockdown exit, regardless of the health risks linked to the spread of a second wave of contagion, and consequently a possible new lockdown of populations, could lead to a rapid disruption of supply chains faced with the consumerist frenzy mentioned above. The issue is not simply a question of production units more or less capable of recovering their pre-pandemic level of activity. They must also be able to obtain from their first tier and second tier suppliers sufficient volumes of materials, components and sub-assemblies needed to produce finished products.

Considering that a standard motor vehicle consists of 30,000 parts for a total of about 200 types of equipment involving between 8,000 and 10,000 subcontractors and suppliers, it is easy to understand that local manufacturing or delivery failures, including on “secondary” parts, can paralyze the entire supply chain (Blackhurst, Scheibe & Johnson, 2008). This is even more obvious when the mapping conducted by Xu *et al.* (2019) shows unambiguously that this supply chain is now part of a globalized dynamic (see Figure 4). The automobile is far from being a unique case. On the contrary, many assembly industries, such as household appliances and microcomputers, are part of the same framework. However, the Covid-19 pandemic has exposed two types of fragility that are likely to be long lasting and directly threaten the resilience of supply chains:

- Unfortunately, it is likely that many European subcontractors and suppliers, especially small ones, whose financial weakness has been repeatedly highlighted (Pillu & Zlotowski, 2014), will not be able to resist the economic “purge”, despite strong governments support.
- For subcontractors and suppliers located in Asia in particular (Haren & Simchi-Levi, 2020), the slow recovery of transport/logistics systems on a global scale is likely to make supplies to Europe uncertain, both in terms of frequency and reliability.

The logistical risk mentioned here is not a true surprise. It corresponds to what business school students have been learning in their strategic management classes for decades: the domination of global value chains that are economically and geographically fragmented in a “business network” logic (Gereffi, Humphrey & Sturgeon, 2005). What is more surprising is the way in which a major health crisis – that 25 experts gathered in mid-2000s by the CIA (2005) announced as a very plausible scenario... by 2020 – underlines how much we have become dependent on continuous logistics performance. If this fails, we could find in a situation of lockdown exit during which consumers would be restricted in their desire to consume because of recurrent stockouts, just as they were unable to consume during the lockdown period.

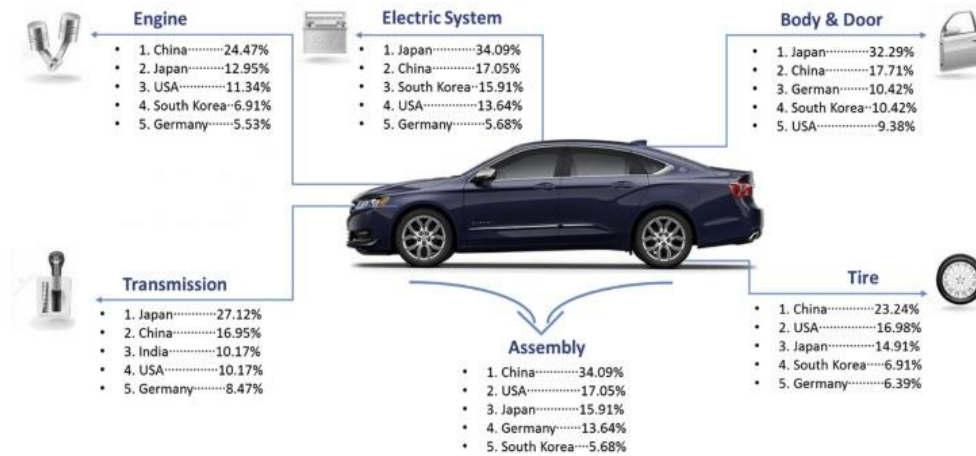


Figure 4. Automotive supply chain mapping: a highly globalized approach

(adapted from Xu *et al.*, 2019)

### 5. Moderate Rhythm of Lockdown Exit and Economic Recovery

European countries have chosen to organize a lockdown exit in a very gradual manner, by authorizing in dribs and drabs the reopening of stores, for example with reference to geographical zoning (“red zones” vs “green zones” in France). For the various governments, progressiveness is mainly linked to public health issues and reasoned control of the number of social contacts: it is imperative to avoid the development of a second wave of contagion that could once again clutter up hospitals with an uncontrolled flow of patients in acute respiratory distress. Of course, no politician justifies the gradual lockdown exit by the desire to restart consumption step by step, while limiting the negative impacts of possible logistical disorders. This would undoubtedly be an inaudible discourse by populations whose freedom to consume for several (long) weeks would be hindered.

Europe is therefore facing an unprecedented challenge: slowly reviving its economies in order to avoid the multiplication of “supply chain disruptions” (Wu, Blackhurst & O’Grady, 2007). The difficulty is immense because the decision must be well understood by industry leaders, who may be tempted to want to make up for lost time too quickly. It must also be well understood by consumers, who will be asked for a longer or shorter period of time to give up their freedom to buy certain products or services, when they want and where they want. Already, all the difficulties of the exercise are being felt, especially in view of the summer period in 2020, which is a significant source of income for countries such as Spain and France. We are not talking about de-consumption, and even less about degrowth, but rather about *demand smoothing strategies* to facilitate the adjustment with supply.

Can we then speak of a radical rupture, as some people are beginning to write, by evoking the “day after”? The answer will undoubtedly be both positive and negative at the same time. A positive response because it seems clear that the architecture of global value chains will be profoundly questioned given the major logistical dysfunctions it introduces, perhaps with a trend towards relocations in the Europe/Maghreb region. The Grand Est region in France, around Nancy, Mulhouse and Strasbourg, is one of the European areas hardest affected by the Covid-19 pandemic, and one that has reacted most quickly to the “relocation” issue. On March 12, the President of the Regional Council announced the launch in April 2020 of a “Relocation Pact” for all companies wishing to repatriate part of their supply chain to the Grand Est region, France or Europe, and thus reduce their dependence on Asian suppliers.

But the answer is also negative, as we can imagine that the major health crisis we are going through is simply at the origin of original resilience scenarios, capable of formalizing reactivity “scripts” to ensure the continuity of supply chains without calling into question consumerist ways of thinking. Since the seminal paper of Christopher & Peck (2004), many studies have focused on resilient supply chains faced with violent external shocks. One of the most important dimensions is the definition of a *business continuity plan* as a prerequisite for being able to manage any crisis. The business continuity plan should guide both short-term operational and long-term strategic decisions. Supply chain managers will ensure that they use several supplier sources for the same part, which will make it possible to maintain supplies in the event of a disruption from one country. Redundancy of vital activities to allow the continuity of the company’s business could then lead to the reactivation of global value chains, but with backup solutions in case of paralysis of certain logistical nodes. Which path will be taken during the “day after”? As John Connor, the hero of *Terminator 3*, says, “the future has not been written, there is no fate but what we make for ourselves”.

## 6. Managerial Implications

Although it will take months before lessons can be learned from the Covid-19 pandemic, the health and economic crisis provides an opportunity to highlight useful managerial implications to better manage potential future pandemics. The European example thus shows that countries initially focused on short-term measures in two main directions. On the one hand, at the microeconomic level, working from home for many support functions has been strongly encouraged to guarantee business continuity as much as possible; however, working from home can only be properly organized if information systems meet users' expectations, particularly in terms of data robustness and security. On the other hand, at the macroeconomic level, various national and international political institutions have understood the urgent need to take into account post-crisis financial risks by injecting massive amounts of liquidity to avoid a cascade of bankruptcies, preventing a rapid resumption of activities and economic growth.

From a structural perspective, the Covid-19 pandemic highlights the presence of major organizational and logistical challenges. The experience accumulated during the crisis of 2020 concerns first of all the organizational changes on which a reflection must be carried out at company level. As indicated previously, a business continuity plan is essential to face the "day after"; it requires the construction of efficient risk management policies, but also succession plans for the main top managers if necessary. The experience accumulated during the 2020 crisis then concerns the logistical dimensions. It is essential to assess available supply capacities and alternative logistical options, such as the existence of pools of resources shared between companies. Above all, however, it is essential to project oneself into decision-making processes by answering the following two questions: (1) what are the possible pandemic scenarios that could occur in the next few years, with what probability and impact; and (2) under each scenario, what are the priorities in terms of production scheduling according to the priority demands to be met?

It is likely that the Covid-19 pandemic will accelerate the deep changes already underway in the monitoring of supply chains. Indeed, for several years, digitalization processes have been leading to rethinking the architecture of logistics networks with the use of big data and the implementation of advanced digital solutions to develop agility for quick reconfiguration of supply networks (artificial intelligence, machine learning, cloud computing, Internet of Things, 3D printing, etc.). Figure 5, suggested by Kilpatrick & Barter (2020), is an excellent synthesis of digital supply networks that prefigures the near future, breaking with the traditional supply chain. The global supply chains of the "day after" will certainly be impacted since one of the major dimensions of resilience in a pandemic situation is to obtain total and instantaneous visibility on the supply networks. More broadly, this visibility must be accompanied by models of collaboration between supply chain members to initiate increased flexibility in the face of external shocks. We can talk about *collective and shared intelligence* in the formulation of a policy of integrated risk management and business continuity.

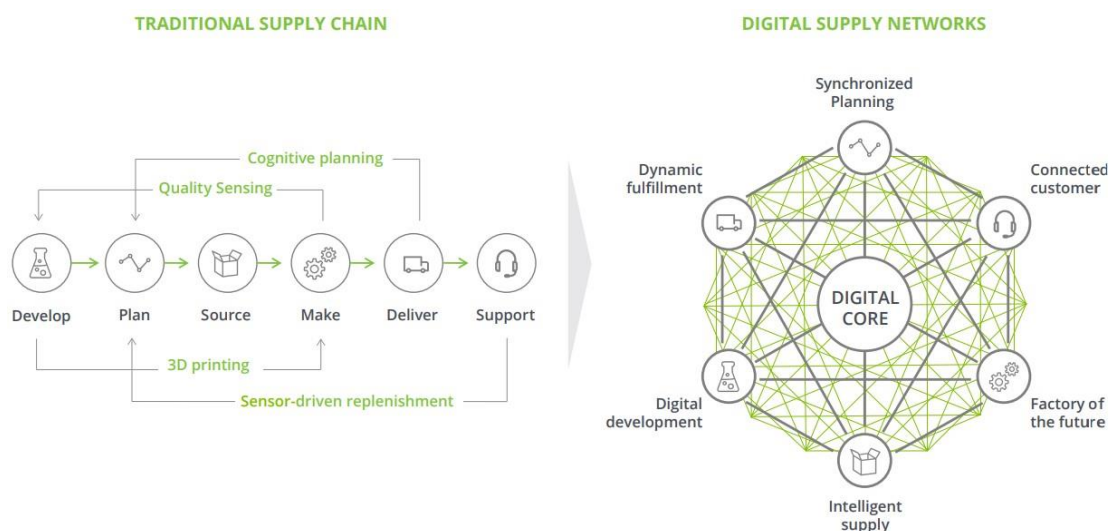


Figure 5. From traditional supply chain to digital supply networks (Kilpatrick & Barter, 2020)

## 7. Conclusion

The Covid-19 pandemic has severely shaken the functioning of globalized supply chains and, more broadly, our economic and social systems. On a purely health level, several hundred thousand people will have lost their lives, which remains, in a "cold" way, a rather low figure compared to other pandemics like Spanish flu, or even to the annual number of deaths in the world as a result of famines. Nevertheless, the effects of the Covid-19 pandemic are and will be significant in terms of

the organization, or rather disorganization, of product flows, both at the time of the outbreak of the crisis (paralysis of supplies) and at the time of the end of the crisis (potential inability to cope with the consumption boom). While the first dimension has already given rise to academic investigations, this is not yet the case for the second dimension, no doubt because some believe that it will simply be enough to reactivate dormant logistical facilities to improve supply chain viability: “Viable supply chain is a dynamically adaptable and structurally changeable value-adding network able to react agilely to positive changes, be resilient to absorb negative events and recover after the disruptions, and survive at the times of long term, global disruptions by adjusting capacities utilizations and their allocations to demands in response to internal and external changes” (Ivanov, 2000b:5).

This research note analyzes that majority of European countries followed the quarantine model despite the significant restrictions on democratic societies this process engenders (e.g. limited movement and freedoms). The lockdown strategy and social distancing measures impacted negatively on household consumption and set an unprecedented recession. From this point of view, the turbulent times during the Covid-19 pandemic have one main virtue: they offer a large-scale *in vivo* laboratory for observing the capacity of supply chains to demonstrate, or not, resilience. Admittedly, there have been many external shocks over the past several decades, with a relentless terrorist threat, the repetition of tsunamis and earthquakes, and the resurgence of seasonal epidemics. However, the Covid-19 pandemic, by its globalized, long lasting and uncontrolled nature, puts us to the test of a major trauma that requires a hitherto unknown recovery effort. Too great consumption boom risks having deleterious effects, even though it is understandable that an economic growth is imperative to absorb the social cost of the health crisis and avoid collapse. More than ever, academics in management must therefore be a source of proposals to best guide reflection and action in decision-making.

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### References

- Blackhurst, J., Scheibe, K., & Johnson, D. (2008). Supplier risk assessment and monitoring for the automotive industry. *International Journal of Physical Distribution & Logistics Management*, 38(2), 143-165. <https://doi.org/10.1108/09600030810861215>
- CIA (2005). *The 2005 CIA World Factbook*. Central Intelligence Agency: Langley (VA).
- Christopher, M., & Peck, H. (2004). Building the resilient supply chain. *International Journal of Logistics Management*, 15(2), 1-13. <http://dx.doi.org/10.1108/09574090410700275>
- Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Economy*, 12(1), 78-104. <https://doi.org/10.1080/09692290500049805>
- Giles, C., & Romei, V. (2020). Economic activity crashes across Europe after coronavirus lockdowns. *The Financial Times*. April 3. Retrieved from <https://www.ft.com/content/f8e58c8a-de5e-44ac-84c4-dac767e6cfca>
- Gradus, R. (2012). Reforms to limit increases in health care expenditures, with special attention to the Netherlands. *Review of European Studies*, 4(1), 73-84. <http://dx.doi.org/10.5539/res.v4n1p73>
- Haren, P., & Simchi-Levi, D. (2020). How coronavirus could impact the global supply chain by mid-March. *Harvard Business Review Digital*. February 28. Retrieved from <https://hbr.org/2020/02/how-coronavirus-could-impact-the-global-supply-chain-by-mid-march>
- Ivanov, D. (2020a). Predicting the impacts of epidemic outbreaks on global supply chains: a simulation-based analysis on the coronavirus outbreak (COVID-19/SARS-CoV-2) case. *Transportation Research Part E: Logistics & Transportation Review*, 136, Article 101922. <https://doi.org/10.1016/j.tre.2020.101922>.
- Ivanov, D. (2020b). Viable supply chain model: integrating agility, resilience and sustainability perspectives—Lessons from and thinking beyond the COVID-19 pandemic. *Annals of Operations Research*, forthcoming. <https://doi.org/10.1007/s10479-020-03640-6>
- Kilpatrick, J., & Barter, L. (2020). *COVID-19: managing supply chain risk and disruption*. Deloitte: Toronto.
- Lau, H., Khosrawipour, V., Kocbach, P., Mikołajczyk, A., Schubert, J., Bania, J., & Khosrawipour, T. (2020). The positive impact of lockdown in Wuhan on containing the COVID-19 outbreak in China. *Journal of Travel Medicine*, 27(3), Article taaa037. <https://doi.org/10.1093/jtm/taaa037>
- Mann, C. (2020). Real and financial lenses to assess the economic consequences of COVID-19. In Baldwin, R., & Weder di Mauro, B. (eds.), *Economics in the time of COVID-19* (pp. 81-85). London: CEPR Press.

- Mejean, I., Martinez, A., & Gerschel, E. (2020). How global value chains became victims of Covid-19. *The European Financial Review*, March 30. Retrieved from <https://www.europeanfinancialreview.com/how-global-value-chains-became-victims-of-covid-19>
- Mirlicourtois, A. (2020). *La descente aux enfers de la consommation des ménages*. Paris: Xerfi Canal.
- Paché G. (2020a). Gestion des capacités de lits d'hospitalisation en réanimation pendant la crise sanitaire du Covid-19. *Revue de Management & de Stratégie*, April 8. Retrieved from [https://www.revue-rms.fr/Gestion-des-capacites-de-lits-d-hospitalisation-en-reanimation-pendant-la-crise-sanitaire-du-Covid-19\\_a354.html](https://www.revue-rms.fr/Gestion-des-capacites-de-lits-d-hospitalisation-en-reanimation-pendant-la-crise-sanitaire-du-Covid-19_a354.html)
- Paché G. (2020b). French hospitals faced with the COVID-19 pandemic: the reality of logistical strategies. *British Journal of Healthcare Management*, forthcoming. <https://doi.org/10.12968/bjhc.2020.0045>
- Pillu, J.-M., & Zlotowski, Y. (2014). PME françaises: fragiles et indispensables. *Revue d'Economie Financière*, 114, 75-90. <https://doi.org/10.3917/ecofi.114.0075>
- Richards, T., & Rickard, B. (2020). COVID-19 impact on fruit and vegetable markets. *Canadian Journal of Agricultural Economics*, forthcoming. <https://doi.org/10.1111/cjag.12231>
- Velychko, O. (2014). Fundamental basis and connection of modern entrepreneurial logistics and SCM. *Review of European Studies*, 6(4), 135-146. <http://dx.doi.org/10.5539/res.v6n4p135>
- Wu, T., Blackhurst, J., & O'Grady, P. (2007). Methodology for supply chain disruption analysis. *International Journal of Production Research*, 45(7), 1665-1682. <https://doi.org/10.1080/00207540500362138>
- Xu, M., Cui, Y., Hu, M., Xu, X., Zhang, Z., Liang, S., & Qu, S. (2019). Supply chain sustainability risk and assessment. *Journal of Cleaner Production*, 225, 857-867. <https://doi.org/10.1016/j.jclepro.2019.03.307>

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