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Digitalisation: An engine for structural change – A challenge for economic policy

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Inhalt

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Summary[1]

Digitalisation is in everyone's hands. During the last nine years the smartphone tremendously changed private lifestyle. Anytime and everywhere we are connected, we have options for decision making and controlling in real-time. Producer of hardware as well as software service provider of platforms are driving these current structural change's aspects. However – although less visible publicly – digital transformation also includes traditional industry, this is what the buzzword "Industrie 4.0" stands for.

The political and public debate on necessary control of this transformation is as much hallmarked by the search for starting points as by heated demands for targeted competition law based interventions. In this context, it has to be noted that the digital transformation's different aspects are neither adequately differentiated nor systematically captured. That is the task this contribution tackles. A classification for digital business models is developed, in order to analytically exploit the different scopes and consistently infer politico-economic need for action

[1] This contribution was authored during my visiting professorship at Stanford University. The paper profited from various conversations in Silicon Valley. I would like to thank for helpful comments from the Cologne Institute for Economic Research: Vera Demary, Matthias Diermeier, Barbara Engels, Henry Goecke, Hanno Kempermann, Hans-Peter Klös and Christian Rusche.

1. An analytical system for digital transformation

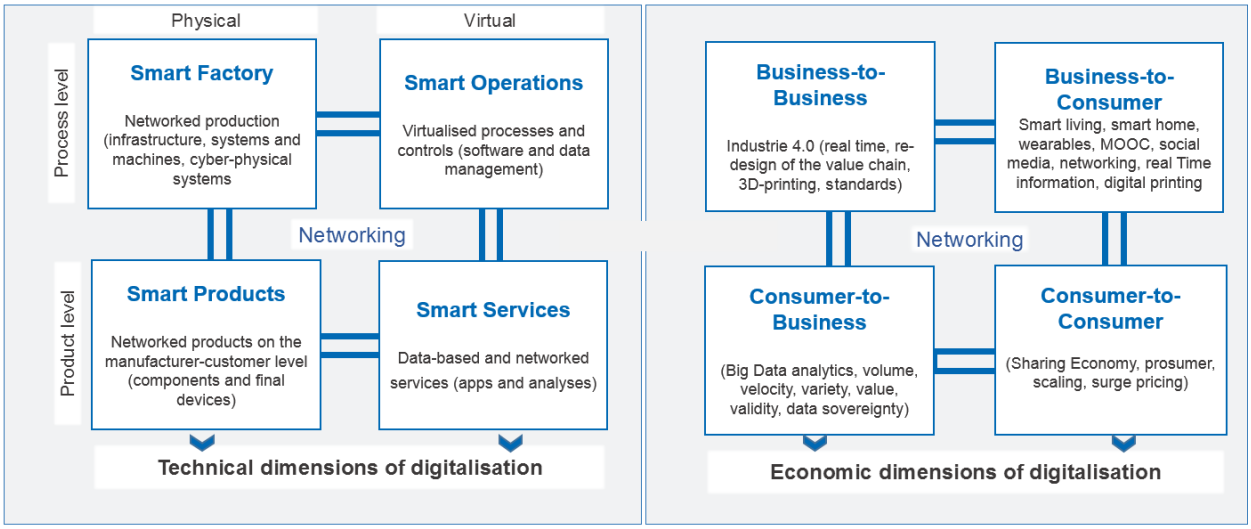
The digitalisation megatrend affects our lives like nearly no other societal, technological or economic development: from smartphones with their first applications of artificial intelligence, to the sharing economy, to machines that exchange information in real-time without human controls and replace discretionary coordination services. Implementing newer technologies places the societal model in question: online platforms overtake printed media, small, decentralised fintech firms challenge classical banks, and self-driving clearly affects long-established automobile manufacturers, which are experiencing breakthroughs through digitalisation. Many innovations over recent years are based on skilful analysis of large quantities of data that offer customers values that can ultimately be monetised-possibly even in a completely different sector or industry. Data are the new currency, data determine market positions.

Since digital transformation penetrates many structures and interactions, it is important to systematically and contextually classify the subsequent effects. In many cases, digitalisation only means that what comes from Silicon Valley is globally visible in new business models (Keese, 2016). At the same time, there are clearly various paths to monetise digital transformation. The lack of a transparent and global system makes this visible where, for example, politics is unable to develop a regulatory response or to affect the investment hesitations of some companies – particularly in the Mittelstand [German small- to medium-sized companies]. Either all will be expressed in the sense of the California business model and evaluated in terms of scaling and the “winner takes all”. This leaves little room for manoeuvre for Europe and the German industry. It is often said that the trade fair is unable to compete in this round of structural change. Or everything will be much more differentiated, because the concept of Industry 4.0 is promising due to its compatibility with the position of German industry, and is barely open to other economies without comparable industries, at least in the short term. This must do with differentiation to cost-efficient provision of a batch size of 1 item.

How to get it started: one is not able to adequately answer related questions about business models and political design tasks without a systematic approach to digitalisation. At the same time, such a systematic approach provides the opportunity to consistently address further issues, such as the productivity effects, procurement effects and competitive consequences of digitalisation, as well as the resulting needs for political action.

The two fundamental effects of the systematic approach to digitalisation: the technical dimension and the associated business models. These respective connections are shown in Overview 1.

Overview 1: Effects of digitalisation by effects context



Source: Own presentation

(1) First, *digitalisation* mainly describes a *technical process*, which affects production processes as well as products, which is both physically tangible and virtual. These two perspectives are contained in the left four-quadrant box in Overview 1:

- Digitalisation is reflected in the physical world's production facilities in *smart factories.* For example, systems and machines in production processes are digitally networked, and exchange data between themselves in real time. In this case, digitalisation continues what industry began over four decades ago with automation.
- For physical products, combining digitalisation creates so-called *smart products.* These products are characterised by their digital networking between the manufacturer and the customers. For example, a manufacturer of lifts can optimise energy use in their operation, by analysing the data with a user profile in daily use, and taking in to account the frequency of lift rides.
- In the virtual world, digitalisation is found in production in the form of *smart operations.* Efficiencies are gained through the analysis of production processes. For example, a logistics company can adjust the routes of its vehicles to traffic in real time. The virtualisation of production processes is also crucial, as they can be cost-optimised.
- Digitalisation enables the creation of *smart services* as virtual products. These are data-based services in which the final product can be presented as a file,

or a data-based business model can create added value. These include, for example, apps and online shops, as well as *predictive maintenance.*

These four categories mentioned above have existed for some time already. Highly-automated, robot-based factories or permanently sensor-controlled and -tracked products in the physical world as well as control units based on algorithms or networked services in the virtual world have existed for years. The innovative jump from this state is that various elements in respective systems can be identified automatically, without contact (*Internet of things).* On the other hand, there is *constant, stable networking* of digital control with production, which then enables real-time assessment of data from products' life-cycles by the machines themselves. These will become intelligent, self-learning units that exchange data from many interactions between economic subjects. Virtual activities are relevant to the complete implementation of digitalisation. Digitalisation cannot be implemented without a *virtual picture of physical processes.* This also means that the disruption often associated with digitalisation may arise mainly through the development of virtual concepts.

The mainly technical potential of digitalisation poses *infrastructural challenges.* Networking needs gapless and disruption-free high-speed broadband networks and clear rules for access and use. Broadband availability in Germany is altogether above the EU-28 average. It is, however, particularly bad in rural areas. Thus, the Mittelstand and geographically decentralised economy needs high and dense high-speed internet coverage. A loss in connectivity disadvantages constant information exchange.

Networked production works with real-time data. Even short-term connectivity losses can lead to production process delays, resulting in high costs. "Industrial capability" is the key phrase that describes these requirements in the industry; fast, symmetrical and stable internet connections are needed. In addition, these connections must provide guaranteed latency that is as short as possible. This means there should be no, or only little delay between the requirement and the execution ("real-time capability," see the Federal Ministry of Economic Affairs and Energy, 2015). That is why there are good reasons to argue against full net neutrality. These would eliminate any preferential rules on the internet, and equate consumers with relatively low opportunity costs and producers with disproportionately higher costs. Equal treatment of both groups would be economically inefficient.

(2) Networks that are initially purely technically configured must have specific characteristics to develop their economic potential over *platform markets* (relying on Shy, 2001; Demary, 2015a). These include:

- *Compatibility.* Networking over platform markets assumes that one can achieve high compatibility between the articulated supply and demand through matching. This compatibility can also relate to goods categories, as well as affect the institutional quality of suppliers and consumers.
- *Standards*. The aim is to facilitate exchange using uniform communications standards with the lowest transaction costs. This particularly relates to coding, languages and processes.
- *Scale income.* The increasing number of users is associated with an extremely flexible elasticity of supply and reductions in unit costs. This supply-side effect leads to the fact that one additional user adds very little cost. While declining average costs result in “winner takes all” potential, they also make the market position of existing providers vulnerable.
- *Externalities*. Externalities are not related to the cost effects of increasing user numbers. Rather, it has to do with the quality benefits of an increasing number of participants for all those involved (demand-side effect, positive feedback). The attractiveness of networks in the form of global platforms derives from increased participation on all sides.

The above conditions are the reason for savings in transaction costs for digital platforms, through which the associated business models become attractive (Demary, 2015a): (a) Search and information costs, (b) transaction and decision costs, as well as (c) implementation, enforcement and monitoring costs are reduced. Costs are reduced from preparation through to the complete conclusion of a transaction. The various cost categories require different solutions: comprehensive, valid and fast information is provided about search and information costs. Transaction and decision costs require reliable interaction procedures and quality assurance. Monitoring and overseeing, and reaction capabilities are particularly significant for implementation, enforcement and monitoring.

(3) New *business models* from digital networking and the creation of platforms point to significant differences in the relationship between producers and customers. One can visualise the producer-customer relationship in a four-box matrix. The various interaction interfaces reflect the differences in the economic fields of application for digitalisation (Diermeier/Goecke/Hüther, 2016, Hüther, 2016a, Hüther, 2016b). This results in the right four-quadrant scheme in Overview 1, with the following fields:

- The *business-to-business* (B2B) interface is particularly interesting from an industrial perspective. This describes the interaction between companies in a highly-digitalised network or along a value chain in the industry-service joint production, as referred to by the term *industrial internet* in “Industrie 4.0”.

- The counterpart to this is the *business-to-consumer* (B2C) interface, in which, inter alia, large internet firms provide services to consumers, often using online platforms, which communicate information to suppliers in real-time, and save consumers primarily search, assessment and coordination costs.
- The *Consumer-to-Consumer* (C2C) interface includes the *sharing* or *collaborative economy*, which brings together consumers as providers and consumers (also *Peer-to-Peer*, P2P). The economic effects are derived on the one hand by mobilising capital not used on the market, and on the other hand, constant efficient market clearing through appropriate pricing.
- Customers use goods or services in the *Consumer-to-Business* (C2B) world, and frequently pay with their personal data, which opens new business fields to the provider, or helps it to improve its business model and optimise offerings.

2. Digitalisation business models: characteristics and effects

The four basic types of business models can be assigned concrete classifications of characteristics and effects using the business policy dimensions of digitalisation. The systematic approach developed allows one to practically break down all relevant interactions along the four interfaces of societal exchange between companies and consumers. The various cause-effect relationships of digitalisation can be classified and delimited in this way. Business models that have hitherto only been introduced in a cursory manner can now be described in more detail.

(1) The purely business interface (*business-to-business)* includes the “Industrie 4.0” concept, whose potential follows from the strong position of German industry in global competition. German companies secure their competitiveness in associations of industry and services. This allows for cost-efficient production as well as creating innovative services, which can be differentiated in a customer-specific manner. This explains the strong position of German industrial companies in the groups of global leaders and hidden champions.

This was indirectly confirmed in two studies at the Massachusetts Institute of Technology (Dertouzos, 1989; Berger, 2013), which were dedicated to the question, first in 1989, and then again in 2013, on what the competitive capabilities of American industry are based. While a quarter century ago, production efficiency problems as well as quality problems in products were found, and thus there was a perceptible gap with international levels, this was no longer the case. The increased competitiveness of American companies could also be traced back to the tougher

global competitive situation. Only with suitable, constantly evolving technologies, can one act effectively in the current framework over the long term.

Although productivity and quality were adjusted to global standards, one notes a progressive loss of industrial value added and employment in the United States. The reason stated in the new study is clear: American industrial companies are focused on themselves, and stand against competition without any involvement in functioning networks of various kinds (ecosystems). This can be seen in the Internet economy in the San Francisco Bay Area, the Innovation Cluster in Boston and the financial business in the New York Metropolitan Region.

The opposite is true for German industry. The companies are interwoven in scientific, concession, production and service networks, which gives them a great deal of room for flexible provision of goods and services. This flexibility runs through the entire production chain from pre-levels (quality and availability of human capital and infrastructure) to innovation performance, the ability to implement and adjust to technological changes as well as the differentiation of services for individual customers. Associations in the metal and electrical industry as well as the chemical industry are significant success factors. Clusters are gathered in Germany in the classical as well as modern industrial sectors more than any other European economy; this is also not seen in the United States (European Commission, 2014; IW Köln/IW Consult, 2016).

One can build “Industrie 4.0” on this basis. The connection of classical mechanical-electronic production structures with software and IT (cyber-physical systems) as well as the use of private cloud services extends the value chain to an information chain in real time, which integrates customer use data, which is reflected virtually. Companies are privately networking in a new way. They use industrial and sector-wide standards (such as the eCl@ss procurements standard) as well as closed platforms. Thus, it is possible to provide completely customised products (*smart products*, batch size of 1) not only in a cost-efficient manner, but also to anticipate future disruptions in running operations, so that the various and extensive customer data’s relevant effects correlations (correlations instead of causalities) can be determined. Digitalisation does not lead to scale, but rather the opposite, it opens unimagined benefits in specialisation. Furthermore, there is a re-invention of existing business models, which may seem less than ground-breaking, but result from a variety of step-wise changes with long after-effects of earlier structural decisions.

This positive picture may not continue (Keese, 2016, p. 45 et seq). One can be justified in being sceptical when one sees a dominating vertical network and platforms in the B2B world, which are closed to the outside world. The trend towards

horizontal networks, which are central to Silicon Valley's digital transformation, is neither automatically laid out, nor is it easy to achieve. In industry, both perspectives – the hierarchical-vertical and democratic-horizontal – differ strongly from one another. Networking at eye height is found in some levels of the value chain, but not in the manufacturer-customer relationship. To date, digitalisation in industry has been of greater application in narrowly-defined, closed areas (Keese, 2016, p. 35).

(2) Another picture of economic digitalisation is seen by applying the economic interfaces between companies and consumers (*business-to-consumer*). That is where Silicon Valley Internet firms dominate. They combine an almost unlimited expansion of the business model with a correspondingly high company valuation and capital strength. The many large and small facilitations provided to daily life, such as search engine services or goods that are easily purchased online, which are provided by these companies, are neither space- nor culture-bound. This also applies to the intermediary function of these companies in what are frequently created platform markets, which hew to general standards and procedures.

These companies' market penetration is related to standardisation. This reduces complexity, but forces the customer to adjust to the standards. Customised differentiation would be consulting-intensive and costly. The economic benefits of scale would be lost. Assessing larger amounts of data from the use of Internet services makes it possible to determine exact-fitting purchase or transaction recommendations for individual users. Internet companies are therefore seeking to combine horizontal structures and networks to permanently take part in research-driven innovation dynamics, and continuing to secure their own business model. The capital investment and location advantage of Silicon Valley are of great importance. Effective path dependencies from earlier technological success, intensively trained technical capabilities, the appeal to potential employees from other countries and extensive business experiences play important roles, and connect these Internet companies to the location in a unique manner.

The variety of platform markets (two-sided or multi-sided markets) make access to goods and services easier, faster, more flexible and more reversible. There are frequently opportunities for such offerings, where existing markets leave gaps due to regulations or institutional borders. Since manufactures and customers do not personally meet, the necessary trust basis must be created in other ways. This gives non-uniform incentives to provide the relevant information using transparency, ratings and assessment options (Demary, 2015b). The fascinating thing about this development is that trust can be built in a market through a network whose size could not be imagined in the past despite all security and manipulation risks.

Digital printing provided a further strand in digital transformation in the B2C world, in which the creation of customisable offers is possible in the consumer goods area. It opened new opportunities to stationary retailers with the combined greater willingness to pay for otherwise unchanged products in the food sector and through supplemental service offerings offered successful differentiation. In any case, the characteristics of digital products are missing, as neither self-management nor networking plays a role.

The characterisation of the B2C world as a horizontal, and to some degree an equally networked market, only applies to the extent that it exists in emerging platform markets and their interaction logic. Internet companies themselves compete just like classic industrial firms with a tense relationship between hierarchy and networks. This is due to the normal maturation process of organisations. Ultimately the aim is to ensure the horizontal flexibility and openness of the company's daily business. This is of unequal and existential importance for companies under the conditions of digitalisation.

(3) Intermediary platforms play a central role, particularly for economic interfaces in the consumer world (*consumer-to-consumer,* in a more limited concept, also *peer-to-peer*). Old ideas can be used in new ways using digitalisation. Consumers arrange with consumers by transferring temporary use rights or offering services. Global markets in sharing or the collaborative economy have arisen from local phenomena such as ride sharing and co-living arrangements. The sharing of property, which can be mobilised for use by strangers, is gaining worldwide importance through platforms such as Airbnb and Uber. FinTechs create, among other things, private direct financing, new types of database structures (blockchains), making self-organised global transfers between actors who don't know one another without the need to bring in intermediaries. These new platforms create not only technical opportunities to securely implement transactions, but also enable the building of needed trust. The needed references are created using assessments, inspectable as well as credible, unchangeable histories of transactions and transparent analyses by the portal operator (Monopolkommission, 2016, Vol. 1182).

As regards market effects, one must consider the market relationship that exists from the matching of supply and demand and that relates to existing markets. On the other hand, there is a focus on platform operators, because they have their own competition issues (Demary, 2015b). This problem is not fundamentally new. It is known, for example, in the healthcare sector through the distinction between the market for insurance services and the market for health care services. There are special regulatory tasks related to this (Deregulierungskommission, 1991).

It is economically exciting, on the one hand, to mobilise previously unused capital to provide services. This leads to a broadening of offers with interesting distribution effects. The providers generate additional income provided they have the relevant assets, skills or time, are accepted by the platforms, and achieve good evaluations. Those who do not have positive features or relevant abilities cannot benefit from the digital opportunities of the sharing economy. In any case, the broadening of the offer can only lower prices in fragmented markets and accordingly increase consumer rent. Both (additional income and higher consumer spending) should be sufficient to compensate the losers among the existing providers. One can also imagine that additional offers mobilise additional demand, that the quality of the offers increases in general, and therefore no price-lowering effect occurs. In this case, market expansion is combined with concomitant fragmentation in sub-markets. This can reinforce the fact that professional providers, such as hotels, sell their services flexibly and efficiently, coordinated over several channels, whereas the sharing community uses only one category of distribution channel, such as Airbnb (Demary, 2015b).

On the other hand, it is proving to be economically attractive for certain offers to provide effective information in real time (surge pricing). The Walrasian auctioneer operates round-the-clock in these markets, while the price signals affect demand and supply. What is decisive here is not to opt for the highest prices or price tables. In addition, the algorithms used can lead to the fact that demand and supply are not only combined with low transaction costs for the consumer, but also for the provider, or generally by mobilising the offers. These aspects were frequently overlooked in the public debates about the conditions (private ownership), distribution effects (favouring owners) and supposed social or labour market-related consequences (solo independence) in the sharing economy. This is the result, however, of a superior gain in economic efficiency (Brühn/Goetz, 2014; Monopolkommission, 2016, Vol. 1207).

(4) The last is a view of an economic interface in which the consumer interacts with the corporate sector (*consumer-to-business*) in a new form of exchange. This refers to the voluntary or involuntary (in any case, often unknowing), mainly non-monetary compensated data generation using digital services. This results in giant, mostly unstructured, data sets (Big Data). Through their transactions or collaboration, users create the basis to optimise existing business or develop new opportunities, which result from the populating of user profiles, easier determination of functional defects and disturbances or improvement of diagnostic methods. To a degree, this form of digital transformation is also based on networking and (semi-) public platforms whose intensive use creates the potential for big data analyses.

The C2B interface perspective shows that individuals are not only the users of information in the digital world, but they clearly produce data in a way that was unimaginable earlier of a type and intensity that personality profiles are possible, as is the identification of business examples or estimating societal trends (Acquisti/Taylor/Wagman, 2016, p. 444). Although less in the foreground, new companies, services and markets have also been formed. Also, there is a growing public awareness around protecting one's private sphere, and an associated political debate. This has to do with the question and the relevant consideration of the extent to which the protection of privacy is associated with positive and negative economic effects, whereby privacy does not conflict with data production, but rather requires its control (*control over sharing*) (Acquisti/Taylor/Wagman, 2016). Waiving this data production can mean that one must also waive the possible improvement in personal services, and thereby increasing consumer surplus. At the same time, transparency in individual information can lead to disadvantages (such as with reservation prices). Also, the protection of privacy can prevent social returns (such as the quality of search engines) or have benefits if specific information is not made public (to not reduce opportunities for integration of otherwise stigmatised persons).

3. Effects of digital transformation and resulting needs for action

There are various effects associated with digital business models. That begins with productivity effects, which make possible sustainable business growth through stable profits, and determine the entire economy together with work volumes and the ability to expand (3.1.). It continues with employment effects, which have broad effects on the structure of the working world and affect labour market policy (3.2.). Competition is especially challenging for economic policy since digitalisation affects many of the traditional standards of competition law and competition policy assessments (3.3.).

3.1 Productivity effects

The significance of continuing digitalisation for the entire economy's productivity today and in the future is a controversial topic. Basically, higher productivity means that one can produce more output with the same volume of input factors, or the identical output with less input. The question is now to what degree advancing digitalisation and its application to respective economic interfaces leads to increased productivity. One normally looks at work productivity, which is clearly influenced by the use intensity of the other production factors (see as an overview: Syverson, 2011). Total factor productivity is also exciting, as it captures every production change that is independent from the deployment of different production factors and

above all is clarified by new technologies, technical-organisational progress as well as management's ability to manage.

Total factor productivity as a residual variable is a challenge to determine empirically (Diermeier/Goecke, 2017). Thus, prior calculations of investment in IT and communications technologies only provide a limited explanation for total economic growth. At sector level, slightly significant effects can be identified only for companies (in contrast to infrastructure and individuals) (Diermeier/Goecke, 2017). The actual digital penetration of companies bolsters the view (Egon Zehnder, 2016) that we are still in the middle of an implementation phase in which, to a great degree, not all effects have had an impact on productivity. The dynamics of digitalisation have only started (van Ark, 2016).

Frequently one advances the theory that the economic effects of digitalisation are not suitably considered in GDP – and therefore also in productivity. Mandel (2012) as well as Brynjolfsson/Oh (2012) argued for a basic reform of this measurement concept due to structural change. Groemling (2016a, 2016b) makes it clear that the total economic calculation based on market prices concerning assessments of transactions is not distorted. There are virulent measurement problems where the sharing economy (C2C) substitutes for the economic performance that was previously in the B2C interface.

Work productivity is of special interest for conceptual considerations. It determines total economic expansion with given capital investment together with work volumes. Capital intensity, human capital and residual total factor productivity are also important as a condition and expression of economic functional connectivity. The possible effects of digitalisation on these productivity aspects with the resulting specific needs for action are systematically captured in Overview 2.

Overview 2: Productivity effects of digitalisation

	B2B	B2C	C2C	C2B
Capital intensity	unclear	neutral	neutral	neutral
Human Capital	positive	neutral/positive	neutral	neutral
Total factor productivity	positive	neutral	neutral/positive	neutral/positive
Labour productivity	positive	neutral/positive	neutral/positive	neutral
Need for action	Re(De)-regulation	./.	Re(De)-regulation	Consumer protection

Source: Own summary. Positive/neutral/negative indicates the effects of digitalisation on various productivity dimensions.

(1) for the *interface between companies* (B2B), digitalisation and advancing networking makes production value chains more efficient. The manufacturer reduces the equipping and repair times and idle time, approval processes are shorter and freer of disruption, the reaction to changed demand becomes faster or takes place in real-time. Thus, in shorter time and with lower resource deployment, the same volume of goods can be produced, and productivity increases. The reason that one cannot find a measurable effect today is that only a few avant-garde companies use Industrie 4.0 technologies in a comprehensive way. The effects on macroeconomic productivity only become visible when a larger section of companies intensify the use of innovative technologies (Diemeier/Goecke, 2017). Opportunities therefore increase with the proliferation and expansion of digitalisation, which also leads to productivity gains among company customers. Buyers and users of a machine or system achieve shorter downtimes and work without production interruptions due to networking with the manufacturer in real-time, because data assessment (correlations) make service predictable. To this extent, one can expect measurable productivity gains in all digitally networked companies.

This does not necessarily assume increasing capital intensity, as – different than the automation trend after 1970 - the machines and systems used today are capable of being digitised, and do not require a comparably large additional investment (*retrofitting*). However, additional investments may be required by connecting customers and suppliers or for the security of the digital structure as well as data protection. In any case, one cannot formulate a clear expectation about capital intensity. This is different in the case of further training for employees, who need special technical skills, above all engineering science and IT capabilities.
There is a need for action in terms of economic policy, in particular with regard to making digital networking between companies easier without causing legal

competition problems. The discussion revolves around the if and how of a regulation, which serves the development of technical standards as well as the formulation of new data rights (see Section 3.3.).

(2) In the *B2C* area, households consume new goods and services which make private life more comfortable and can reduce costs, or respond more precisely to one's own desires and preferences: for example, the refrigerator takes over purchasing online or the heater heats the apartment through remote control when needed. These opportunities can only have a very indirect effect with little resource use on economic productivity. They increase consumer surplus, but this is not relevant for production. One could clearly think that digital offerings through platform markets improve provider capacity, and thus positively influence productivity. This may be countered by the fact that additional offers intensify competition so that prices fall and thus market income is lower. Also in this case, it's correct that the system increases consumer surplus.

Capital intensity in this segment is barely affected, as is also the case with total factor productivity. Human capital and work productivity can have positive effects due to working with digital products and services.

(3) In the sharing economy in the *C2C area*, customers meet by renting long-lived consumer goods or offering services. If the actors are consumers as per definition, this remains irrelevant for economic productivity measurement. Basically, this only changes if the consumers attain corporate characteristics through their activity, and are then statistically captured; in any case the value added is captured through income tax and sales tax. There can be productivity losses due to threats to traditional offers over the short term, during an adjustment phase. If activities are moved from classic markets into the sharing economy, one can reduce performance over the short term, but by adjusting the technologies used and performance standards, there are no consequences for long-term productivity. One should also think about the greater competition (and possible adjustment in regulation) which, over the medium-term results in increases in work productivity (more efficient work deployment) and, if relevant, also increases total factor productivity (better corporate management).

The economic policy needs for actions are related to the question of how the new offers must be treated from a regulatory standpoint, and to what degree suitable, comparable competition conditions are to be obtained (see Section 3.2. and 3.3.). These may have effects on markets and consequentially for productivity depending upon the effects on market dynamics, market fragmentation and the shift in sales between traditional and unconventional new markets.

(4) In the *C2B interface* the consequences for productivity are also unclear. Big Data analyses give platforms, but also differently digitalised industries the opportunity to adjust and optimise their goods and services accordingly. This can improve the performance capability of the network modules or help to optimise production. This should have a corresponding impact on companies. On the other hand, new personalised products and services can be offered that simplify private life by reducing search costs for the individual dream trip, as this is automatically offered without an explicit request. These new opportunities have no direct influence, however, on the productivity of the entire economy. In this context, consumer protection (data protection) is gaining importance in economic policy, given the balance between the benefits and costs of such policies for data production (Acquisti/Taylor/Wagman, 2016).

3.2 Employment effects and changes in the working world

The overall employment effects of digitalisation have aroused the interest of those in economic policy as a comprehensive approach to labour market policy (BMAS, 2015). There are several aspects here. It is about the consequences of digitalisation for the overall volume of employment and social security resulting from this (macro level), for corporate culture and social partnerships (middle level) as well as for individual work relationships in one's life with the aspects of qualification, controlling one's time and general quality of work (micro level). These effects are summarised in Overview 3 and extended by plausible action corollaries.

There are various studies in general on the employment effects of digitalisation. The results ranges from horror scenarios, in which nearly all jobs will no longer be needed due to digitalisation, to significant positive employment effects of 1.5 million additional jobs in Germany alone, which have already been created by digitalisation up to 2012 (BITKOM/Forecast 2014). However, based on model-supported analyses as well as empirical evidence, consensus can be made that there will be shifts in the *employment structure* irrespective of the overall economic effect. More workers need technical and IT specialist knowledge, digital and media skills as well as the ability to manage themselves compared to the past (Hammermann/Stettes, 2016; Wolter et al. 2016). In addition, qualification, training and further education will become significantly more important through digital change in expanding employment and retraining current employees.

Overview 3: Digitalisation and the working world

	B2B	B2C	C2C	C2B
Macro level				
- Employment volume	positive	neutral/positive	neutral/negative	neutral
- Social system	positive	neutral/positive	neutral/negative	neutral
Middle level				
- Social partnership	positive	negative	negative	neutral
- Corporate culture	positive	neutral/positive	neutral	neutral
Micro level				
- Life cycle orientation	positive	neutral	neutral	neutral
- Time sovereignty	positive	positive	positive	neutral
- Qualification	positive	neutral/positive	positive	neutral
Need for action	(1) Education (2) Continuing education (engineering science)	Customisation of social security	(1) Clarify corporate characteristic (2) Regulatory 'level playing field'	./.

Source: Own summary. Positive/neutral/negative indicates the effects on employment related to the functionality of impacted institutions.

(1) For the *B2B* world, which combines structural change with the traditional model of work sharing and which continues to develop this, there are positive effects in all areas of the working world and employment now and probably for the next decade. One might want to change this if the performance capability of the computer, analytical skills for large data sets as well as automation and robotics continue to develop so dynamically, and make qualitative jumps. Appropriate training and further education initiatives are needed to support the technical consequences of digitalisation. Corporate investments are already being drawn to locations where critical human capital (engineers and IT specialists) is sufficiently available.

(2) In the *B2C world,* large employment growth has remained elusive: Facebook, Google and Apple together only have 200,000 full-time employees – Volkswagen has over half a million employees, a quarter million in Germany alone. There are completely new employment templates in the world of internet companies, which are difficult to connect with traditional institutions in the labour market. This is due to the fact that large Internet companies have a specific history and origin in regards to their institutional character (for example, distance to social partnership). One can expect, however, that with continuing organisational maturity, this will become more possible as soon as the corporate organisations are easier to access. Also, social acceptance, which is ultimately important to business success, requires greater willingness to adjust to the institutional characteristics of their target markets. Even clearer is the challenge of the prior and post value added stages for large internet companies.

Crowd working and fluid, project-related cooperations pose a challenge to established instruments of income security over the course of a lifetime. One must clarify whether existing social security – with basic income from continuous working careers without status changes – Is sufficient, or whether there might be an insurance obligation (with a counterparty requirement for insurance) (Deregulation Commission, 1991).

(3) Intensive networking of consumers with one another (*C2C interfaces*) can have negative employment effects on the overall economy, as, for example, increased use of Uber services has a negative effect on the number of classic taxi drivers. The formerly centrally organised employment through companies with a variety of employees has been replaced by a decentrally organised employment structure. What is also decisive here is whether, and to what degree the commercial service is captured, and a corporate characteristic has been developed. Basically, due to demand shifts, but also threats to the established companies, one could surmise that the overall effect could be neutral.

As in the case of the B2C interface, new employment forms, work sharing patterns and time structures are emerging, the overall effect of which is not clear on the various characteristics of the working world. The sharing economy remains outside the area of dependent employment, to the degree that an independent activity is created, and that this is at least supplementary to existing, dependent work activities. People mobilise their long-lived consumer goods to obtain additional income or to receive other employment. Legislators must clarify whether the corporate characteristics (in terms of regulations for small businesses in Section 19 of the Umsatzsteuergesetz [Sales Tax Law]) and what regulator conditions should apply for all providers in the same markets - B2C and C2C.

(4) As compared to the business model categories, the *C2B interface* is for the most part neutral, as it is not itself subject to employment. There are also nearly no employment incentives among the large Internet companies, at least in start-up companies. This remains very clear both from a qualitative and a quantitative aspect. Effects on other aspects of the working world cannot be found.

3.3 Competition effects

There is a variety of competitive effects from the various business models because of digitalisation. One must first develop a competition policy paradigm to perform an analysis here. This begins with an estimate of whether competition is an instrument or the goal by which its significance will be measured. Various positions have

developed in US and German literature over the 20th Century; even today, the term of competition in law is neither clear nor conclusive.

- From a regulatory perspective, competition is an expression of free order, influences freedom, and is an objective in itself (principle of freedom of competition according to Erich Hoppmann, see Vanberg (2009)). Freedom to compete ensures that a price mechanism works. Thus, one can cast a very sceptical view of discretionary interventions by the State, which are oriented to assessments of individual cases.
- On the other hand, the approach of functional competition (Erhard Kantzenbach, see also “workable competition,” according to John M. Clark) clearly provides room for further state intervention to make competition as effective as possible (“second best” perspective). The idea of “optimal competitive intensive” derived from this has caused a lot of contradiction (Hoppmann-Kantzenbach controversy) because of its defensive nature.
- Finally, one can weigh the freedom principle in the elite of efficiency considerations (see also the “more economic approach”, which is important for the EU Commission to strengthen the idea of competition as an instrument to create value and increase consumer satisfaction).

With a dynamic view of competition, the contradiction fades into the background, especially be expanding the focus on potential competition and the question about hurdles to market entry. This can be found, for example, in the EU Merger Regulation, which emphasises “significant impediment to effective competition” and potential competition. Such a view values structural arguments (market share, market power) as well as the promotion of economic well-being (market behaviour, market results). To suitably capture this point of view, Overview 4 creates a system for this under market structure, market behaviour and market results, and extends the view to the need for competition policy action.

Overview 4: Digitalisation and competition

	B2B	B2C	C2C	C2B
Market structure - Market share - Market power - Market entry barriers	 neutral negative negative	 negative negative neutral/positive	 positive positive positive	 neutral/negative neutral/negative neutral
Market behaviour - Abuse of power - Unfair behaviour	 neutral/negative neutral/negative	 negative positive	 positive positive	 neutral neutral
Market results - Competition to secure freedom - Functioning price mechanism - Value added / consumer surplus	 neutral neutral positive	 neutral/negative positive positive	 positive positive positive	 neutral neutral/positive positive
Need for action	(1) Setting standards (2) Property rights to data	(1) Market power analysis (2) Abuse supervsion	(1). Clarify corporate characteristics (2) Regulatory 'level playing field'	(1) EU data protection regulations (2) Consumer protection

Source: Own summary. Positive/neutral/negative indicate the effects on the level of competition in the sense of strengthening effective competition.

(1) The *B2B world business models* cannot be clearly assessed from a competition policy point of view. While market results and market behaviour provide no additional reasons for intervention, new competitive policy instruments appear to be needed; this is basically different than market structure.

Deepening and extending the value chain through cyber-physical systems more strongly ties customers to manufacturers. The change to another provider will then be conditioned an ever-more specific configuration of the product made of goods and services, and therefore makes meaningful exclusive data transfer from users to the manufacturer costlier, and more difficult. Digital transformation causes vertical integration to a degree. This need not impact market share, but the actual market power in the existing business relationship when the provider dominates a market niche (*hidden champion*).

This is strengthened by the fact that market entry for other providers tends to become more difficult if this must do with the use of established technology, and not with the invention of new, disruptive technologies. Potential competition confronts higher hurdles which arise from threatening sunk costs due to incorrect investment. This applies even more if digitalisation makes it possible for classic providers to provide their products in a way that is highly customised and cost-efficient. In a mid-sized company environment, this can be compensated, so that one can apply a mid-sized company clause to Section 3 of the *Gesetz gegen Wettbewerbsbeschränkungen* [Law Against Restrictions to Competition].

In any case, the lock-in effect can be reflected in the provider having a relative dependency on its customers if a technological break-through has changed the business model and they move to other manufacturers (Christensen 2011). Two considerations are significant from a competition legal standpoint:

Integration along the value change makes the option of changing providers easier if the generally applicable standards apply (Monopolkommission, 2015, Vol. 569 et seq; Monopolkommission 2016, Vol. 1198 et seq). Then changing to another manufacturer is not made difficult, at least from a technology viewpoint. The development of such standards depends - as in previous contexts - on market dynamics. The difference to known standards development in the consumer goods industry is that there is a lot of room for vertical differentiation in the B2B interface, which lacks transparency and volume dimensions like those in the B2C interface. Only if manufacturers and customers act with equal rights in the B2B world is there a potential for a horizontal network in the sense of a platform. Then competition concerns also disappear. Considering the high level of innovation in digital transformation, there is a lot to be said for the fact that industrial companies work together to develop industry standards even though they are competitive. Digitalisation provides an incentive if, as in the case of 3D printing, high development and investment costs arise, which cannot be easily borne by individual companies. To this degree, special, new competition policy actions are not needed.

The lock-in effects are also reduced because, in addition to the definition of uniform technical standards, the *ownership and use rights to machine-related data* (use, technical reactions, disruptions, etc.) are clarified. At present, the customer is largely exposed to the manufacturer's conditions, who also tries to obtain legal access to these data through sale, or obtains them in a defacto manner. Other than with personally-related data, there is no clear, clarified use right to machine data. This gap can hardly be satisfactorily clarified on a private contractual basis if the negotiating positions of the partners are unequal. There is a legal problem because data within the meaning of the Civil Code (BGB Section 90) are not subject to property rights due to a lack of physicality, even if the relationship to a natural or legal person can be established. Existing data protection and copyright laws do not provide an approach to provide specific data with specific property rights. A legal system extended to the Internet age would address the challenge of competition policy (Bräutigam/Klindt, 2015).

The EU Commission took up this topic in its strategy for a digital internal market (European Commission, 2015). Of course, legal clarification is neither easy – clarification of the protected subject matter and the scope of protection – nor is it

undisputed (Max Planck Institute for Innovation and Competition, 2016, 4 et seq; Zimmer 2016). In any case, the legal discussion can gain clarity if it systematically differentiates between digital business models. In a B2B world, competition policy issues are different from those in the B2C or C2C areas because the market structure opens up other market behavioural options. To a degree, the question about ownership rights to data, even if these are not physical objects, and in this context, are included in our legal tradition, one must examine them, especially with a view to their exclusionary effects (Zimmer, 2016). Above all, existing anti-trust regulations must be considered. This is in no way a simple economic consideration, but the different contexts should be appreciated. Especially in the B2B world, the competition law consequences should be regarded, and clearly considered in narrow markets.

(2) In the *B2C world business models,* competition law issues and policy challenges have to do with the effects on market structure and market behaviour. The particular competition policy relevance of internet companies has to do with their intermediary function in platforms, which means that standards developed must be as effective as possible. The use quality of the platform increases as the number of users rises. Depending upon the platform's function – for example, a search engine or social network – various consequences result for the market power of the providers (Monopolkommission, 2015, Vol. 175 et seq, 288 et seq). However, competition policy is now being moved within the existing framework, because it is either possible to change to lower costs – see the current market pressure on Facebook due to its avoidance of user groups – or the legally recorded facts about hindrance abuses and abuse of exploitation do not pose essentially new issues. The applied "fairness regulation" and the fight against unfair competition address certain acts as wrong (Max Planck Institute for Innovation and Competition 2016, 7).

One should also not overlook in this context the fact that large internet companies – Google, Amazon, Facebook, etc. – have, on the one hand, their own core areas. For example, search engines at Google, which have considerable scale effects, and scale, especially because of associated capitalisation, is strategically essential. On the other hand, open source logic provides the basis for new business models for other actors and innovators. Uber developed through a software modification based on Google Maps (the same can be expected working with Google Photos). These unimagined, unpredictable new services make it clear that large internet companies must also accept the downsides of their scaling strategies ("inverse scaling problem"): They are not able to differentiate and to manage complexity from a business policy point of view in a more limited context (see, for example, the collaboration of NetSuite (cloud computing thought of as scaling) with iCharts (business intelligence for special applications)). The perception here that market

position and economic power resulting from scale should be crushed in a competitive manner overlooks this phenomenon. Also, the abuse-independent dismantling of company size as an instrument of competition law (in addition to cartel prohibitions, abuse supervision and merger controls, as well as unbundling in the case of a proven misuse of a dominant position) can be seen critically, as they interfere very broadly with the right to property and use without any cause or finding. The 9th amendment of the Act against Restraints of Competition (GWB) issued by the Federal Government intends, not without reason, to introduce this unbundling option (Federal Government, 2016).

On the other hand, competition is a problem when internet companies try to leverage their market power through the accumulation of data and bundling offers (Monopolkommission, 2015, Vol. 22 et seq). Data protection is applied here. There is currently no need for a new competition law, especially since the accumulation of data, their analysis and resulting implementation into new services and products are not free of charge, and are also liable to improve customer satisfaction. The extent to which a regulation for data portability is meaningful and necessary remains fundamentally controversial. It must be designed in an appropriate way, considering adverse accompanying effects (Engels, 2016). Existing competition law instruments are sufficient to arrive at findings and decisions for the analysis of dominant positions (see: Autorité de la concurrence, Bundeskartellamt [Federal Cartel Office] 2016; contrary: Max Planck Institute for Innovation and Competition 2016, 10 et seq).

(3) For the sharing economy at the *C2C interface*, the same need for action arises in view of competition distortion as from the perspective of the working world. The corporate characteristics of private providers must be clarified, as well as the appropriate regulatory environment (Monopolkommission, 2016, Vol. 1198 et seq). A new kind of competitive policy action is not needed, as digital platforms are moving towards a level playing field through their development of standards. Fairer competition assumes that the opportunities in the digital world are not discriminated against through regulations of the analogue world. In terms of competition policy, possible market fragmentation can be significant by increasing potential competition in the classical B2C markets. This could be observed by the competition authorities in market power analyses.

(4) At the *C2B interface,* data protection in the sense of an international harmonisation is required (EU Data Protection Basic Regulation) and – generally included – consumer protection. According to recent press reports (Frankfurter Allgemeine Zeitung, November 2016, p. 15), the Federal Government intends to equip the Federal Cartel Office with a new amendment of the GWB [Competition Law] to this end with expanded competencies, enforcement rights and

responsibilities. To ensure fair competition, where honest companies are not disadvantaged if they adhere to consumer and data protection standards, the cartel office is the right place for consumer protection. The change in political discussion is interesting to observe. The Federal Chancellor and the Federal Minister of Economics at the IT summit in 2016 warned against excessive data protection, instead applying the concept of data sovereignty: “The principle of data economy … cannot be the general guiding principle of the development of new products.” (Merkel, 2016). Against all too far-reaching general rules, it is also important that the quality of the information is not generally determined by data producers (Acquisti/Taylor/Wagman, 2016, p. 446 et seq), as it is context dependent, changes over time, can be tangible or intangible, and is not easy to measure with market standards. In view of this, the relevant charter of the Federal Cartel Office appears to be reasonable. This leaves room for market-driven solutions for *privacy-protecting services*, which develop with greater dynamism.

4. Summary

This journey through the various aspects of digital transformation has shown that the system developed for possible business models is viable. This makes it possible to identify and describe the need for action much more specifically, as shown in Overview 5 using the individual results.

Overview 5: Digitalisation and economic policy corollaries

	B2B	B2C	C2C	C2B
Productivity effects	Re(De)-regulation	./.	Re(De)-regulation	./:
Employment effects	(1) Education (2) Further education (engineering science)	Customisation of social security	(1) Clarify corporate characteristic (2) Regulatory ‘level playing field’	./.
Effects on competition	(1) Setting standards (2) Ownership rights to data	(1) Market power analysis (2) Abuse supervision	(1). Clarify corporate characteristics (2) Regulatory ‘level playing field’	(1) EU data protection regulations (2) Consumer protection

Source: Own summary

Thus, digitalisation loses its monstrous nature, which is sometimes found in descriptions that assert that this structural change has only one pace, allows only one step and one direction. The effect of path dependencies, which ultimately do not

oppose a disruptive upheaval, are also shown. But there are different manifestations, dynamics and adaptive opportunities on these paths.

The business model system of analysis opens up a differentiated view, especially in terms of competition law, where the fundamental requirement has already begun to emerge in relation to competition policy, such as when calling for the destruction of large Internet companies. Some arguments, in which digitalisation is only found in large and capital-intensive companies, which is true in the B2C world as well as reciprocally in the C2B world, prove to be useful, but can be ultimately misleading. The problem of “inverse scaling” affects not only recent developments in business models, but also shows that market power in one position cannot be easily transferred to other businesses, but can create potential competition. Overall, the action needed in competition law remains manageable. The existing regulatory field and areas for intervention are sufficient with only a few exceptions. The same is true of existing institutions, which, of course, can have their effectiveness increased.

Regulatory policy should, above all, be concerned with the classification of productivity effects. The development of standards, the interplay of various technical solutions in real-time without physical contact is crucial here. They can be sector or industry standards. Whoever is a first entrant here has the best opportunity to make them compatible to its needs. Economies with an already high share of robotics have an advantage. This is also important regarding the entire value-added chain (such as eCl@ss) and for the issue of new technology connectivity.

It is important to link the dynamics of the business models repeatedly with the technical basics (see Overview 1) and to question the central characteristics of digital transformation for meaning – automatic and non-contact identification of various objects, virtual and self-learning management of processes, networking and real-time. The great trends of “artificial intelligence,” robotics and automation as well as mobile solutions will, conditioned by further massive increases in performance capabilities of processors, trigger enormous, still unforeseen changes.

It is therefore helpful to be able to classify these developments using a systematic approach. It is particularly important that there is a targeted orientation in the education system, especially in the B2B area, which is central if structural change is to be successful and not eroded due to a lack of specific human capital. This need for action exists today. A challenge for Germany is infrastructure deficits in rural areas coinciding with an under-supply of specific human capital (Koppel, 2016). It is also important that the principle of data sovereignty is promoted through general digital knowledge and consumer protection.

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