INDUSTRIAL POLICY: STRUCTURAL CHANGE AS AN OPPORTUNITY

This is a translated version of the original German-language chapter "Industriepolitik: Strukturwandel als Chance", which is the sole authoritative text. Please cite the original German-language chapter if any reference is made to this text.

KEY MESSAGES

- Industrial policy should focus primarily on innovation. It should be designed in a non-discriminatory manner based on transparent criteria and evaluated at regular intervals.
- In order to benefit from structural change, Germany and Europe should strive for further integration of the single market, a deeper capital markets union and a rules-based framework for global trade.
- Improving digital infrastructure and human capital is a key prerequisite for creating conditions under which innovation policies can be effective, not least at the regional level.

SUMMARY

In Germany, the new challenges posed by the strategic industrial policies pursued by other countries and the rapid pace of digitisation have fuelled intense debate on what constitutes the **right industrial policy strategy**. Discussions have addressed, for example, the question of providing support to specific sectors and technologies or even individual companies.

However, German and European industrial policy should primarily be based on a **horizontal approach**. This means creating good conditions for entrepreneurial activity and dynamic structural change as well as remedying **market failures** in a manner that does not favour any particular sector and technology. Such an approach includes clear advocacy of an open, rules-based international trading system. Fears regarding China, for example, should not lead to restrictions on the free movement of capital or to competition policy favouring European “champions”.

In the event of market failure in specific sectors, **vertical intervention** in the economic structure, tailored to individual sectors or technologies, could be justified. To prevent this support from being appropriated by interest groups, the State must comply with **strict criteria**: The extent of the market failure must be laid out compellingly; resources must be allocated in a competitive fashion and disbursed only for a limited time, and the use of funding must be critically evaluated. A **mission-oriented industrial policy** can usefully link elements of horizontal and vertical industrial policy by pursuing major, socially relevant objectives across sectors. An example of this would be to aim for **greenhouse gas neutrality** in Europe by the year 2050 and to apply a uniform cross-sectoral **carbon price as a key instrument in achieving this goal**.

As **structural change** towards **knowledge-based value creation** comes into force, network effects and intangible production factors will become increasingly important. To facilitate the development of European platform providers, efforts must be made to deepen the digital single market. The lack of **entrepreneurial activity** could obstruct structural change in Germany and therefore a deepening of the European capital markets union, a financing-neutral tax system and greater incentives for private investment are needed.

In Germany, **research and development** expenditure is high, relative to other developed economies. However, private research spending is concentrated in a few sectors and larger companies. In addition to alleviating the skills shortage, the extensive state system of **research funding** and **knowledge transfer** must be expanded through innovation clusters and supplemented by increased European cooperation.

Since regions are affected differently by the challenges posed by structural change, a regionally differentiated industrial policy should be applied: **Regional policy** should improve the digital infrastructure and the local level of education in order to strengthen research and innovation activities with a regional focus.

I. NEW CHALLENGES

245. The global **advance of structural change** from an industrialised to a knowledge-based economic structure poses major challenges for developed economies. The global division of labour is undergoing a restructuring, with the emerging economies playing a greater role than ever before. While China has so far failed to provide a **level playing field** for foreign companies established economies seem to find it harder to counter intensified competition with their own strength in view of their own declining productivity growth.

246. Higher productivity growth in Germany would, not least, require **more intensive structural change**. However, the change required for an economy can worsen conditions for specific groups compared to the status quo. The very thought of potential losses can give rise to social and political resistance, thus making structural change more difficult. The question therefore arises as to how structural change can be accompanied by economic policy and which instruments should be used.

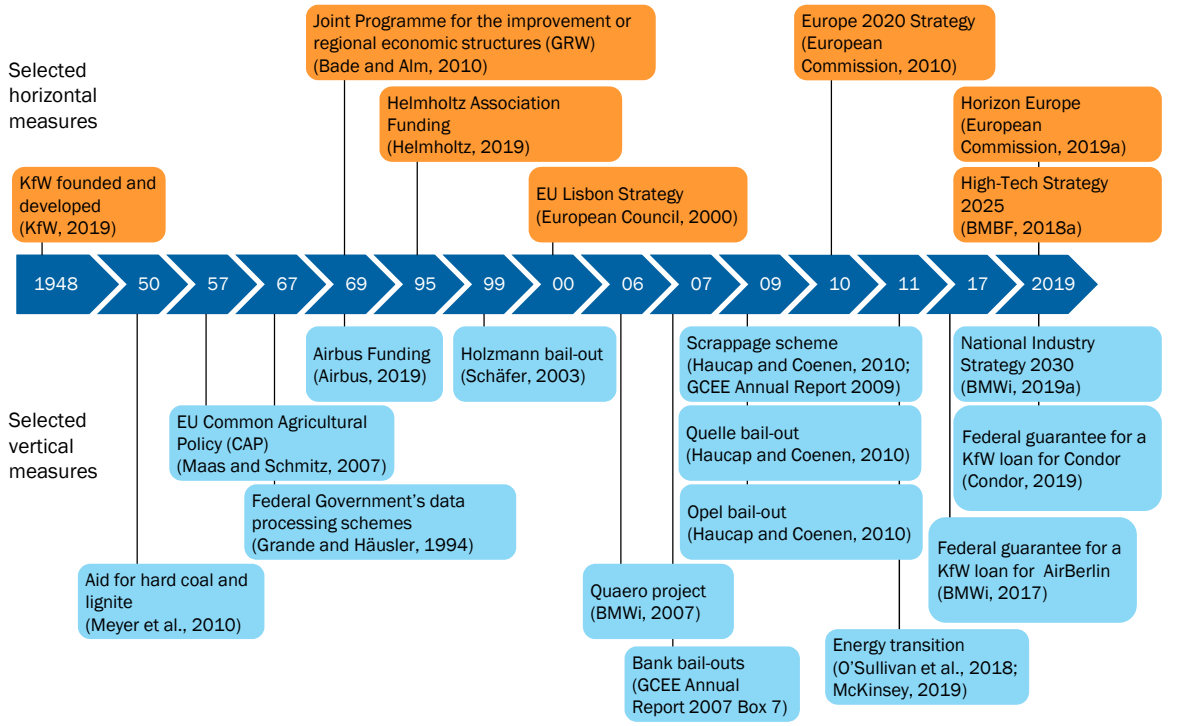
247. Against this background, calls for industrial policy intervention are increasing. Germany, thanks to its strong industrial base and focus on exports, has been able to benefit considerably from China's partial opening of markets and the eastward enlargement of the EU. Intensive discussions recently took place here on the draft publication by the Federal Ministry of Economic Affairs and Energy (BMWi, 2019a) for a **National Industrial Strategy 2030**. This strategy focuses on the need for Germany to establish its own industrial strategy. Three reasons are provided for this need: the interventionist industrial policy pursued by other countries, a possible backlog in important economic sectors and the rapidly advancing digitisation.

248. Public debate on **industrial policy** also suffers from confusion in relation to terminology. It is often not clear which policy measures should be subsumed under the term "industrial policy". Industrial policy refers to the design of framework conditions and policies that influence the extent of certain economic activities and that facilitate structural change associated with economic growth or are intended to influence the economic structure (Rodrik, 2004; Stiglitz et al., 2013). The term applies to the manufacturing and the service sector. A distinction should be made here between **horizontal** industrial policy, which is sector-independent, and **vertical** industrial policy, which is sector-specific (Riess and Välilä, 2006). ↘ ITEMS 253 FF. AND 267 FF.

249. Industrial policy is by no means a new phenomenon. In the past, both the European Union (EU) and Germany have used various horizontal and vertical industrial policy instruments. ↘ CHART 43 Based on this experience and the literature published on the subject, it is possible to derive **criteria** that can lead to **successful industrial policy** and resist political capture by special interest groups. ↘ ITEMS 250 FF. The advancing digitisation comes with new challenges that call for new answers. In addition, due to changing global market conditions, solutions must also found to well-known, recurring threats such as increasing pro-

↘ CHART 43

Selected industrial policy measures



Sources: Sources provided

tectionism. The development of industrial policy must therefore consider numerous new action areas. ↘ ITEMS 279 FF.

The ongoing structural shift from an industrialised economy to a knowledge-based economy challenges regions in different ways. A regional industrial policy should reflect this heterogeneity by **promoting innovation with a regional focus**. ↘ ITEMS 332 FF.

II. INDUSTRIAL POLICY INSTRUMENTS

1. Strengthening the economic discovery process

250. Economic prosperity is the result of constant structural change, which in turn is the result of a **continuous discovery process** that is driven by the development of new technologies and markets as well as the invention of new products (Cimoli et al., 2008; Greenwald and Stiglitz, 2013; Stiglitz et al., 2013). This process of discovery is largely accompanied by **external effects**. Knowledge that is acquired benefits not only those who have made efforts to obtain it (Hausmann and Rodrik, 2003; Rodrik, 2008).

Given this gap between private and social returns, there may be insufficient investment in identifying new options without government intervention. At the

same time, the process of discovery can only occur if the market participants operate under the **right framework conditions**. Government decision-makers and their decisions on industrial policy are vital in creating a successful innovation ecosystem.

251. Whether or not industrial policy should be pursued is therefore not the question. What matters is how such policy is shaped (Rodrik, 2010). There is a risk, however, of industrial policy being abused by interest groups or hijacked by market participants to **preserve the status quo** (Baldwin and Robert-Nicoud, 2007). Three principles can be derived from lessons learned to date in order to avoid undesirable developments in shaping industrial policy from the outset.

First, the policy should follow a general **principle of non-discrimination**. The benefits of industrial policy must be accessible to all market participants. If resources are limited, a competitive process must be used to decide which projects will be supported. Second, **transparent criteria** that are measurable and targeted should be used for prioritisation and funding. Third, industrial policy measures should be subject to **continuous evaluation**, in order to identify successful measures.

252. However, in any **discovery process**, it is natural and inevitable that some of the supported activities that appear worthwhile based on initial forecasts may not ultimately prove worth the investment. That said, supporting these activities may still be useful: identifying a lack of profitability is also valuable information. Innovative activities and the exploration of new markets notably frauhgt with **considerable uncertainty**, which necessarily includes the risk of failure. Successful industrial policy must be aware of this possibility of failure and, if necessary, be able to muster the political courage required to terminate unsuccessful projects.

2. Horizontal industrial policy – sector-independent support of entrepreneurial activity

253. Entrepreneurial activities that drive the process of economic growth and discovery, such as research and development (R&D), start-ups or market development, take place across a wide range of economic sectors. The **horizontal industrial policy** approach therefore seeks to support these activities, which are conducted inefficiently due to various types of market failure, **independently of any particular sector**. This reduces the risk of industrial policy either discriminating against or favouring individual market participants.

On the one hand, a horizontal approach draws on the assumption that sector-independent support is far more resistant to political influence by individual interest groups than sector-specific support. It therefore avoids small-scale interventions that favour individual interest groups. On the other hand, policymakers are typically less adept than decentralised market participants at identifying strategically important future markets and technologies. When it comes to sec-

toral and technological measures, horizontal industrial policy relies on **decentralised knowledge** and the **individual actions** of various economic agents.

Horizontal industrial policy through framework conditions

254. The creation of framework conditions is a vital component of horizontal industrial policy. The foundation of the entrepreneurial discovery process of a dynamic economy are **reliable legal regulations,** an efficient administration and functioning markets. Reliable legal frameworks ensure that those agents receive the returns from entrepreneurial risk who bear this risk through their investments.

Effective public administration ensures that the agents can comply with the legal framework without undue effort. A national economy also fundamentally requires an efficient **digital and physical infrastructure**, which can be provided by private or public providers. This type of infrastructure is necessary to fully exploit the potential of Industry 4.0 and solutions based on artificial intelligence or machine learning.

255. At the heart of the market-based discovery process is a **functioning, dynamic competition**. Start-up companies will only introduce their new ideas to the market if they see an opportunity to compete with existing market players. Restrictive or **anti-competitive behaviour** that prevents the entry of new competitors must therefore be avoided or sanctioned. However, competition policy should not be too restrictive: the prospect of reasonable profit creates incentives for market entry and innovation (Aghion et al., 2005). The German and European competition policy approach, which considers business mergers in the context of consumer welfare while weighing positive synergy effects against the negative effects of increasing market power, takes these considerations into account.

256. However, simply ensuring a functioning competitive environment is not enough to provide adequate incentives for innovation. A functioning **patent system** and the protection of intellectual property are important for these incentives. Patents ensure that those who bear the **entrepreneurial risk** of innovation can obtain temporary monopoly rents. This creates greater incentives for investment in R&D. However, many discoveries are not patentable, even though they promote growth. The patent system is therefore subject to natural limitations.

257. Likewise, a **competitive tax system** can help support start-ups and innovations domestically (Akcigit et al., 2018; Curtis and Decker, 2018). Entrepreneurial activities only take place domestically if the legal, infrastructural and fiscal framework conditions of an economy are jointly internationally competitive. A high **tax burden** on entrepreneurial activity can be compensated for by good framework conditions in other areas. **Distortions** that are triggered, for example, through discrimination in equity financing should be eliminated in a targeted manner (GCEE Annual Report 2012 items 385 ff.).

258. In **labour markets**, horizontal industrial policy can take the form of immigration laws, public employment agencies or the tax-transfer system. While the wel-

fare state cushions individual losses caused by structural change through its insurance function, a sufficient labour supply can be ensured by adequate regulation. ↘ ITEMS 648 FF. In addition, measures aimed specifically at promoting immigration of skilled workers can strengthen an economy's innovative capacity. ↘ ITEM 295 Finally, the entire education system, including the further education of employable persons, contains an industrial policy component.

Market failures and state intervention

259. Framework conditions are not always sufficient to ensure efficient allocation within markets. **Market failures** can occur for various reasons, despite good framework conditions. Horizontal industrial policy can correct such undesirable developments and foster the discovery process.

260. Because of its **positive externalities**, R&D is especially important for horizontal industrial policy. Private expenditure on research and development not only has a positive effect on individual companies and their competitiveness. It also benefits the entire economy. Lucking et al. (2018) identify a marginal return for R&D spending of an individual company in the United States of approximately 15 %. According to the authors, the social marginal return is around four times higher. Accordingly, most of the research does not actually benefit the companies themselves. From a social perspective therefore, investment in R&D is too low.

261. The State should not support research that is close to the market due to a lack of information: the risk of violating the principle of non-discrimination is too high in this case. To maximize social benefit from R&D while meeting the criteria for successful innovation policy, the **diffusion of innovation** should remain possible, even while preserving intellectual property (Comin and Hobijn, 2010; Akcigit and Ates, 2019). **Cross-sectional technologies** are of particular importance in this context since they provide a basis for further innovations. In many cases, these technologies have no immediate added value for individual companies at the outset because they are not directly applicable on any market. They would not materialise without state support.

262. **Broadly based research funding** in the fields of basic and applied research can help overcome this dilemma. The state has a coordinating function in this area. With the help of its universities and research institutes, the state enhances the **transfer of knowledge** from research to industry, by means of innovation clusters, for example. ↘ ITEMS 345 FF. Funding selections can be carried out using competitive selection processes, research awards or public tenders. In addition, universities make a major contribution by training highly qualified employees who can advance innovation processes within companies.

263. Externalities affect not only the national level. In knowledge-based value creation, positive local externalities can already be used in **agglomeration areas** (Glaeser, 2011; Moretti, 2012). ↘ ITEM 335 These externalities are the result of regional specialisation that can imply a more efficient use of existing resources. Workers can switch from one employer to another within the region, thereby

promoting the transfer of knowledge. The suppliers of upstream products can achieve economies of scale, while public infrastructure can be tailored to the specific needs of businesses.

The government can play an important coordinating role in this context in providing the digital and physical infrastructure. Efficient infrastructure can **strengthen the externalities of agglomeration** and reduce the costs associated with the spatial concentration of economic activity, such as congestion and air pollution. In addition, the spatial separation of production and consumption which takes advantage of lower physical transport costs encourages greater spatial concentration. While this increases efficiency, it also leads to greater regional inequality, which the government can counteract with **regional policy measures**. ↘ ITEMS 334 FF.

264. **Start-ups** and **young companies** are essential to the entrepreneurial discovery process (Decker et al., 2014). They can come along with new product ideas and innovations. At the same time, very high uncertainty is usually attached to their profitability and growth potential. Funding is therefore a particular challenge for these companies. In cases where the market structurally fails to provide adequate equity for start-ups, it could make sense for the government to increase its supply. ↘ ITEMS 284 FF.

265. **Path dependencies** represent one important factor that runs counter to the discovery process and structural change. They result from a complementarity between established capital and the skills employees specifically acquire for this purpose. Concerns about past investments losing their value, along with existing knowledge and skills, as well as uncertainty about worthwhile investments, can result in technology changes not being implemented at all or only too late. If such path dependencies lead to business failure, this is part of the process of creative destruction. State intervention should not stop this process. ↘ ITEM 271 However, the government can **facilitate the transformation** for workers through training programmes and cushion losses of income through the social security system.

266. Industrial policy plays a **coordinating and cross-cutting role** in two respects (Rodrik, 2004): First, it should aim to ensure that decisions taken in other policy areas, such as taxation or labour market policies, consider the impact on incentives for the economic discovery process. Second, it plays an important role in coordinating the free-market transformation process, since many worthwhile projects can only be completed through the coordinated decisions of different stakeholders.

3. Vertical industrial policy – targeted support of sectors and companies

267. In contrast to horizontal industrial policy, **vertical industrial policy** aims to promote specific sectors and companies. However, this focus is associated with numerous problems. Compared to decentralised market participants, the State

often lacks crucial knowledge about the market. Vertical industrial policy is therefore vulnerable to political capture by individual interest groups. Privileges for individual companies are often gained at the expense of their competitors, taxpayers or consumers. This discriminatory treatment can have a protectionist effect, inhibit innovation incentives and thereby jeopardise the functioning of markets.

268. Vertical intervention in the economic structure can be justified if a **sector-specific market failure** occurs that cannot be addressed or only partially addressed by horizontal measures. The challenge in this case is to assess the size of the market failure with sufficient certainty. Often, political preferences must determine the scope of support. For example, the agricultural sector may receive funding in order to meet demands for security of supply, or funding may be assigned to the military sphere in the interests of defence.

In the military sector, positive externalities can be expected to influence other innovators (Mazzucato, 2014). The **boundary** between **vertical and horizontal industrial policy** in this case is sometimes blurred. Support for military research may well produce universally applicable innovations. The Internet and GPS systems are examples of such applications. In this context, the effect of this support can then be classified as cross-sectoral rather than sector-specific.

269. State support for certain industries through subsidies or protectionist measures can be justified in the case of **high barriers to entry**, such as high fixed costs. Private investors would not opt to enter such markets, which include, for example, IT services, although domestic players could have a comparative advantage in this area. Especially for developing countries, this policy was expected to come along with a **learning curve effect** (Melitz, 2005). According to this theory, specific industries must be given time to be able to compete in world markets. In Europe, Airbus is an example of such an intervention. ↘ BOX 7

Apart from learning effects, government subsidies can be justified, for example, in oligopolistic markets. Subsidies that lower the production costs of local companies can help them achieve a higher world market share. Since in oligopolistic markets such as the passenger aircraft market, producer surpluses may be greater than subsidy costs, this type of **strategic industrial policy** can enhance national welfare (Brander and Spencer, 1985).

↘ BOX 7

Airbus: An example of successful industrial policy?

Airbus was founded with an eye to the strategic and **military considerations** of Europe having its own aviation industry and also the question of whether **autonomy in civil aviation** was necessary. On the one hand, the aviation industry was identified as an industry of the future. On the other hand, there were concerns about a technological gap in relation to the United States in this area (Hepperle, 2000). In addition, the aviation market had long been dominated by McDonnell-Douglas and (most notably) by Boeing. Nowadays, the Internet and telecommunications sectors are similarly structured and dominated by a small number of superstar companies such as Amazon, Facebook, Alibaba and Alphabet. There is a lack of domestic, independent platforms in Germany and Europe and those that do exist are

too small to be competitive. ↘ ITEMS 311 FF. In order to make up for this technological deficit, Federal Minister of Economic Affairs and Energy Peter Altmaier introduced the notion of KI-Airbus into the arena (BMWi, 2019a).

In the aviation market, static and dynamic **economies of scale and scope** give incumbent companies a significant competitive advantage. These can be reflected in **high barriers to market entry** and result in monopoly positions. The German weekly newspaper DIE ZEIT (2018) cites managers in the aviation industry, according to whom Boeing could achieve virtual monopoly rents with its Jumbo jet 747, comparable to the costs of today's Airbus aircraft, up until the 1990s. Analyses by Irwin and Pavcnik (2001) confirm this narrative. In contrast, the civil division of European aircraft manufacturers such as Aérospatiale, British Aerospace or Messerschmitt-Bölkow-Blohm on their own was never big enough to break up the duopoly of Boeing and McDonnell-Douglas. With the help of cross-border support from European governments, the Airbus Group succeeded in securing a market share of between 30 and 35 % by the mid-1990s (Klepper, 1994).

Arguments for government intervention

In addition to military considerations and high barriers to entering the aviation market, **competitive considerations** were another reason for active intervention by policymakers. Ultimately, it was Airbus's entry into the market that led to genuine and tough competition in the aviation industry (DIE ZEIT, 2018). The **duopoly of Boeing and McDonnell-Douglas** was **broken up**. Neven and Seabright (1995) show that the Airbus Group's profits were realised at the expense of Boeing and, in particular, McDonnell-Douglas, which Boeing took over in 1997. However, the authors also point out that Airbus's entry into the market could have led to welfare gains in Europe, but also simultaneously to negative overall welfare effects worldwide. This can be explained by a decline in scale and scope effects (Klepper, 1994). Irwin and Pavcnik (2001) also highlight the negative welfare effects of the US-EU trade agreement from 1992, which supposedly resulted in higher aircraft prices.

Subsidy strategy: Success story or problem case?

Similar to Boeing, the **economic achievements** of the Airbus Group are very likely linked to the **subsidy strategy followed for decades**. ↘ TABLE 14 Klepper (1994) estimates the subsidies provided by European governments between 1970 and the early 1990s to be in the range of 11 to 12 billion US dollars. Maennig and Hölzer (1999) also calculate that Germany alone provided around 4.37 billion DM in subsidies between 1990 and 1997 for Airbus projects. Profits generated by Airbus can only prove that the subsidy strategy was successful if in fact the profits subsequently show that the subsidies disbursed are a viable investment. However, the implicit interest payments on subsidies would have to be taken into account for this purpose (Monopolies Commission, 2004). It is also possible that the subsidies paid to Airbus would have been used more efficiently elsewhere. However, there is no way of quantifying this counterfactual scenario.

Furthermore, the subsidy strategy has been a bone of contention between the United States and the EU since 2004. Recently, the Airbus-Boeing case was the subject of a **hearing before the highest arbitration panel of the World Trade Organization** (WTO). Boeing had projected that the state aid to Airbus now amounted to €22 billion – figure rejected by Airbus as too high (DIE ZEIT, 2018). According to the ruling of May 15, 2019, France, Germany, Spain and the United Kingdom failed to comply with a previous WTO ruling in 2016 that prohibited all state aid to Airbus (FAZ, 2018). The United States immediately threatened sanctions against EU goods if it did not end subsidies to Airbus (Reuters, 2018). In addition, the United States mandated a WTO arbitrator to determine if and to what extent the United States would be allowed to sanction EU goods in accordance with WTO rules (Handelsblatt, 2018).

However, according to Airbus's interpretation, the ruling only requires minor adjustments in the case of the A350 and the A380 in order to bring subsidies into line with WTO rules (Airbus, 2018). The Group also contends that 94 % of Boeing's original claims were completely rejected (Airbus, 2018). In

early October 2019, the WTO arbitrator authorised the United States to impose **tariffs on goods worth up to 7.5 billion US dollars annually on EU imports** (WTO, 2019). These tariffs came into effect on October 18, 2019 (Deutsche Welle, 2019). The EU subsequently announced that it would impose tariffs in the Boeing case because it also considers subsidies provided to Boeing to be in breach of WTO rules (European Commission, 2019b).

↘ TABLE 14

Start-up financing from the euro area member states invested in Airbus[1]

Aircraft type	Germany	France	Spain
	€ million[2]		
A300	1,227[a]	459	23
A310		485	47
A320	680	630	65
A330/A340	1,498	1,189	177
A330-200	–	50	–
A340-500/600	–	322	68
A380	1,095[b]	(***)[c]	(***)[c]
Total	4,500	3,135	380

1 – Of the total Airbus shares, 11 % are held by Gesellschaft zur Beteiligungsverwaltung (GZBV) for Germany, 11 % are held by Société de Gestion de Participations Aéronautiques (SOGEPA) for France and 4.2 % are held by Sociedad Estatal de Participaciones Industriales (SEPI) for Spain; as of: 30.06.2019. 2 – National currencies are converted with the relevant irrevocable euro exchange rate. a – Applies for A300 and A310. b – Loans for development of the A380 to Airbus and suppliers. c – Values are classified information.

Sources: Airbus SE, Eurostat, Federal Ministry of Economic Affairs and Energy, WTO, own calculations

270. Vertical state interventions also serve to initiate or accelerate development processes. With this approach, the government aims to support the so-called winners in technological change at an early stage (**picking winners**). However, there is often doubt as to whether those acting on behalf of the government have sufficient information about which sectors will be important in the future. With the exception of the military sector, where the state and its allies are the only buyers, **decentralised investment decisions** tend to be superior to those of the state. In particular, if there is no market failure and innovation processes are to be triggered only in a more timely manner, it is questionable whether state intervention creates added value. Ultimately, this intervention always takes place to the detriment of others.

271. Besides being fettered by the disadvantages of centrally made decisions, vertical industrial policy is also associated with the major risk of political capture (Baldwin and Robert-Nicoud, 2007). The sectors to which support is allocated are likely to be those whose existence is threatened (**sunset industries**) rather than those that have a future (**sunrise industries**). Companies in the former sectors will use political influence to slow down or even halt structural change. In many cases, stakeholders then justify intervention using industrial policy with questions of distribution, such as, in previous years, the protection of jobs in the German coal industry. However, providing support to these industries merely delays structural change (**helping losers**). It cannot halt it completely.

272. Economic theory does not offer any clear solutions for evaluating vertical industrial policy. In the end, empirical evidence must be used to determine if vertical measures achieve their goals. However, the **empirical evaluation literature** in the field of industrial policy suffers from the notorious problem of missing **counterfactual scenarios**. It is unclear how, for example, Japan would have developed without its industrial policy, or whether the generous subsidies to Airbus could have been better used elsewhere in the economy. Of course numerous methodological policy options are available (Bauer et al., 2009). However, the problem of missing counterfactuals cannot be completely solved (Lane, 2019).

273. **Examples** of countries where vertical industrial policy has been implemented include, in particular, **Japan** and the **Republic of Korea**, which embarked on a huge economic effort to catch up in a relatively short period (World Bank, 1993). However, it is unclear to what extent the industrial policies in those countries actually drove this process or whether this growth path would have resulted anyway. Earlier studies were sceptical about the industrial policies (Beason and Weinstein, 1996; Pack, 2000; Lawrence and Weinstein, 2001).

However, better data and methods paint a slightly more **differentiated picture**. Pons-Benaiges (2017) indicates that industrial policy in **Japan** favoured sectors with economies of scale between 1974 and 1983. Yet, the results also imply that industries with strong learning effects were not supported. Using the shipbuilding industry in **China** as case study, Barwick et al. (2019) show that it was possible to increase China's world market share with the help of industrial policy. The support however, chiefly benefited unproductive companies. Lane (2017) identifies positive growth effects for the **Republic of Korea** in the 1970s outside of directly targeted sectors.

274. Despite the methodological progress made in analysing vertical industrial policy, the following question remains unanswered: what kind of economic development would have occurred in the absence of this industrial policy? In addition, it is questionable to what extent successful vertical measures would be relevant for developed industrialised countries at the cutting edge of technological progress.

4. Mission-oriented approach

275. While vertical industrial policy is likely to violate the principle of non-discrimination, horizontal industrial policy has also been criticized for failing to fully exploit the potential of effective industrial policy, due to its focus on framework conditions and overcoming market failures. Mazzucato (2018a) proposes a **mission-oriented approach**. At its core is the pursuit of a democratically defined, overarching goal that aims to create **benefits for society at large**. The goal is supposed to be **cross-sectoral,** that is, the intention is not to favour specific sectors, but rather to stimulate innovation in a variety of fields and scientific disciplines.

276. It is this approach that helped the United States put a man on the moon, a mission that was successfully accomplished thanks to various innovations in different sectors (Mazzucato, 2018a). However, achieving goals is only one part of success. The process is intended to create spillover effects on other areas, which in turn trigger innovations. A foundation for breakthrough innovations could thus be laid. Implementing such an approach would require different **instruments**, which are already being used in **horizontal industrial policy**. In addition to research funding, these include research competitions or specific grants (Mazzucato, 2018b). Similarly, the awarding of public contracts can favour and promote innovation (Czarnitzki et al., 2018).

277. The EU Framework Programme for Research and Innovation, **Horizon Europe**, expected to enter into force in 2021, partly follows the concept of the mission-oriented approach. By 2027, the plan is to fund EU-wide programmes that follow mission objectives. This will build on the project-based approach used in the previous Horizon 2020 Framework Programme.

278. Outside this framework programme for research and innovation, **greenhouse gas neutrality by 2050** for the EU and Germany could also be a potential goal for the mission-oriented approach. Research funding is not the only means to be used with this approach. **Putting a price on carbon dioxide emissions** could also be part of such a mission (GCEE Special Report 2019 items 7 ff.).

The evaluation criteria for effective industrial policy obviously also apply to the mission-oriented approach. ↘ ITEM 251 Every mission is therefore subject to **accountability**, a requirement that must be met in a continuous evaluation process. It is also important to ensure that small-scale objectives that conflict with the **principle of non-discrimination** are not pursued under the guise of a mission-oriented industrial policy.

III. CURRENT ACTION AREAS

279. Structural change is currently reflected in the ongoing digital transformation and advances towards **knowledge-based economy**. Various forms of market failure are more pronounced in knowledge-based sectors. As a result, there are **new action areas** for industrial policy. For example, intangible factors of production often cannot be used as collateral for loans. This increases financial frictions for young and smaller companies, in particular. ↘ ITEMS 284 FF. R&D is also playing an increasingly important role in the knowledge-based economy, while R&D costs are on the rise. ↘ ITEMS 291 FF.

280. In the **digital economy**, network effects and the scalability of intangible factors of production favour the business model of **multi-sided platforms**. This poses new challenges to competition policy since it creates a winner-take-all dynamic that leads to high market concentration. Due to network effects, large, uniformly regulated markets are an important prerequisite for the profitability of invest-

ments. Completion of the European digital single market is therefore gaining in importance. ↘ ITEMS 313 FF. Recurring **protectionism** and the strategic industrial policy of other countries should be countered with a firm commitment to open, rules-based international trade. ↘ ITEMS 318 FF.

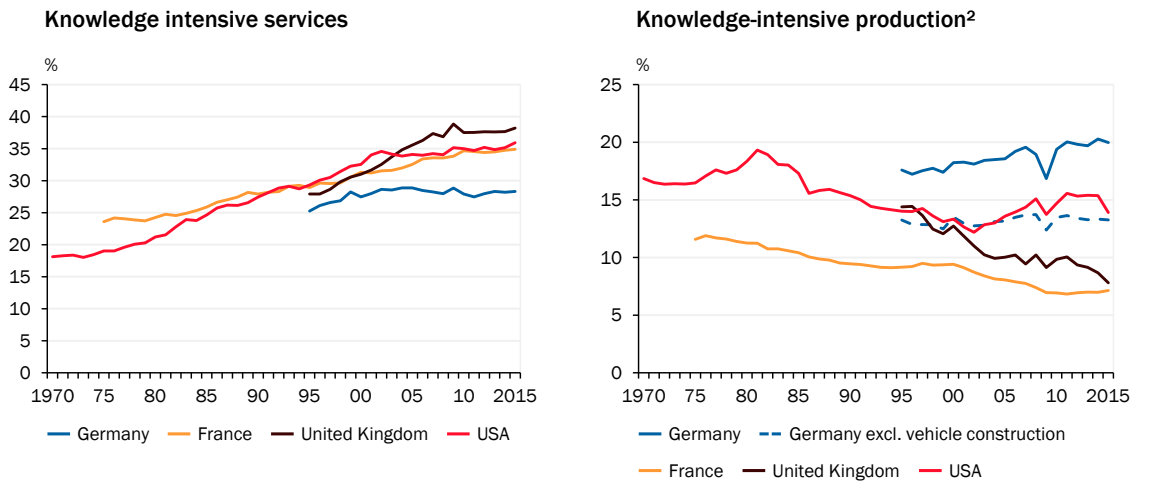
1. Start-ups and economic dynamism important for structural change

281. Since the late 1970s, there has been a worldwide shift in economic structure towards knowledge-based industries and production methods. While the proportion of **knowledge-intensive services** is rather increasing, the importance of **knowledge-intensive production** is decreasing in France, the United Kingdom and the United States, for example. ↘ CHART 44 In contrast, the gross-value added share of knowledge-intensive production increased in Germany. This is due in particular to **Germany's previous strenght** in vehicle construction, which was primarily responsible for the increase in the value-added share of knowledge-intensive production. At the same time, knowledge-based services have grown less in importance than in other countries. This probably reflects the strength of traditional industries and their relatively high productivity by international standards, as well as barriers to structural change.

282. However, structural change is not only promoted by technology: it can also be a response to changes in the **international division of labour**. For example, German companies have a comparative advantage in areas with high added value, while areas with lower added value have been relocated abroad. ↘ ITEMS 204 FF. These knowledge-intensive industries pay relatively high wages. ↘ CHART 45 Due to the attractive employment conditions, the motivation for highly skilled workers

↘ CHART 44

Value-added components of knowledge-intensive economic sectors



1 – Information and communication, financial and insurance services as well as business services. 2 – Mining, manufacture of coke and refined petroleum products, chemical and pharmaceutical industry, manufacture of electrical and optical equipment, mechanical engineering and vehicle construction.

Sources: EU KLEMS, own calculations

to set up their own companies or move to start-ups is likely to be low (Jiang and Sohail, 2017; Kozeniauskas, 2017; Salgado, 2019).

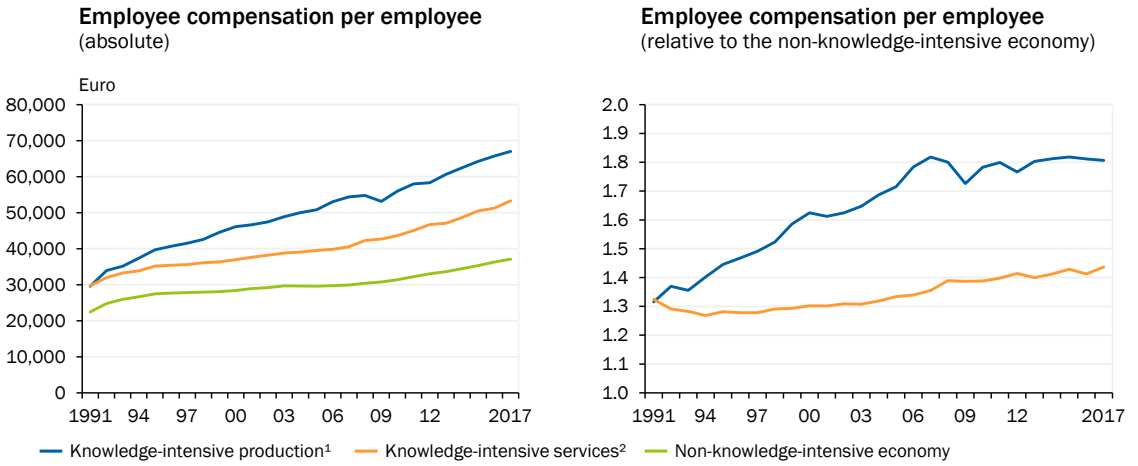
This could be a reason for Germany's **weaker start-up dynamism** compared to the United States. ↘ ITEMS 181 FF. However, such comparisons should be treated with caution given the different national measurement methodology. The weak start-up dynamism could in turn be a reason for the relatively slow pace of structural change.

283. For dynamic structural change, **entrepreneurial and start-up dynamism** are essential to an economy (Metzger and Rammer, 2009; Dent et al., 2016). The **reallocation of resources** from shrinking to growing sectors mainly occurs through business closures and start-ups. This process leads to an increase in overall productivity. ↘ ITEM 185 In addition, a high degree of start-up and entrepreneurial dynamism promotes the **diffusion of new technologies**, in particular cross-sectional technologies (Atkeson and Kehoe, 2007), such as information and communication technology (ICT). With this in mind, the worldwide decline in entrepreneurial and labour market dynamism, which is particularly pronounced in Germany, should be a matter of concern. ↘ ITEMS 186 FF.

284. An important factor in the establishment of new companies, especially innovative start-ups, is **start-up financing**. **Equity financing** plays a more important role for these companies than debt financing as the risk of defaulting on borrowed capital is particularly high due to the lack of collateral and large degree of uncertainty about young companies' success. Debt financing, through a bank, for example, will often be difficult for these companies. Surveys show that **start-ups in Germany** are disproportionately affected by **financing difficulties** due to their high capital requirements (Metzger, 2018). After a slight de-

↘ CHART 45

Wage structure according to knowledge intensity of economic sectors in Germany



1 – Mining and quarrying, manufacture of coke and refined petroleum products, manufacture of chemical products, manufacture of pharmaceutical products, manufacture of data processing devices, electronic and optical products, manufacture of electrical equipment, mechanical engineering, vehicle construction as well as repair of machines and equipment. 2 – Information and communication, provision of financial and insurance services, provision of professional, scientific and technical services, health care and arts and culture, gambling.

Sources: Federal Statistical Office, own calculations

cline in financing difficulties since 2014, they increased again last year (Metzger, 2019).

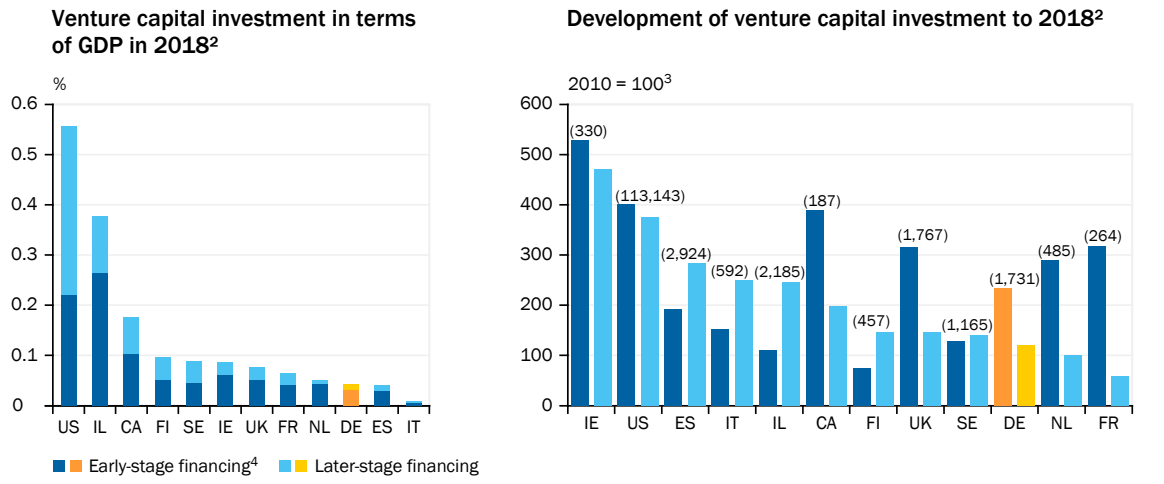
285. In particular, venture capital is needed for start-up and growth financing. **Venture capital** belongs to the private equity category of assets and refers to over-the-counter equity capital. However, compared to other developed economies, venture capital investment has so far played a minor role in **Germany**, although its importance has increased significantly in recent years. ↘ CHART 46 In 2018, approximately 1.73 billion US dollars of venture capital was invested in Germany (0.043 % of GDP), representing an increase in investment of almost 190% compared to 2010 (OECD, 2018a). Over the same period, investment in the United States almost quadrupled to 113.1 billion US dollars in 2017 (0.55 % of GDP). KfW (2017), the state-owned development bank, estimates the gap in the start-up and early growth phase to be between 500 and 600 million Euro per year. It is notable that **late-stage financing** is particularly **weak** in Germany.

286. There are a number of **obstacles** in Germany that could prevent growth in private venture capital financing. Due to the **less significant role played by large institutional investors** such as pension funds, there is a shortage of anchor investors who could attract private investors and, above all, foreign investors (EFI, 2019). Further developing the funded pension system (GCEE Annual Report 2018 items 552, 556) could therefore be beneficial for venture capital financing.

287. In Europe, the **share of government investment** in venture capital financing is **high** compared to the United States (Bertoni et al., 2019). Empirical evidence shows that the influence of private and government equity financing on companies can differ significantly. For example, young growth companies financed by **government-backed venture capital** have **comparatively low**

↘ CHART 46

International comparison of venture capital investment by target company location[1]



1 –US-USA, IL-Israel, CA-Canada, FI-Finland, SE-Sweden, IE-Ireland, UK-United Kingdom, FR-France, NL-Netherlands, DE-Germany, ES-Spain, IT-Italy. 2 – For Canada: values from 2017; for Israel: values from 2014. 3 – Percentage change for early and later-stage financing, respectively. Values in paratheses: total venture capital in 2018 in million US dollars, for Canada in 2017; for Israel in 2014. 4 – Including seed, start-up and early-stage.

Sources: OECD, own calculations

returns from selling their companies, along with a **low level of innovation** (Bertoni et al., 2015). Brander et al. (2010), attribute this weakness, in the case of Canada, to a lack of effective company backing by public venture capitalists.

In addition, there is a risk of **crowding out** of private investment. Engel and Heger (2005) provide evidence for these crowding-out effects in the German market. However, recent studies show that strong government involvement, while associated with a smaller private venture capital industry, generally attracts larger investments overall. This is because the State's signalling of a credible commitment to this form of funding inspires private investors with more confidence (Brander et al., 2015; Hellmann and Thiele, 2019). The aim of public support in the venture capital market should be to increase incentives for private investment (**crowding in**), for example using **models** linking public support to private co-financing. However, the success of these initiatives depends on how they are set up (Colombo et al., 2016).

288. One important **exit** strategy for venture capital investors is taking a company public through an initial public offering **(IPO)**, which often offers the best prospects for return on investment. The comparatively small IPO market in Germany makes this route more challenging. The market has yet to recover from the new economy bubble bursting and Neuer Markt segment going bust at the start of the millennium. In Germany, the number of IPOs remains extremely low, while IPOs for young start-up companies in the United States are an established part of the stock market landscape. Although the IPO market in the United States also collapsed during the financial crisis, it recovered quickly. Meanwhile it has been stagnating at a low level in Germany since 2010 (Metzger and Bauer, 2015). Livelier IPO activity may be one reason why investment sums in the US venture capital market are significantly greater than in Germany: investors are likely to be more willing to invest if there is a receptive exit market for large-scale equity holdings.

The European capital markets union could improve access to venture capital for young entrepreneurs by creating **larger, more liquid** markets through harmonisation. Young companies in the growth phase could benefit in particular from this (GCEE Annual Report 2018 items 539 ff.).

289. Finally, the **limited deduction for losses** for corporations according to Section 8c of the German Corporation Tax Act (KStG) could explain the low availability of venture capital, in particular for **young companies**. The provision prevents a deduction of losses by a company if more than half of the shares in the company are sold within five years (GCEE Expertise 2008 item 109). Investors are restricted in their ability to use the accumulated losses for loss compensation and are therefore likely to apply a discount to the purchase price.

The new **Section 8d of the Corporation Tax Act** is intended to promote venture capital financing by making it possible to carry forward losses if business operation is continued. However, the required unchanged continuation is likely to represent a **considerable restriction** especially for young companies. The Act also mentions transactions such as the commencement of additional

business operations, which also result in the cancellation of loss carryforwards. However, these transactions are not unlikely events for young companies. If loss carryforwards exist, investors must consider whether not to claim them or whether to postpone further development of the company. Even in the case of an equity holding, the risk of losing the loss carryforwards is reflected in the purchase price. This could reduce the **entrepreneurs' incentive to expand their businesses**.

290. However, in addition to financing difficulties, other factors probably contribute to the low level of entrepreneurial activity. These factors include, for example, strict regulations, excessive bureaucracy and a shortage of skilled workers. Such factors are likely to play an important role in the **relocation of start-ups in the growth phase** to other countries such as the United States. **Improving the framework conditions** is therefore **essential** to support business start-ups.

2. Research and innovation

291. Productivity growth is a key factor for long-term economic growth. ↘ ITEMS 132 FF. This relies, to a large extent, on investment in R&D and the resulting innovations (Jones, 2016). Since R&D tends to be under-provided due to positive externalities, government intervention is needed to promote it. Therefore, modern industrial policy must be understood, first and foremost, as **research and innovation policy**. Structural change towards a knowledge-based economy increases the importance of R&D activities. As increasing R&D effort appears necessary to achieve consistent productivity gains (Bloom et al., 2017), targeted innovation policy is more important than ever.

292. **Domestic R&D spending** includes privately and publicly funded projects. The share of total domestic spending on R&D in GDP has risen by about one percentage point in Germany since the 1980s. ↘ CHART 47 LEFT It is now above the 3 % target specified by the Lisbon strategy. Compared to other major economies, Germany spends a relatively high proportion of its economic output on research and development.

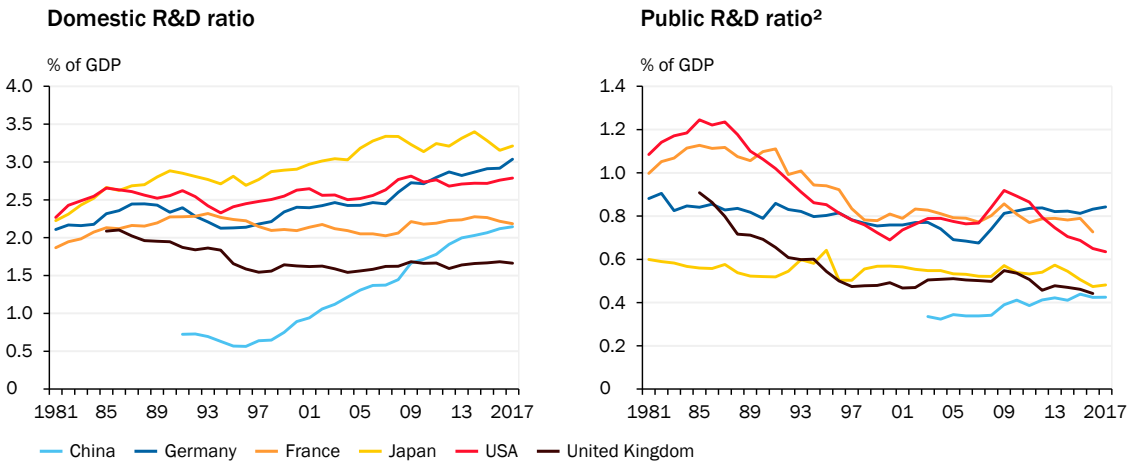
In contrast, **publicly funded R&D spending** relative to GDP has barely changed and stands at around 0.8 %. ↘ CHART 47 RIGHT Publicly funded R&D spending in other developed economies has fallen notedly since reaching a peak in the 1980s and is now at a lower level than in Germany.

Research and innovation activity in the private sector

293. The increase in domestic R&D spending relative to GDP is mainly attributable to the private sector. However, **R&D spending** by German companies is concentrated on individual sectors. The German **automotive industry**, for example, accounts for more than 50 % of the research expenditure undertaken by corporations headquartered in Germany. ↘ CHART 48 Approximately 59 % of all R&D spending in the manufacturing and services sectors in 2017 was related to the

↘ CHART 47

R&D ratios[1] in selected countries



1 – R&D expenditure in relation to GDP. 2 – Publicly funded R&D expenditure. Privately funded research at higher education institutions is not included. Expenses for R&D staff, such as professors or research team leaders, are allocated to R&D expenditure in line with the proportion of working hours directly used for R&D activities.

Sources: OECD, own calculations

automotive industry (Stifterverband, 2019). This includes, for example, R&D spending incurred by ICT companies on autonomous driving.

Research in industries that have gained international importance in recent decades, such as biotechnology and health or ICT, is rather conducted by companies from the United States, China, Switzerland or Israel. However, it is worth noting that research carried out for **cross-cutting technologies** such as ICT can occur in other sectors if it is relevant for applications there.

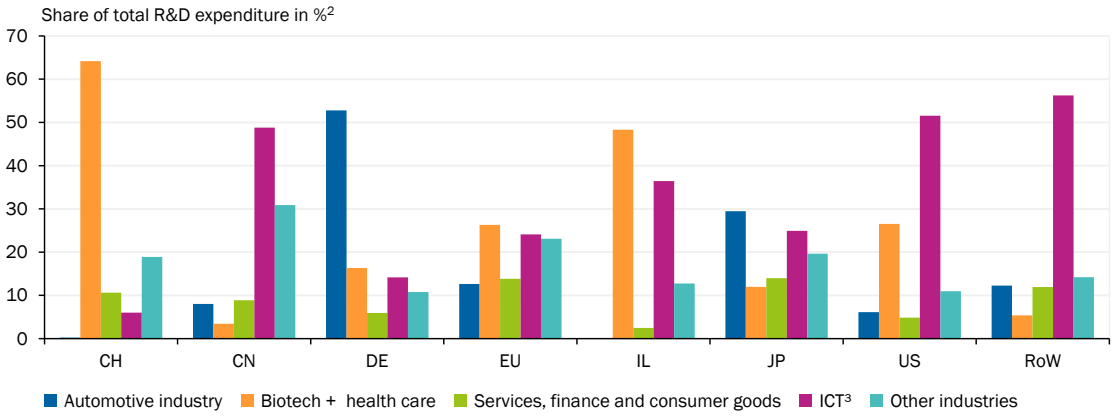
294. The R&D focus on capital-intensive sectors could explain the relatively **high concentration of R&D spending in larger companies** in Germany. With regard to smaller companies, those in the bottom 50 % of the national size distribution by employment in Germany have the lowest share of R&D spending compared to other countries. ↘ CHART 49 RIGHT An analysis of the R&D intensity of research-intensive companies by company size shows that this is due to the small difference between the research intensity of small and large companies. Smaller companies are much more research-intensive in the United States and Israel, in particular.

The lack of smaller innovative companies in Germany could be problematic in that these companies are typically young and expand very rapidly. They thus provide a **basis for future innovations and increases in productivity**. In comparison with other European countries, it is also evident that **smaller German companies** have a relatively **low R&D intensity**. ↘ CHART 49 LEFT

295. Although R&D output, measured as the share of companies with product or process innovations, is comparatively high among small companies, German small and medium-sized businesses (SMEs) are only **middle-ranking** in terms of selling innovative products and **patent intensity** (EFI, 2016). Excessively high innovation costs and a shortage of skilled workers seem to present particular

↘ CHART 48

Private expenditure on research in 2018, according to sector[1]



1 – CH-Switzerland, CN-China, DE-Germany, EU-European Union excluding Germany, IL-Israel, JP-Japan, US-USA, RoW-Rest of the world. The data is based on the 2,500 companies with the highest expenditure on R&D in the world in 2018 (cut-off point at 25.1 million US dollars). 2 – R&D expenditure by companies in the relevant sector as a share of the total R&D expenditure of all companies headquartered in the relevant country. 3 – Information and communication technology.

Sources: European Commission, own calculations

challenges to smaller companies in their R&D activities. The Skilled Immigration Act (*Fachkräftezuwanderungsgesetz*) adopted in June this year is a step in the right direction. Given that promoting immigration of skilled labour has been identified in many studies as an effective policy measure to increase R&D activities (Bloom et al., 2019), this could give a boost to innovation.

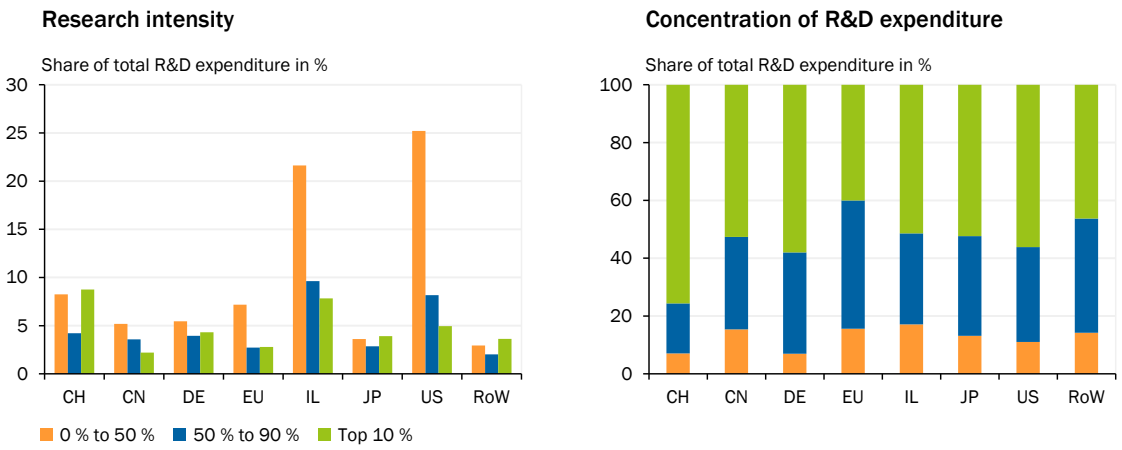
296. The low importance of R&D expenditure in smaller companies in Germany could be due to the relatively modest **venture capital market** and higher risk aversion. ↘ ITEMS 285 FF. Small innovative companies are prone to high uncertainty and **information asymmetries** (Hall and Lerner, 2010). Since R&D investments are predominantly made in intangible rather than tangible assets, the amount of collateral that can be provided is limited, unlike in the case of physical investments. **Venture capitalists**, and **business angels** in particular, can signal high-quality investment opportunities to other market participants and also provide expertise and contacts. A thriving venture capital market can therefore have a positive impact on overall R&D spending and productivity development (Kortum and Lerner, 2000; Akcigit et al., 2019).

297. While young innovative companies play an important role, especially for future R&D investment, **large, research-intensive companies** are the **backbone of current R&D.** These companies are often engaged in collaboration with small companies and universities through research clusters. ↘ ITEMS 345 FF. They also benefit from advantages in terms of risk sharing since they are involved in the implementation of numerous different research projects. This is why these companies were previously very active in basic research.

However, it is noticeable that since the 1980s in the United States, **large corporations** have increasingly **withdrawn from basic research** and have turned instead to applied development (Arora et al., 2015). One reason for this development could be a stronger capital market orientation. Since companies

↘ CHART 49

Research intensity by company size[1]



1 – Quantiles of companies in the region, according to the number of employees worldwide. CH-Switzerland, CN-China, DE-Germany, EU-European Union excluding Germany, IL-Israel, JP-Japan, US-USA, RoW-Rest of the world. The data is based on the 2,500 companies with the highest expenditure on R&D in the world in 2018 (cut-off point at 25.1 million US dollars). The R&D expenditure of these companies is allocated to the country where the headquarters are located, irrespective of where the R&D expenditure was actually incurred.

Sources: European Commission, own calculations

carrying out basic research retain a smaller portion of returns from the innovation process, the economic cost-benefit ratio in applied research is higher (Akcigit et al., 2016) and thus more highly regarded on the capital market (Mazzucato, 2014).

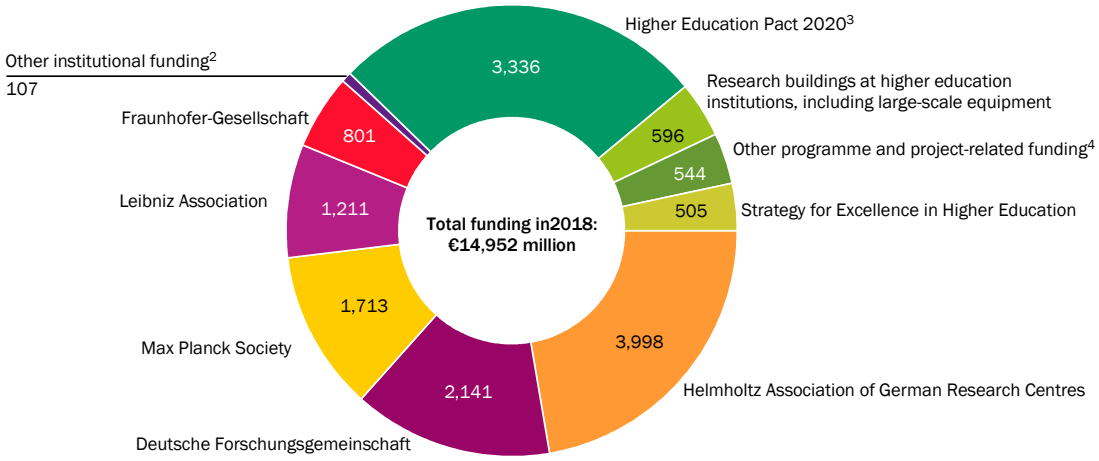
Public research and innovation policy

298. Since **basic research** is particularly affected by externalities, the State has an important role to play in its funding. Germany already has a comprehensive funding system with non-university research organisations such as the Max Planck Society, the Leibniz Association and the Helmholtz Association. Funding targeted at research in universities is available from the German Research Foundation (DFG) and at the European level from the European Research Council (ERC). In Germany, the sum of about €9 billion was planned to be disbursed through these organisations on R&D in 2018, the equivalent of approximately 10 % of total domestic R&D expenditure. These funds comprise part of the joint research funding of the German federal and state governments, which also includes application-oriented research funding and other project-related funding, for which expenditures amounting to just under €15 billion were planned for 2018. ↘ CHART 50 Overall federal and State expenditure on R&D, including other non-project-related funding, such as basic funding for higher education institutions, came to approximately €26 billion in 2015 (BMBF, 2018b).

In comparison, the budgets of the **large US research funding institutions** are around €35 billion for the National Institutes of Health, €6 billion for the National Science Foundation, €5 billion for Department of Energy research funding and €3 billion for DARPA, the research agency of the US military. These expenditures are at a similar level, relative to GDP, as in Germany.

↘ CHART 50

Joint research funding by federal government and Länder in 2018[1]
(Target in € million)



1 – Contributions from the federal government and Länder in accordance with the Skeleton Agreement on Research Promotion pursuant to Article 91b § 1 of the Basic Law. For details (in German), see: www.gwk-bonn.de/themen/finanzierung-von-wissenschaft-und forschung/finanzierungsbericht/. 2 – acatech - National Academy of Science and Engineering, Berlin Institute of Health, National Academy of Sciences Leopoldina, German Centre for Higher Education and Science Studies, Institute for Advanced Study in Berlin. 3 – Additional first-year student, DFG programme allowance. 4 – Academic programme, „Innovative University" funding initiative, NAKO Health Study, Programme for Women Professors, Programme for Research and Development at Universities, Programme for Fostering Young Research Talent, National Programme to improve the quality of teacher training, Quality Pact for Teaching, „Advancement through Education: Open Universities" competition.

Sources: Federal Ministry of Education and Research, Joint Science Conference (GWK)

299. Applied research outside the university sector is funded in Germany by the Fraunhofer-Gesellschaft and the market-oriented funding programme of Industrial Collective Research (IGF). **Innovation clusters** make an important contribution to **knowledge transfer** from academic research to the business sector by linking universities and other research institutes with economic agents. ↘ ITEMS 345 FF.

300. As a new instrument for **knowledge transfer** from basic research to marketable products, the Federal Government decided in 2018 to set up the **Agency for Breakthrough Innovations** (BMBF, 2018c; EFI, 2019). This agency is tasked with promoting the creation of highly innovative products and services that solve specific problems in society, in line with the mission-oriented approach. ↘ ITEMS 275 FF.

During a start-up phase, the topics are proposed by the federal ministries and then **defined** in a dialogue with representatives from science, industry and society. **Innovation competitions** are to be held on these topics in order to spur the development of innovative problem-solving approaches. It is planned to create **links** with similar European institutions in order to conduct joint innovation competitions. The plan is then for the most promising solutions to be developed until market maturity within three to six years within the framework of **leading-edge projects**, which could potentially pursue several approaches. In the interests of transparency, both the projects and the agency will be subject to regular external evaluations. The agency's planned funding of around €100 million per year is comparable to that of smaller Helmholtz centres.

301. In addition to national research funding, **European research and innovation policy** is playing an increasingly important role. The planned budget of the new Horizon Europe research framework programme, which runs from 2021 to 2027, is between €100 and €120 billion. This is well above the budget of around €70 billion of the current Horizon 2020 framework programme. In light of the increasing importance of R&D, this rise seems reasonable, although it is lower than the doubling called for by the advisory high-level group (European Commission, 2017).

To promote **efficient division of labour** in research, the competition and coordination around research funding at European level can make better use of the research strengths of individual countries. Complementarities can help improve research effectiveness by fostering **transnational, interdisciplinary collaboration** and increasing researcher mobility. A further deepening of European research and innovation policy should be helpful to respond effectively to increasingly complex R&D (Bloom et al., 2017).

302. **Empirical studies** carried out on the effectiveness of state institutions for research funding reveal a **differentiated picture**. Quasi-experimental studies suggest that state funding only generates a slight increase in publication output. The fewer alternatives that are available to public funding, the greater the effects (Jacob and Lefgren, 2011). State funding does seem to have a positive effect on patenting activity. Projects funded by the US National Institutes of Health have an additional output of 2.3 patents in total, as well as 0.034 patents for approved drugs with an estimated value of $14.7 million US dollars per $10 million US dollar in funding (Azoulay et al., 2019). The European research funding programme Horizon 2020 has had a positive impact on publication quality and on the number of patents generated (European Commission, 2018a).

One concern often voiced is that public funding crowds out private R&D spending. However, Moretti et al. (2016) show that in the case of military R&D funding in the United States, an increase of 10 % in public funding boosts private R&D expenditures by 3 %, and that **public and private R&D expenditures** may therefore be **complementary**.

303. In addition to direct funding, the state can use **tax regulations on R&D expenditure** and **patent income** to mobilise further R&D resources. However, a tax system that offers tax benefits for R&D expenditure should be considered from multiple perspectives. On the one hand, there is ample quasi-experimental evidence that a lower tax burden is associated with an increase in R&D expenditure (Bloom et al., 2002; Wilson, 2009). On the other, this approach is likely to be associated with deadweight effects and tax avoidance: expenditures already incurred will be partially reclassified to benefit from the support (Chen et al., 2018).

One reason for the low R&D expenditure officially recorded by **smaller German companies** could therefore be that this is not always declared as R&D expenditure due to the **lack of tax incentives** in Germany (OECD, 2018b). Nevertheless, many studies show that R&D output in the form of patents increases as a result of tax concessions (Bøler et al., 2015; Dechezleprêtre et al., 2016).

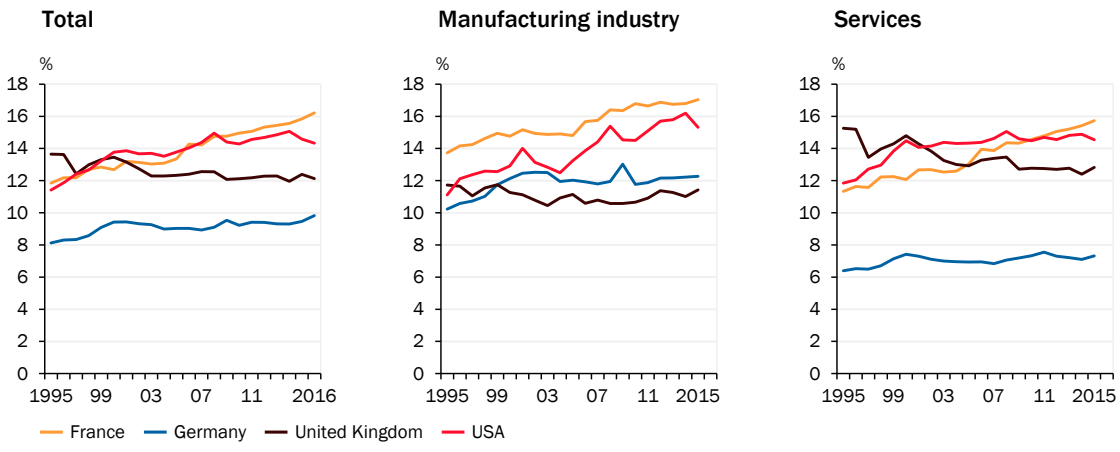
304. Furthermore, the tax on patent income can be reduced by means of **patent boxes**. Gaessler et al. (2018) show that patent boxes barely generate any increase in innovation activity and are primarily used to shift patents for more favourable tax treatment. Patent boxes that take into account the R&D expenditure actually incurred locally, in line with the OECD's nexus approach, seem more suitable to stimulating local R&D activities (Alstadsæter et al., 2018). Nevertheless, patent boxes should be considered more as an instrument to deploy in tax competition for intangible factors of production than a tool for promoting innovation (GCEE Annual Report 2018 item 605).

3. Digitisation and the platform economy

305. As a result of the **digital transformation** of the past 20 years, **intangible factors of production** have become increasingly important. In the period from 1995 to 2016, the proportion of investment in intangibles to gross value added rose by around 2 percentage points in Germany and the US, and by around 4 percentage points in France. By contrast, the share of investment in the United Kingdom fell by roughly 2 percentage points. These developments took place on a similar scale in both the manufacturing industry and the services sector. ↘ CHART 51 While investment in intangible factors of production as a percentage of gross value added is growing, in Germany it is still far below that of other economies, particularly in the services sector. Intangible factors of production are much more affected by market failure on financial markets than tangible factors. Furthermore, they are more easily scalable and therefore facilitate concentration on sales markets. This poses additional challenges for industrial policy.

↘ CHART 51

Investment in intangible factors of production[1]



1 – Investment in intangible factors of production in relation to the gross value added of the particular sector. Compared with official figures, the gross value added has been corrected by the value added contained in intangible factors of production. For more information on the methods used, see Corrado et al. (2016).

Sources: INTAN-Invest, own calculations

Intangible factors of production: distinctive characteristics

306. Intangible factors of production fall into three main categories: **computerised information**, such as software and databases, **economic competencies**, such as market research information, a customer base, organisational capital and human capital based on continuing education, and **innovative property** (Corrado and Hulten, 2010). These intangible assets have four defining characteristics that distinguish them from tangible capital (Haskel and Westlake, 2017).

They are **scalable** in the sense that they are not consumed or become worn through use and can therefore be reused almost indefinitely. They are often associated with high **sunk cost**, as they are very specific to a particular company and therefore cannot be easily resold on the market, or only at a significant discount. Through **spillovers,** they generate high secondary benefits outside the company actually paying for the investment. And finally, intangible factors of production often tend to have **synergies** with one another (Haskel and Westlake, 2017).

307. These characteristics of intangible factors of production give rise to a variety of forms of market failure and offer explanations for potentially worrying macroeconomic trends. Large firms benefit more from the **scalability** of intangible factors of production given the high fixed costs and low variable costs involved (Sutton, 1991). This results in a higher **concentration** of economic activity in superstar firms (Autor et al., 2017; Bajgar et al., 2019). This could lead to an **increase in market power** and higher price mark-ups, which in turn reduces consumer benefits (De Loecker and Eeckhout, 2017; Gutiérrez and Philippon, 2017). While the increased efficiency of large firms could have short-term positive effects, this is likely to be outweighed on the longer term, however, by the negative effects on incentives for research among smaller firms (Aghion et al., 2019).

308. As intangible factors of production are very firm-specific, they often have only a **low resale value**. Even if they can be sold, any sale is often associated with **high transaction costs** due to the high degree of **specificity** compared with tangible factors of production. Therefore they do not easily lend themselves to be used as collateral to overcome asymmetric information in securing a loan and therefore borrowers with intangible assets face greater **financing difficulties** than in the case of tangible assets (Dell'Ariccia et al., 2017). This makes it harder to obtain finance, particularly for smaller and younger firms that cannot finance these investments internally. Furthermore, the uncertainty associated with investment in intangible factors of production is likely to be higher in the case of younger firms. At the macroeconomic level, the shift toward intangible factors of production may have been a reason for the weak investment growth in recent years (Crouzet and Eberly, 2019).

309. Investment in intangible assets is likely to be too modest from a social perspective not only on account of financing difficulties but also because such investment often generates **positive external effects** outside the companies making

the investment. This is true for investment in R&D, staff training or in the case of market research spending that results in the development of new markets and accompanying information gains for competitors. Such **spillovers,** although welcome from a social point of view, are downright harmful from the business perspective of the investing company. As a result, efforts are made to reduce spillover effects, such as through patent and copyright infringement lawsuits.

310. Synergies are not specific to intangible factors of production. They also apply to physical capital, as e.g. between different production machines. That said, the synergy effects between intangible assets are far higher, such as the synergy between technologies or organisational practices. As they are scalable, they can be recombined in multiple ways. These **synergies from recombination** are an important driver of technological progress (Arthur, 2009). Synergies between the intangible assets of different companies provide an incentive to share technologies – in patent pools for instance – and set compatible standards (Shapiro, 2000; Lerner et al., 2003). This counteracts the incentive to keep external spillovers to a minimum.

Synergies between intangible assets within a company can, however, raise barriers to market access for competitors, as the latter need to compete effectively along multiple dimensions rather than just one. The creation of such **access barriers through synergy** is the stated strategy of successful tech companies (Thiel and Masters, 2014) and is likely to play an important role particularly in the case of multisided platforms.

Consistency of regulation and contestable markets for platforms

311. Innovations in the field of ICT and synergies between intangible assets have changed business models. While traditional industrial companies have primarily interacted with one side of the market, currently the most valuable listed companies are all **multisided platforms** (GCEE Annual Report 2017 Box 21). Their business models are based on the creation and utilisation of **network effects**. The benefit their platforms offer for one side of the market is higher the more participants from the other market side are active on the platform (Evans and Schmalensee, 2016). This facilitates concentrated market structures and also results in path dependency and high costs of switching between platforms, which could create barriers to innovation and the development of new offerings.

312. Currently, of the ten **most valuable listed companies, seven are providers of multisided platforms** from the **United States** (Alphabet, Microsoft, Apple, Amazon, Facebook) and **China** (Alibaba, Tencent). In Europe, this development is regarded with increasing concern, as the fear is that Europe is not actively taking part in a sector that is important for the future (BMWi, 2019a). On the one hand, this could be a legitimate concern given the switching costs deriving from network effects and the resulting lock-in effects. To address this issue, some sections of the political community have called for the **creation of national or European "champions"**, such as an "AI Airbus" for example. On the other hand, the digital sector is still very dynamic, with new companies

regularly rising to the top of the rankings. This in turn casts doubt on the extent of lock-in effects.

313. Instead of government action to create national champions, the more effective approach would be to **address the reasons for this development**. In this context, it is telling that the market leaders in the digital economy come from the United States and China, i.e. they can rely on a large, consistently regulated domestic market. This makes the scaling of platforms easier, which is necessary to achieve the critical size for network effects. The deepening of the **European Digital Single Market** could establish these conditions in Europe and foster the development of European digital companies (European Commission, 2018b; GCEE Annual Report 2018 item 143).

For this purpose, efforts should be made to bring about the further **harmonisation of regulations** in the digital sector and guarantee the free cross-border movement of data. Moreover, common standards in the ICT sector should ensure the interoperability of digital technologies. Furthermore, action to strengthen the once-only principle for the provision of data to public administrations and to extend the "single digital gateway" for companies could help reduce the administrative burden on business.

314. The conditions for European cloud computing solutions are to be improved with the **GAIA-X** project (BMWi, 2019b). This project aims to connect decentralised infrastructure services and in doing so create a secure data infrastructure in Europe. It is to be based on a central organisation at the European level that develops a reference architecture and defines standards to guarantee interoperability between the solutions available on this platform. GAIA-X is intended to strengthen the **digital sovereignty** of users of cloud services, particularly their complete control of stored and processed data and of access to this information. Furthermore, by linking the data of individual companies, the project seeks to create the environment for the development of innovative services and business models and improve the competitiveness of European cloud service providers as a result of greater scalability.

The aim of the **Digital Single Market Strategy for Europe** (European Commission, 2015) is to establish a supportive investment climate for digital networks, research and innovative business. Barriers to cross-border online activities are to be reduced within the context of "better access for consumers and businesses to online goods and services across Europe". This involves harmonisation measures in contract and copyright law, the abolition of unjustified geo-blocking and improvements to the European VAT system, such as through electronic registration and payment mechanisms for online trade. To "create the right conditions and a level playing field for advanced digital networks and innovative services", competition in the telecoms sector is to be facilitated by standardising regulations within the EU. Furthermore, consistent rules for platform service providers and data protection are sought through the General Data Protection Regulation (GDPR), for example. In addition, the Strategy aims to guarantee the "maximum growth potential of our European Digital Economy". This goal is planned to be supported by a Free Flow of Data Initiative and a European Cloud Initiative. In addition, a common set of standards in the digital economy is to guarantee the interoperability of different systems and expedite the digitisation process in public administration.

315. To ensure dynamic competition in the digital economy, and particularly in the platform economy, it must continue to be possible to **challenge positions of market power**. This allows new competitors to bring innovation to the market and encourage established providers to engage in innovation themselves. In light of this, the "Competition Law 4.0" Commission (Kommission Wettbewerbsrecht 4.0, 2019) has suggested taking the particularities of the digital economy into consideration in competition law. Action to reduce barriers to market entry for new providers – despite the network effects and economies of scale associated with data utilisation – and to facilitate competition calls for an obligation to ensure **data portability** and the strengthening of the **sovereignty of consumers** over their data. Particularly for dominant platforms, data portability should be guaranteed by making it compulsory to provide interoperable data formats.

316. In addition to opening the databases of platform operators, a **critical examination of preferential treatment for in-house products** could also be effective. In digital markets, in particular, market access is often via individual products which could potentially compete with the in-house products of the platform operator. If these in-house products are already available for free with the platform, this can prevent new providers from entering the market or squeeze other providers out of the market. One particular example is Microsoft's Internet Explorer, which was sold as part of the Microsoft Windows operating system package. As a result, many users no longer felt the need to install an alternative Internet browser, causing Netscape Navigator – previously the most widely used browser – to leave the market (Tirole, 2017).

317. Control of platform markets under competition law is complex, as new factors such as network effects, the availability of user data and the dynamics of the market concerned must be taken into consideration (Monopolies Commission, 2015). For example, lowering the threshold for **merger control** might be worth considering, as companies in the digital sector primarily purchase future competitors that are small at the time of acquisition but are fast-growing firms. In this context, however, it is important to consider that such mergers are often an attractive exit option for venture capitalists. Removing this option could mean that venture capitalists would be less willing to make equity capital available.

4. Confronting protectionism and strategic industrial policy

318. For some years now, the **increasing protectionism** and **strategic industrial policy of other countries** have presented challenges for world trade and for Germany's export-driven economic model. The National Industrial Strategy (BMWi, 2019a) is therefore not alone in asking what tools are most effective to address these challenges.

319. Using game theory, there is an incentive for exporting countries to rely on **vertical industrial policy** in the form of **subsidies**. Government assistance can drive down the production costs of domestic producers, making national businesses more competitive and generating additional market shares in the world

market for the country. All exporting countries have the incentive to support domestic businesses, however (Brander and Spencer, 1985). Therefore all importing countries – rather than the actual exporting countries – ultimately benefit from industry subsidies, as they get to enjoy lower product prices.

Therefore, from the viewpoint of all exporting countries, the optimum solution would be to forego the provision of subsidies altogether and to let producers **compete with one another without state aid** in oligopolistic markets. The World Trade Organisation (WTO) is an attempt to establish such a system and address unfair competition. Instead of assisting specific companies and entering an **inefficient subsidy race** or trade dispute with other countries, the primary objective – as in the past – should be to have free trade.

320. Beyond conventional protectionist instruments, **competition with China** poses a **new challenge**. Up to now, China has not provided European businesses with a level playing field. At the same time, with its "Made in China 2025" industrial strategy, the country is pushing its agenda to achieve global market leadership in central industries by 2025. This has put China and its industrial policy in the public spotlight more than ever before and sparked a discussion on the best approach to dealing with Chinese industrial policy.

321. The European Commission's decision to block the merger of Alstom and Siemens (European Commission, 2019c) was met with growing demands to relax European antitrust law to be able to create heavyweight "**European champions**" in the hope that such companies will be able to rival Chinese state-backed conglomerates that were established to exploit economies of scale (Hsieh and Song, 2016). It is questionable, however, whether **state-controlled companies** that do not face any competition at home can be more innovative than their Western competitors on the long term. The lack of competition could therefore spell trouble for future growth, particularly in China itself (World Bank, 2019).

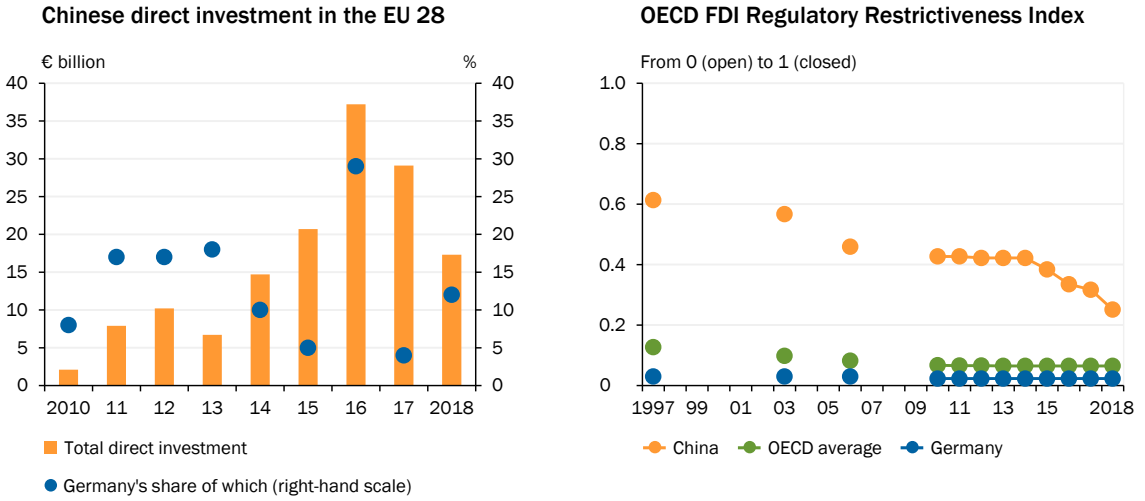
322. A critical view must be taken of political interference in decisions of the competition commission in order to create national or European champions. It would be excessive to forego the **benefits of competition** today for fear of possible competition from abroad in the future. Competition not only ensures lower prices; it can also safeguard the innovative capacity (Aghion et al., 2005) and, in turn, the future competitiveness of European producers.

323. By its industrial strategy, China seeks to catch up technologically, a process it wishes to accelerate through direct investment in foreign technology firms (Wübbeke et al., 2016). While **Chinese direct investment** is chiefly concentrated in Asia, investment in Europe and Germany did, however, reach a record high in 2016. The capital flows from China were dominated by very large individual investments, however, which could have distorted the general perception. The absolute level of investment does not indicate a **flood of Chinese investment** (Felbermayr et al., 2019) and recently even appears to be on a downward trend again in Europe (Hanemann et al., 2019). ↘ CHART 52 LEFT

324. The debate surrounding Chinese takeovers gained new momentum with the attempt by the **State Grid Corporation of China** (SGCC), China's largest pow-

↘ CHART 52

Chinese direct investment in the EU and barriers to foreign direct investment in China



Sources: Hanemann et al. (2019), OECD

er grid operator, to acquire a shareholding in German transmission system operator **50Hertz**. The Federal Government prevented the takeover in 2018 with the help of the KfW. This experience appears to have triggered the need to be able to monitor – and if necessary prevent – foreign direct investment more easily in future.

For example, **stricter screening of investment** was adopted at the end of 2018. Under the provisions of this amendment, the Federal Ministry for Economic Affairs and Energy can – in agreement with the Federal Government – prohibit investment by companies that are not domiciled in the EU or the European Free Trade Association (EFTA) if the target company plays a **critical role for security** and more than 10 % of the company shares are to be acquired. Previously this threshold was 25 %. At the same time, the European Commission (2019d) adopted measures for greater control of non-European direct investment.

325. If investment is prohibited, this constitutes a serious encroachment on **individual freedom of contract** and limits the use of private property (Gerhard, 2018). Screening of investment must therefore be carefully justified. One reason can be if the acquisition poses a threat to **security** and **critical service provision in the community** (critical infrastructure). The protection of general interest should not, however, be abused to restrict the free movement of capital in an opaque, arbitrary manner. In addition, it is questionable to what extent a stake by foreign investors below the blocking minority can actually constitute a threat for the community.

326. Foreign acquisitions can be associated with a **decline in innovation activity** (Stiebale and Reize, 2011; Stiebale, 2016) and a reduction in highly skilled workers (Huttunen, 2007). Nevertheless, foreign direct investment has a positive effect on the growth of an economy (Iamsiraroj, 2016). It appears, however, that **Chinese investment** stokes particular **suspicion**. For example, the ac-

quisition of robotics firm Kuka caused quite a stir potentially due to the high purchase price (GCEE Annual Report 2016 item 985).

The willingness to pay a high price could be a sign that Chinese companies recognise the societal value of a high-tech business and are internalising the positive spillovers for their own economy (Dullien, 2019). Yet, high willingness to pay could also simply be a reflection of the **wasteful management of state-run enterprises** (Guo et al., 2016). Furthermore, single costly takeovers in Germany seem to distort the public's perception of Chinese investment. In the global context, Fuest et al. (2019) demonstrate that on average Chinese investors pay less for a business takeover than investors of other nationalities.

327. Critics regarding Chinese investment are reinforced by the comparatively **restrictive regulation of foreign investment in China**. ↘ CHART 52 RIGHT Furthermore, poor protection of intellectual property rights is a cause for concern when it comes to investment in China (BMWi, 2019c).

328. In the context of foreign direct investment, the Federal Ministry for Economic Affairs and Energy (BMWi, 2019a) has proposed the creation of a **participation facility**, i.e. a government agency that could prevent takeover bids by foreign investors by providing a counter offer. ↘ CHART 324 A state-owned facility that has both time and monetary restrictions can, however, be exposed to strategic behaviour of foreign and domestic investors, which could cause **disruptions on capital markets**. Finally, the facility – like the investment screening mechanism – also constitutes an encroachment on the freedom of contract. Such infringements should be subject to strict conditions.

329. Investments should be blocked – irrespective of the investing country – if a resulting merger negatively impacts competition. China is a distinctive case in this regard, as Chinese companies operate under **state patronage** to a certain extent and may already cooperate with one another. While they operate and invest individually in markets, they are heavily influenced by the state. Therefore, investment by an individual Chinese company ought to be assessed from the perspective of a potential overriding government objective (Wambach, 2019). Where this is the case, mergers should be deemed anti-competitive.

330. Discussions surrounding China's ambitions are not limited to the capital market, however. Recent events concerning telecommunications equipment provider Huawei and the expansion of the 5G network has sparked a debate on Germany's **technological sovereignty,** which asks to what extent a technological dependence on non-EU providers has arisen that could, on the one hand, constitute a security risk while, on the other, also indicate poor future vision of German industry. This not only applies to the telecommunications sector but also to other cross-sectoral IT services, such as cloud computing, data analytics or server farms.

331. IT services can involve high fixed costs, making **market entry** more **difficult**. This becomes even more relevant if businesses immediately have to compete with market heavyweights, such as Alphabet or Amazon, for market shares. Barriers to market entry could be reduced with targeted government support. How-

ever, the Quaero and Theseus projects – two Internet search engines developed in Europe with government funding – are a reminder that such government intervention does not automatically guarantee success.

The international division of labour is a successful model which should be preserved (GCEE Annual Report 2017 items 629 ff.). Should **IT services** resemble a **natural monopoly** on account of their structure, regulatory measures could reduce distortions and ensure security requirements are satisfied. ↘ ITEMS 311 FF. Justified security requirements for IT services are likely to be in the providers' own interest anyway to some extent, as a convincing security concept can give them the competitive edge over rivals.

IV. REGIONAL INDUSTRIAL POLICY

332. Global trends such as **digitisation, globalisation and** the shift towards more **knowledge-intensive industries** can justify industrial policy interventions. Due to heterogeneous regional economic structures these trends can present different challenges for individual regions. A single national policy is then not equally suited to all regions. Germany has a long tradition of place-based policies in the form of the **Joint Federal Government/*Länder* Task to Improve the Regional Economic Structure** (GRW). GRW funding primarily comprises **investment grants** for firms and establishments **in less developed regions** (BMWi, 2019d). ↘ BOX 8

↘ BOX 8

Promotion of regional economic development in Germany

The promotion of regional development is a **central component of economic policy** in Germany and the EU. At the EU level, structural policy funding expenditures constitute the second-biggest item, accounting for 34 % of the EU budget in the 2014-2020 period (European Commission, 2019e). Expenditures are organised through five **European Structural and Investment Funds** (ESIF) and aim to generate and strengthen economic growth. In terms of place-based policies, the European Regional Development Fund (ERDF) and the European Social Fund (ESF) are the most important funding instruments.

Regions with a per capita GDP of less than 75 % the EU average are considered particularly eligible for funding. For the **ERDF**, funding centres on strengthening research, technological development and innovation, the competitiveness of SMEs and the reduction of carbon emissions in all sectors of the economy. The **ESF** focuses on the advancement of sustainable employment and worker mobility, the promotion of social inclusion, the fight against poverty and discrimination, and investment in education. In the 2014-2020 funding period, Germany is receiving a total of €27.5 billion (GEFRA and RUFIS, 2016), with €11.7 billion coming from the ERDF and €7.5 billion from the ESF. The remaining €8.3 billion come from the European Agricultural Fund for Rural Development (EAFRD).

In addition to the European funds, the **Joint Federal Government/Länder Task to Improve the Regional Economic Structure** (GRW) is at the **core** of **national regional policy** in Germany. The GRW provides investment subsidies for businesses and municipalities in less developed regions. Pursuant to Article 72 (2) of the Basic Law, regional policy in Germany seeks to establish equal living conditions by improving competitiveness and creating a balanced economic structure. In contrast, European

regional policy is not solely focussed on regional convergence. Rather, it promotes smart, sustainable and inclusive growth (GEFRA and RUFIS, 2016).

Since 1969, the GRW has been jointly coordinated and funded by the Federal Government and the *Länder*. Through the provision of **investment subsidies**, the aim is to **create jobs in the manufacturing sector** in particular. A multiplier effect on supplier sectors and service industries is also expected (Eckey, 1995). No fundamental changes have been made to the instruments of the GRW funding programme since its launch (including the GRW predecessor programme from 1959). The direction has been adjusted several times, however. While the focus was initially on disadvantaged rural areas in western Germany, funding in the 1980s concentrated more on the promotion of old industrial regions undergoing structural change.

Following reunification, around 90 % of funding was concentrated on **regions in eastern Germany**. From 1995, the focus changed, broadening from the exclusive promotion of investment in the commercial sector and municipal infrastructure to funding for technology centres and education and skills development activities (GEFRA and RUFIS, 2016). In the period from reunification to the last completed funding period in 2013, €67.7 billion in total were paid out in subsidies (Dettmann et al., 2016). During the same period, the annual budget decreased from €5.9 billion in 1991 to €1.3 billion (BAFA, 2015). Total expenditure has continued to decline since 2015, not least because the utilized funds by *Länder* in eastern Germany are below the projected volumes (Röhl, 2019).

Under the GRW programme, the regions in which firms and establishments can receive support are selected using a **weighted indicator**, which **measures regional structural weakness**. The average values for the unemployment rate and gross annual wages measured in the two years prior to the start of the funding period, an employment forecast and the infrastructure quality are variables that feed into the indicator (Schwengler and Binder, 2006). While the variables are measured at the labour market region level, eligibility for funding is determined at the district and urban municipality level. Major adjustments to the choice of assisted areas were made in the 1990s. Prior to 1997, all regions in eastern Germany had the highest funding status. In 1997, the introduction of the indicator to measure structural weakness in east German districts was introduced. Starting in 2007, assisted areas were classified together for eastern and western German (Etzel, 2018). Furthermore, EU rules limit the number of regions receiving assistance under the GRW programme on the basis of the maximum assisted population. For example, in the 2007-2013 funding period, around 40 % of the population lived in assisted regions (Dettmann et al., 2016).

Stierwald and Wiemers (2003) and Ragnitz and Lehmann (2005) provide initial **empirical evidence** of the **effects of GRW assistance**. Based on business-specific data of the Institute for Employment Research (IAB), positive effects on business investment and turnover are observed for the period around 2000. For the funding period up to 2006, Bade and Alm (2010) demonstrate positive effects on the development of employment in assisted businesses. Negative effects for non-assisted businesses within the particular district are also observed, indicating a crowding-out effect. Dettmann et al. (2017) document positive effects for establishments in Saxony-Anhalt. The effects are less significant at the regional level. With regard to support of the area along the inner German border – a funding instrument within the GRW programme – von Ehrlich and Seidel (2018) find evidence of small, positive – yet persistent – effects on regional economic development between 1971 and 1994.

For western Germany, Dettmann et al. (2016) identify positive effects of GRW assistance on gross value added and productivity but no effects on employment and wage growth. Etzel (2018) shows positive effects of GRW assistance on employment development in the manufacturing sector in eastern German regions. Two-thirds of these positive effects are absorbed at the labour market region level, however. **Indirect effects both within** and **between the regions** therefore appear to play an **important role**.

333. Regional policies aim to influence **factor endowments and resource allocation** between regions and, in turn, promote economic growth (European Commission, 2001). In a world with perfect mobility of labour and capital, interventions to influence production factors would not be necessary. Shocks of varying regional intensity, such as increased trade integration with eastern European countries and China (Dauth et al., 2014; Autor et al., 2016), could be optimally offset by factor mobility. Higher factor mobility would also increase general economic productivity (Bryan and Morten, 2019). However, we observe persistent regional imbalances in Germany which are not offset due to lower labour mobility and high costs of adjustment (Blanchard et al., 1992; Amior and Manning, 2019).

334. How persistent existing **regional differences** can be, becomes obvious by analysing of the **rate of unemployment** and **income** over time. Over the period from 2000 to 2015, a one percentage point higher unemployment rate in 2000 is associated with a 0.48 percentage points higher rate in 2015. The correlation is far more pronounced within regional types, such as metropolitan regions or rural regions. The process of convergence therefore primarily indicates convergence of different types of regions (Oberst et al., 2019). Gathmann et al. (2018) demonstrate pronounced and persistent effects in the form of lower employment and higher unemployment rates for regions affected by plant closures. The results vary depending on the age of the workers, with workers up to the age of 50 being more mobile and finding a new job relatively quickly in neighbouring regions.

335. Large disparities in income level, measured by **regional GDP per inhabitant**, are also apparent. Based on statistics from the INKAR database, the Helmstedt labour market region is bottom of the league with €17,350 in 2015. With a GDP per inhabitant 3.5 times that of Helmstedt, Dingolfing was identified as the labour market region with the highest income. While poorer regions did **catch up** in the period between 2000 and 2015 (Oberst et al., 2019), this catch-up process appears to have slowed compared to the period between 1994 and 2003 (Eggert et al., 2007). Gaps are therefore only closing very slowly. These imbalances can produce long-term disadvantages for individual workers – such as low-skilled workers – owing to diminishing employment opportunities.

The persistent trends observed are accompanied by agglomeration effects. **Agglomeration economies**, such as a large pool of labour, lower transportation costs and the concentration of knowledge by knowledge diffusion across companies, particularly in knowledge-intensive sectors of the economy, give rise to **regional concentration of economic activity** (Romer, 1990; Krugman, 1991).

336. Depending on the nature of the region-specific externality, regional policy intervention can increase societal well-being and **boost efficiency** by reallocating production factors (Glaeser and Hausman, 2019). The promotion of regional economic development appears to produce positive employment effects at the level of individual businesses; at the regional level these effects seem to be significantly less pronounced. ↘ BOX 8 Persistent structural problems in regions in western Germany, such as the Ruhr area, for instance, could play an important

role with the restructuring of the GRW programme from 2020 onwards. In light of demographic change, an increasing shortage of labour can be expected in the future, with the result that employment development will not be a priority focus. These points could be the catalyst for a realignment of regional funding that places a stronger emphasis on the promotion of innovation.

337. The promotion of innovation with a regional focus traditionally only plays a minor role (BMBF, 2005; Röhl, 2019). The growing **significance of knowledge in production processes and in the services sector** could increase the importance of facilitating innovation in a specific region. The central question in this context is whether the region-specific promotion of research and innovation will result in the convergence of economic activity, the reduction of unemployment and non-employment, and more innovation in less developed regions and the overall economy.

1. Innovation policy with a regional focus

338. **Traditional place-based policies** focus in particular on infrastructure and incentive policies. **Infrastructure policies** involve improving transport routes, digital infrastructure and education and research facilities. **Incentive policies** refer to the promotion of businesses through subsidies, which can take the form of direct government expenditure or tax advantages.

339. It is unclear whether the impact of higher R&D spending is most effective in less developed regions. It is often stated that top performance in research requires a critical size (EFI, 2014). From an economic perspective, it is necessary to weigh the effect of each additional euro spent between the relative increase in regional economic performance and the maximisation of the overall knowledge base for the economy. If, on the one hand, the return on research funding is considered from the stock of knowledge aspect, each additional euro should be invested in the region with the strongest growth in the overall knowledge base. Due to regional differences in initial endowments and network effects between businesses, universities and non-university research facilities, the **return on investment** varies from region to region and is likely to be higher in urban areas. With an approach focussed on optimising the return on each additional euro, innovative regions would receive greater support.

340. On the other hand, the relative increase in regional economic performance in **less developed regions** as a result of additional innovation and knowledge could be greater than in innovative regions. As a result of additional knowledge, living conditions in regions with high unemployment would improve more and generate a welfare gain in society even if innovation activity decreased on the whole or relative to the counterfactual situation. Gruber and Johnson (2019) argue that R&D spending in less developed regions increases innovation activity, and more employment could be generated as a result.

341. The societal process involves more than the trade-off between return on investment and average unemployment. The fact that the principle of **equal living**

conditions is incorporated in **German Basic Law** and **social cohesion** is a reason for German and European regional policy, could be an argument for conducting innovation policy with a regional focus. In this context, the level of research funding could be based on the extent of disparities in unemployment and non-employment.

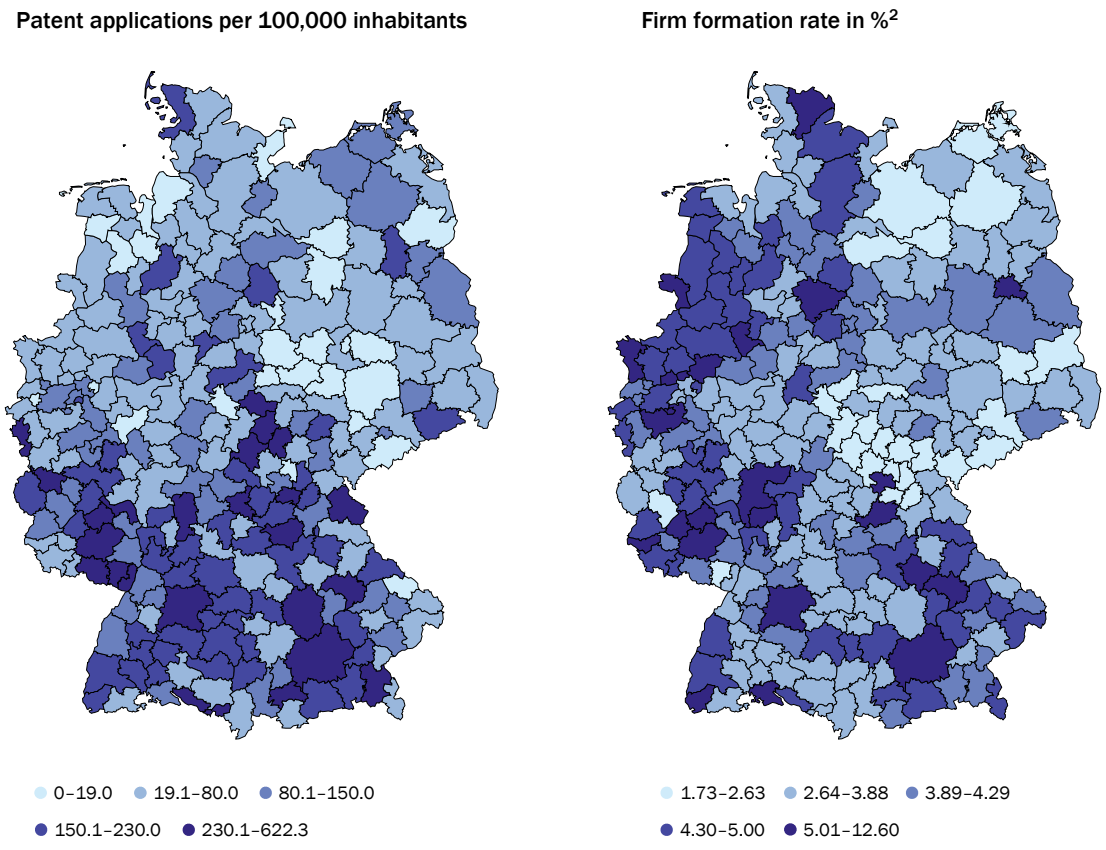
2. The geography of innovation activity in Germany

342. Innovation activity in Germany can be described with comprehensive patent data for the period between 1990 and 2014 (de Rassenfosse et al., 2019). In Germany, the innovation landscape is characterised by significant regional differences and a north-south divide. ↘ CHART 53 Based on the total number of patent applications filed per 100,000 inhabitants in Germany in 2014, about **10 % of the most innovative regions** were responsible for around **31 % of all patent applications filed**. ↘ CHART 53 LEFT This share increased by 0.5 percentage points between 2000 and 2014.

In the same period, the number of actual patent applications rose from 66,500 in 2000 to 87,200. The data also reveal the **growing internationalisation of**

↘ CHART 53

Innovation and business start-up activities in 2014[1]



1 – The category divisions are derived from the first decile, the second to fifth decile, the sixth and seventh decile, the eighth and ninth decile, and the top decile; minor differences due to rounding for presentation purposes. 2 – Number of new businesses established in relation to the existing business base.

Sources: Federal Agency for Cartography and Geodesy, Mannheim Enterprise Panel (MUP), de Rassenfosse et al.(2019), own calculations

innovation activity. While 79 % of German inventions were filed with the German Patent Office in 2000, this share decreased to 73 % in 2014.

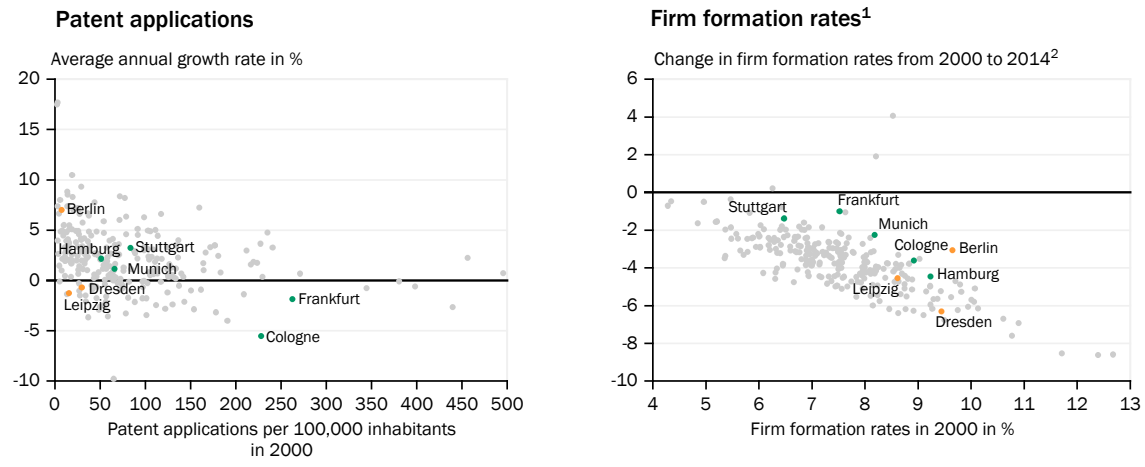
343. Apart from patent applications, **start-up activity** can also be an indicator for the **development of new ideas**. Firm entry in a certain region depends heavily on the level of education in that region (Acs and Armington, 2004; Doms et al., 2010). At the same time, newly established businesses are of central importance for productivity development. ↘ ITEM 185 In the United States, for example, new ideas created at universities and in highly innovative firms often give rise to start-ups and spin-off companies in the same region (Shane, 2004; Agrawal et al., 2014). In Germany, agglomeration areas with a high demand for high-tech products exhibit higher business start-up rates in the high-tech industry (Bade and Nerlinger, 2000). University spin-offs take place close to universities if they need highly skilled staff (Egeln et al., 2004). Start-ups in knowledge-based business sectors are also increasingly found in university regions (Audretsch and Lehmann, 2005).

According to the new-firm formation rate, the number of newly established firms varies significantly between eastern and western Germany. ↘ CHART 53 RIGHT The **new-firm formation indicator** is particularly high **in metropolitan areas**, i.e., regions with a high population density. For example, 37 % of new businesses were established in just 10 of Germany's 257 labour market regions.

344. For the United States, Glaeser and Hausman (2019) document growing regional concentration of innovation activity over time. In Germany, by contrast, no evidence can be found of increasing regional concentration of innovation activity in the past two decades. For example, there is no correlation between patents filed in 2000 and regional growth rates between the years 2000 and 2014. The **geographical concentration** observed has therefore been relatively **constant** over time. ↘ CHART 54 LEFT On the other hand, a negative correlation is found between the firm formation rate in 2000 and the change in the firm formation rate

↘ CHART 54

Innovation and business start-up activities between 2000 and 2014



1 – Number of new businesses established in relation to the existing business base. 2 – Difference in percentage points.

Sources: Mannheim Enterprise Panel (MUP), de Rassenfosse et al. (2019), own calculations

between 2000 and 2014. This suggests regional convergence in firm formation rates. ↘ CHART 54 RIGHT

3. Technology clusters in Germany

345. One instrument of regional innovation policy in Germany is the promotion of value-added clusters that centre on the creation and exploitation of agglomeration externalities. **Cluster initiatives** are frequently registered associations that **coordinate** a **network** of SMEs, large corporations, universities and higher education institutions, non-university facilities and other stakeholders, such as chambers of commerce.

So far, cluster promotion in Germany has been characterized by a **bottom-up approach**. This institutionalised funding approach limits the state to supportive measures that are to promote existing cluster initiatives and encourage cooperation between existing companies and research facilities. The focus lies on the promotion and coordination of **value chains and related sectors** rather than on the promotion of individual businesses or industries (Benner, 2012). The linking of universities and non-university research facilities with economic agents in **innovation clusters** makes a key contribution to the **transfer of knowledge** from academic research to the business community. The regional economic structure is central to knowledge transfer, with agglomerations and regions with a well-developed high-tech industry demonstrating stronger innovation spillovers (Schlegel et al., 2019).

346. The promotion of clusters has been an **important and successful component of German industrial policy** at the latest since the BioRegio Competition in 1995. Launched by the Federal Ministry of Education and Research (BMBF), this competition aimed to encourage greater cooperation between regional businesses and research facilities in the field of biotechnology. The federal government and the *Länder* have implementedadditional cluster initiatives modelled on this cluster programme (Dohse and Staehler, 2008). The federal government's first High-Tech Strategy launched in 2006 developed a standardised system of cluster promotion for all government ministries for the first time ever (BMBF, 2006). The current High-Tech Strategy 2025, which seeks to increase **R&D spending** by the federal government, *Länder* and business sector to **3.5 % of GDP**, also puts a strong emphasis on the promotion of cluster initiatives (BMBF, 2018a).

347. Apart from cooperation, competition between the participating actors is a key ingredient for successful cluster development. Research therefore refers to the concept of **cooperative competition** (Schmitz, 1995; Cimoli et al., 2008; Herr and Nettekoven, 2018), which will produce the best technological solutions and the most competitive companies. This competition between actors, a high level of internal dynamism and a culture of openness characterise successful clusters.

The divergent development of the semiconductor industry in Silicon Valley and Route 128 (beltway around Boston) illuminate this point. Policy-makers frequently cite the example of **Silicon Valley** as an argument for the promotion of

clusters. It is often forgotten, however, that different factors contribute to success. Until the early 1980s, for example, Route 128 was as important as Silicon Valley as a centre of electronics and high-tech industries. However, it was primarily dominated by older, hierarchical and less dynamic firms; furthermore, legal regulations hindered both labour mobility and spin-off (Saxenian, 1994; Franco and Mitchell, 2008). Silicon Valley was able to respond far more flexibly to the challenge posed by increasing competition from Asian companies, particularly with a **structural change** towards software and IT solutions and the move away from semi-conductor manufacturing (Rosenthal and Strange, 2004).

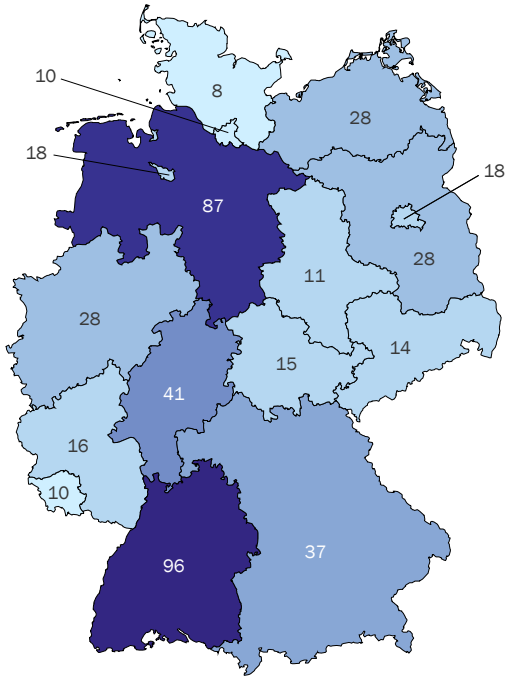
348. In Germany cluster support is primarily concentrated in Baden-Württemberg and Lower Saxony, with the states of Hesse and Bavaria occupying third and fourth place in terms of the number of cluster initiatives. ↘ CHART 55 LEFT This is a reflection of **existing** technical **knowledge** and the presence of universities and large businesses with spillover effects on the region and with higher research spending overall. ↘ ITEMS 291 FF.

With regard to **technological priorities,** it is found that the cluster initiatives have long been focussing on the areas that are expected to be important for the future – such as Industry 4.0, automotives and ICT – as posited in the National Industrial Strategy 2030. ↘ CHART 55 RIGHT This illustrates that businesses and research facilities respond to technological innovations more quickly and purposefully than policy-makers do. Clusters may be well placed to build on the good research position and ensure implementation in domestic production.

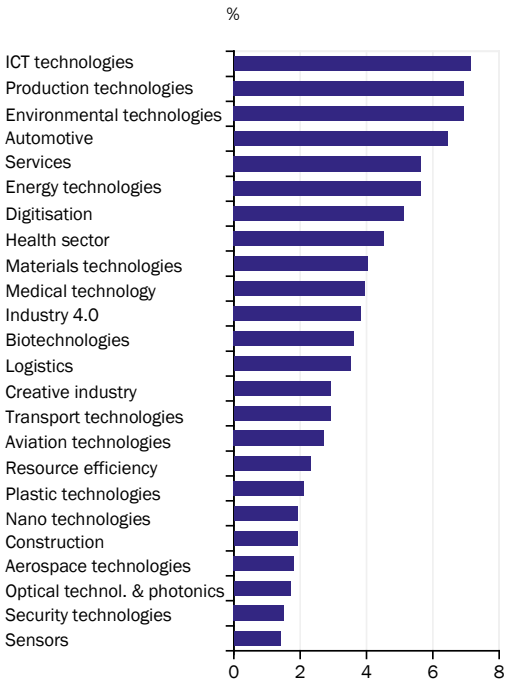
↘ CHART 55

Cluster initiatives in Germany[1]

Number of cluster initiatives in the Länder in 2019[2]



Technology fields of the cluster initiatives[3]



1 – 430 cluster initiatives in total, data as at October 2019. 2 – A cluster initiative can extend beyond Land boundaries. 3 – A cluster initiative can cover several fields of technology.

Sources: Clusterplattform Deutschland, Federal Agency for Cartography and Geodesy, own calculations

349. Cluster development and any resulting positive external effects take time. As private investment is often more short-term in nature (Brandt, 2008), long-term **cluster promotion** can generate added value. The danger, however, is that businesses do not wean themselves off state funding and do not become profitable. This can lead to **negative lock-in effects** with overspecialisation and monostructures without additional processes of modernisation and innovation (Saxenian, 1994). The risk of providing assistance to less successful clusters for too long should be addressed by conducting regular external evaluations based on transparent criteria.

350. While current cluster evaluations are **largely positive** and **the continued development of clusters** is recommended (Ekert et al., 2016), the impact on the national stock of knowledge or GDP is difficult to quantify. Crass et al. (2017) demonstrate that firms operating in a cluster are more likely to participate in public innovation support programmes. This effect could reflect the diffusion of information or a higher propensity to seek public funding among clusters. However, no impacts on R&D intensity or on revenue from new products are identified.

351. The estimation of **opportunity cost** poses another challenge when it comes to evaluating clusters. Talented, highly skilled workers can be as beneficial for production and innovation processes in Munich as in the Lausitz region. The question is whether the **reallocation of productive workers** from Munich to the Lausitz region would produce a better or worse macroeconomic result overall. The same applies with regard to inventions and the entrepreneurial discovery process. As regional production processes for knowledge and innovation are difficult to quantify, it is not clear whether the reallocation of human capital or research funding would lead to greater innovation overall.

4. Key conditions for successful regional innovation policy

352. The local education level plays a critical role in regional resource allocation decisions. The prospects of research funding in less developed regions are poor if the regions lack a **critical threshold in human capital**. There is a positive correlation between **innovation activity** and the **regional education level**. Regions with a higher proportion of individuals graduated from a university or university of applied sciences demonstrate higher innovation activity. ↘ CHART 56 LEFT

An above-average qualification level can be observed in larger cities and metropolitan regions, in particular. When weighted by the local population, there is a **correlation coefficient** of 0.15 between a **university qualification** and the number of **patent applications** at regional level. This correlation is 0.5 between **new business registrations** and the **level of education**. A high individual level of education correlates with start-up activities, and decisions to start a business are more likely in regions with a skilled, well-educated population. Furthermore, the success of a new entrepreneur increases with her level of edu-

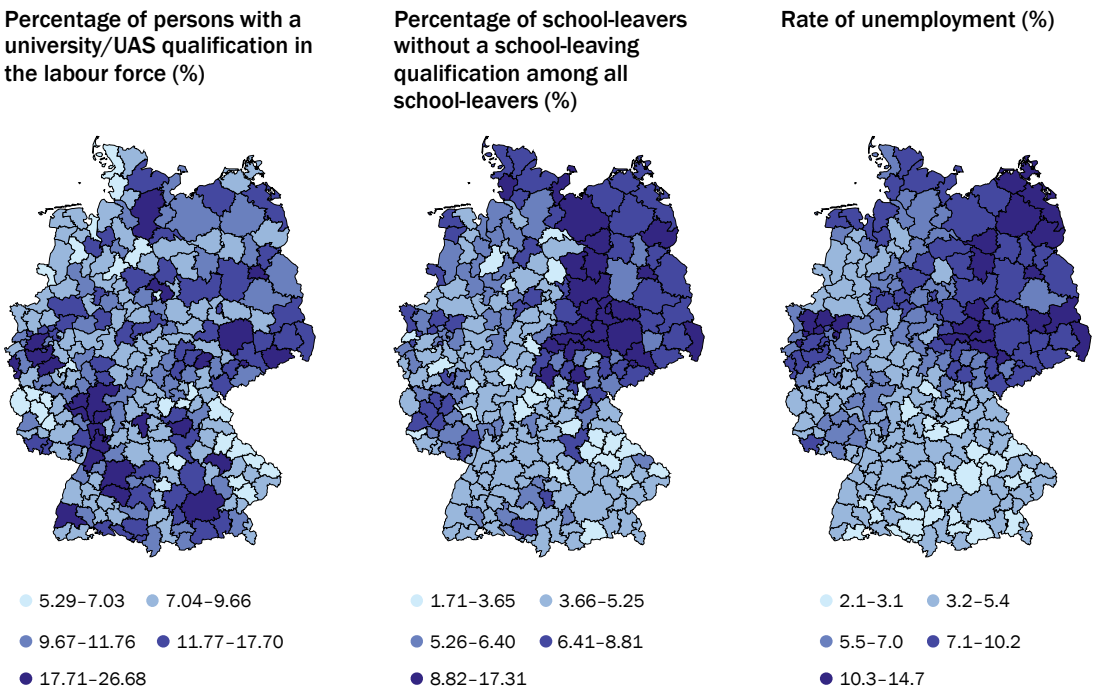
cation and labour market experience (Blanchflower and Oswald, 1998; Baptista et al., 2014).

353. There is a decidedly negative link between the proportion of **school-leavers without a school-leaving qualification** and the number of patents. ↘ CHART 56 CENTRE Regions with a high drop-out rate have a low level of innovation activity, with the correlation coefficient at –0.32. Given the lower regional mobility of low-skilled workers, high school drop-out rates are a first indication of higher unemployment rates and long-term unemployment in the future. The graphic on the right illustrates the regional distribution of **unemployment**. High unemployment rates are a reflection of low innovation activity. ↘ CHART 56 RIGHT The link between the rate of unemployment and patent applications is most pronounced with a correlation coefficient of –0.5.

354. The connection between education, unemployment and innovative processes may provide an indication of the regions that will prosper in the future. However, regional discrepancies in economic activity, innovation and unemployment as well as the quality of human capital suggest that the **creativity yield** is **lower** in regions with higher levels of **underemployment** (Glaeser and Hausman, 2019). Heterogeneous regional unemployment rates and non-employment also signify fiscal externalities, as less tax revenue is generated and social spending is higher. This is linked to higher indebtedness of local authorities and a lower municipal taxing capacity (Kommission Gleichwertige Lebensverhältnisse, 2019), which could, in turn, restrict spending on education and research. ↘ ITEMS 536 FF.

↘ CHART 56

Regional distribution of education and unemployment in 2015[1]



1 – The category divisions are derived from the first decile, the second to fifth decile, the sixth and seventh decile, the eighth and ninth decile, and the top decile; minor differences due to rounding for presentation purposes.

Sources: Federal Agency for Cartography and Geodesy, INKAR database, own calculations

5. Policy implications

355. For regional innovation policies to be implemented successfully, the improvement of the current level of education, particularly in underperforming regions, is of central importance. Increasing shortages of skilled labour in conjunction with elevated school drop-out rates in some regions call for investment in the **quality of school education** and an improvement in early childhood education. Furthermore, a **strengthening of local universities** can make a significant contribution to regional success. Businesses benefit from the more intensive diffusion of knowledge in locations where knowledge is produced. Positive causal effects of universities on local innovation activities, such as patent applications and business creation (Jaffe, 1989; Andersson et al., 2009; Schlegel et al., 2019), economic success (Valero and Van Reenen, 2019) and dynamic wage developments (Moretti, 2004), are documented in the literature.

Universities, however, are not only producers of knowledge and ideas, but also educators of students who often remain in the region and in doing so drive up the demand for cultural and social amenities (Diamond, 2016). This indirect effect **makes a region more attractive**.

356. Between 1990 and 2016, the number of private and public universities of applied sciences rose from 73 to 217. By comparison, the number of universities rose from 84 to 110. The *Länder* with the highest number of new education institutions are Berlin, North-Rhine Westphalia, Baden-Wuerttemberg and Bavaria, a development which correlates with the number of school-leavers with an *Abitur* (qualification to enter higher education) and regional economic performance (Hüning et al., 2017). Compared with universities, **universities of applied sciences** tend to focus more on application-oriented research and teaching. For instance, this is reflected in closer collaboration with businesses, (Haug and Hetmeier, 2003). The stronger focus on **application orientation** can be a critical factor when it comes to the **commercialisation of innovations**.

A drive to **strengthen research-intensive universities** could have a positive impact on local development, attract leading researchers in all fields and encourage young people to remain in the region. Research funding with incentives to commercialise innovations would then be an appropriate tool to generate cooperation, boost innovation output and create jobs and employment.

357. Germany is engaged in the **global competition for talent**. Highly skilled immigrants could have a positive influence on the innovation process (Kerr and Kerr, 2018) and also increase the productivity of other workers (Ciccone and Peri, 2006). In light of demographic change and growing shortages of skilled labour, specialist workers will become increasingly important for the production process. Policy-makers could give preferential treatment to less developed regions in this context. For example, under the **Skilled Immigration Act** (*Fachkräfteeinwanderungsgesetz*), which is due to enter into force on March 1, 2020, a residence permit could be granted for longer or on a permanent basis for individuals in certain regions. Less developed regions could them-

selves decide whether they wish to participate in such an incentive schemes or not.

358. If Germany is to boost entrepreneurship and increase firm formation rates in weak regions it cannot rely on local innovations alone, however. Numerous examples show that the "importing of ideas" can lead to local employment. For **sustained success**, however, jobs in **export-oriented industries** can make a particular contribution (Glaeser and Hausman, 2019).

Regulatory sandboxes could be established to boost local economic dynamism in disadvantaged regions (BMWi, 2019e). Substantial barriers resulting from **regulation present high fixed costs** for firms. Reducing these barriers for a limited time in a particular region creates an environment to test and evaluate new ideas. The creation of such regulatory sandboxes with lower regulatory barriers can therefore help foster innovation. However, due to large distances no effect in the services industry can be expected in very sparsely populated regions.

359. A well **developed infrastructure** can also support regional **adjustment mechanisms**. For example, in the past, better train services have meant that a change of job is less likely to be associated with the need to relocate (Heuermann and Schmieder, 2018), thereby reducing the persistence of unemployment. However, as the transport infrastructure in Germany is already relatively well developed, additional stimulus for growth is not very likely. In the rail sector, better links to medium-sized cities and metropolitan centres, such as links to Berlin and Leipzig, could generate bigger positive spillovers on the regions farther away (Demary et al., 2019).

360. With regard to the digital infrastructure, Germany's performance is relatively weak compared with other countries (European Commission, 2019f). With some gaps, the basic broadband technology (6 Mbit/s) is well established throughout Germany, yet progress with **digitisation** in German companies is slow (Armbrüster et al., 2019). Further to this, Industry 4.0 requires **faster, more efficient broadband Internet**. In Germany, the availability of Internet speeds of 200 Mbit/s is primarily concentrated in urban areas. Investment by both the public and private sector is needed here.

In this regard, it is important to bear in mind that **government assistance should be technology neutral** and should only play a role if private investments are not likely due to poor return on investments (GCEE Annual Report 2018 items 149 ff.). A greater concentration of high-tech start-ups in disadvantaged, sparsely populated regions as a result of broadband expansion is rather unlikely in this context.

V. CONCLUSION

361. Industrial policy can help an economy **deal with** ongoing **structural change**. By using industrial policy instruments to foster a culture of innovation, the discovery process can be boosted and competitiveness strengthened. However, the choice of measures is of central importance to the success of industrial policy. As a result of pressure from special interest groups, industrial policy measures could be wrongly applied to **preserve old structures** and delay structural change.

362. Past experience has shown that industrial policy is particularly successful where a horizontal industrial policy is pursued. The principles underlying the reliable legal, infrastructural and fiscal **framework conditions** must be understood to be as much a part of industrial policy as broad **support for research and business start-ups**.

363. **Weak start-up dynamism** could be a barrier to structural change in Germany. By international standards, the level of **private venture capital investment** is very **low**, particularly when it comes to later stage financing. This could be explained by the less significant role played by large institutional investors, such as pension funds, a less developed IPO market and taxation aspects. A deepening of the **European Capital Markets Union** and a business taxation system with no bias towards any particular kind of financing could help remedy this situation. Public involvement in the venture capital market should increase incentives for private-sector investment (**crowding in**), for example through co-financing models. Furthermore, economic framework conditions are of central importance for the promotion of firm creation and to prevent start-ups from relocating to other countries during the growth phase.

364. In the knowledge-based economy, the **ability** of an economy **to innovate** is becoming increasingly important. Germany is already investing a lot in R&D, and has a comprehensive system of research funding. In light of the growing complexity of R&D, increased **European cooperation** could be effective in order to complement Germany's strengths with those of the other Member States. **Addressing the shortage of skilled labour** – through the promotion of skilled immigration, for example – could boost innovation in the private sector, particularly among small and young businesses.

365. Intangible production factors are becoming increasingly important. These factors favour the business model of multi-sided platforms, which have a dominant market position at this stage. Competition policy must take this development into account so that **positions of power on the markets can be contested** and pro-innovation competition can take place. Apart from that, large consistently regulated markets are more important than ever for business growth. The deepening of the **Digital Single Market** would therefore be an important step to encourage the development of European digital companies.

366. Although China still does not grant European businesses fair conditions of competition and a level playing field, Europe should continue to resolutely support the **principles of competition, the free movement of capital and rules-based international trade**. Neither the creation of European champions nor restrictions on foreign direct investment can preserve the competitiveness of European businesses in the long term. On the contrary, they will delay necessary structural adjustments and foster inefficiencies. The key to future prosperity therefore continues to lie in a **high degree of innovation,** which cannot be achieved through vertical industrial policy.

367. There is a long tradition of regional industrial policy in Germany and Europe. In light of demographic change, an increasing shortage of labour can be expected in the future, with the result that employment development in the manufacturing sector will not be a priority focus. Ongoing structural change from an industrialised to a knowledge-based economic structure enhances the importance of **promoting innovation with a regional focus**.

The success of regional industrial policy depends crucially on the local standard of education and on a well-developed physical and digital infrastructure. In order to reduce school drop-out rates, investment in the education infrastructure is required. Not least, there is a need for enough qualified teachers. The **expansion of the digital infrastructure** should be pursued more resolutely, as this is the only way to leverage potential in the production and innovation process.

REFERENCES

Acs, Z.J. and C. Armington (2004), The impact of geographic differences in human capital on service firm formation rates, Journal of Urban Economics 56 (2), 244–278.

Aghion, P., A. Bergeaud, T. Boppart, P.J. Klenow and H. Li (2019), A theory of falling growth and rising rents, Working Paper 2019–11, Federal Reserve Bank of San Francisco.

Aghion, P., N. Bloom, R. Blundell, R. Griffith and P. Howitt (2005), Competition and innovation: An inverted-U relationship, Quarterly Journal of Economics 120 (2), 701–728.

Agrawal, A., C. Catalini and A. Goldfarb (2014), Some simple economics of crowdfunding, Innovation Policy and the Economy 14 (1), 63–97.

Airbus (2019), The moment two signatures made Europe fly, https://www.airbus.com/company/history/airbus50/day1.html, retrieved 16 October 2019.

Airbus (2018), WTO bestätigt: Keine verbotenen Subventionen bei Airbus, einige wenige Subventionsbestandteile bedürfen Klärung, Press release, Amsterdam, 15 May.

Akcigit, U. and S.T. Ates (2019), Ten facts on declining business dynamism and lessons from endogenous growth theory, NBER Working Paper 25755, National Bureau of Economic Research, Cambridge, MA.

Akcigit, U., E. Dinlersoz, J. Greenwood and V. Penciakova (2019), Synergizing ventures, NBER Working Paper 26196, National Bureau of Economic Research, Cambridge, MA.

Akcigit, U., J. Grigsby, T. Nicholas and S. Stantcheva (2018), Taxation and innovation in the 20th century, NBER Working Paper 24982, National Bureau of Economic Research, Cambridge, MA.

Akcigit, U., D. Hanley and N. Serrano-Velarde (2016), Back to basics: Basic research spillovers, innovation policy and growth, CEPR Discussion Paper 11707, Centre for Economic Policy Research, London.

Alstadsæter, A., S. Barrios, G. Nicodeme, A.M. Skonieczna and A. Vezzani (2018), Patent boxes design, patents location, and local R&D, Economic Policy 33 (93), 131–177.

Amior, M. and A. Manning (2019), Commuting, migration and local joblessness, CEP Discussion Paper 1623, Centre for Economic Performance, LSE, London.

Andersson, R., J.M. Quigley and M. Wilhelmsson (2009), Urbanization, productivity, and innovation: Evidence from investment in higher education, Journal of Urban Economics 66 (1), 2–15.

Armbrüster, T., G. Sames, I. Bertschek and S. Human (2019), Die acht Schritte zur Digitalisierung, https://www.industry-of-things.de/die-acht-schritte-zur-digitalisierung-a-850376/, retrieved 13 September 2019.

Arora, A., S. Belenzon and A. Patacconi (2015), Killing the golden goose? The decline of science in corporate R&D, NBER Working Paper 20902, National Bureau of Economic Research, Cambridge, MA.

Arthur, W.B. (2009), The nature of technology: What it is and how it evolves, Free Press (Simon and Schuster), New York.

Atkeson, A. and P.J. Kehoe (2007), Modeling the transition to a new economy: Lessons from two technological revolutions, American Economic Review 97 (1), 64–88.

Audretsch, D.B. and E.E. Lehmann (2005), Does the knowledge spillover theory of entrepreneurship hold for regions?, Research Policy 34 (8), 1191–1202.

Autor, D.H., D. Dorn and G.H. Hanson (2016), The China shock: Learning from labor-market adjustment to large changes in trade, Annual Review of Economics 8 (1), 205–240.

Autor, D.H., D. Dorn, L.F. Katz, C. Patterson and J. Van Reenen (2017), The fall of the labor share and the rise of superstar firms, NBER Working Paper 23396, National Bureau of Economic Research, Cambridge, MA.

Azoulay, P., J.S. Graff Zivin, D. Li and B.N. Sampat (2019), Public R&D investments and private-sector patenting: Evidence from NIH funding rules, Review of Economic Studies 86 (1), 117–152.

Bade, F.-J. and B. Alm (2010), Evaluierung der Gemeinschaftsaufgabe „Verbesserung der regionalen Wirtschaftsstruktur“ (GRW) durch einzelbetriebliche Erfolgskontrolle für den Förderzeitraum 1999-2008 und Schaffung eines Systems für ein gleitendes Monitoring, Endbericht zum Gutachten, Technische Universität Dortmund.

Bade, F.-J. and E.A. Nerlinger (2000), The spatial distribution of new technology-based firms: Empirical results for West-Germany, Papers in Regional Science 79 (2), 155–176.

BAFA (2015), Statistik der Gemeinschaftsaufgabe „Verbesserung der regionalen Wirtschaftsstruktur", Bewilligungsbescheide seit 1991, Federal Office of Economics and Export Control, Eschborn.

Bajgar, M., C. Criscuolo and J. Timmis (2019), Supersize me: Intangibles and industry concentration, Working Paper DSTI/CIIE(2019)13, Organisation for Economic Co-operation and Development, Paris.

Baldwin, R.E. and F. Robert-Nicoud (2007), Entry and asymmetric lobbying: Why governments pick losers, Journal of the European Economic Association 5 (5), 1064–1093.

Baptista, R., M. Karaöz and J. Mendonça (2014), The impact of human capital on the early success of necessity versus opportunity-based entrepreneurs, Small Business Economics 42 (4), 831–847.

Barwick, P.J., M. Kalouptsidi and N.B. Zahur (2019), China's industrial policy: An empirical evaluation, NBER Working Paper 26075, National Bureau of Economic Research, Cambridge, MA.

Bauer, T.K., M. Fertig and C.M. Schmidt (2009), Empirische Wirtschaftsforschung: Eine Einführung, Springer, Berlin and Heidelberg.

Beason, R. and D.E. Weinstein (1996), Growth, economies of scale, and targeting in Japan (1955-1990), Review of Economics and Statistics 78 (2), 286–295.

Benner, M. (2012), Clusterpolitik – Wege zur Verknüpfung von Theorie und politischer Umsetzung, Vol. 52, LIT publisher, Münster.

Bertoni, F., M.G. Colombo and A. Quas (2015), The patterns of venture capital investment in Europe, Small Business Economics 45 (3), 543–560.

Bertoni, F., M.G. Colombo, A. Quas and F. Tenca (2019), The changing patterns of venture capital investments in Europe, Journal of Industrial and Business Economics 46 (2), 229–250.

Blanchard, O.J., L.F. Katz, R.E. Hall and B. Eichengreen (1992), Regional evolutions, Brookings Papers on Economic Activity 1992 (1), 1–75.

Blanchflower, D.G. and A.J. Oswald (1998), What makes an entrepreneur?, Journal of Labor Economics 16 (1), 26–60.

Bloom, N., R. Griffith and J. Van Reenen (2002), Do R&D tax credits work? Evidence from a panel of countries 1979–1997, Journal of Public Economics 85 (1), 1–31.

Bloom, N., C. Jones, J. Van Reenen and M. Webb (2017), Are ideas getting harder to find?, NBER Working Paper 23782, National Bureau of Economic Research, Cambridge, MA.

Bloom, N., J. Van Reenen and H. Williams (2019), A toolkit of policies to promote innovation, Journal of Economic Perspectives 33 (3), 163–184.

BMBF (2018a), Forschung und Innovation für die Menschen: Die Hightech-Strategie 2025, Federal Ministry of Education and Research, Berlin.

BMBF (2018b), Bundesbericht Forschung und Innovation 2018: Forschungs- und innovationspolitische Ziele und Maßnahmen, Federal Ministry of Education and Research, Berlin.

BMBF (2018c), Eckpunkte der Agentur zur Förderung von Sprunginnovationen, Federal Ministry of Education and Research, Berlin.

BMBF (2006), Die Hightech-Strategie für Deutschland, Federal Ministry of Education and Research, Berlin.

BMBF (2005), Das BMBF-Förderprogramm InnoRegio – Ergebnisse der Begleitforschung, Federal Ministry of Education and Research, Berlin.

BMWi (2019a), Nationale Industriestrategie 2030: Strategische Leitlinien für eine deutsche und europäische Industriepolitik, Federal Ministry for Economic Affairs and Energy, Berlin.

BMWi (2019b), Das Projekt GAIA-X: Eine vernetzte Dateninfrastruktur als Wiege eines vitalen, europäischen Ökosystems, Federal Ministry for Economic Affairs and Energy, Berlin.

BMWi (2019c), China – Wirtschaftliche Beziehungen, https://www.bmwi.de/Redaktion/DE/Artikel/Aussenwirtschaft/laendervermerk-china.html, retrieved 14 October 2019.

BMWi (2019d), Gemeinschaftsaufgabe „Verbesserung der regionalen Wirtschaftsstruktur" (GRW), http://www.foerderdatenbank.de/Foerder-

DB/Navigation/Foerderrecherche/suche.html?get=views;document&doc=373, retrieved 13 September 2019.

BMWi (2019e), Freiräume für Innovationen – Das Handbuch für Reallabore, Federal Ministry for Economic Affairs and Energy, Berlin.

BMWi (2017), Gemeinsame Pressemitteilung zu Air Berlin, https://www.bmwi.de/Redaktion/DE/Pressemitteilungen/2017/20170815-gemeinsame-pressemitteilung-zu-air-berlin.html, retrieved 16 October 2019.

BMWi (2007), Nationaler IT-Gipfel 2007 in Hannover, https://www.de.digital/DIGITAL/Redaktion/DE/Standardartikel/Digital-Gipfel/it-gipfel-rueckblick-2007.html, retrieved 16 October 2019.

Bøler, E.A., A. Moxnes and K.H. Ulltveit-Moe (2015), R&D, international sourcing, and the joint impact on firm performance, American Economic Review 105 (12), 3704–3739.

Brander, J.A., Q. Du and T. Hellmann (2015), The effects of government-sponsored venture capital: International evidence, Review of Finance 19 (2), 571–618.

Brander, J.A., E. Egan and T.F. Hellmann (2010), Government sponsored versus private venture capital: Canadian evidence, in: Lerner, J. and A. Schoar (Eds.), International Differences in Entrepreneurship, University of Chicago Press, 275–320.

Brander, J.A. and B.J. Spencer (1985), Export subsidies and international market share rivalry, Journal of International Economics 18 (1–2), 83–100.

Brandt, A. (2008), Sind Cluster machbar? Zur ökonomischen Begründung von Clusterpolitik und zur politischen Gestaltbarkeit von Clusterkonzepten, in: Kiese, M. and L. Schätzl (Eds.), Cluster und Regionalentwicklung: Theorie, Beratung und praktische Umsetzung, Rohn publisher, Dortmund, 111–126.

Bryan, G. and M. Morten (2019), The aggregate productivity effects of internal migration: Evidence from Indonesia, Journal of Political Economy 127 (5), 2229–2268.

Chen, Z., Z. Liu, J.C. Suárez Serrato and D.Y. Xu (2018), Notching R&D investment with corporate income tax cuts in China, NBER Working Paper 24749, National Bureau of Economic Research, Cambridge, MA.

Ciccone, A. and G. Peri (2006), Identifying human-capital externalities: Theory with applications, Review of Economic Studies 73 (2), 381–412.

Cimoli, M., G. Dosi and J.E. Stiglitz (2008), The future of industrial policies in the new millennium: Toward a knowledge-centered development agenda, LEM Working Paper 2008/19, Laboratory of Economics and Management, Sant'Anna School of Advanced Studies, Pisa.

Colombo, M.G., D.J. Cumming and S. Vismara (2016), Governmental venture capital for innovative young firms, Journal of Technology Transfer 41 (1), 10–24.

Comin, D. and B. Hobijn (2010), An exploration of technology diffusion, American Economic Review 100 (5), 2031–2059.

Condor (2019), Bundesbürgschaft für Überbrückungskredit zugesagt, https://condor-newsroom.condor.com/de/de/news-artikel/bundesbuergschaft-fuer-ueberbrueckungskredit-zugesagt/, retrieved 16 October 2019.

Corrado, C., J. Haskel, C. Jona-Lasinio and M. Iommi (2016), Intangible investment in the EU and US before and since the Great Recession and its contribution to productivity growth, EIB Working Paper 2016/08, European Investment Bank, Luxembourg.

Corrado, C.A. and C.R. Hulten (2010), How do you measure a „technological revolution"?, American Economic Review 100 (2), 99–104.

Crass, D., C. Rammer and B. Aschhoff (2017), Geographical clustering and the effectiveness of public innovation programs, Journal of Technology Transfer, 1–32.

Crouzet, N. and J. Eberly (2019), Understanding weak capital investment: The role of market concentration and intangibles, NBER Working Paper 25869, National Bureau of Economic Research, Cambridge, MA.

Curtis, E.M. and R.A. Decker (2018), Entrepreneurship and state taxation, FEDS Working Paper 2018–003, Board of Governors of the Federal Reserve System, Washington, DC.

Czarnitzki, D., P. Hünermund and N. Moshgbar (2018), Public procurement as policy instrument for innovation, ZEW Discussion Paper 18–001, Centre for European Economic Research, Mannheim.

Dauth, W., S. Findeisen and J. Südekum (2014), The rise of the East and the Far East: German labor markets and trade integration, Journal of the European Economic Association 12 (6), 1643–1675.

De Loecker, J. and J. Eeckhout (2017), The rise of market power and the macroeconomic implications, NBER Working Paper 23687, National Bureau of Economic Research, Cambridge, MA.

Dechezleprêtre, A., E. Einiö, R. Martin, K.-T. Nguyen and J. Van Reenen (2016), Do tax incentives for research increase firm innovation? An RD design for R&D, NBER Working Paper 22405, National Bureau of Economic Research, Cambridge, MA.

Decker, R.A., J. Haltiwanger, R.S. Jarmin and J. Miranda (2014), The role of entrepreneurship in US job creation and economic dynamism, Journal of Economic Perspectives 28 (3), 3–24.

Dell'Ariccia, G., D. Kadyrzhanova, C. Minoiu and L. Ratnovski (2017), Bank lending in the knowledge economy, IMF Working Paper 17/234, International Monetary Fund, Washington, DC.

Demary, V., F. Obermüller and T. Puls (2019), Infrastruktur als Rückgrat von Regionen, in: Hüther, M., J. Südekum and M. Voigtländer (Eds.), Die Zukunft der Regionen in Deutschland: Zwischen Vielfalt und Gleichwertigkeit, German Economic Institute, Cologne, 210–235.

Dent, R.C., F. Karahan, B. Pugsley and A. Şahin (2016), The role of startups in structural transformation, American Economic Review 106 (5), 219–223.

Dettmann, E., M. Brachert and M. Titze (2016), Identifying the effects of place-based policies – Causal evidence from Germany, CESifo Working Paper 5901, Munich.

Dettmann, E., M. Titze and A. Weyh (2017), Who benefits from GRW? Heterogeneous employment effects of investment subsidies in Saxony Anhalt, IWH Discussion Paper 27/2017, Halle Institute for Economic Research.

Deutsche Welle (2019), US-Strafzölle auf EU-Importe treten in Kraft, https://www.dw.com/de/us-strafz%C3%B6lle-auf-eu-importe-treten-in-kraft/a-50880628, retrieved 18 October 2019.

Diamond, R. (2016), The determinants and welfare implications of US workers' diverging location choices by skill: 1980-2000, American Economic Review 106 (3), 479–524.

DIE ZEIT (2018), Subventionen: Sind Hilfen für Airbus unfair?, https://www.zeit.de/2018/21/airbus-subventionen-boeing-wettbewerb, retrieved 20 February 2019.

Dohse, D. and T. Staehler (2008), BioRegio, BioProfile and the rise of the German biotech industry, Kiel Working Paper 1456, Kiel Institute for the World Economy (IfW).

Doms, M., E. Lewis and A. Robb (2010), Local labor force education, new business characteristics, and firm performance, Journal of Urban Economics 67 (1), 61–77.

Dullien, S. (2019), Kontrolle bei Übernahmen durch Nicht-EU-Ausländer auch zur Verteidigung von Technologieführerschaft sinnvoll, Journal for Economic Policy 68 (1), 45–52.

Eckey, H.-F. (1995), Exportbasistheorie, in: Akademie für Raumforschung and Landesplanung (Eds.), Handwörterbuch der Raumordnung, Hannover, 281–282.

EFI (2019), Gutachten zu Forschung, Innovation und technologischer Leistungsfähigkeit Deutschlands 2019, Expertenkommission Forschung und Innovation, Berlin.

EFI (2016), Gutachten zu Forschung, Innovation und technologischer Leistungsfähigkeit Deutschlands 2016, Expertenkommission Forschung und Innovation, Berlin.

EFI (2014), Gutachten zu Forschung, Innovation und technologischer Leistungsfähigkeit Deutschlands 2014, Expertenkommission Forschung und Innovation, Berlin.

Egeln, J., S. Gottschalk and C. Rammer (2004), Location decisions of spin-offs from public research institutions, Industry and Innovation 11 (3), 207–223.

Eggert, W., M. von Ehrlich and R. Fenge (2007), Konvergenz- und Wachstumseffekte der europäischen Regionalpolitik in Deutschland, Perspektiven der Wirtschaftspolitik 8 (2), 130–146.

von Ehrlich, M. and T. Seidel (2018), The persistent effects of place-based policy: Evidence from the West-German Zonenrandgebiet, American Economic Journal: Economic Policy 10 (4), 344–374.

Ekert, S., V. Schüren and A. Bode (2016), Evaluation des Programms go-cluster des Bundesministeriums für Wirtschaft und Energie, Studie im Auftrag des BMWi, InterVal, Berlin.

Engel, D. and D. Heger (2005), Differences in public and private venture capital companies' activities: Microeconometric evidence for Germany, mimeo.

Etzel, T. (2018), Essays in local public finance and political economy, Inauguraldissertation, University of Mannheim.

European Commission (2019a), Horizon Europe – The next research and innovation framework programme, https://ec.europa.eu/info/horizon-europe-next-research-and-innovation-framework-programme_en, retrieved 16 October 2019.

European Commission (2019b), Statement by Commissioner for Trade Cecilia Malmström on the U.S. countermeasures in the Airbus dispute, STATEMENT/19/6132, Brussels, 18 October.

European Commission (2019c), Kommission untersagt geplante Übernahme von Alstom und Siemens, Press release IP/19/881, Brussels, 6 February.

European Commission (2019d), EU-Verordnung zur Überprüfung ausländischer Direktinvestitionen tritt in Kraft, Press release IP/19/2088, Brussels, 10 April.

European Commission (2019e), Draft general budget of the European Union, https://eur-lex.europa.eu/budget/www/index-en.htm, retrieved 13 September 2019.

European Commission (2019f), The Digital Economy and Society Index (DESI), https://ec.europa.eu/digital-single-market/en/desi, retrieved 13 September 2019.

European Commission (2018a), Impact assessment of Horizon Europe, Staff Working Document SWD(2018) 307 final, Brussels.

European Commission (2018b), Der Binnenmarkt in einer Welt im Wandel – Ein wertvoller Aktivposten braucht neues politisches Engagement, COM(2018) 772 final, Brussels.

European Commission (2017), LAB – FAB – APP: Investing in the European future we want, Report of the independent High Level Group on maximising the impact of EU Research & Innovation Programmes, Brussels.

European Commission (2015), Strategie für einen digitalen Binnenmarkt für Europa, COM(2015) 192 final, Brussels.

European Commission (2010), EUROPA 2020 – Eine Strategie für intelligentes, nachhaltiges und integratives Wachstum, KOM(2010) 2020 endgültig, Brussels.

European Commission (2001), Einheit Europas, Solidarität der Völker, Vielfalt der Regionen – Zweiter Bericht über den wirtschaftlichen und sozialen Zusammenhalt, Luxembourg.

European Council (2000), Schlußfolgerungen des Vorsitzes nach Lissabon-Sondertagung, Lissabon, 23.–24 March.

Evans, D.S. and R. Schmalensee (2016), Matchmakers: The new economics of multisided platforms, Harvard Business Review Press, Boston, MA.

FAZ (2018), Urteil der WTO: EU-Subventionen für Airbus sind illegal, https://www.faz.net/1.5591938, retrieved 20 February 2019.

Felbermayr, G., M. Goldbeck and A. Sandkamp (2019), Chinas ausländische Direktinvestitionen: Ein Überblick, Kiel Policy Brief 123, Kiel Institute for the World Economy (IfW).

Franco, A.M. and M.F. Mitchell (2008), Covenants not to compete, labor mobility, and industry dynamics, Journal of Economics & Management Strategy 17 (3), 581–606.

Fuest, C., F. Hugger, S. Sultan and J. Xing (2019), Chinese acquisitions abroad: Are they different?, CESifo Working Paper 7585, Munich.

Gaessler, F., B.H. Hall and D. Harhoff (2018), Should there be lower taxes on patent income?, NBER Working Paper 24843, National Bureau of Economic Research, Cambridge, MA.

Gathmann, C., I. Helm and U. Schönberg (2018), Spillover effects of mass layoffs, Journal of the European Economic Association, im Erscheinen, https://doi.org/10.1093/jeea/jvy045.

GEFRA and RUFIS (2016), Aufgaben, Struktur und mögliche Ausgestaltung eines gesamtdeutschen Systems zur Förderung von strukturschwachen Regionen ab 2020, Endbericht zum Dienstleistungsprojekt No. 13/14 des Bundesministeriums für Wirtschaft und Energie, Gesellschaft für Finanz- und Regionalanalysen und Ruhr-Forschungsinstitut für Innovations- und Strukturpolitik, Münster and Bochum.

Gerhard, M. (2018), Mehr Schutz vor ausländischen Direktinvestitionen?, Wirtschaftsdienst 98 (11), 820–824.

Glaeser, E.L. (2011), Triumph of the city: How urban spaces make us human, Pan Macmillan, London.

Glaeser, E.L. and N. Hausman (2019), The spatial mismatch between innovation and joblessness, NBER Working Paper 25913, National Bureau of Economic Research, Cambridge, MA.

Grande, E. and J. Häusler (1994), Industrieforschung und Forschungspolitik: Staatliche Steuerungspotentiale in der Informationstechnik, Campus, Frankfurt am Main.

Greenwald, B. and J.E. Stiglitz (2013), Industrial policies, the creation of a learning society, and economic development, in: Stiglitz, J. E. and J. Y. Lin (Eds.), The Industrial Policy Revolution I: The Role of Government Beyond Ideology, International Economic Association Series, Palgrave Macmillan, London, 43–71.

Gruber, J. and S. Johnson (2019), Jump-starting America: How breakthrough science can revive economic growth and the American dream, Public Affairs, New York.

Guo, W., J.A. Clougherty and T. Duso (2016), Why are Chinese MNEs not financially competitive in cross-border acquisitions? The role of state ownership, Long Range Planning 49 (5), 614–631.

Gutiérrez, G. and T. Philippon (2017), Declining competition and investment in the U.S., NBER Working Paper 23583, National Bureau of Economic Research, Cambridge, MA.

Hall, B.H. and J. Lerner (2010), The financing of R&D and innovation, in: Hall, B. H. and N. Rosenberg (Eds.), Handbook of the Economics of Innovation, Vol. 1, North-Holland (Elsevier), Amsterdam, 609–639.

Handelsblatt (2018), Handelskonflikt: USA lassen im Subventions-Streit mit Airbus Milde walten, https://www.handelsblatt.com/unternehmen/industrie/handelskonflikt-usa-lassen-im-subventions-streit-mit-airbus-milde-walten/22612936.html, retrieved 28 February 2019.

Hanemann, T., M. Huotari and A. Kratz (2019), Chinese FDI in Europe: 2018 trends and impact of new screening policies, MERICS Papers on China, MERICS and Rhodium Group, Berlin.

Haskel, J. and S. Westlake (2017), Capitalism without capital: The rise of the intangible economy, Princeton University Press.

Haucap, J. and M. Coenen (2010), Industriepolitische Konsequenzen der Wirtschaftskrise, DICE Ordnungspolitische Perspektiven, Working Paper 03, Düsseldorf Institute for Competition Economics.

Haug, H.-F. and H.-W. Hetmeier (2003), Bericht zur finanziellen Lage der Hochschulen, Federal Statistical Office, Wiesbaden.

Hausmann, R. and D. Rodrik (2003), Economic development as self-discovery, Journal of Development Economics 72 (2), 603–633.

Hellmann, T. and V. Thiele (2019), Fostering entrepreneurship: Promoting founding or funding?, Management Science 65 (6), 2502–2521.

Helmholtz (2019), Die Geschichte der Helmholtz-Gemeinschaft, https://www.helmholtz.de/ueber_uns/die_gemeinschaft/geschichte/, retrieved 16 October 2019.

Hepperle, G.R.M. (2000), Airbus – ein gelungenes Beispiel für beschäftigungsorientierte Industriepolitik?, Schriftenreihe des Promotionsschwerpunkts Makroökonomische Diagnosen und Therapien der Arbeitslosigkeit 12/2000, University of Hohenheim, Stuttgart.

Herr, H. and Z.M. Nettekoven (2018), The role of small and medium-sized enterprises in development: What can be learned from the German experience?, GLU Working Paper 53, Global Labour University and International Labour Organization, Geneva.

Heuermann, D.F. and J.F. Schmieder (2018), The effect of infrastructure on worker mobility: Evidence from high-speed rail expansion in Germany, Journal of Economic Geography 19 (2), 335–372.

Hsieh, C.-T. and Z. (M.) Song (2016), Grasp the large, let go of the small: The transformation of the state sector in China, Brookings Papers on Economic Activity 2015 (1), 295–366.

Hüning, L., L. Mordhorst, R. Röwert and F. Ziegele (2017), Hochschulbildung wird zum Normalfall – auch in räumlicher Hinsicht?, Im Blickpunkt, CHE Centrum für Hochschulentwicklung, Gütersloh.

Huttunen, K. (2007), The effect of foreign acquisition on employment and wages: Evidence from Finnish establishments, Review of Economics and Statistics 89 (3), 497–509.

Iamsiraroj, S. (2016), The foreign direct investment-economic growth nexus, International Review of Economics & Finance 42, 116–133.

Irwin, D. and N. Pavcnik (2001), Airbus versus Boeing revisited: International competition in the aircraft market, NBER Working Paper 8648, National Bureau of Economic Research, Cambridge, MA, Revised in October 2014.

Jacob, B.A. and L. Lefgren (2011), The impact of research grant funding on scientific productivity, Journal of Public Economics 95 (9), 1168–1177.

Jaffe, A.B. (1989), Real effects of academic research, American Economic Review 79 (5), 957–970.

Jiang, H. and F. Sohail (2017), Skill biased entrepreneurial decline, Working Paper, Washington University, St. Louis.

Jones, C. (2016), The facts of economic growth, in: Taylor, J. B. and H. Uhlig (Eds.), Handbook of Macroeconomics, Vol. 2, Elsevier, Amsterdam, 3–69.

Kerr, S.P. and W.R. Kerr (2018), Immigrant entrepreneurship in America: Evidence from the survey of business owners 2007 & 2012, NBER Working Paper 24494, National Bureau of Economic Research, Cambridge, MA.

KfW (2019), Erfolg in Zahlen: Tabellarischer Überblick der KfW Bankengruppe, https://www.kfw.de/KfW-Konzern/Über-die-KfW/Zahlen-und-Fakten/KfW-auf-einen-Blick/, retrieved 16 October 2019.

KfW (2017), KfW gründet Tochtergesellschaft für Beteiligungsfinanzierung, Press release, KfW Group, Frankfurt am Main, 30 June.

Klepper, G. (1994), Industrial policy in the transport aircraft industry, in: Krugman, P. R. and A. Smith (Eds.), Empirical studies of strategic trade policy, A National Bureau of Economic Research Project Report, University of Chicago Press, 101–130.

Kommission Gleichwertige Lebensverhältnisse (2019), Unser Plan für Deutschland – Gleichwertige Lebensverhältnisse überall –, Federal Ministry of the Interior, Building and Community with Federal Ministry of Food and Agriculture and Federal Ministry for Family Affairs, Senior Citizens, Women and Youth, Berlin.

Kommission Wettbewerbsrecht 4.0 (2019), Ein neuer Wettbewerbsrahmen für die Digitalwirtschaft, Federal Ministry for Economic Affairs and Energy, Berlin.

Kortum, S. and J. Lerner (2000), Assessing the contribution of venture capital to innovation, RAND Journal of Economics 31 (4), 674–692.

Kozeniauskas, N. (2017), What's driving the decline in entrepreneurship, mimeo.

Krugman, P.R. (1991), Geography and trade, MIT Press, Cambridge, MA.

Lane, N. (2019), The new empirics of industrial policy, Working Paper, Monash University, Melbourne.

Lane, N. (2017), Manufacturing revolutions: Industrial policy and networks in South Korea, Working Paper, Monash University, Melbourne.

Lawrence, R.Z. and D.E. Weinstein (2001), Trade and growth: Import-led or export-led? Evidence from Japan and Korea, in: Stiglitz, J. E. and S. Yusuf (Eds.), Rethinking the East Asian Miracle, World Bank and Oxford University Press, Washington, DC, 379–408.

Lerner, J., M. Strojwas and J. Tirole (2003), The structure and performance of patent pools: Empirical evidence, Working Paper, Harvard University, Cambridge, MA.

Lucking, B., N. Bloom and J. Van Reenen (2018), Have R&D spillovers changed?, NBER Working Paper 24622, National Bureau of Economic Research, Cambridge, MA.

Maas, S. and P.M. Schmitz (2007), Gemeinsame Agrarpolitik der EU, Wirtschaftsdienst 87 (2), S. 94-100.

Maennig, W. and K. Hölzer (1999), Zur aktuellen deutschen Förderung der Airbus-Industrie, Wirtschaftsdienst 79 (3), 191–200.

Mazzucato, M. (2018a), Mission-oriented innovation policies: Challenges and opportunities, Industrial and Corporate Change 27 (5), 803–815.

Mazzucato, M. (2018b), Mission-oriented research & innovation in the European Union: A problem-solving approach to fuel innovation-led growth, European Commission, Luxembourg.

Mazzucato, M. (2014), The entrepreneurial state: Debunking public vs. private sector myths, Anthem Press, London.

McKinsey (2019), Energiewende-Index, https://www.mckinsey.de/branchen/chemie-energie-rohstoffe/energiewende-index, retrieved 7 October 2019.

Melitz, M.J. (2005), When and how should infant industries be protected?, Journal of International Economics 66 (1), 177–196.

Metzger, G. (2019), KfW-Gründungsmonitor 2019 – Gründungstätigkeit in Deutschland stabilisiert sich: Zwischenhalt oder Ende der Talfahrt?, KfW Group, Frankfurt am Main.

Metzger, G. (2018), KfW-Gründungsmonitor 2018 – Gründungstätigkeit weiter im Tief, aber Wachstum, Innovation und Digitales gewinnen an Bedeutung, KfW Group, Frankfurt am Main.

Metzger, G. and A. Bauer (2015), Beteiligungsmarkt in Deutschland – Lücke bei Venture Capital, Fokus Volkswirtschaft No. 98, KfW Group, Frankfurt am Main.

Metzger, G. and C. Rammer (2009), Unternehmensdynamik in forschungs- und wissensintensiven Wirtschaftszweigen in Deutschland, Studien zum deutschen Innovationssystem No. 05-2009, Centre for European Economic Research, im Auftrag der Expertenkommission Forschung und Innovation (EFI), Berlin.

Meyer, B., S. Küchler and O. Hölzinger (2010), Staatliche Förderungen der Stein- und Braunkohle im Zeitraum 1950-2008, FÖS-Studie im Auftrag von Greenpeace, Forum Ökologisch-Soziale Marktwirtschaft, Berlin.

Monopolies Commission (2015), Wettbewerbspolitik: Herausforderung digitale Märkte, Sondergutachten 68, Bonn.

Monopolies Commission (2004), Wettbewerbspolitik im Schatten „Nationaler Champions“, 15. Hauptgutachten (2002/2003), Bonn.

Moretti, E. (2012), The new geography of jobs, Houghton Mifflin Harcourt, New York.

Moretti, E. (2004), Workers' education, spillovers, and productivity: Evidence from plant-level production functions, American Economic Review 94 (3), 656–690.

Moretti, E., C. Steinwender and J. Van Reenen (2016), The intellectual spoils of war? Defense R&D, productivity and spillovers, mimeo.

Neven, D. and P. Seabright (1995), European industrial policy: The Airbus case, Economic Policy 10 (21), 313–358.

Oberst, C.A., H. Kempermann and C. Schröder (2019), Räumliche Entwicklung in Deutschland, in: Hüther, M., J. Südekum and M. Voigtländer (Eds.), Die Zukunft der Regionen in Deutschland: Zwischen Vielfalt und Gleichwertigkeit, German Economic Institute, Cologne, 87–114.

OECD (2018a), Venture capital investments, https://stats.oecd.org/Index.aspx?DataSetCode=VC_INVEST, retrieved 21 October 2019.

OECD (2018b), OECD review of national R&D tax incentives and estimates of R&D tax subsidy rates 2017, TAX4INNO Project 674888, Organisation for Economic Co-operation and Development, Paris.

O'Sullivan, M., D. Edler and U. Lehr (2018), Ökonomische Indikatoren des Energiesystems, GWS Research Report 2018/01, Gesellschaft für Wirtschaftliche Strukturforschung, Osnabrück.

Pack, H. (2000), Industrial policy: Growth elixir or poison?, World Bank Research Observer 15 (1), 47–67.

Pons-Benaiges, O. (2017), Did government intervention target technological externalities? Industrial policy and economic growth in Postwar Japan, 1964–1983, mimeo.

Ragnitz, J. and H. Lehmann (2005), Wirkungsanalyse der Wirtschaftsförderung in Ostdeutschland, in: Engel, D. (Eds.), Mittelstandsfinanzierung, Basel II und die Wirkung öffentlicher sowie privater Kapitalhilfen, Veröffentlichungen des Round Table Mittelstand, Vol. 5, Duncker & Humblot, Berlin, 221–236.

de Rassenfosse, G., J. Kozak and F. Seliger (2019), Geocoding of worldwide patent data, KOF Working Paper 458, KOF Swiss Economic Institute, ETH Zurich.

Reuters (2018), USA drohen EU nach WTO-Urteil zu Airbus mit Strafen, https://de.reuters.com/article/usa-eu-wto-idDEKCN1IG2GC, retrieved 28 February 2019.

Riess, A. and T. Välilä (2006), Industrial policy: A tale of innovators, champions, and B52s, EIB Papers 11 (1), European Investment Bank, Luxembourg, 10–34.

Rodrik, D. (2010), The return of industrial policy, https://www.project-syndicate.org/commentary/the-return-of-industrial-policy?, retrieved 12 October 2019.

Rodrik, D. (2008), Normalizing industrial policy, Commission on Growth and Development Working Paper 3, World Bank, Washington, DC.

Rodrik, D. (2004), Industrial policy for the twenty-first century, Faculty Research Working Paper RWP04-047, John F. Kennedy School of Government or Harvard University, Cambridge, MA.

Röhl, K.-H. (2019), Regionalpolitik in Deutschland: Instrumente und Erfahrungen, in: Hüther, M., J. Südekum and M. Voigtländer (Eds.), Die Zukunft der Regionen in Deutschland: Zwischen Vielfalt und Gleichwertigkeit, German Economic Institute, Cologne, 115–132.

Romer, P.M. (1990), Endogenous technological change, Journal of Political Economy 98 (5), S71–S102.

Rosenthal, S.S. and W.C. Strange (2004), Evidence on the nature and sources of agglomeration economies, in: Henderson, J. V. and J.-F. Thisse (Eds.), Handbook of Regional and Urban Economics, Cities and Geography, Vol. 4, Elsevier, Amsterdam, 2119–2171.

Salgado, S. (2019), Technical change and entrepreneurship, Conference paper, 2019 Annual Meeting of the Society for Economic Dynamics, St. Louis, MO, 27 June.

Saxenian, A. (1994), Regional advantage: Culture and competition in Silicon Valley and Route 128, Harvard University Press, Cambridge, MA.

Schäfer, D. (2003), Die „Geiselhaft" des Relationship-Intermediärs: Eine Nachlese zur Beinahe-Insolvenz des Holzmann-Konzerns, EconStor Open Access Articles, 65–84.

Schlegel, T., C. Pfister, D. Harhoff and U. Backes-Gellner (2019), Heterogeneous regional innovation spillovers of universities of applied sciences, Swiss Leading House Working Paper 161, University of Zurich.

Schmitz, H. (1995), Small shoemakers and fordist giants: Tale of a supercluster, World Development 23 (1), 9–28.

Schwengler, B. and J. Binder (2006), Solutions for the weighting problem of regional aid indicators when changing to one model for Germany, Raumforschung und Raumordnung 64 (4), 284–298.

Shane, S.A. (2004), Academic entrepreneurship: University spinoffs and wealth creation, Edward Elgar Publishing, Cheltenham.

Shapiro, C. (2000), Competition policy in the information economy, in: Hope, E. (Eds.), Competition Policy Analysis, Routledge, London, 109–132.

Stiebale, J. (2016), Cross-border M&As and innovative activity of acquiring and target firms, Journal of International Economics 99 (C), 1–15.

Stiebale, J. and F. Reize (2011), The impact of FDI through mergers and acquisitions on innovation in target firms, International Journal of Industrial Organization 29 (2), 155–167.

Stierwald, A. and J. Wiemers (2003), Auswirkungen der Gemeinschaftsaufgabe zur „Verbesserung der regionalen Wirtschaftsstruktur" auf die Investitionstätigkeit – Eine einzelwirtschaftliche Wirkungsanalyse für Betriebe des Verarbeitenden Gewerbes in Ostdeutschland, IWH Discussion Paper 185, Halle Institute for Economic Research.

Stifterverband (2019), Forschung und Entwicklung in der Wirtschaft 2017, facts – Zahlen und Fakten aus der Wissenschaftsstatistik, im Auftrag des Bundesministeriums für Bildung und Forschung, Stifterverband für die Deutsche Wissenschaft, Essen.

Stiglitz, J.E., J.Y. Lin and C. Monga (2013), The rejuvenation of industrial policy, Policy Research Working Paper WPS6628, World Bank, Washington, DC.

Sutton, J. (1991), Sunk costs and market structure: Price competition, advertising, and the evolution of concentration, MIT Press, Cambridge, MA.

Thiel, P. and B. Masters (2014), Zero to one: Notes on start ups, or how to build the future, Random House, New York.

Tirole, J. (2017), Economics for the common good, Princeton University Press.

Valero, A. and J. Van Reenen (2019), The economic impact of universities: Evidence from across the globe, Economics of Education Review 68, 53–67.

Wambach, A. (2019), In systemic competition with China, EconPol opinion 24, European Network of Economic and Fiscal Policy Research, Munich.

World Bank (2019), Innovative China: New drivers of growth, in Kooperation mit Development Research Center of the State Council, P.R. China, Washington, DC.

World Bank (1993), The East Asian miracle: Economic growth and public policy, Oxford University Press, New York.

Wilson, D.J. (2009), Beggar thy neighbor? The in-state, out-of-state, and aggregate effects of R&D tax credits, Review of Economics and Statistics 91 (2), 431–436.

WTO (2019), Arbitrator issues decision in Airbus subsidy dispute, Dispute Settlement WT/DS316/ARB, World Trade Organization, Geneva, 2 October.

Wübbeke, J., M. Meissner, M.J. Zenglein, J. Ives and B. Conrad (2016), Made in China 2025: The making of a high-tech superpower and consequences for industrial countries, Merics Paper No. 2/2016, Mercator Institute for China Studies, Berlin.