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Economic Effects of Recent Social and Technological Developments

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Economic Effects of Recent Social and Technological Developments

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Abstract

This paper summarizes and connects the main findings of the habilitation project.

The important social developments analyzed, result from the demographic change that many economies will face in the future. Especially on the regional level, problems arise due to increasing disparities in population. This challenges the comprehensive provision of public services such as health care or basic infrastructure. Therefore, new strategies have to be implemented and previous structures have to be adapted. In particular, as also many cities, which have always been agglomeration areas of economic activity, face demographic and/or economic problems, appropriate proactive strategies must be developed to ensure future prosperity.

The most predominant recent technological development is the emergence and comprehensive availability of the Internet. This has led to new business opportunities but also new threats for economic activity. One particular online market comprises online games. In this market, due to the virtuality on the one hand and the importance of network externalities on the other hand, challenges for the assignment of property rights of virtual objects and optimal pricing strategies arise that have to considered. In the context of B2B, and also B2C, cloud computing becomes more and more important, however, this service is threatened by cybercriminals that force access into the cloud. Thus, the provider must develop strategies to prevent damage for his customers and the economy.

All in all, overall analysis shows that only cooperation of all relevant (economic) stakeholders can help to overcome challenges of social and technological developments.

JEL-classification. D9 ◦ H7 ◦ K4 ◦ L1 ◦ L86 ◦ O1 ◦ O3 ◦ R1

I. Introduction

The economic development of a country is characterized by many structural factors that basically depend on social and technological developments. Whereas society, that is all individuals and their ideals, decides about allocation and provision of scarce resources, technology determines how available resources can be used in production of all technically feasible and socially favored goods. Thus, changes in these two spheres have direct impacts on the development of an economy, as they either open new opportunities or intensify existing restrictions. However, these changes on a macroeconomic as well as a global level do not occur suddenly, but are caused by reinforcing changes on microeconomic and local levels. In this paper, one specific social and technological development, respectively, is selected and analyzed. Furthermore, the most appropriate methodological approach was chosen for both topics: Whereas socio-demographic changes are best analyzed in a descriptive-empirical approach as there is a large array of relevant factors, a formal-theoretical model framework is more appropriate for the analysis of technological aspects.

An important social trend that has not yet affected the current economic potential of many countries to a large extent, but will have a very sustainable effect on growth and development of all developed economies, is demographic change. This change causes both, aging of society as well as a shrinking of the total population of a country. At the moment these shrinking processes do not have a very big impact as there are local disparities within the economies. Whereas there are already shrinking regions that are fully struck by demographic development, other regions record large migratory surpluses and thus will be affected by the impact of aging only in decades. In addition, as cities in particular have been and are centers of economic activity, the economic potential of a country is linked to urban development. That is, if cities are able to grow strong economically and/or demographically and thus are able to compensate for negative development of other regions, overall economy will benefit. However, if cities have to struggle with problems by themselves, the economy will face lasting impacts. Section IIb shows on the basis of the development of selected German major cities how cities handle shrinking and how suitable strategies for moderating shrinking processes can be designed. Since economic literature so far is mainly concerned with growth, and analyzing or modelling negative growth does not adequately describe shrinking processes, data-based analysis can help to better understand the processes.

One of the most distinctive technological developments of the past few years was the implementation of the Internet accompanied by global networking. This process has been further intensified by the wide dissemination of broadband Internet in developed countries. Now both, companies and end users, face many new opportunities but also many challenges. In particular, opportunities arose for companies as many new business concepts are developed or made possible in the first place. One important market that appeared is cloud computing. This service allows for better allocation and thus more efficient use of IT services between companies. Firms in this market benefit from network effects whereas, at the same time, facing intensified competition that requires suitable business models and monetization strategies. As transactions in cloud computing require the exchange of sensitive data, ensuring of data-security is crucial. However, this security is threatened by hacking. Thus, section III b analyzes the impact of these criminal activities on the economic efficiency of the markets and the market participants (providers, users and hackers) and how this problem could be addressed.

This article is divided into two parts that analyze social development (section II) as well as technological developments (section III). The focus of section II rests on Bartholomae *et al.* (2017), while the focus of section III is Bartholomae (2017a). Other articles that have been made in the context of this habilitation project are presented in sections a, respectively, and are integrated into the overall consideration of the topics. The final section IV summarizes the most important results of the overall project.

II. Social and regional development

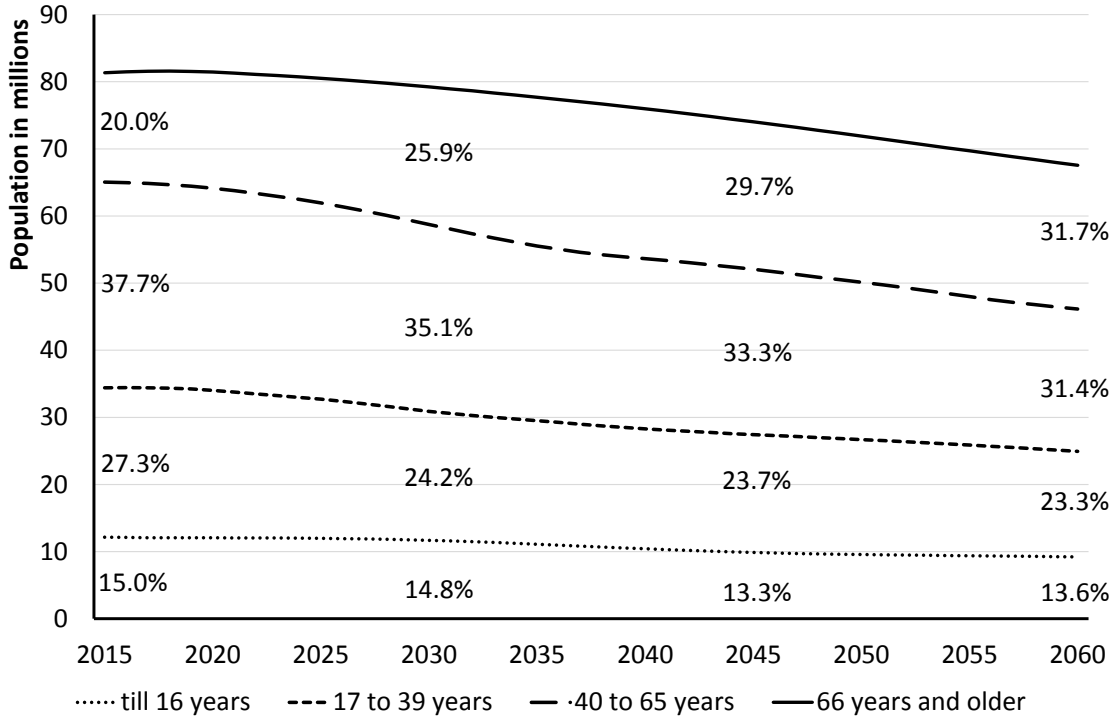
For sure, demographic change is the social development which has the most sustainable effect on the economy. As figure 1 shows, Germany is increasingly affected by demographic changes. Economically, this change affects all market participants: On the demand side, a smaller population size leads to a reduction in the overall market—by 2060, the population is expected to decline by almost 17% to around 68 million. In addition, the changed age structure—almost one third of population will be 65 years or older in 2060—will also change the preference structure. On the supply side, the production potential decreases as less working population is available for production—the number of persons in employable age between 17 and 65 years will decrease from about 53 million (2015) to about 37 million (2060). Already today, many industries face shortage of skilled workers that will soon intensify even more as prediction shows. Social systems also face major challenges, as the pay-as-you-go pension system is increasingly confronted by a decreasing number of contributors and a growing number of pensioners. The main reasons for demographic change are a low fertility rate and an increase in life expectancy due to medical advances.

Two approaches in population policy are available to address the problems: either measures that increase fertility or immigration from other countries. However, these approaches can lead to problems at other levels, like migration to social systems for example.

a. The importance of demographic development for regions and the provision of public service

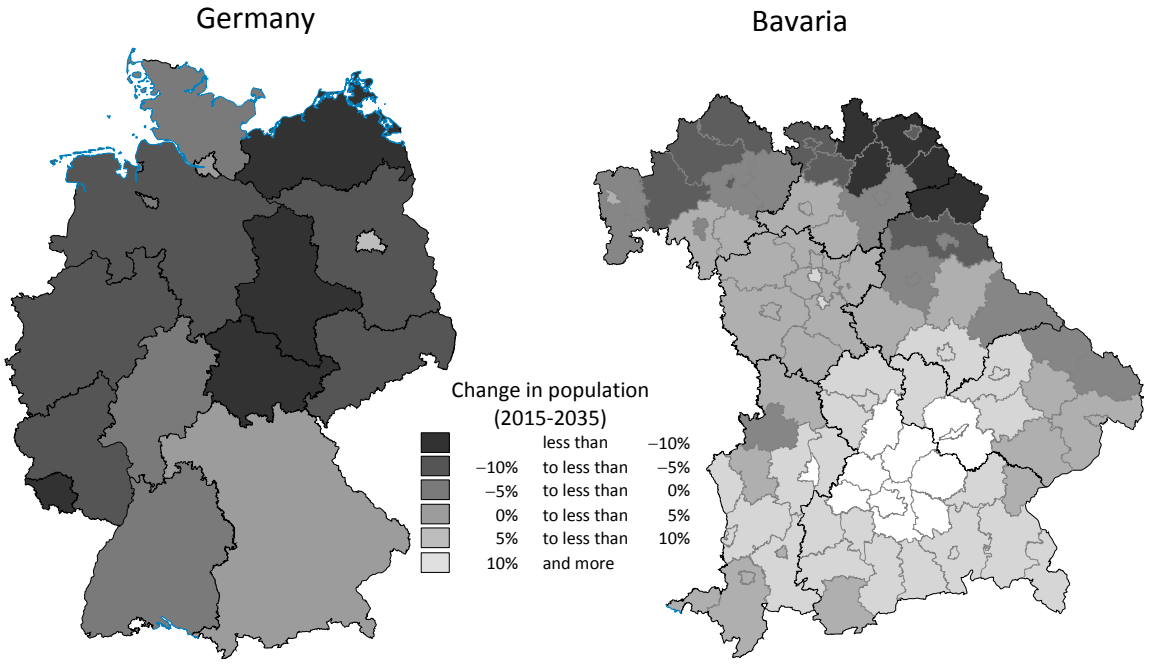
At the regional level, the demographic problems addressed do not affect all regions equally: While some regions are already struggling with enormous demographic problems, others will face these challenges much later. This is caused by international and in particular internal migration flows from economically underdeveloped to economically developed regions.

Figure 2 shows differences in demographic development. The comparison across Germany shows



Source: Scenario "continuity with weaker immigration (G1-L1-W1)" of the Federal Statistical Office and own calculations.

Figure 1. Forecast of population size and age structure in Germany



Source: Own presentation based on scenario "continuity with weaker immigration (G1-L1-W1)" of the Federal Statistical Office, the Bavarian State Office for Statistics and own calculations.

Figure 2. Comparison of regional development in Germany and Bavaria

that almost all states will shrink by 2035. Taking the example of Bavaria, whose population will be almost unchanged by 2035,[1] nevertheless there are regional disparities within this state. While many Upper Franconian districts will shrink considerably, in particular the Munich area benefits from a population growth of more than 13%. In total, 28 districts will shrink by an average of about 6%, while 66 districts will grow by an average of 6.6%.[2]

Figure 2 also shows that the states in East Germany are affected the most by the population decline—the population of the five new states will shrink by an average of almost 13%. This is due to the fact that many young people, particularly young women between the ages of 18 and 29, are migrating from East to West Germany. As a result, many West German regions will not be affected by demographic change at first. However, this is only a temporary delay as the overall German development shows a demographic decline (see figure 1). A major problem for the municipalities caused by a population decline is the lack of utilization of the existing infrastructure, which entails considerable costs in some cases. An adaptation to lower needs is often difficult to implement (cf. Herz *et al.*, 2002).

Given these problems, it comes as no surprise that regional disparities in demographic development will ultimately result in regional competition for population. Municipalities and regions try to attract or at least to keep inhabitants by implementing various measures and economic incentives. However, in the end this results in a prisoner's dilemma, which is characterized by high expenditures in order to attract population while populations are still declining. If regions handle this competition inadequate, regional disparities emerge and/or are aggravated.

In a model-theoretic analysis, Bartholomae and Popescu (2007a) as well as Bartholomae and Popescu (2007b) show that it can be optimal for regions, despite strong competition, not to react

[1] In the predicted scenario considered, population increases by 0.04%.

[2] The district of Wunsiedel (located in Fichtelgebirge) will shrink the most with −15%, while the district of Dachau with 17% will grow the most.

to policy measurements of the competing region(s). Changing one's own policies in response to political changes in other regions can lead to a more unfavorable outcome. The analysis assumes a certain region's need for a critical population size which ensures that the existing infrastructure can be maintained. Depending on how the population size of the regions react with respect to the critical level, different degrees of competition arise. In principle, each region has three possible strategies how to deal with the demographic problem: dismantling of the existing infrastructure, increase in spending on population attraction, or laissez-faire. It turns out that there are a lot of equilibrium output combinations in which no region has an incentive to change its output level.

However, the population decline poses major challenges for the regions, not only with respect to the maintenance of the utilization of the infrastructure, but also with respect to the maintenance or securing of public services as required by the German constitution. In particular, the German constitution (*Grundgesetz*—GG) stipulates that equivalent regional living conditions must be created (Article 72 (2) GG), which is, in particular, the task and the guiding principle of regional planning (§ 1 para 2 ROG).

The example of rural hospital care, which is an important part of the provision of public services, shows that the demographic development jeopardizes this target. On the one hand, demand for medical care is growing considerably as a result of the aging population. On the other hand, the diminution of many regions, especially in rural areas, implies that this supply cannot be ensured economically. However, rural hospitals are an important location factor: First, they are an object of prestige which helps to attract skilled workers and firms—an important competitive advantage for the regions—and second, they also create jobs with a broad range of qualifications. To ensure hospital care in rural areas, Bartholomae and Beivers (2008) as well as more detailed Bartholomae and Beivers (2009) propose to establish so-called "Integrated Specialist Care Centers." These centers provides for the concentration of specialist medical care as well as the consolidation of practicing physicians and hospital doctors, which allows for a full-range, part-hospital and out-patient care. A suitable organizational form of these centers is provided by "Functional Overlapping Competing Jurisdictions" (FOCJ).[3] The advantage of FOCJ is, in particular, that it enables economic efficiency while at the same time it accounts for preferences of the government or regional decision makers and their citizens.

The planning and ensuring of comprehensive provision of public services is carried out in each state on the basis of a regional development program (*Landesentwicklungsprogramm*—LEP). There are different approaches on which the planning is based. In Bavaria, for example, the central-city system of Christaller (1933) is used. In this case, places are grouped into a hierarchical system of different centrality levels, based on several requirements which they have to fulfill—requirements include infrastructure as well as socioeconomic criteria. As the level of centrality grows, the demands on the specificity and scope of the supply to be provided, and thus of the provision of public services, are increasing. However, in an evaluation, Bartholomae and Schoenberg (2013) based on Bartholomae *et al.* (2012) show that many places do not fulfill the necessary needs of their level of centrality. Especially at the level of the basic services, a considerable discrepancy between the LEP and the actual endowment of the place is apparent. This leads to the fact that the actual spatial provision of public services in Bavaria is distorted and therefore has shortcoming. In 2013, a revision of the LEP came into force. Two major changes were implemented: The specific list of criteria was abolished and centrality levels were reduced from seven to three. However, no revaluation of the places was performed and thus shortcomings still exist and a comprehensive provision of public services is virtually not

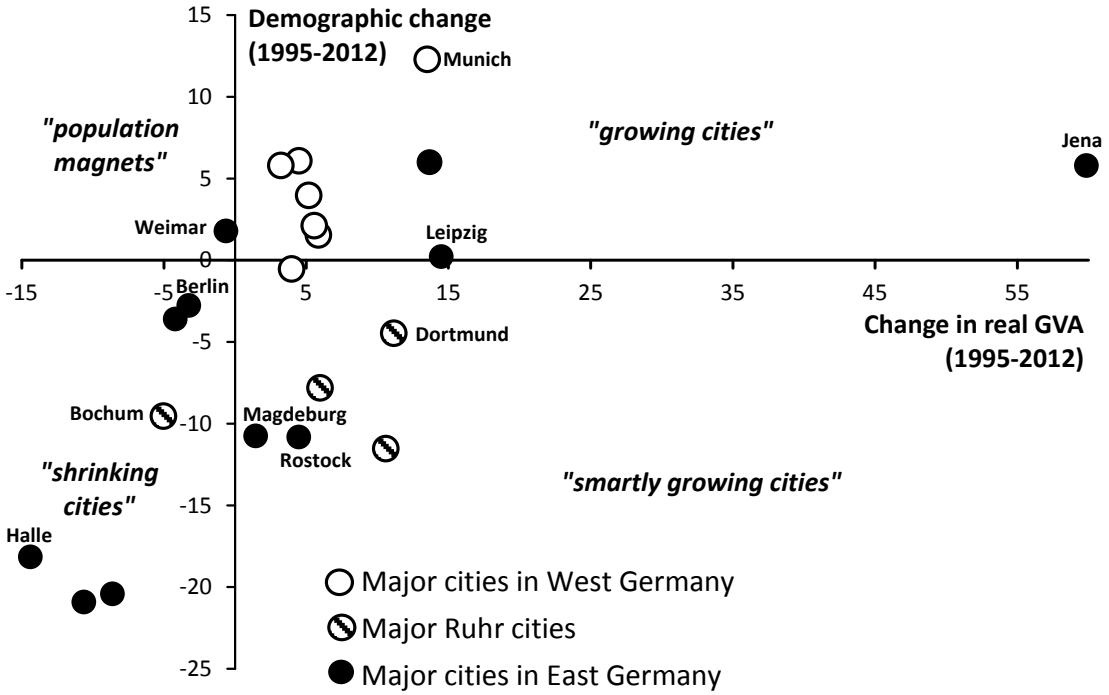
[3] A detailed description of this organization is given by Frey (1997). Further application examples can be found in Friedrich and Bartholomae (2008).

guaranteed. Furthermore, adaptation to the changing requirements of demographic change as well as the divergent population development shown in figure 2 is only possible to a limited extent.

b. Shrinking Cities in Germany: Extent and Political Strategies

Demographic change does not only affect rural areas and districts, but also large cities (which have always been agglomeration areas of economic activity). While on a global scale an increasing urbanization can be observed, at the same time one in six cities—in Europe even one in three—is facing a population loss (Turok and Mykhnenko, 2008; Hollander *et al.*, 2009).[4] In addition to the purely demographic aspects mentioned at the beginning of section II, such as the aging of the population, low fertility rates or low immigration, other developments such as suburbanization, industrial transformation processes as well as wars and natural catastrophes are responsible for shrinking. As a consequence, the affected cities face an (expensive) under-utilization of their infrastructure and the loss of the competitiveness of local enterprises.

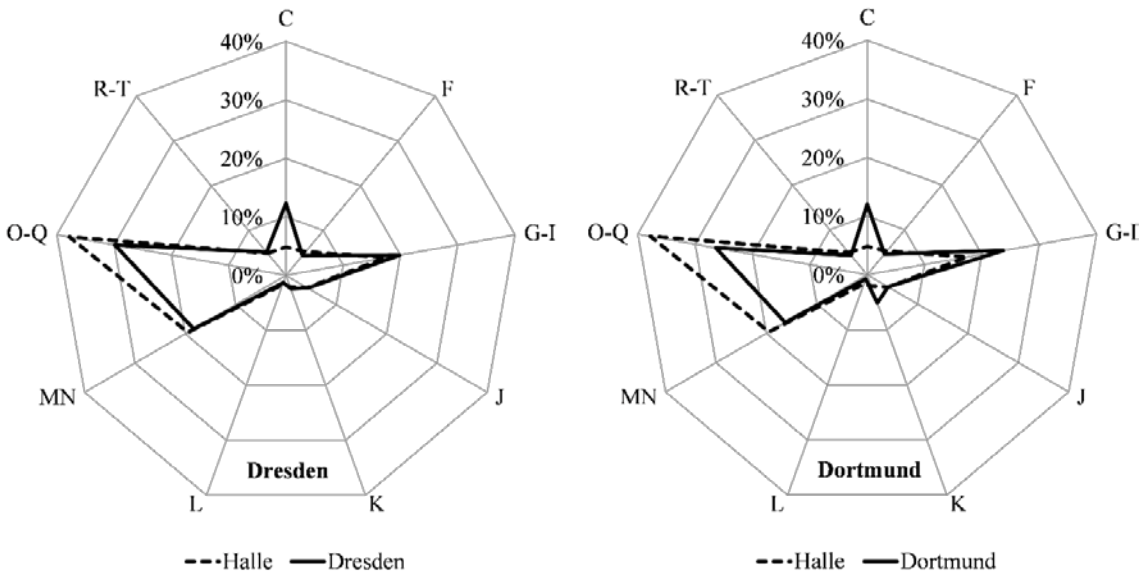
In scientific discussion, shrinking cities are mostly only characterized by population decline (cf. Rink *et al.*, 2012; Hospers, 2014). However, two important questions are neglected: Firstly, to what extent urban shrinkage is actually characterized by a decline in population and, secondly, whether there is a parallelism between economic and demographic development in the characterization of this phenomenon. Especially in (economic) policy, consideration of demographic decline as single criterion for shrinking is problematic as this may lead to implementation of non-targeted measures, if population decline does not capture decline in overall urban development. Starting from this consideration, Bartholomae and Nam (2014a) as well as Bartholomae *et al.* (2017) propose to include the economic potential of cities when describing urban shrinkage.



Source: Bartholomae et al. (2017) and own calculation

Figure 3. Classification of German Cities

[4] This section is a revised version of Bartholomae *et al.* (2016).



C—Manufacturing; F—construction; G-I—Trade, hotel and restaurant, transport; J—Information and communication; K—Bank and insurance; L—Real estate and housing; MN—Freelance, scientific and technic service; O-Q—Public administration, defense, social insurance, education; R-T—Arts, entertainment, recreation, personal services

Source: Federal Statistical Office, regional database and own calculation.

Figure 4. Comparison of employment structure in Halle and Dresden as well as Halle and Dortmund (2014)

Taking the example of the development of selected German cities of Ruhr, West and East Germany in the period from 1995 to 2012, it can be shown that this broader view is insightful for future urban policy. Figure 3 considers gross value added in addition to the change in the population size, and reveals that demographic and economic development do not necessarily have the same direction. All in all, the two dimensions allow for the cities to be divided into four categories: cities with positive economic and demographic development ("growing cities"); cities with positive economic but negative demographic development ("smartly growing cities"); cities with negative economic but positive demographic development ("population magnets"); and cities with negative economic and demographic development ("shrinking cities").

The classification of the cities clearly reveals differences in their urban development: Whereas most West German cities have grown both demographically and economically in the last few years, especially many Ruhr cities—which were affected by post-industrial transformation—as well as some East German cities—which were affected by post-socialist transformation—have lost population. Nevertheless, these cities managed to grow economically. For example, between 1995 and 2012, the population in Dortmund declined by almost 5%, but a substantial increase in productivity led to an increase in the gross value added of 11%. The situation is different in the case of many East German cities, which can be described as shrinking in terms of both dimensions. Halle is affected the most by urban shrinkage: In addition to a very serious population loss of 18%, its gross value added also decreased drastically by 14%—in comparison to similar Jena which grew demographically by around 6%, and economically even by almost 60%. A "population magnet" among the analyzed cities is Weimar, which despite the losses in its gross value added could record a population growth of 2%.

Contrary, many Ruhr cities and some East German cities such as Magdeburg, Rostock and Leipzig demonstrate that economic growth is also possible in the case of population decline—"smart growth." Thus, comparison of the cities should shed some light on differences and success factors, respectively, which favor positive development.

Table 1. Federal subsidies for urban reconstruction and improvement of city centers in Germany

Project title		**Total amount of subsidy 2009-2012**
Social City (*Soziale Stadt*)		268 million Euro
Urban Reconstruction as an Adaption to Demographic and Structural Change (*Stadtumbau für die Anpassung an den demographischen und strukturellen Wandel—Stadtumbau Ost / Stadtumbau West*)	East: West:	381 million Euro 328 million Euro
Preservation of Centrally Located Monuments in Eastern Germany (*Städtebaulicher Denkmalschutz für den Erhalt historischer Stadtkerne und Stadtquartiere in Ostdeutschland*)	East: West:	280 million Euro 119 million Euro
Active Inner-City Development (*Aktive Stadt- und Ortsteilzentren für die Innenentwicklung*)		312 million Euro
Urban Regeneration and Development Measures (*Städtebauliche Sanierungs- und Entwicklungsmaßnahmen*)	East: West:	113 million Euro 113 million Euro

Source: Bartholomae et al. (2017).

Whereas growing cities can increase their productivity and prosperity, shrinking cities suffer from massive structural problems. A closer look at the economic structure points to a failed transformation process in these cities, as, unlike the successful cities, they feature a very small sector of modern industries and services. In particular, the negative example of Halle illustrates this (cf. also Bartholomae and Nam, 2014b): Taking the number of employed workers in each sector as a proxy for the importance of the considered sector, comparison of Halle with the *smartly growing cities* in Ruhr and in East Germany, shows that Halle's share of employees in manufacturing is significantly lower. Figure 4 illustrates the comparison of the employment structure between Halle and *smartly growing* Ruhr city Dortmund as well as Halle and (economically and demographically) growing East German city Dresden, which managed to overcome transformation after German reunification in a much better way. Halle's high shares of employees in the less productive education, health and public sector is highly indicative of the fact that the transformation to modern services and industries has not been successful there.

With respect to (economic) policy measures that deal with urban shrinkage, two types of political strategies can be distinguished: an active "growth-oriented" policy and a passive "shrinkage-oriented" policy. Whereas an active policy aims at improving the conditions for economic growth by supporting clustering of certain industries in order to promote agglomeration advantages, for example, a passive policy is more likely to increase the quality of life of the remaining citizens without fighting economic shrinkage. So far in Germany, the passive shrinkage-oriented policy has been used predominantly (Hospers, 2014). The development of this policy is reflected in numerous projects promoted by the federal government, as table 1 shows. Furthermore, for example, the city renewal in Halle and Cottbus is also being promoted within the framework of the *Joint Task for Improving Regional Economic Structure*, which is financially supported by the EU Cohesion Fund.

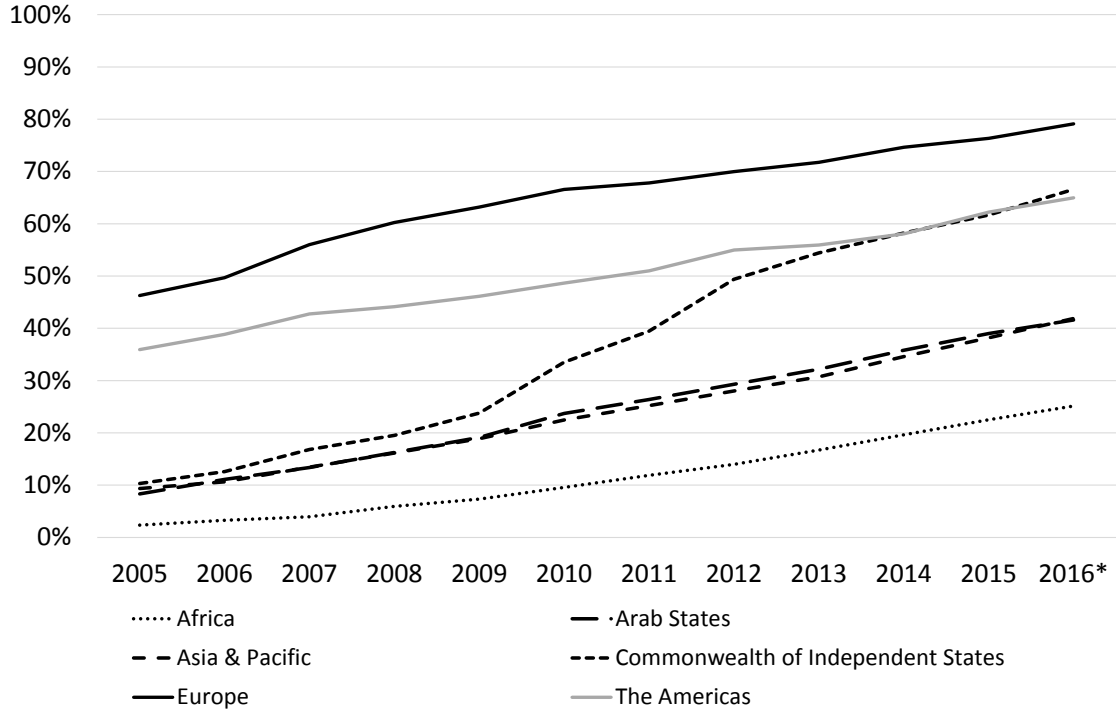
However, this passive handling of shrinkage leads to the problem that high investment in infrastructure, education and culture to increase the attractiveness of the inner city and the citizens' quality of life, respectively, can hardly solve the structural problems. Such programs neither promote local productivity and thus competitiveness of resident firms nor innovation activities. It is precisely this problem that can be observed very well in Halle, Schwerin or Cottbus. Thus, a growth-oriented industrial policy is urgently required to overcome structural difficulties. Improvements and other renovations in the inner city do not solve the problems.

Such a change of course can be implemented by building a healthy economic structure, which also includes, in particular, modern industries and services. Cluster formation should be fostered that support creation of local and regional innovation networks that promote the interaction between firms, business services and research institutes. Such an active structural policy against urban shrinkage is also compatible with EU cohesion policy, which aims at promoting the growth of less developed regions. In this way, sustainable economic growth can also be achieved in shrinking cities, which helps to absorb the consequences of an (imminent) demographic change in regions and cities that have so far been structurally weak. An improvement in the economic structure will ultimately benefit the inhabitants of the city, thus, also achieving the goals of passive policy, such as the improvement of the quality of life.

III. Technological Development

One of the most important innovations of the past few years that had a big impact on society and economy has been the comprehensive availability of the Internet. As figure 5 illustrates, most Internet users are still from developed regions of the world, nevertheless more and more people from less developed countries use the Internet as well. This will have a lasting impact on the economic development of these countries: Choi and Yi (2009) showed in an empiric comparison of several countries that the Internet positively influences the economic development of these countries by promoting knowledge spillovers between countries.

However, the Internet does not only indirectly contribute to economic growth, but also directly: In the member states of the European Union, the information and communication technology sector, which is closely linked to the Internet, comprises almost 5% of the gross domestic product. During the establishment of many technology companies, which focused on services around the Internet, at the end of the 20th century, the term “new market” was introduced, as this market



Source: ITU World Telecommunication / ICT Indicators database.

Figure 5. Development of the share of Internet users by region

seemed to be different from traditional, non-virtual markets. One particular feature of many services offered through the Internet is that they are subject to network effects, that is, users' willingness to pay is strongly correlated with the overall user base of the service. However, such effects are not new as many traditional sectors, such as energy supply, rail transport and telecommunications, also face such network effects.

a. Modern network markets and business models of the online game industry

Despite the overwhelming number of similarities between traditional and "new" markets, there are some characteristics that other industries do not feature and are challenging new entrants. Above all, the differences are linked to the virtuality of the goods or services, which are almost detached from physical objects—unlike other information goods like text that is more or less physical bound to a medium such as paper. To demonstrate these problems, the example of the online game industry is considered, and, in particular, the genre of *Massive Multiplayer Online Role Playing Games* (MMORPG).

The online game industry indicates steadily growing sales and has grown into an economically relevant sector. In particular, this development was promoted by the expansion of broadband Internet access and the spread of Internet flat rates. Both allow Internet users to be permanently connected to the Internet at low costs and to use the services offered by this industry. In particular MMORPG, which feature a potentially infinite playtime, are dependent on a permanent Internet access of their users.

An important game element of MMORPG is the acquisition and collection of virtual objects, which serve both the achievement of game progress and the individualization of the player's experience. In the MMORPG's virtual world, the player earns these items through a game figure, the so-called "avatar" which is controlled by him. In this context, Bartholomae and Koch (2009) analyzed in an interdisciplinary study how the (intellectual) property rights of the virtual objects on the one hand and the avatar on the other hand are assigned on the players and the provider of the MMORPG. The analysis considers both the legal view on intellectual property rights and economic efficiency of the allocation.

According to the MMORPG provider, the legal assignment of property rights appears to be clear. Before playing, players have to confirm the terms of use which prohibit the trade of avatars and virtual items between the players for real money. In contrast, there is still an active trade and there are even commercial firms that offer this service. A legal analysis with respect to German law shows that, at least in the case of avatars, individualization results in a creative performance of the player. This creates an imaginary as well as economic value against the online game which finally leads to intangible rights of the player. This is against the fact that the provider of the game has a primary interest in the selection and control of the players and content. It is beyond dispute, however, that the players do not acquire property rights to the virtual objects, since these are merely constructs of the provider and cannot be changed by the player in general.

The economically relevant aspect of property rights is that they determine whether and to what extent they can be traded with them. In principle, virtual objects—virtual goods as well as the avatar—have to be equated with real goods due to similar characteristics. This implies that the possibility of a free (real money) trade and/or exchange with these items can increase the utility of the players—and thus their willingness to pay as well. However, the problem is that the users are represented in the game only by their avatar. Since participants are thus anonymous, a change of an avatar between players is not visible to other users. This may lead to game manipulative and/or fraudulent activities, thereby reducing the utility of other players. Therefore, an economic as well as legally reasonable design of the trade must always take this trade-off into account.

Table 2. Proposal of a tariff classification for MMORPG

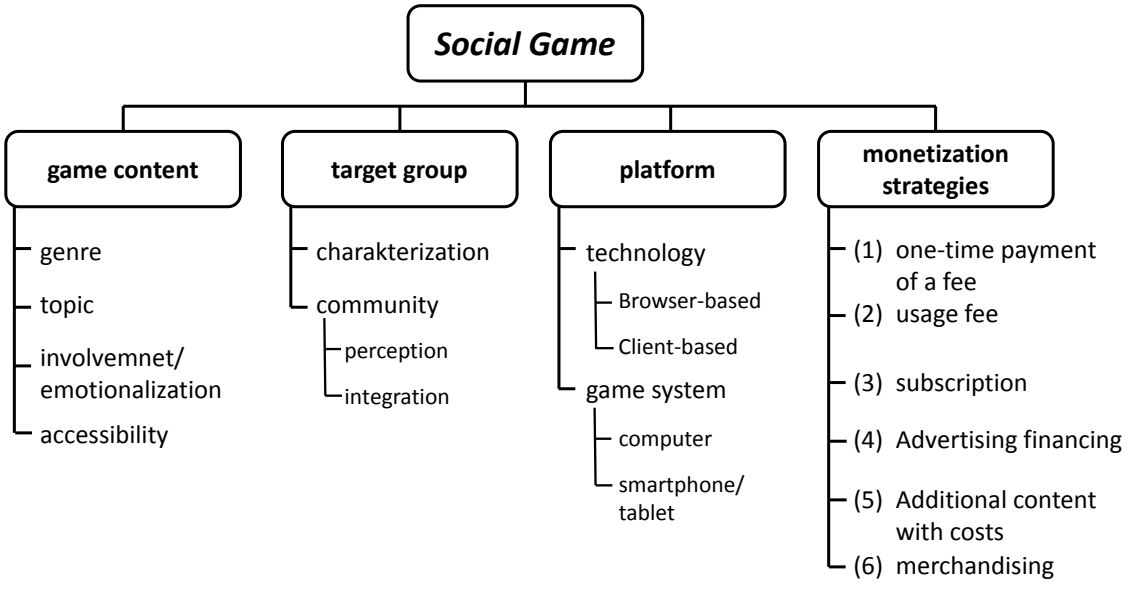
Tariff	Property rights of the player	Game fees
Type A	Little property rights	Low price
Type B	Medium property rights, trade only with provider	Low/medium price
Type C	Full property rights	High price

Source: Own representation based on Bartholomae and Koch (2009).

In order to ensure an efficient contract design of the property rights for all participants in accordance with their respective preferences and interests, Bartholomae and Koch (2009) propose a tripartite tariff arrangement. This would lead to a self-selection of the players taking into account their preferred property position concerning virtual objects. In addition, this arrangement would ensure that all users are aware of the correspondent specificity (table 2). Such a design can ensure that on the one hand the property rights and thus the income claims of the players are adequately taken into account. On the other hand users with similar interests can interact with each other and thus can experience the optimal playing atmosphere for them.

Compared to MMORPG so-called social games show even higher growth rates with respect to both number of users and providers. In the narrow sense a social game is an online game in social networks like Facebook. In a broader sense, social games comprise all games on all platforms that require social interactions with other players, but are characterized by more simple game mechanics compared to other *Massive Multiplayer Online Games* (such as MMORPG). This allows a wide range of players to have quick access to the game experience. Figure 6 illustrates the different dimensions that characterize social games.

Compared to traditional goods or services, most social games have two special features. On the one hand, they depend on existing social networks of third-party providers for distribution and on the other hand they use a price system, which allows a free use of their basic services. The idea behind this price system is that users are encouraged to perform micro transactions which allow them to acquire additional game content at minimum stake (strategies (4) and (5) in figure 6). Both features are linked: Since only a small per-



Source: Bartholomae (2014).

Figure 6. Characterization dimensions of a social game

centage of users acquire additional goods, it is essential for providers to have as large a network as possible, like the one offered by Facebook. Alternatively, providers can build a network themselves, similar to some MMORPG that follow a classic subscription pricing model (strategy (3)), but this comes at considerable costs which can be difficult to cover. At least when applying their typical strategies with respect to target group and pricing model. These costs do not incur when selling via social networks, but game providers are dependent on the network provider and a classic hold-up problem arises (cf. Bartholomae, 2012; Morasch and Bartholomae, 2014).

Bartholomae (2012) shows that the network selection in the market entry decision of an online game provider depends not only on considerations about potential dependencies and costs, but also on which target group is addressed and how experienced the market newcomer already is. Serious players with a generally higher willingness to pay, but also higher demands on the quality of the game, can only be attracted if an own network is established. The mass of the players consists mostly of casual gamers or users that are inexperienced with computer games. These players have a low level of willingness to pay and also a low loyalty to the game and are more likely to be attracted on social networks which they already know. Entrants, who are (still) in the experimental phase, should also choose the more cost-effective utilization of social networks in order to push the development of their own (cost-intensive) network in the long term.

b. Cloud Computing and Cybercrime

Although they report a high level of revenue growth, the described online games represent only a small part of the services offered via the Internet. A large part of the services, which are also highly relevant for businesses, is cloud computing.[5] Basically every Internet user uses cloud computing—like e-mail services, online data storage or other online applications (image processing, Windows Terminal Service, etc.). In order to use the services, more or less confidential data are needed for the purpose of efficient use and billing of the services. Whereas consumers are aware of some data which are transmitted, also a lot of information beyond their knowledge is generated.

To a large extend, the success of cloud computing is due to the advantages for both individuals and firms, which can be attributed in particular to network effects: Direct network effects, such as the fast and simple, worldwide possible data exchange between shared participants, and indirect network effects, such as the exchange of experience between users of the same service. All of these factors result in a cost-saving benefit for both private users and businesses, both in monetary (for example, the elimination of acquisition and upgrade costs) and non-monetary terms (reduction of transaction costs, such as coordination and search costs) (Boss *et al.*, 2007; Armbrust *et al.*, 2010; Nazir, 2012; Henneberger, 2016).

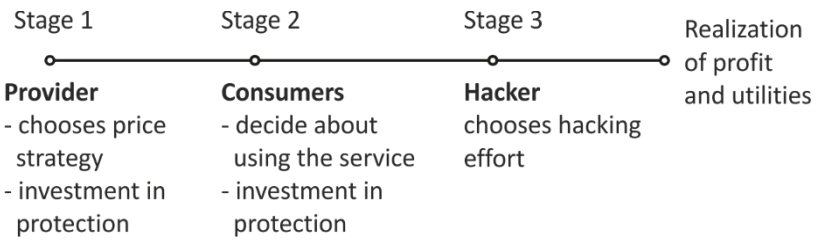
Table 3. Share of firms buy cloud computing services used over the internet

Country	2014	2016	Change
France	12	17	+42%
Germany	11	16	+45%
Ireland	28	36	+29%
Macedonia	12	7	−42%
Norway	29	40	+38%
UK	24	35	+46%
EU-28	19	21	+11%

Source: Eurostat and own calculation.

Table 3 shows the share of firms that buy cloud computing services used over the Internet for selected EU states. The development from 2014 to 2016 identifies significant growth, which points to an increasing importance of this sector. This positive development is against the fact that, as German insurer Allianz (2017) points out in several assessments of business risks, cybercrime is becoming increasingly dangerous for firms: A transfer of data to outside companies (cloud computing provider) endangers data security, since the safety precautions of the outside company

[5] This section is a revised version of Bartholomae (2017b).



Source: Own representation based on Bartholomae (2017a).

Figure 7. Structure of the game, players and strategies in Bartholomae (2017a)

against unauthorized third parties are difficult to monitor (Abadi, 2009; Bisong and Rahman, 2011; Hashizume *et al.*, 2013). In the best case, this can lead to the use of the data in order to obtain information about preferences that are used for targeted marketing measures. However, in the worst case, data are transferred to the hands of unauthorized persons (competitors, economic spies, criminals, etc.).

In order to understand the effects of hacking, that is, (illegal) intrusion into computer systems by unauthorized third parties, on networks, it is important to clarify the aims and motives of hackers. Everyone can become a victim of hacking: Besides firms, also private individuals, institutions and state agencies are affected (cf. Adams, 2001; Katyal, 2001).[6]

With respect to the motivation, Leeson and Coyne (2005) distinguish three types of hackers: the "good hacker", who pursues noble aims like making the world a better place, the "bad hacker", who seeks for notoriety and fame and the "greedy hacker", who wants to earn income from his activities. Often, there is also a distinction between the "white hat", who operates within the limits of legality, the "black hat", who is mainly concerned with illegal activities, and the "gray hat", who is to be settled in between. In principle, however, two main motivations can be identified: Whereas the predominantly "legal" part of the hackers pursues the goal of gaining fame and recognition, thereby indirectly improving their abilities and/or professional perspectives, the other part operates outside the legal economy and strives for immediate economic advantage. This is achieved, for example, by direct (mis)use of the stolen data (misuse of credit card information, sale of valuable business secrets to competitors), or, especially in the case of sensitive data, by extortion of the victim. Alternatively, the hacker can also work on behalf of a third party against payment.

In a game theoretic analysis of a modified network model, Bartholomae (2017a) analyzes the economic impact of hacking on providers of cloud computing, consumers, and welfare. Figure 7 shows the structure of the game in detail. As with any economic activity, a (rational) hacker will only attempt to intrude into the cloud as long as his (expected) advantage exceeds his (expected) costs. The expected costs are independent of the motivation and include the effort of hacking, which depends on the safety precautions of both the cloud computing provider and the users, as well as the (monetary) scope and psychological impact of a possible punishment. In contrast, the expected advantage depends on the hacker's intention and may include a psychological benefit, for example in the form of recognition in the community, and/or a monetary gain from the (mis)use of the data. This monetary gain depends on the size of the network to which the hacker has forced access into: The larger the size of the network, the higher the probability of obtaining valuable data and the higher the probability of successful hacking. This probability increases in the number of users as not all customers handle their access data carefully, which potentially increases security gaps. Thus, in case of hacking a

[6] In the case of attacks on the latter two, there is the possibility that this is so-called cyberterrorism, which threatens less to economic activity, but to society as a whole. In the following, only hacking, which is motivated by the private sector, is considered.

negative network arises, as more users increase the probability of a successful hacking attempt.

This negative network effect results in considerable economic consequences. First and foremost, network users will reduce their willingness to pay, as they will have to take into account any potential damage in their decision. At the same time, fewer consumers are willing to use the service, which leads to a reduction in the network size. These effects do not occur if the network is too small for the hacker *ex ante*. This is the case when the hacker's costs of hacking exceed the potential benefit and, thus, he refrains from the criminal activity—especially if the hacker can track more worthwhile targets. If the network is large and attractive, the hacker will make a hacking attack.[7] As a result of worrying about their data, some consumers will no longer use the network service because the expected costs of a hacking attack outweigh the advantage of the network. The network provider is also affected by this: Since his consumers are less willing to pay, he has to lower the price while having less customers at the same time.

However, the cloud computing provider can counteract this problem. An option is to limit the network to a size that is unattractive for the hacker, so that the hacker no longer has a net gain shows from hacking. Although consumers' willingness to pay increases, in most cases this strategy will result in a considerable loss of profits for the provider and a loss in utility for the consumers. Thus, limitation is not a real option. A better strategy is to take concrete safety precautions. In this case, however, it is necessary to clarify which market side should implement these measures or who has to bear the costs. Safety precautions by consumers have two effects: On the one hand, the expected costs of hacking are reduced as the probability of a successful hacking attack is reduced and/or access to the data for the hacker is hardly possible, which further increase the willingness to pay. On the other hand, however, the willingness to pay is reduced since consumers have to bear the costs of the measures, whether it is monetary costs for better protection software (virus scanner, firewall) or higher transaction costs (management of passwords, appropriation of additional technical knowledge).

The provider will only invest in security measures if consumers protect themselves—the best technical protection mechanism is ineffective when users record their passwords in easily accessible places. But even if a technically perfect protection against hacking would exist, the provider would not choose this, since the additional costs do not justify this and, thus, would only reduce profit. Consumers also have additional costs for their protection, which is why only a part of the users will finally protect themselves. The share of unprotected users is the lower, the higher the risk of a hacking attack. Contrary, there is a substitutive relationship with the provider's protective measures, which means that the better the protection offered by the provider, the fewer users themselves will be protected. But even if everyone does not choose the best possible protection, there is the possibility that hacking will not take place: This is the case when the number of hackable targets for the hacker is reduced so much that the hacker no longer has any incentive to intrude into the cloud.

Alternatively or in addition to the private precautions, the government can intervene, for example by increasing the penalty or by improving prosecution. However, a fundamental problem is the detection probability of hacking, which is relatively low for two reasons: On the one hand, the investigating authorities are often not in a position to find offenders (Kshetri, 2006) or cannot get hold of the offenders acting abroad. On the other hand, the crime is often not reported: For example, Germany's digital association Bitkom indicates that about 75% of the affected companies do not turn to state authorities, mainly because they fear of damage to their image (36%) (Kopke *et al.*, 2016). But even if law enforcement is im-

[7] The same was observed in the early days between the competing systems *Windows* and *iOs*—since the number of *iOS* users was much lower than that of the *Windows* users, computer viruses were practically unknown for this system.

proved, costs incur, which must be borne by society as a whole. Thus, it is necessary to consider whether the overall economic advantage—utility of the consumers and profit of the network providers—is sufficiently high to justify these measures.

IV. Conclusion

This article selected and analyzed particular aspects from current social and technological developments.

At the social level, the demographic change was addressed, in particular its effects on regional disparities. It has been shown how regions, and particularly, cities as centers of economic activity, are affected and how they deal with this change. Although not all regions in Germany are currently affected by population decline, this is only temporary in the face of overall demographic development. This means that the regions and cities already affected are responsible for testing measures from which future decision-makers can learn and finally have to develop sustainable concepts.

The challenges and opportunities for technology companies in modern network markets were analyzed as an important technological development. In addition to the entertainment industry, service providers who explicitly make use of the advantages and possibilities of the current technical infrastructure—especially the providers of cloud computing services—benefit from enormous possibilities. However, new dangers and risks arise which endanger welfare gains for the stakeholders involved. In addition to dependency positions, the (illegal) misuse of data by third parties must also be mentioned here. Although the danger can be reduced, this is always at the expense of welfare, so that an optimal solution cannot be achieved. Since it is not only a national problem, an international solution must be found to counter the dangers effectively.

Finally, both challenges show that only a cooperation between all the actors involved can lead to a solution: Regions must jointly develop strategies to deal with demographic change and should not compete against each other. Countries must develop common solutions and implement measures to effectively counteract the threats to technological progress for national as well as international economic activity.

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