DATA
A NEW FORM OF **CAPITAL**

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Introduction

Science and technology have always played an important role in the evolution of human societies. The case of the industrial revolution is a clear illustration of this fact. Of course technology was not the only factor. Ideas, geographical factors, climate, or even accidental events in history have also played a key role in the evolution of societies.

Today, a new factor can be added to this list: data. Data are the product of today's technological tools, which we can call "digital technologies". Data also shape the world around us, in a trend that is commonly referred to as "digitalization". This trend is apparent in every aspect of our lives, ranging from our personal environment and health to transportation, energy generation and management, and industry.

Today the role of science and technology is more important than in the past. And digitalization is playing a key role in this change. Digitalization both impacts society and improves efficiency and productivity in existing processes. It also creates impact by introducing completely new processes, generating disruption in traditional businesses. There is a continuum, from technology, through industry trends, to societal and economic challenges. These three elements are approaching one another and their mutual interaction is becoming ever stronger and stronger. This interaction is bidirectional: not only does technology create disruption in the economy and society, this disruption creates a need for new technologies. Digitalization plays a key role in accelerating the interaction between the three aforementioned elements of the continuum: technology, industry, and the economy and society.

Impact on novel innovation mechanisms: the role of data

At the end of the last century computing, electronics, and robots replaced the human factor with regard to improving productivity in almost every sector of the economy. This model was, in its basic economic mechanism, the acceleration of productivity by replacing older elements (irrespective of whether these were human or machinery) with new, more productive ones (Fig. 1). Technology (or technological innovation) was "simply" the process of making this mechanism more efficient.

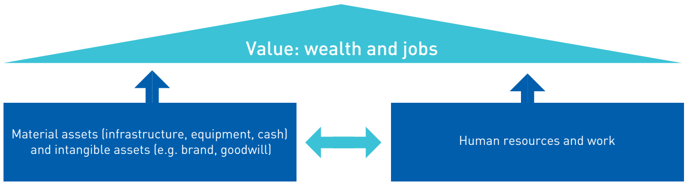

Figure 1. Up to very recently the key to value creation was the coexistence (cooperation and competition) between assets and human work. Technology can improve the efficiency of each of these two pillars.

What is different today, compared to the end of the twentieth century (and all periods before), is the creation of an increasing amount of data, made possible by the rapid manufacture of intelligent electronic devices of ever-increasing complexity. The Internet creates, communicates, and collects data on a daily basis—for example, our photos, messages, answers to questionnaires, web searches. This is the "classic" Internet. In addition to the classic Internet, the Internet of Things (IoT) collects data that are not generated by humans but by "things"—so, for instance, by smart sensors that read from machines, from ourselves, from our environment, or from our vehicles and homes. Data from the Internet and the Internet of Things are transmitted over powerful fiber-optic networks to giant servers, which store and process them to generate information and knowledge. The term "Big Data" is used for the tsunami of all these bits, which flow from both the classic Internet and the Internet of Things. In addition to the exponential growth of the classic Internet, the growth of the IoT—even more tremendous—is expected to lead to trillions of devices surrounding us, creating data flows that rapidly overcome those of the classic Internet, generating unknown quantities of bits. At the end of the chain, the data processed allow informed decisions to be taken without human intervention, or provide valuable information, allowing humans to make better decisions. Artificial intelligence (AI) is a decision-making process that involves the sophisticated processing of data that allows improved and accelerated decision-making. AI can take place on large supercomputers that can be far from the point of action. AI can also take place locally, when adequately engineered to be embedded in the devices that are at the edge of the IoT. All these actions are the basic elements and the backbone of digitalization.

While data are being, thanks to digital technologies, created at such an unprecedented pace, is such attention to digitalization, in terms of its economic impact, justified? Are we not living in a process where the machine "simply" replaces the human and where capital competes or cooperates with human labor, as illustrated in Figure 1, in a "business-as-usual" manner? Or are we living something more fundamental, something that is no longer an evolution but a radical paradigm shift?

We have been hearing every day for several years now that "data is gold" or that "data is the oil of the twenty-first century". The simplest reasoning tells us that since data are a form capital they are part of one of the two pillars of value creation, as illustrated in Figure 2—the "capital" pillar.

The question we must ask ourselves is whether the nature of this capital is the same as that of classic capital—that is, capital that consists of buildings, equipment, infrastructure, and/or other physical assets. The answer is: not really. Data do indeed constitute a form of capital, but of a different nature than conventional capital; a new type of capital. The main difference between "data capital" and classic capital is ownership. The latter, by its nature, belongs to a single organization or person at any one time. In contrast, data can be accessible to several people and organizations at the same time. Data is not always someone's property, but access to it provides essential information and data itself is thus de facto similar to property with multiple owners. Information, knowledge, or human creations that are present on the Internet may have an author, but knowledge and intellectual stimulation is common to all. For instance, information about a person's location, for example as a result of a shared photo or a GPS locator, is usually held by a multitude of people, including that person's friends, enemies, colleagues, and commercial competitors, and numerous electronic platforms. This type of capital, "data capital", cannot be compared directly to classic capital.

The difference in nature between classic capital and "data capital" is having a huge impact on the economy and its evolution. Today, "data capital" intervenes in the interaction between classic capital and work (which can be cooperation or competition) and modifies it. If used properly, "data capital" can be a lever both for classic capital and for work. It is more than obvious that this cannot be the case equally for all types of work: value created by the work of an economic analyst or a computer scientist, for instance, is much more likely to be leveraged by data than is the value of work produced by a construction company.

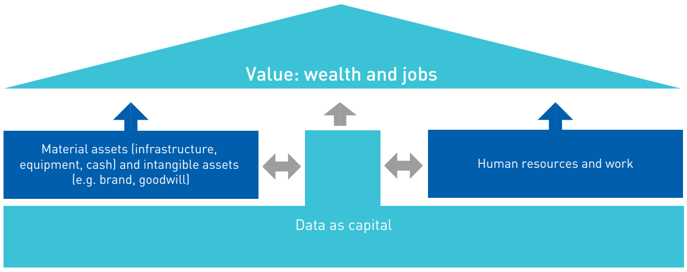

Figure 2. The advent of capital allowed the creation of a new pillar in the value creation mechanism. Data is a kind of capital that creates value but also leverages material and intangible assets as well as human work. The expected outcome value is much bigger.

"Data capital", by its nature, is accessible to (and often, de facto, as argued above, belongs to) several people or organizations. Further, data, being more fluid by nature, are more easily accessible to users. The nature of "data capital", therefore, makes it possible to bypass conventional commercial and societal links and bridges. Today's simplest examples are Bitcoin, which envisages bypassing established structures such as banks, or, similarly, blockchain technology, which is thought to be able to replace contacts and many other concepts that the economy and society are familiar with and that we consider as established. Today, companies capable of building virtual bridges (and shortcuts) can and do dominate international trade, and sometimes even master politics. The difference between the twentieth century and today is that the speed of "construction" of these virtual bridges is infinitely greater than that of any material construction.

We stated above that access to data is possible for several persons and/or organizations simultaneously. One can, however, argue that, on one hand, the ease of access to data and, on the other, the effectiveness of such access can be different, as a function of (1) the size of the organization that accesses and uses the data, and (2) that organization's nature.

The leverage effect of "data capital" is most effective when it belongs to a large organization such as a large commercial company. When a large company and a small company—an SME (small and medium-sized enterprise)—access the same amount of information, the large company has a de facto advantage. The reason for this is that the multiplier (i.e., the "data capital") multiplies a larger value (i.e., the classic capital) of capital in the form of material assets in the case of a large company than it does in the case of a small business; therefore, by definition the result of such a "multiplication" is larger.

In addition, there is a second reason why large companies have an advantage when using "data capital" compared to smaller companies. Large companies have the ability to accumulate data from different sources (text, images, data from different sensors) while small companies do not. There are many reasons for this. The first is that large companies have more access to the resources necessary to build huge databases. These are human resources but also material resources (e.g., IT resources, access rights). The second is bargaining power. In a value chain, an SME is often forced to collaborate with a large company. Imagine an SME that manufactures switches for automobile doors: without an integrator that manufactures automobile doors, the SME cannot function. In the "classic" world the company sold automobile door switches. In today's world, the SME continues to sell the same switches, while continuously sharing its data (and probably its problems), which enriches its larger partner ("data capital") and consequently modifies the power ratio between the two. The existence of almost total transparency, brought about by the exchange of data, also makes it possible to observe potential problems (for example, in the SME's production processes), which makes the SME's commercial negotiating position with regard to its larger partner (the integrator of automobile doors, in our example) weaker.

It is reasonable to conclude that data are much more useful for large organizations than for small ones. A large structure has two inherent advantages: (i) large organizations can more easily collect and access data and thus build up a larger capital base, and (ii) through the multiplier effect, they can produce a greater leverage effect on their physical capital. Hence the increasing risk of creating imbalances and concentrating power.

This simple, mechanistic effect induces greater market dominance by larger economic structures, particularly data-based platforms. Thus, large structures have a competitive advantage, solely because of their volume. Large structures whose main business is related to and/or leveraged by data are in an obviously advantageous position vis-à-vis large structures that are not in a data-related business (e.g., construction) since the latter do not profit from this leverage effect.

New mechanisms as sources of societal imbalances, and of opportunities

Imbalances and opportunities

The global economy and the global distribution of wealth are both closely linked to access to advanced technologies. The Internet industry creates wealth[1] of a value of no less than USD 8 trillion. However, more important that the value of the wealth created is how that wealth is distributed.

Silicon Valley's entrepreneurial culture has enabled Big Data companies to flourish, accumulating not only data but capital. These include not only the famous—GAFA—but many others, such as Airbnb or Uber, which in turn touch many others still, which in turn play a part in every sector of the economy and society, building the increasing domination of this particular region. Intuitively, there is nothing to prevent the further expansion of this established dominance, with its roots in both a geographical area and a segment of the population (highly qualified; very entrepreneurial) that is, of course, unrepresentative of the vast majority of the population—even in this one geographical area. The expansion of these companies seems to indicate that although geographical specialization was initially present, the profile and level of training of different regions is ultimately the driving force behind growth. The very high incomes of the people involved in this adventure—whether that takes the form of the salaries of executives, stock options, or venture capital—shows precisely the importance of the leverage effect of data ownership. It is highly unlikely that such income gaps will prove sustainable, particularly when compared to the stagnant incomes of segments of the population that are not benefiting from this wave.

According to the World Bank, average per capita income in OECD countries is more than 50 times higher than in non-member countries. In Europe itself, the share of the population whose incomes are rising by 20 percent is five times higher than the share that is falling by the same percentage. It can be seen that this gap is constantly increasing as a function of time.

It is highly likely that the widening income gap and unemployment are[2], at least in part, the cause of political and social unrest. Such unrest can be expressed through significant migratory movements between the world's richest and poorest regions. Another type of unrest within the same geographical area comes from fractions of the population suffering from this widening gap—as demonstrated by the "yellow vests" (gilets jaunes) in France. This widening of gaps is potentially unsustainable.

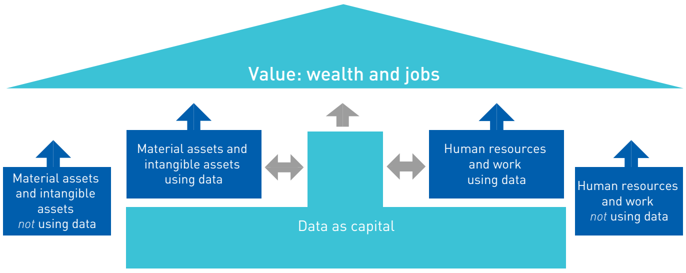

Figure 3. Data as a form of capital that can leverage assets and human work cannot be universal.

Some assets and some forms of labor cannot, by their nature, profit—or can only profit less—from data (e.g., the local grocery store profits much less from data than does a big bank), as illustrated in Figure 3. Value continues to be created without the use of data, but it becomes more marginal, less sustainable, and competes on unequal terms. This can potentially create unsustainable inequalities.

From another point of view, it can be observed that the fluidity of "data capital", which is much more mobile than material capital, makes it possible to create opportunities in places around the globe provided that human resources are properly trained. This is a factor that can, subject to the availability of resources, contribute to a better income balance between geographical areas of the world. Two interesting examples that illustrate the offshoring of "data capital" creation are the Bangalore region of India and Mongolia, the latter favored for the mining of cryptocurrencies such as Bitcoin.

These two illustrations indicate that human capital can be formed elsewhere and imported into a place of production. However, the proximity between training, research, and innovation is very important, even in a world dominated by data. Clusters such as Silicon Valley or the Boston area in the US are proof of this. In general, the education and training of resources is an important factor in attracting value creation to a geographical location (in addition to other framework conditions such as political stability and infrastructure availability, and others that we will not address in detail here). It is also important to note that the availability of quality education and training is generally highly dependent both on the wealth of the individual and the family and their societal background and on the geographical origin of human resources: world regions with a good education system—more often developed countries, therefore—remain favored.

Manufactured products—all along the value chain—generate data and/or enable opportunities for data analysis, artificial intelligence, and hardware; this, simply, is the concept of Industry 4.0. Value chains and products become more complex as several basic functions interact to produce data: data collection, cleaning and formatting, pre-processing, and communication. To make the whole system sustainable in the long term, resource sustainability (e.g., energy) must be taken into account, which is rarely the case today. The continuous increase in the demand for data acquisition, communication, processing, and storage implies a continuous increase in the demand for resources, including energy, bandwidth, and storage space. So what does it mean when we make products and processes more complex? A simple web search for popular product value chains, such as that of the iPhone, illustrates that the value chain covers the entire planet. Digitalization and complexity leads to a globalization of products, and so to a tendency to equalize differences between geographical areas while maintaining the advantage of qualified organizations and people who master specific parts of the production process, all widely geographically distributed throughout the world.

We have seen so far that the momentous changes in our lives, both present and future, are being more and more influenced by digitalization. Digitalization has its origins in the huge potential created by digital technologies—the Internet of Things, robotics, artificial intelligence, advanced manufacturing technologies, and simulation technologies. The possibility of manufacturing ultraminiaturized smart devices that operate with very low power consumption together with networking and communication technologies allows us to envisage ubiquitous smart devices. The IoT is the backbone digital technology; without it no digitalization can take place. High-power computing, artificial intelligence, and Big Data processing allow data collection to impact—to have a real commercial value—on the one hand, and to leverage value (which is a new phenomenon), on the other. We identify data-based capital ("data capital") as a leverage effect—a multiplier effect and not an addition effect—that acts on cooperation or competition between "traditional" capital and "labor". Data owners, especially the largest companies that can collect and use data, are clearly in an advantageous position. The presence of data also has an impact on the global distribution of both industrial and data production capacities.

The sustainability of the evolving innovation landscape

With regard to digitalization, we note that specialization is essential, but that it is probably not socially viable due to growing income and wage gaps. The mobility of data and the complexification of value creation processes act as a mitigating factor, at least geographically, with the tendency to better distribute wealth across geographical areas, but not necessarily between individuals (where core competencies are the winning factor). However, it is understandable that this global coverage requires specific skills, which are not necessarily mastered by the majority of the population.

Our societies must position the cursor in the right place between two paths if they are to optimize the advantages of these paths' impact and above all avoid any economic divide. The first of these paths is to let the "invisible hand of the market" balance all forces and hope that the complexification factor will allow manufacturing to take place with a greater focus on work and that the riches of digitization will be distributed fairly. The second is to give a clear direction to the market, either through incentives or regulation. In the second category is the new law on GDPR in Europe, and the different legal frameworks regarding data access, which is much more liberal in the United States than in Europe or Japan. The creation of international initiatives with strong political support, such as Industry 4.0 in Europe or Forchungsfabrik Mikroelektronik[3] in Germany, can act as a stabilizing factor if they can operate in a flexible way and without significant administrative costs.

While placing that cursor in the right place, we should not forget that to the old equation of labor and capital we must add a new form of capital—data, which plays a multiplier and an accelerator role with regard to the old equation. A leverage effect can be both a positive accelerator and a destabilizing factor. We are all responsible for verifying the validity of these reflections, identifying the role and potential impact of technology and data and bringing this information to society.

Economic mechanisms can only be channeled by political decisions—that is, by creating appropriate legal frameworks and adequate economic incentives. However, such political decisions can, de facto, be applied to well delimited (and limited) geographical regions or countries, even while the economy is global and data flows with the speed of light around the globe. But local enforcement of legislation in a small or medium-sized country or region (even one with a strong economy, such as Switzerland or Germany) cannot have an impact at the global level. Policy measures, applied through law, can only have an impact when the regions to which they are applied are large enough to have a significant influence on international trade. The recent GDPR legislation is the embodiment of a unilateral effort by the European Parliament, which has been able to create a global framework to channel the impact of digitalization. The time that has passed since the implementation of the GDPR is not sufficient for us to be able to draw conclusions with regard to its effectiveness. On the other hand, it suggests a potential way, in parallel with possible incentives, to optimize the impact of megatrends and make them economically and socially sustainable.

Local measures (legislative or incentive) are not sufficient to contain interregional imbalances: legal frameworks between regions and countries must be compatible and as far-reaching as possible.

The legal measures and incentives mentioned above are tools to help us position the cursor in the right place between the two extremes:

i. Full freedom, which will allow mechanistic effects due to "data capital" (with the risk of uncontrolled economic imbalances between people of the same region and between regions).
ii. Full control by public authorities, which can be exercised by legal means or incentives.

It is important to understand the role of digitalization and the digital technologies that enable it—at the intersection of technological change and the challenges faced by society, the economy, the environment, and also politics. It is as important to understand how these technologies' impact is increasing, and their mutual and catalytic role in the emergence of data. When we understand this, it will be easier for our economies and societies to position themselves through political means, whether legislative or incentive, at the level of nations and supranational structures.

Conclusions

The emergence of Big Data is both the result and the enabler of a complex interaction between technological evolution, industry trends, and societal/economic impact. This increasingly rapid and strong interaction enables changes in the very nature of both technology and the value creation process.

The key effect is that data achieve real monetary value. They become capital. "Data capital". Data capital's nature is different from capital as we traditionally know it. This type of capital is a new element in the usual interaction (whether cooperation or competition) between classic and work capital. By its nature, it plays a leveraging role, a multiplier role, first toward traditional capital and then toward those actors who have technological knowledge, and therefore also with regard to labor, and in particular those people, regions, and structures (private or public) who have access to a scientific and technological education. Thus, data capital radically modifies competition and creates new forces that can potentially unbalance incomes between geographical regions and population groups. Education and training are becoming the dividing factor, the digital divide between regions of the world and between peoples. Right now, significant imbalances are being created. And the speed at which this is occurring does not seem to be sustainable. The question that governments (or clusters of governments, such as the European Union) must ask themselves is whether they should intervene, and—if so—in what way (legislative or incentive) and also in what geographical context.

What becomes evident, however, from the above analysis is the existence of two antagonistic trends: On the one hand, the ensemble of mechanisms that seem to influence value creation and leverage due to data, as detailed above, create opportunities for flexible and fast-moving individuals and organizations, when conditions (capital, training, business environment) allow. On the other, significant imbalances are created. To mitigate these imbalances the overall economic and societal environment needs framing. Framing requires the consensus and action of important economic (large companies) and political (large countries, or associations of countries such as the European Union) actors. The capacity for impact is directly proportional to the economic weight of the constituent parts: the bigger they are, the more impactful their action can be, whether it be legislative- or incentive-based. A last point, which lies between legislative- and incentive-based approaches, is the processing of "data capital" as financial capital: the taxation and banking of data are aspects that require a dedicated analysis. What if every MB stored were treated as wealth, every MB acquired as revenue? How much value should be assigned to data flow or storage, as revenue and capital, respectively? Who should assign that value? And should that value be measured in bits or in terms of information? While these questions are beyond the scope of this short text, they certainly need to be addressed soon.

References

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