Technology and globalization in the post-COVID economy

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Introduction

On January 25, 2020, the first international day of protest against 5G technology took place in hundreds of cities in both industrialized and developing countries. Protesters argued that 5G technology poses a serious threat to health and the environment, to privacy and cybersecurity, and to energy consumption, and called for a moratorium on the adoption and wide-scale implementation of this technology. This event was soon eclipsed by the coronavirus crisis. In the United States, the first few cases were diagnosed at the end of January. The epidemic unfolded in Europe in February and March, and on March 11 the World Health Organization (WHO) declared the COVID-19 outbreak a global pandemic. If anything, tensions around 5G technologies only escalated during the COVID crisis. With half of humanity on lockdown in April 2020, the surge of telework, e-learning and online socializing amplified the need for high-speed broadband internet services. In the meantime, amid growing geopolitical tensions between the United States and China, the Trump administration urged European leaders to ban Chinese companies from Europe's 5G infrastructure on national-security grounds. While the race to roll out 5G seems unstoppable, concerns have emerged that the post-COVID era could witness a technological fragmentation of the world economy between two "Internet systems", a Chinese one and a Western one.

The example of 5G technologies illustrates well the intricate relationships between technology, globalization, and the pandemic. It brings to light the existence of trends that predate the crisis -- dissensions about the adoption of a new technology, in a context of increasing fragmentation of the world economy. And it begs the question of whether the COVID-19 crisis is a *krisis* in the Ancient Greek meaning of the word, that is to say a turning point. Will the pandemic bring prior trends in technological change and globalization to a halt? Or, instead, will it amplify the developments that started before the pandemic? These are the questions that we address in this chapter. To answer them, our approach is to systematically provide context and perspective we see relevant to understand the long-lasting impact of the crisis on technology and globalization. There is much to say about the interaction between the crisis and technology on the one hand, and that between the crisis and globalization on the other hand. Therefore, we first examine these two topics in isolation from each other. We then discuss what we see as the unifying, underlying theme: how economic disparities will be addressed after the pandemic. We argue that this issue will deeply shape the evolutions of the post-COVID economy.

Part I: Technology

The way we work, spend our leisure time or shop have all been profoundly altered during the pandemic. Information and communication technologies (ICT) and digital services have been a lifeline during the crisis as many of these activities moved online in an effort to limit in-person contacts. In the U.S., it is estimated that half of all employed persons worked entirely or partly from home in May 2020 (Bick et al., 2020). The videoconferencing company Zoom reported a fivefold increase in its number of clients in the third quarter of 2020, relative to the same quarter last fiscal year. In a period during which many companies were struggling financially, the online retailer Amazon reported year-on-year increases in its total sales of 37% in the third quarter of 2020. Without the support of ICT and digital services, the lockdowns that were put in place during the pandemic could never have lasted long enough to "flatten the curve".

Although exceptional in its magnitude, the surge in the use of ICT and digital services during the pandemic is only the acceleration of a long-run trend towards the digitization of our economies for most sectors. The crisis is transformative only for a few sectors.

To put current developments in perspective, let us remind that our economies have been operating more and more in the digital space since the invention of the computer. A few numbers showing the pre-COVID growth of the use of digital services and online shopping illustrate this fact. The digital economy, which includes online trade, computers, software, and online services, grew in the U.S. at a remarkable 6.8% annual rate from 2005 to 2018.[1] Before the crisis, the tech companies, Google, Amazon, Facebook, Apple, and Microsoft were already among the largest firms by market capitalization. Online retail sales went from less than 1% of total retail sales in 2000 to 11% at the end of 2019.[2] The pandemic pushed the share of online retail to 14% in the third quarter of 2020. Like in online retail, in many areas, the acceleration of digital services is noteworthy but maybe not as transformative as one could have thought.

Pandemic-related change has been more radical for sectors like health or education, in which the movement towards digitization had been much slower and online services were scant before the crisis. For example, a recent study of 16 million American patients shows that virtual medical consultation accounted for less than 1 percent of total visits before the pandemic. By June 2020, virtual consultations had reached about 20% of total visits (Patel et al, 2020). Doctolib, a French digital health firm, reported that its video consultations in Europe increased during the pandemic from 1,000 to 100,000 a day. Higher education is also profoundly affected. Online learning became the norm in many universities across the world, and Massive Online Open Courses (MOOCs) grew exponentially during the pandemic. For instance, the online provider of

[1] Growth rate of the value added of the digital economy (Bureau of Economic Analysis's "New Digital Economy Estimates" 2020 report).

[2] U.S. Census, Quarterly e-commerce sales Report.

MOOCs Coursera reports that enrollment went from 1.6 million to 10.3 million between mid-March and mid-April – a 543% increase.

Which of these changes will persist in the post-COVID economy?

This is an open question as of this writing, but several elements strongly point to permanent shifts towards digitization and online services. First, after being forced to experiment these technologies and new services, many firms and consumers would discover they have a taste for them. As an example, early surveys suggest that working-from-home arrangements would stay in high-demand when the pandemic is over (Barrero et al., 2020). Another important force suggesting that changes will persist post-pandemic is the digital investments that firms have made in order to continue operating during the pandemic. Economists call them "sunk costs", in the sense that these costs cannot be easily recouped once they have been incurred. Firms will continue using these new digital processes now that these up-front costs have been paid. Finally, in some sectors the pandemic has forced regulators to lift barriers that had hampered the development of online services. In France, regulators relaxed the rule that allowed video medical consultations only after a first in-person visit. In the U.S., Medicare expanded its coverage of remote consultations beyond rural areas. It is unlikely that these regulations will revert to what they were before the pandemic.

More importantly, to understand whether and how these changes will matter for the post-COVID economy, we must ask ourselves how they will affect productivity. In turn, this will inform us about future implications for labor markets.

The key point is that the acceleration of digitization opens the way to more *computerization* and *automation*. Indeed, with the shift to paperless information and the development of digital services, more data becomes available to feed machine-learning algorithms and more tasks become amenable to automation. In the retail industry, for example, the development of e-commerce will increase automation since robots can more easily operate in warehouses than in brick-and-mortar stores. Beyond the forced adoption of these new technologies during the pandemic, the increase in digitization and automation may also be driven by firms' willingness to reduce their exposure to future epidemic risks. As digital information facilitates the optimization of production and automation lowers production costs and improves quality, these changes will bolster productivity. In the medium to long run, this improvement in productivity will be accentuated by the reallocation of activities and workers towards firms that were quicker to adopt new technologies[3].

[3] This reallocation of resources towards high-productivity firms, which is central for aggregate productivity growth, typically accelerate during downturns (e.g., Foster et al, 2016). This productivity-enhancing feature

As computerization and automation expand, what will happen to workers whose jobs will disappear in this process?

This is not the first time society is anxious about technological progress displacing workers and creating unemployment. This question has surged many times in the past, particularly in periods of accelerating technological change. In his 1930 writing about the « Economic Possibilities for our Grandchildren », John Maynard Keynes warned his readers about the pressing issue of technological unemployment. So did Wassily Leontief who grimly predicted that "the role of humans as the most important factor of production is bound to diminish in the same way that the role of horses in agricultural production was first diminished and then eliminated by the introduction of tractors" (Leontief, 1983). History has proved both of them wrong. The three technological revolutions that we have witnessed since the 19th century have not made human labor redundant. In fact, the employment rate, calculated as share of employed workers out of the working-age population, has been roughly constant throughout this period.

While there is no debate that technological progress causes some workers to lose their jobs, the question of how long those workers will remain unemployed and how important this issue is in the long run is much more complex. By reducing the number of workers needed to produce the same quantity of goods, automation reduces labor demand. At the same time, however, automation drastically cuts production costs and therefore lowers prices and increases demand for goods. If demand and output increase sufficiently, then labor demand and employment will actually increase after automation. Given the lack of downward trend in the employment rate, the consensus among economists is that the increase in demand is sufficiently strong that technological unemployment is not an issue.

In a recent work, Acemoglu and Restropo (2018) propose a complementary explanation. They argue that viewing technological change has a force that only substitutes machines for humans is restrictive. Technological change also leads to the creation of new tasks--- tasks in which humans have a comparative advantage. As they explained using Leontief's analogy "the difference between human labor and horses is that humans have a comparative advantage in new and more complex tasks. Horses did not." This comparative advantage is what allows employment and the labor share to remain stable even if the number of tasks that is automated grows over time. Key to their analysis is also the fact that technological change is endogenous: a wave of automation lowers the effective cost of producing with labor, discouraging further efforts to automate additional tasks and encouraging the creation of new tasks.[4] While higher unemployment remains a possibility, taken together, these elements do suggest that, like previous episodes of technological adoption, digitization will not create mass unemployment in the near future.

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will be present in the current recession as well, although the large COVID-19 relief packages implemented in many countries may reduce the strength of this channel.

[4] However, Acemoglu and Restropo (2018) also show that technological change can reduce employment (increase unemployment) if automating tasks becomes increasingly easier relative to creating new tasks.

Digitization will, however, exacerbate the *polarization* of the labor market. Polarization refers to the rapid employment growth in jobs at the bottom and top of the skill distribution relative to middle-skill jobs.[5] Several works by David Autor and co-authors (see, e.g., Autor et al, 2006) help understand the relationships between the development of computers and increasing automation of tasks on the one hand, and polarization on the other hand. The main idea is that not all tasks are affected by computerization and automation in the same way; computers can replace workers in some tasks while they can contribute to the workers' inputs and raise their productivity in other tasks. In the words of economists, the key distinction is whether computers are substitute or complement to workers for the various tasks performed on the job. As emphasized by Autor et al (2006), routine tasks (either cognitive or manual) are more susceptible to computerization. The demand for workers who perform routine tasks, such as bookkeeping or repetitive assembly work, and who are typically middle-skill workers, declines with automation. By contrast, non-routine manual tasks, such as janitorial or home-care work, are harder to automate. Computers hence do not substitute for the least-skilled workers, who are typically employed in these occupations. Finally, Autor et al (2006) show that if computers are complementary to non-routine cognitive tasks, the demand for workers performing these types of tasks, such as physicians or financial analysts, increases. Hence, by accelerating digitization, the pandemic crisis will contribute to increasing computerization and automation, which in turn leads to more labor market polarization.[6]

With recent advances in machine learning and mobile robotics and the surge in data brought about by the increasing digitization of our economies, the range of tasks that can be automated is constantly broadening. In fact, since Autor and co-authors wrote their paper in 2006, technological advances have permitted the automation of many tasks considered non-routine. Improvement in pattern recognition has made possible the automation of non-routine cognitive tasks, such as translation, which until recently were deemed too complex to be automated.[7] At the same time, progress in mobile robotics has widen the scope of computerization towards non-routine manual tasks. In a much-discussed work, Frey and Osborne (2013) find that with these recent technological advances, 47% of jobs in the U.S. are at high risk of computerization. These are jobs that do not involve tasks that remain challenging to computerize (perception and manipulation, creative intelligence and social intelligence tasks). In short, assembly line or clerical jobs are far from the only jobs at risk of being displaced by computers.

In sum, technology developments in the aftermath for the pandemic crisis will likely amplify inequality across workers. We will discuss policy responses in the last section of this

[5] There is a vast literature on the polarization of labor markets, showing that this phenomenon has been observed since the late 1980s in many industrialized economies; see, among many others, Goos and Maning (2003) for evidence for the United Kingdom and Autor et al (2006) for U.S. evidence.

[6] This aspect is not specific to the pandemic, in the sense that recessions in general are times of increased labor market polarization. Recent work by Jaimovich and Siu (2020) shows that the reduction in the proportion of middle-skill jobs is concentrated in periods of recession: 88% of the job loss in middle-skill, routine occupations since the mid-1980s has occurred during economic downturns.

[7] Brynjolfsson and McAfee (2014) provide a vivid description of recent progress in artificial intelligence, robotics and digital technologies.

chapter. Before doing so, to fully understand the post-COVID challenges that increased inequality will pose, we must place them in a global context.

Part II: Globalization

Globalization, broadly defined, refers to the acceleration of the flow of goods and services, people, capital, and technologies all over the planet. Most indicators used to measure these flows exhibit the same profile in 2020: they fall precipitously with the outbreak of the COVID crisis. For example, the world trade monitor of the Netherlands' Bureau of Economic Analysis indicates that world merchandise trade fell by 15 percent between the beginning of 2020 and mid-March;[8] foreign direct investment flows, for which 2020 data are not yet available, are expected to fall by 40 percent relative to 2019;[9] the number of international commercial flights dropped by 80 percent between the end of February and mid-April.[10] By these metrics, it seems that globalization suffered a sudden regress during the COVID-19 crisis. This being said, the picture is not entirely bleak. The crisis has also coincided with an increased flow of ideas exchanged all over the planet, as well as a burst in scientific collaboration well illustrated by the development of a vaccine against the new virus.

Besides the collapse of international trade and investment, several developments related to policy making and international relations cast a larger shadow over the process of globalization. Indeed, multilateral cooperation has been seriously challenged during the crisis. Perhaps the most emblematic example was the announcement made on April 14, 2020 that the U.S. were to halt funding to the World Health Organization. Another telling example were the series of uncoordinated border closures in Europe, openly violating the Schengen regulations. In parallel, the COVID crisis also witnessed a resurgence of protectionist policies and isolationism in both industrialized and developing countries.[11] The crisis laid ground for a my-country-first rhetoric that seems to appeal to a large part of the public opinion. More generally, the crisis has been perceived by many as an indication that economies were excessively interconnected, and that the appropriate policy response would be to sever some of these connections to prevent future health and economic crises from spreading over the world so rapidly.

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[8] See https://www.cpb.nl/en/worldtrademonitor.

[9] Calculations from the Organization for Economic Co-operation and Development (OECD); see http://www.oecd.org/coronavirus/policy-responses/foreign-direct-investment-flows-in-the-time-of-covid-19-a2fa20c4/.

[10] According to the trade barometers monitored by the World Trade Organization (WTO).

[11] We should note that these protectionist policies were of a somewhat unusual nature. While standard protectionist measures aim at slowing down imports of foreign goods to protect the domestic economy, the goal of policies that were in place during the crisis was instead to prevent the export of certain goods, such as face masks and artificial respirators.

The backlash against globalization is, however, not new. The pandemic crisis took place in a context where globalization had already started to slow down.

To put current developments in perspective, it is worth starting by noting that globalization is a process that evolves through *waves* -- that is to say bursts of progress, often followed by periods of regress. During the forty-year period that begun around 1870, the world economy experienced what has become known as "the first globalization". Largely propelled by the invention of the steamship, which reduced shipping time and costs, international trade developed rapidly during that period, so much so that export as a share of world GDP went from 6% at the beginning of the period to 14% on the eve of WWI.[12] Not only were the flows of goods, capital and people high across borders during that period, but there were also fierce political debates on trade openness and the desirability of implementing trade barriers to protect the domestic economy. This era of globalization came to an end with WWI and the Great depression. After a few decades, the globalization process resumed, and the world economy experienced another wave of globalization. A distinctive feature of this wave, which started in the early 1980s, is the emergence of so-called global value chains. To quote Antràs (2020)'s definition, "a global value chain, or GVC, consists of a series of stages involved in producing a product or service that is sold to consumers, with each stage adding value, and with at least two stages being produced in different countries. A firm participates in a GVC if it produces at least one stage in a GVC." Much of our discussion of the future of globalization will revolve around the role of GVCs.

The latest wave of globalization had started to lose strength prior to the pandemic. As shown recently by Pol Antràs (2020), a battery of indicators, such as world trade as a share of world GDP, portfolio investment inflows, and foreign direct investment from multinational companies, have grown at a slower rate since the 2007-09 recession compared to the 1986-2008 period.[13] Antràs calls the years 1986 to 2008 the era of "hyper-globalization", which he argues had been fuelled by mainly three factors. First: automation and the ICT revolution that helped the development of global production networks. Second: trade liberalization, through the lowering of tariffs and making of binding trade commitments via the GATT/WTO and regional agreements. Third: the fall of the "iron curtain" and China's transition to a market economy, which created an enormous increase in the number of workers who participate in the world free-market economy. At least two of these factors – trade liberalization and the spread of the free-market economy – are one-off events, suggesting that hyper-globalization could not have continued at the same pace.[14] As a result, when COVID-19 struck the world economy, it had already entered a new era that can be described as "slowbalisation" – a term coined by the bank Morgan Stanley a year before the COVID crisis.

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[12] Figures from the World Economic Forum; see https://www.weforum.org/.

[13] The trend change in the international flow of people is, however, is not so clear. The share of international migrants in the world population, which was on the rise during the 2000s, continues to grow after the 2007-09 recession at about the same rate.

[14] Whether the other factor – automation and the ICT revolution – is also contributing to the slowdown of globalization after the 2007-09 recession is unclear, as will be discussed in the last paragraphs of this section.

An important dimension of the slowbalisation era is that it witnesses sporadic but fierce protests against globalization throughout the world. These protests are largely rooted in resentment related to what economists call the "distributional effects" of international trade, that is to say the consequences in terms of income inequality. Pressing concerns about these consequences began to mount well before the 2007-09 recession. For instance, in the U.S., income inequality had been on the rise at least since the early 1980s. Although not the only factor explaining this trend, international trade (and in particular trade integration with China) is widely perceived as a key driver of rising inequality.[15] Since the 2000s, these protests have led to the emergence of populist parties and leaders with a de-globalisation policy agenda.[16] Well before the COVID crisis, populist movements had been gaining ground in multiple countries, with Orbán becoming the Prime Minister of Hungary in 2010, the United Kingdom voting to leave the European Union in 2016, and the Trump administration launching a tariff war against China in 2018. Add to these observations the fact that the WTO has been in an impasse for years with the current round of Doha negotiations; it is clear that the policy challenges faced by globalization started long before the pandemic.

Will the pandemic change these pre-existing trends? And how?

The COVID crisis certainly demonstrates the vulnerability of economies to disruptions or "shocks" originating abroad. The key point we wish to make is that there is no reason to believe that the world economy in general, and firms involved in GVCs in particular, had been myopic about the possibility of being hit by some of these shocks. The reason is twofold. First, these shocks are not as rare as one would think. Add together force majeure events (e.g., an acute climate event, a pandemic), geopolitical events (e.g., a financial crisis in a given region of the world, a military conflict), interferences from malicious actors (e.g., a cyber attack), or idiosyncratic events (e.g., an industrial accident): a firm engaged in international trade should expect some disruption of its economic activity over a not-too-long period of time. Second, the disruptions entailed by these events are very costly, and therefore firms likely keep a close eye on the occurrence of these shocks. In a 2020 report, the McKinsey Global Institute evaluates that these disruptions cause top international firms to suffer, on average, a loss worth 42% of one year's revenue every decade.[17] In the report, the Institute surveys 605 leading business executives about their strategy to increase the resilience of their firms. 44 percent of them report that they would sacrifice short-term efficiency to build resilience through, e.g., dual sourcing, making inventories of critical products, etc.

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[15] As has been discussed in Part I: Technology, labor market polarization induced by computerization and automation is another key contributor to the increase of income inequality across workers.

[16] The 2007-09 economic crisis, which started as a financial crisis in the U.S. but then spread globally and triggered a sovereign debt crisis in Europe, probably played a role, by showing the dangers of an un-regulated, hyper-globalized finance industry.

[17] This number is computed on average across sectors. There is a lot of variation across sectors: for firms in the pharmaceutical industry, the expected revenue loss is worth 24% of one year of their revenues, while for firms of the aerospace industry the expected loss is at 67%.

If anything, the COVID crisis helped reveal that GVSs were perhaps too vulnerable to the disruptions caused by these shocks. If firms that participate in GVCs find it worth making investments to avoid these disruptions, what will be their strategy to increase resilience? And how will this shape the future of globalization?

Reducing exposure to international shocks by re-shoring parts of the production process (essentially, a reversal of the process that has been fueling the current wave of globalization) seems unlikely. Indeed, at least two factors run counter to this scenario. One: the presence of large sunk costs when firms engage in offshoring and outsourcing. For instance, an important component of the firms' participation in GVCs is related to search costs, meaning the costs involved in finding the "right" business partner. Besides, the value of trade links involves significant relational capital – economists call it: match-specific capital -- that would be destroyed with a re-shoring of production. Two: the continued search for lower production costs which, among other costs, include the effects of the disruption of production chains. This force has driven much of the offshoring of manufacturing during the era of "hyper-globalization". Concentrating production in the domestic economy reduces exposure to international shocks but at the cost of increasing vulnerability to domestic shocks. To lower disruption costs, a more effective strategy is to build resilience by relying on a more diversified pool of suppliers. In sum, for firms that already participate in GVCs and for those that will join this process, it seems likely that the post-COVID era will be characterized by a re-bound towards more diversification – a re-boost of globalization.

There is one element that might nuance this statement, however. As already mentioned, automation and the ICT revolution have been instrumental in the development of hyper-globalization. The development of digital platforms should continue to foster firm participation in GVCs, and thereby to boost globalization. But recent technological advances might also act in the reverse direction, if new automation becomes a substitute to offshoring. 3D printing might be one such example. This technology has now reached a stage of development where it can be easily adapted and incorporated into firms' production process. In particular, a key feature of 3D printing is that it is highly versatile and portable, which makes it possible to take production to local markets. By being closer to customers, local manufacturing allows to save on transportation costs and becomes cost-competitive compared to mass production in foreign countries. This suggest that manufacturing 3D printing could induce firms to re-shore parts of their production process to the domestic economy and sever their links with some of their foreign suppliers. At the time of writing this chapter, empirical evidence on the substitutability between new technologies and offshoring is still to scarce to reach definite conclusions on this matter. As an aside, note that if firms were to relocate part of their production in the domestic country by using these technological improvements, the number of jobs brought back on the homeland would be close to zero.

Whereas changes in GVC firms' strategies are unlikely to reverse globalization, more serious threats to globalisation exist. The main threat comes from trade policy. Recall that trade liberalization, which is one of the factors that propelled the era of hyper-globalization, is the result

of policy choices. Were more protectionist policies adopted across the world, the international flow of goods and people could be drastically altered. As discussed above, the pandemic occurred in a context of mounting discontent about globalization. The crisis has most likely exacerbated this resentment, notably by widening inequality between workers. It has disproportionately hurt low-income workers, reflecting the toll the crisis took on hotels, restaurants and other businesses in the hospitality sectors (Kurmann et al., 2020). If working-from-home arrangements remain prevalent in the post-COVID economy, many jobs in these sectors will be permanently destroyed, leading this rise in inequality to persist well beyond the COVID crisis. In fact, inequality may widen even further in the coming decades since, as explained earlier, the acceleration in digital trends will amplify the polarization of the labor market. The rise in inequality and the hollowing out of the middle class will continue to tip the political agenda towards anti-globalization policies.

Conclusion

As we have seen, the trends in technology and globalization are interrelated in many dimensions – the most important of which being the rise in inequality, a consequence of technological change (and to a lesser extent of globalization), and at the same time a key factor behind the backlash against globalization. To conclude this chapter, we wish to highlight that the rise in inequality and the resulting push towards deglobalization are not set in stone; these evolutions hinge on the path taken by future policies. Income gaps between low-, middle- and high-wage workers are shaped by tax and other redistributive policies as much as by underlying technological shifts. Take North America and European countries, for instance. These groups of countries have substantially different levels of inequality even though the same technology and globalization factors are at play for both groups. The wealthiest 1% of Americans hold 37% of total wealth whereas the same group holds 23% of wealth in France. What is striking is that transatlantic differences in inequality are observed also on pre-tax income, indicating that the progressivity of the tax code is not the only element shaping the distribution of income.[18] Beyond tax policy, we see two areas where policies can play a critical role in curbing the trend analyzed in this chapter. First: competition and anti-trust policies. Giant tech companies and digital platforms will leave the crisis even stronger than they entered it. The enormous market power of these firms can only tilt the income distribution in favor of the richer section. This is an area where better and more effective anti-trust laws can make a difference. Second: education and training policies. The acceleration of automation will make universal access to higher education and adequate training policies even more important than before in reducing income gaps. More emphasis should be put on developing skills that complement computers, such as creativity and social intelligence.

The pandemic will leave the world economy more digitized and more productive. Without the appropriate policy responses, it will leave it less equal and less global than before.

[18] The top 1 percent earn 20% of national income in the U.S. vs 10% in Europe (Chancel, 2019).

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