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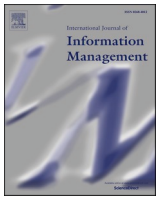

Opinion Paper

Making sense of the confusing mix of digitalization, pandemics and economics

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ABSTRACT

In this short essay, we engage in a sensemaking exercise to understand the economic forces at play during the pandemic. Our primary emphasis is on the implications for digitalization as countries and states try to balance economic and health interests.

1. Introduction

As countries struggle with control of Covid-19, it is fascinating to observe the hundreds of field experiments taking place, mired in a competing mix of scientific, technological, political, and business interests. Described as the "hammer and the dance" (Pueyo, 2020), countries are making decisions on how to respond initially with coercive measures (the hammer), and then later with ongoing adjustments between freedom and constraints modulated by the data on infections and deaths. This is no better epitomized than in USA, where state governors with different value and belief systems, often tied to their political affiliation, are playing this game based on quite different tradeoffs between medical and economic interests. While these experiments are ongoing, the real consequences are unknown, and we will only in the long term be able to evaluate the efficacy of these varying approaches. The lessons learned could have profound implications for preparation and readiness for another similar crisis, much of which depends on data and information technology.

As IS researchers, our interest is in the role of IT in the current crisis. Below, we try to integrate the multiple forces at play in the "dance" where tightening health interventions (social distance, masks, etc.) are in some level of conflict with business interests (opening up the economy). We offer a simple economic framework that incorporates IT, and then use it to study the implications of the virus. Our objective is not to resolve problems associated with the spread of Covid-19, but more modestly to engage in sense making, in an environment replete with a myriad contrasting, and often conflicting, forces.

To develop the framework, we offer two figures. Fig. 1a offers a simple economic framing to describe digitalization and the economics of businesses (Grover, Kohli, & Ramanlal, 2018). Fig. 1b illustrates the pressure on different aspects of the framing due to the "degree of shutdown" (the dance). These are each discussed in the sections below.[2]

2. Digitalization and economics

By digitalization, we mean the infusion of digital objects (bitstrings) into our processes, tasks, products and services – creating major changes in the conduct of business. In Fig. 1a, we propose that with the increasing digitalization over time, the reservation price for products and services is increasing.[3] By reservation price (R), we mean the price that a consumer is willing to pay for a product or service. We propose that increasing digitalization fosters network effects and conveniences that the customers appreciate and are willing to pay for. For instance, a smartphone can be purchased for a price (somewhat steep for Apple

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[2] Our framing focuses on digitalization and does not explicitly consider changes due to reasons beyond digitization, such as increase in import restrictions or increase supply chain constrictions, even though the impact of such changes can be inferred through the framing.

[3] We make this as a general, admittedly sweeping statement, but acknowledge that while this may be true in aggregate, there are some people that may not value digital service options or find them difficult to use.

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brands), but that purchase price is below the R for the consumer purchasing it. Moreover, a customer's R for the smartphone grows as apps are added and the phone serves as a GPS, bank, music device, movie streaming player, shopping device, etc.

Moreover, we propose that digitalization helps lower the marginal cost (MC), i.e., the incremental cost of making one more unit. We argue that MC goes down with the infusion of digital technologies and automation in our production and service processes. For instance, automated ordering Kiosks at McDonalds reduce costs, as does process automation and machine learning being fostered by digitalization.

Based on the proposed trajectories of the R and MC curves in Fig. 1a, we argue that their difference (gap) is an indicator of the economic value (EV) being created through digitalization. This can be for individual products/services or aggregated across the economy. A company producing a product would want to appropriate as much of the EV for themselves. The extent to which they can do this depends on the market price they can charge. The market price (MP) determines how much of EV can be appropriated by the firm as profit (P = MP — MC) and how much goes to the consumer as consumer surplus (CS = R — MP). Of course, MP cannot be set arbitrarily high, as it is constrained by the

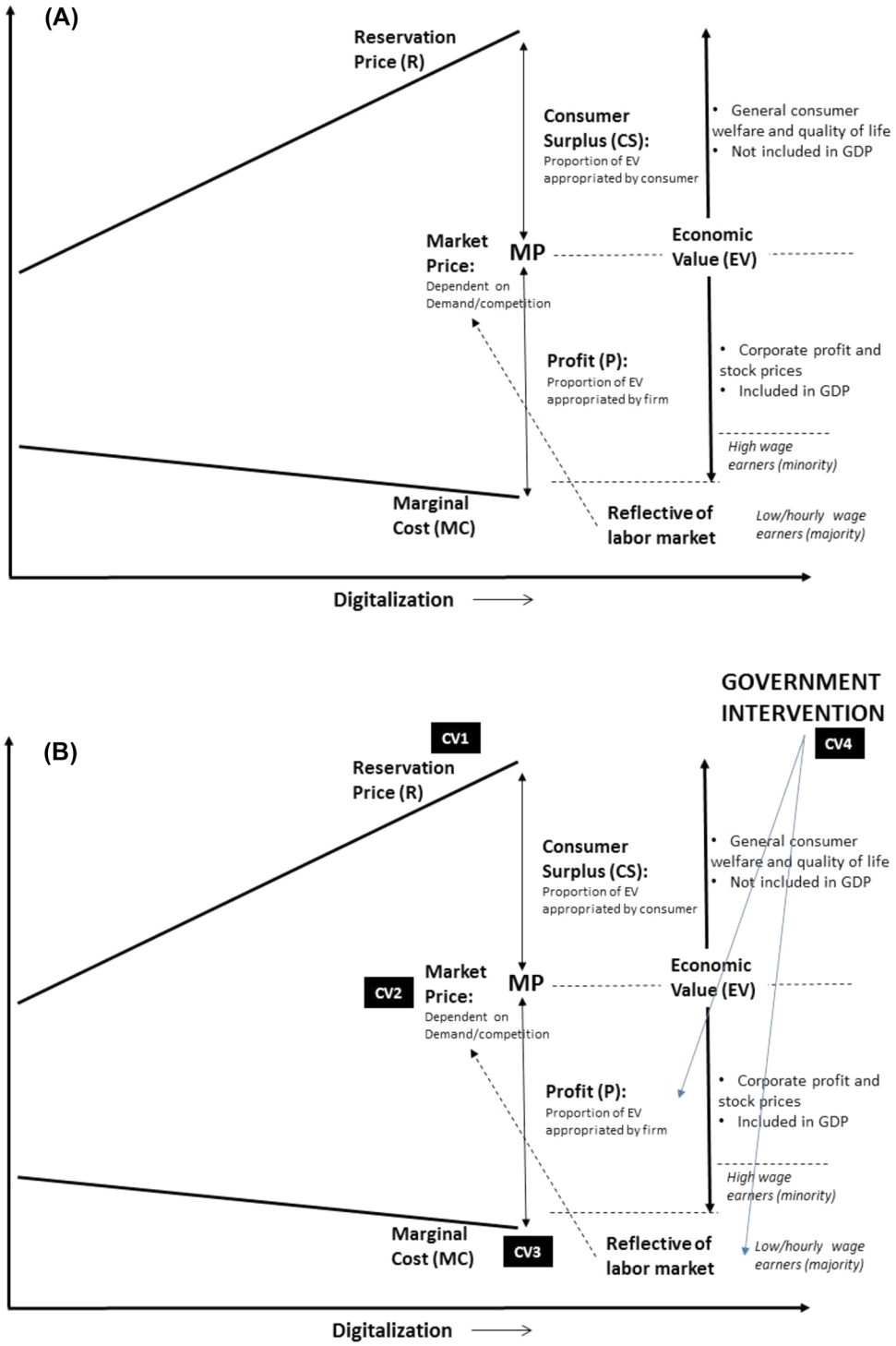

Fig. 1. a. Simplified Economic Farming. b. Impacts of Coronavirus.

competition and the demand for the product/service. In highly competitive environments, MP will be driven down and most of EV will go to the consumer in the form of CS, while in cases where the company has pricing power (e.g., a unique product/service or exclusive arrangements), it can go to the firm in the form of P. Interestingly, CS is not reflected in typical economic indicators like GDP, even though it benefits the consumers' quality of life. On the other hand, appropriate benefits to the company (based on MP) are captured in GDP figures. This suggests that digitalization provides consumers a better quality of life than they pay for. Arguably, as society becomes increasingly digitalized, these consumer welfare benefits will increase rapidly. Correspondingly, the portion of EV that companies capture improves corporate welfare and this is reflected in corporate profits and stock prices.

The final component of our framework is the labor market involved in creating/delivering the product or service. The vast majority of these are hourly workers (many in service industries) or low-wage employees. The higher wageworkers include professionals and managers. At the highest echelons of larger companies, these employees have an increasing stake in corporate welfare, as they could own stock options or salaries and bonuses tied to corporate profits. Of course, the labor market is also reflective of the consumer base that purchases products and services, which would influence the demand (and MP for products and services).

Having presented this simplified framing, depicted in Fig. 1a, we now turn our attention to how the spread of Covid-19 affects components of this framework. This could reflect the "dance" as countries and states try to arrive at some kind of equilibrium in slowing the economy in lieu of saving lives through behavioral controls.

3. Pandemic impact on digitalization and economics

Although various countries and states have timed their reaction to Covid-19 data differently, the vast majority started with a "hammer" approach involving a major shutdown of the economy, followed by the "dance" through a calibrated reopening (Pueyo, 2020). In a major shutdown, services that are deemed essential continue, with risk to their workers. However, non-essential services continue if they can be provided through IT-mediated communication, but shutdown if they cannot continue without physical social interaction. The shutdown affects all industries, but has acute impact on service industries (which are a large part of the US economy), especially restaurants, travel and leisure, and (physical) retail, affecting the profitability of these industries as well as layoffs or furloughs of many service workers. Later initiatives to open parts of the economy in a restricted manner could be difficult due to structural changes (e.g., small businesses that went under) and consumer anxiety arising from the continued prevalence of the virus.[4]

Fig. 1b describes four impacts on the framework presented above due to the "dance" indicated by degree of economic closure and restrictions placed on behaviors (e.g., social distancing, masks). These effects — labeled CV1-4 (Covid1-4) — are interrelated but, for simplicity, discussed individually below.

3.1. CV1: pressures on r

R reflects the value consumers place on products and services. With behavioral restrictions slowing down the economy, consumers are mostly in basic living mode, and not shopping for deals. There is, therefore, limited activity going on for many consumer products that typically have high R and generate considerable CS. Even personal protective equipment like masks may see a boost in demand, but shortages and exploitative prices may preclude any generation of CS.

In general, the R will increase for products and services that are valued more under behavioral restrictions and go down for those that are valued less. In the latter case, the R could be lower due to (a) perceptions of a worse pre-post experience[5] (e.g., going to a restaurant with masks and distancing provisions), and/or (b) risk adjustment (e.g., experience adjusted for higher health risk). However, a corollary pertains to digitalization and the associated products and services. The value of many of these products is gradually changing in the consumer's minds (their R) as many of them discover (out of necessity) the usefulness of digitalization in conducting business and engaging with the outside world. This includes, products/services that mediate online communication promoting social distancing like hardware (e.g., webcams), software (e.g., Zoom, Teams, Skype), internet, online shopping, or services like streaming and gaming that entertain consumers. Therefore, we anticipate that the R for these products will be positively influenced during the crisis, and in the longer run (post-crisis) as consumers increasingly appreciate the possibility of what they can accomplish through digitalization.[6] Not only will digitalization offer potentially higher R for products that facilitate communication and social distancing, but also for new categories of products that can offer "new" safe experiences (e.g., virtual travel, telehealth, virtual parties and streaming concerts).[7] It is possible however that the R for digital services could be lower too – whereas the risk (b above) is alleviated, but the pre-post experience in digital mode (a above) may deteriorate. For instance, in cases where the pre-post experience goes down (e.g., online classes are valued less than physical classes; takeout is valued less than eating in), the R goes down.

3.2. CV2: pressures on MP

A change in R as discussed above, does not translate into MP, since that depends on the ability of the company providing the product or service to innovate and appropriate value better than their competition. MP reflects the price of the product/service supported by the market. Clearly, with massive layoffs and slowdown of businesses, there is a downward pressure on MP, due to: (1) a direct effect through lower demand[8] ; (2) an indirect effect through lower quality (lower R) in cases where the pre to post consumer experience is not perceived to be as good; and (3) the changing competition. As discussed in the downward pressure for R[9], physical services where behavioral restrictions severely limit experience will face downward pressures on both MP and P. For example, personal services like barbers, restaurants, cruises, airlines suffer[10], unless they can effectively mitigate the adverse effects of behavioral restrictions. While (1) is systemic, (2) and (3) offer the greatest potential for digitalization. Companies where the consumer experience through digitalization does not change or is better than the physical experience, will be more resistant to this pressure. For instance, online shopping experiences or automated (AI-based) advisory

[4] The effectiveness of the hammer could influence the modularity with the dance. Countries and states that persisted with more draconian hammer approaches (China) or compensated through testing and isolation measures (S. Korea), could temper the virus to a point where the dance is manageable, outbreaks are local, and contact tracing and isolation work. If the hammer was limited due to politicization (USA), then the dance becomes long and cyclical.

[5] Pre-post experience is the contrast between the regular pre-virus world experience and the experience in the virus world as that point in time

[6] For instance, ride sharing could use data to offer the option of using the same driver to make their customers "feel" safer.

[7] Interestingly, some traditional services like "milk delivery" and drive-in theatres could see a resurgence as the pandemic lingers.

[8] There are of course exceptions to lower demand – for instance, essential goods like grocery, toilet paper, and health protection equipment, not all of which have experienced a lowering of MP and in some cases have seen an increase. Other exceptions are hospital services for Covid19 – which could be in high demand, while other hospital services like elective surgeries are squelched.

[9] If students do not value on-line teaching highly (lower R), they may demand tuition discounts (lower MP)

[10] Prices in China for domestic flights were going for as little as US $4 during the pandemic.

brokerage platforms or streaming services – might experience some systemic reduction in activity due to the economic slowdown, but may not have exceptional reductions in MP.[11] In some cases (2) offers potential for digital innovation, to ensure that the pre-post experience does not drop or perhaps even increases. For example, universities are seeing students demand tuition refunds (lower MP) under pandemic conditions, can try to enhance their value proposition by offering more personalized learning experiences. Increased food safety concerns due to coronavirus have also helped vertical farming companies like Plenty Farms and Bowery Farms, which use indoor spaces under tightly-controlled climate and light conditions for farming[12] (McBride, 2020; Shenk, 2020). In addition, in the digital world, creating alliances that can combine digital objects can preempt competition from easily imitating a novel value proposition (e.g., mobile diagnostics and tele-health services) thereby sustaining higher MP.

3.3. CV3: pressures on MC/Labor

The greatest impact of economic slowdowns is on MC and its constituent labor market. However, this impact also differs significantly between low and high wage earners. The slowdown of service industries results in incredible loss of employment, mainly of hourly and low wageworkers. Even slowdown of manufacturing industries substantially affects factory workers. Smaller businesses (like restaurants) may not be able to retain their employees during the slowdown and are vulnerable to going out of business[13] – resulting in structural changes in the economy. Digitalization has significant relevance here, as the pandemic accelerates process automation in various industries. This makes it difficult for many of the unemployed to be employable without retraining post-crisis. By contrast, high-wage earners are generally in jobs that involve knowledge work – and therefore have higher likelihood of being conducted through digital mediation.[14], [15] Therefore, while low wageworkers, a majority, are suffering, the higher wageworkers, a minority, are relatively better off due to the nature of their work, thus magnifying the existing income disparities in a capitalistic economy. Of course, suffrage in the labor market adversely affects MP due to lower demand. It is possible, however, for companies to foster a virtuous cycle of digitalization established where they continue to reduce MC through automation, and correspondingly leverage their increasing "big" data, to provide better personalized experiences to customers, creating upward pressure on R, CS, and MP – even to the extent of spawning new opportunities for expansion and employment.

3.4. CV4: government spending

Finally, through this simple framing, we can see the impacts of government intervention[16] to stabilize the economy. But what does stabilization mean? Government can prop up vulnerable industries so they can remain viable through the crisis. Alternatively, government can better support individuals who are unemployed to help them survive through the crisis. Or it can do both. Government spending through direct payments or low interest loans given to companies can prop them up but has limitations. Public companies have responsibility to their stockholders, and could potentially use the money to buy back stocks, while laying off their workers during the slowdown. This would result in higher stock prices (and wealth for those invested) but little mitigation of the issues faced by the high number of unemployed low wage earners. On the other hand, making payments directly to workers could increase demand and keep the economy going for essential products like food, housing – but not for discretionary products. This would result in some companies in vulnerable industries going under – with implications for long-term availability of jobs. An intermediate plan would be to make funds accessible to small businesses, where many low-wage earners are employed. A mix of these options could stabilize the economy in the short run – but government spending is not a panacea for the long run.[17],[18],[19] Based on our framing, it should be apparent that governments can play an instrumental role in digitalization. Longer-term government investments in digital infrastructure and worker training in emerging digitally driven industries can increase R, decrease MC, and increase EV, while improving possibilities of employment in the labor market.

4. Digitalization: enhancing and mitigating effects

The simple framing offered above indicates that the effect of the pandemic can have devastating impacts on EV. These can be alleviated with different degrees of success based on how governments implement, and society adapts to, the hammer and the dance. Failure to "bend the curve" can prolog the devastation. Digitalization, however, can have mitigating (and enhancing) impacts on the economy. It can do this by reducing the impacts on R, MP, MC, buttressed by appropriate intervention by government. This is summarized and illustrated in Table 1.

During the pandemic and in the post-pandemic phase, risk mitigation is an important economic parameter that can be the basis of competition. So, one pivotal question is how can companies serve customers in ways that safeguard health? In industries that offer physical services (i.e., restaurants, bars, hairdressers, casinos), this can be done through effective sanitation and personal protection mandates. Digitalization can play a role here, by using touchless menus on smartphones, robot-based services, coordinating touches delivery, etc. The second core question is how to digitalize as much of the experience so that the pre-post effects on R and MP are mitigated. The ability to do this depends on a company's digital readiness, innovativeness and agility. Astute companies may even be able to enhance the pre-post experience through leveraging aspects of digitalization (e.g., sensors, analytics) or create competitive barriers to imitation through collaborations with other companies offering complementary digital services. The nature of digitalization makes it possible to conceive of innovative value propositions through digital combinations. Correspondingly, companies that can effectively transition to remote (knowledge) work can alleviate MC

[11] A quick examination of Amazon and Netflix indicates that their stock prices moved significantly higher due to the pandemic. These companies through their unique digital experience were able to appropriate value.

[12] Matt Barnard, the CEO of Plenty Farms, remarks: "Our goal is for the person eating the food to be the first one who has touched it," and "people … want to know their food is safe" (McBride, 2020). Similarly, Irving Fain, CEO of Bowery Farming, remarks "This pandemic exposed the fragility and vulnerabilities with our food supply system that have left people without access to fresh food when they need it most. Bowery is in a position to support our communities with fresher, safer produce during this time and beyond" (Shenk, 2020).

[13] Famous for its robot-made hamburgers, Creator first used its technological forte to distribute meals in a safe, contact free manner (Turow-Paul, 2020). However, it is now temporarily closed, and states on its website: (https://www.creator.rest): "We'll be back when you're back. Our restaurant at 680 Folsom Street in SoMa is going on a temporary hiatus. Join our mailing list for updates about when we can share burgers again."

[14] Mark Zuckerberg, the CEO of Facebook, anticipates that half of Facebook's workforce will permanently work from home…and processes to begin this transition have started with new hires and engineers (Sandler, 2020).

[15] Based on BLS data (wage & salary workers 2017-18), of the top 25 percent of income earners, more than 60 percent can stay home and do their job, while of the bottom 25 percent fewer than 10 percent can work from home; American's who lost work in March-April, those making over $100K, only 13 percent lost their job, while of those < $40K around 40 percent did.

[16] This is beyond the "normal" safety nets such as unemployment insurance.

[17] In the US, a mix of funding was provided with certain restrictions on how funds could be used.

[18] Governments themselves are vulnerable to deficits, especially with a lower tax base due to economic slowdown.

[19] The longer pandemic persists at an acute level, the longer the dance continues, and governments will struggle to provide long term safety nets.

Table 1
Mitigating and Enhancing Effects of Digitalization.

Pandemic Effects	Economic Value Effects	Positive Effects of Digitalization	Illustrations
Downward pressure on Reservation Price (R)	Negative	• risk mitigation through remote services • replication of experience (pre-post) through remote means	• contactless delivery, telemedicine • remote individualized teaching in universities, health monitoring apps
Increase in R	Positive	• Products/services that facilitate remote work and access to services • Enhancement of pre-post service quality	• webcams, internet and streaming services, video-conferencing software • gyms offer virtual classes with famous instructors
New R	Positive	• Novel services that can be remotely accessed	• livestream service of newly launched handbags with personalized buyer support
Downward Pressure on Market Price (MP)	Negative	• Replication or innovation in pre-post experience • Consortia that integrate digital services and inhibit imitation	• restaurants offer touchless delivery of "components" of dishes from their menu and access to a video of the preparation process; tech support provided through video call centers • medical services co-linked with hotel room reservations
Downward Pressure on Marginal Cost (MC)/Labor	Positive/ Negative	• Employment of (remote) knowledge workers • Virtuous cycle of process automation and data-driven value proposition	• enhanced tool to conduct collaborative work remotely • end-to-end delivery of customized theatric entertainment via streaming
Increased Government Intervention	Positive	• Investment in digital infrastructure and training	• high speed internet in rural areas; virtual training on software products and knowledge work

impacts and foster virtuous cycles through digitalization of processes that offer important new value to consumers and positively influence all economic parameters of the framework. Finally, government intervention through both short-term and long-term funding can mitigate the short-term impacts on people and businesses, and set the infrastructure and labor investment needed to thrive in a post pandemic intensively digital world.

5. Closing thoughts

The objective of this essay was to engage in sense making by framing the interplay between changes caused by the pandemic, economic forces and digitalization. Specifically, we project implications for digitalization. Some of these changes were already underway but have been accelerated by the pandemic. For instance, it seems likely that people have an increasing appreciation for digitalization possibilities. This gives companies an opportunity to appropriate the growing consumer surplus. Businesses should strive to enhance their products and processes through digitalization so that their customer experiences *exceed* their pre-pandemic experience by being sensitive to behavioral shifts. In doing so, companies that can identify the customer's post-pandemic value points (e.g., touchless service) and then deliver on them – foster customer surplus. Correspondingly, companies (and universities) are more calibrated on the remote knowledge work that can be done, and can conduct analysis of work regarding possibilities to stratify employees, including reducing physical space costs, and making some employees permanently do their job remotely. Governments should invest in digital infrastructure and training – particularly during and after the pandemic when the labor base is turbulent and receptive.

A lot of corporate and consumer welfare is based on catalyzing the forces at play in the framework. The pandemic as an extremely disruptive event, is causing major upheaval, uncertainty, and misery. It reveals and acerbates the widening gaps in social power, economic, political, and cultural, in society. But, as they say, understanding some of the forces at play, and "never letting a crisis go to waste" are important steps to facilitating appropriate actions for our reemergence in a better (and more digital) world. The framing we offer is one way to engage with these dynamics.

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