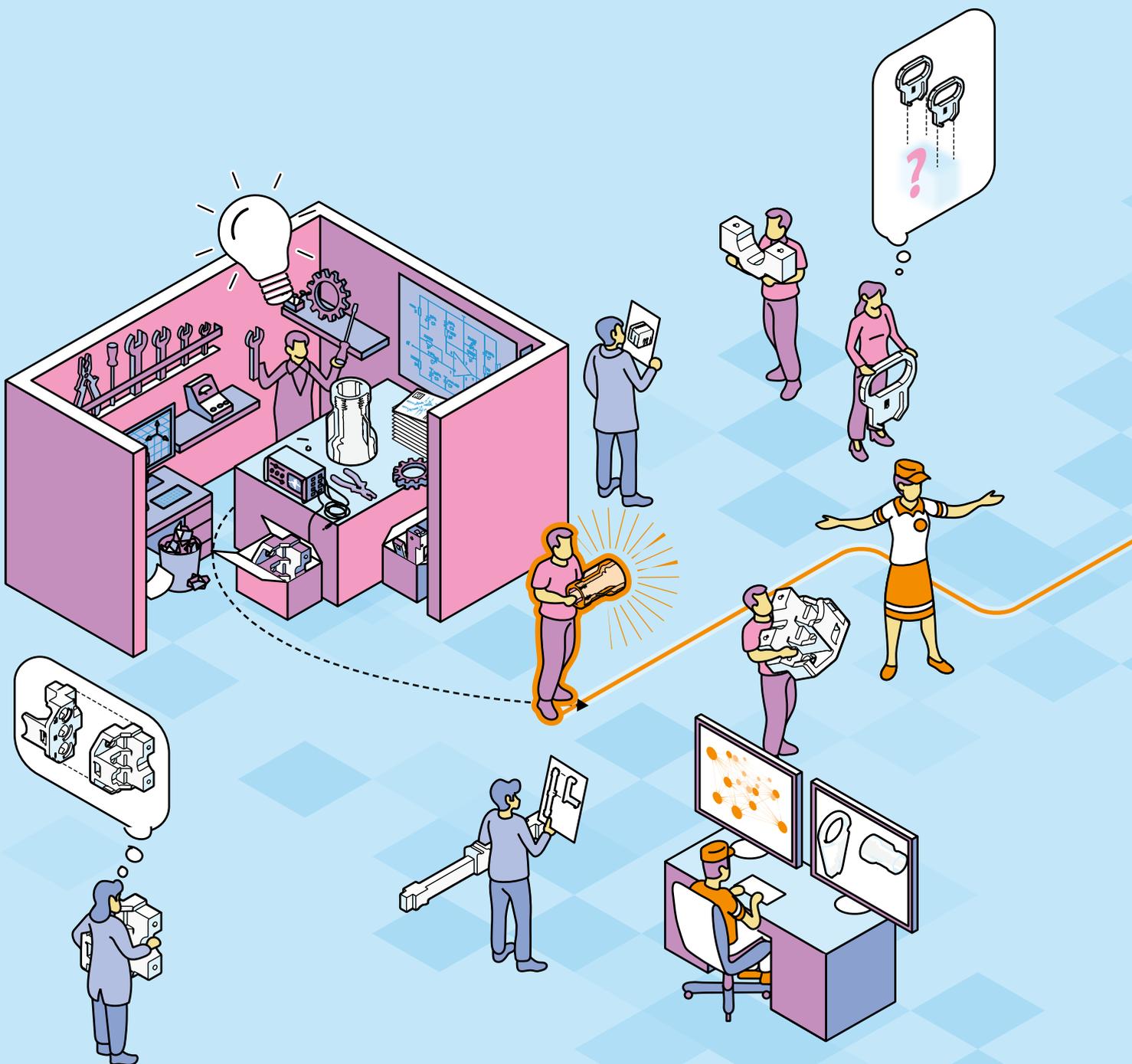


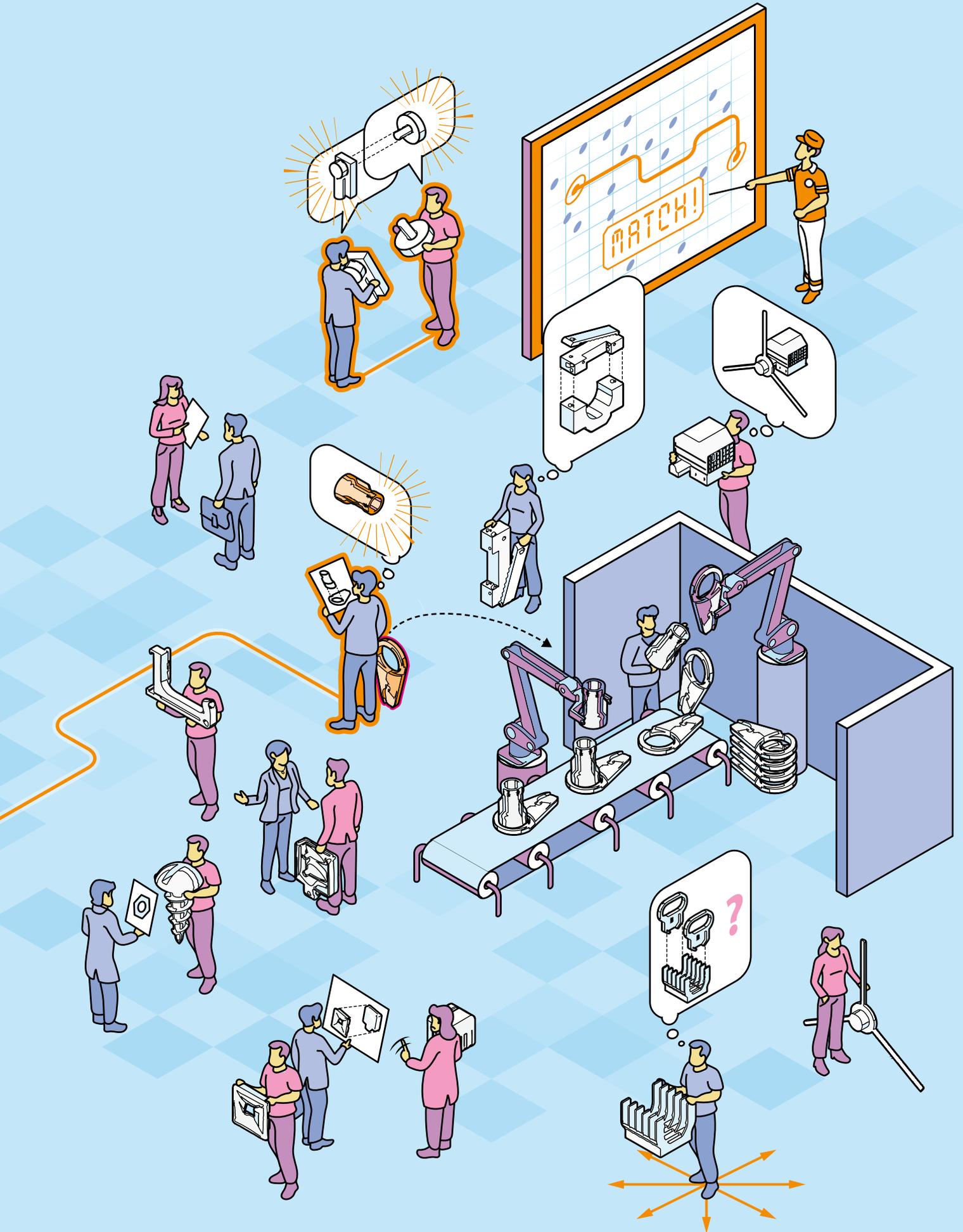
# B2 Markets for Technology



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Technological knowledge is traded on markets for technology in the form of intellectual property rights, e.g. patents. Markets for technology provide the opportunity to transfer rights of use of technologies to those companies that can commercialize these technologies better than the previous owner or current licensor. These companies have the complementary skills and resources needed to introduce the technologies to the market. Markets for technology can thus create significant economic and societal benefits. However, since intellectual property rights are usually very specific goods, there are usually only a few matching suppliers and demanders. The search for suitable trading partners is therefore often associated with high costs. It is essential to increase participation in technology trade as well as the functioning of markets for technology.





# B2 Markets for Technology

**M**arkets for technology are markets where technological knowledge is traded in the form of intellectual property rights (IP rights). An example of this are markets for patents. Markets for technology enable better exploitation of IP rights and thereby create incentives to invest in research and development (R&D). As such, they promote a more efficient division of labour in the innovation process.

Despite the advantages that markets for technology offer, the participation of German companies in such markets lags far behind that of companies in other European countries. In an international comparison, German companies only occupy a lower mid-table position both as suppliers and as demanders of IP rights.<sup>202</sup>

The functioning of markets for technology is limited by several obstacles. For example, it is often difficult for actors on markets for technology to find suitable trading partners or to reliably assess the value of an IP right, especially for small and medium-sized enterprises (SMEs). This is due to information asymmetries between market actors and a lack of trust among actors in the ability of markets for technology to ensure safe and fair transactions. Moreover, the purchase and use of an innovative technology usually require high and specific complementary investments, e.g. in technical knowledge. These difficulties are also reflected in prior studies that point to a large untapped potential of trade in markets for technology.<sup>203</sup>

Larger participation in technology trade and improved functioning of markets for technology are associated with great potentials for innovation and value creation. These must be leveraged by means of

suitable framework conditions and a research and innovation policy (R&I policy) that provides individual and institutional incentives in science and economy.

## B2-1 Definition and Functioning of Markets for Technology

Actors who create or possess technological knowledge are not necessarily those who are best placed to economically exploit or develop it. If technological knowledge and, where applicable, rights to use it are transferred between different actors, then this opens potential for efficiency and innovation. The transfer can take place in different forms and through different channels (see box B 2-1). One possibility is transactions on markets for technology.

### What Are Markets for Technology?

On markets for technology, rights to use technological knowledge are traded.<sup>204</sup> These rights of use take the form of IP rights such as patents.<sup>205</sup> A patent guarantees a patent holder the sole decision on the use of the new technological knowledge for a certain period and a certain scope of content. In markets for technology, companies and research institutions offer IP rights which are then typically demanded by other companies.<sup>206</sup> This can take place by buying and selling IP rights as well as by in-licensing, out-licensing or cross-licensing.<sup>207, 208</sup>

Markets for technology are characterized by two notable features.<sup>209</sup> First, the technological knowledge must be available in a codified<sup>210</sup> form so that rights of use can be transferred. Second, the transaction must be remunerated. The first characteristic distin-

## Box B2-1 Key Forms of Transfer of Knowledge and Rights of Use<sup>211</sup>

### Education and Labour Market:

Tertiary education institutions and non-university research institutions (NURI) are important training centres for technical-scientific and creative professionals who introduce new research and methodological knowledge into companies. Research and methodological knowledge can be transferred further through the mobility of skilled workers between companies.

### Markets for Contract Research:

Contract research enables companies to use the expertise and infrastructure of public and private research institutions to obtain solutions to specific problems.

### Cooperations and Networks:

Cooperation, for example in the form of joint ventures or research collaborations, offers com-

panies the option of working together with other companies or research institutions on an issue and sharing in the knowledge of the respective cooperation and network partners.

### Markets for Technology:

New technological knowledge can often be protected by patents. The thus documented right to use this knowledge can be traded on markets for technology.

### Markets for Companies:

By acquiring or merging with other companies, companies can integrate new knowledge and technologies into their own portfolios.

### Spin-offs:

Via spin-offs from existing companies and research institutions, the knowledge of these organizations and their employees can be transferred to new companies.

guishes markets for technology from other forms of knowledge transfer, e.g. through cooperation, where usually also non-codifiable knowledge of the inventor may be exchanged. The second characteristic excludes all transfers that are not directly remunerated, as is sometimes the case in open source software development.<sup>212</sup>

### How Do Markets for Technology Work?

Markets for technology provide the opportunity to transfer rights for the use of technologies to those companies that can commercialize these technologies better than the previous owner or current licensor.<sup>213</sup> Especially smaller companies often lack the complementary skills to further develop their technology and establish the necessary manufacturing and marketing capacities to introduce it to the market. Moreover, they often lack other technologies with which to combine the newly developed technology. The prospect of selling a newly developed technology rather than exploiting it themselves gives companies additional incentives to invest in R&D.<sup>214</sup>

Markets for technology thus facilitate a more efficient division of labour by making it easier for firms to specialize in those activities where they have competitive advantages. Consequently, companies that are comparatively good at developing innovative technologies can focus on these activities. Companies that are better at commercializing technologies will specialize accordingly and act as demanders in markets for technology.<sup>215</sup> This vertical specialization favours a more efficient use of resources in the innovation process.<sup>216</sup> For technologies with very high product, industry or geographic range of use, a company may not want to or be able to tap into all possible applications of the technologies itself. In this case, it can offer technologies selectively on markets for technology.<sup>217</sup> For tertiary education institutions and non-university research institutions (NURI), markets for technology offer the possibility of transferring research results into economic applications. Since these institutions are usually not active in the production and marketing of products themselves, they can find buyers for the technologies they have developed on markets for technology.

Data on the use of patents shed light on the practical importance of markets for technology. A survey of inventors from 20 European countries, Israel, Japan and the USA indicates that while the majority of patents applied for and used at the EPO are exploited internally, the share of patents that are licensed or sold is considerable at over 10 percent.<sup>218</sup> At the

same time, the share of licensed or sold patents in the USA is significantly higher at over 18 percent than that in European countries and Israel at just under 11 percent. Small companies with fewer than 100 employees even license or sell almost 30 percent of their patents.<sup>219</sup>

## Box B 2-2 Data

### Mannheim Innovation Panel and Community Innovation Survey

As a business survey, the Mannheim Innovation Panel (MIP) can be used to measure the activities of companies in Germany in markets for technology.<sup>220</sup> It is based on the Annual Innovation Survey for the German Economy and includes all legally independent companies based in Germany with at least five employees from selected industries.<sup>221</sup>

As part of the MIP, companies were asked in 2021 and 2019 whether they had in-licensed<sup>222</sup> or acquired IP rights from third parties in the period from 2018 to 2020 and 2016 to 2018, respectively. These activities represent the demand side of markets for technology. In addition, the companies were asked whether they had licensed out, sold or exchanged their own IP rights to third parties during these periods. These activities represent the supply side of markets for technology. Thus, in this analysis, markets for technology include the acquisition and sale of IP rights as well as their temporary use in the form of in-licensing, out-licensing and cross-licensing. IP rights are defined in the MIP as patents, utility models, design patents, trademarks and copyrights. A company may be active in one or more national and international markets for technology.

The MIP is the German contribution to the Europe-wide Community Innovation Survey (CIS), conducted every two years and coordinated by Eurostat, which forms the data basis for the international comparison of the activities of companies on markets for technology. It addresses companies with ten or more employees in manufacturing industry and in selected service sectors.<sup>223</sup> The CIS data are available for the period 2016 to 2018.

### PATSTAT-INPADOC and Orbis Intellectual Property

The legal status data<sup>224</sup> of the German Patent and Trade Mark Office (Deutsches Patent- und Markenamt, DPMA) and the European Patent Office (EPO) contain information on changes of ownership of IP rights, thus enabling the recording of transfers of these rights.<sup>225</sup> The data basis for the legal status data is the EPO's INPADOC data, which has been integrated into the EPO's PATSTAT patent database since 2010.

Patent data and the associated legal status data describe the market for technology from the viewpoint of a jurisdiction. The basic population is therefore, for example, all patents applied for and traded at the DPMA, irrespective of the origin of the applicants.

Patents can be transferred for various economic reasons. The focus below is on technology trading in the narrower sense, where patents are transferred between independent companies at market conditions. Patent transfers within a group of companies and patent transfers in the context of mergers and acquisitions (M&A) are not considered in this analysis.<sup>226</sup>

To identify transfers that take place between independent companies at market conditions, patent and legal status data must be linked with data containing information on the ownership structures of the companies involved. The data basis for this are the Orbis Intellectual Property data (Orbis IP data) from Bureau van Dijk.<sup>227</sup>

Markets for technology are defined more narrowly here than in the MIP and the CIS. Only the purchase and sale, i.e. the transfer, of patents are recorded.<sup>228</sup>

## B2-2 Technology Trading through Transfers and Licensing

Based on a study conducted by the ZEW – Leibniz Centre for European Economic Research (ZEW) on behalf of the Commission of Experts, this section describes the participation of German actors in markets for technology and the development of patent transfers over time. Additionally, the importance of patent transfers by technology field and the characteristics of transferred patents are highlighted. The description of the data on which the analyses are based is provided in box B 2-2.

### Participation of German Companies in Markets for Technology Comparatively Low

The percentage of German companies active in markets for technology is lower than in other European countries (see figure B 2-3). In an international comparison based on CIS data, German companies only occupied a lower mid-table position both as suppliers and as demanders of IP rights in the period from 2016 to 2018.<sup>229</sup> Much greater use was made of markets for technology by companies from Sweden, Poland, Austria or France, for example. In Poland, the share of companies in-licensing or acquiring technologies in the period under review was 7.3 percent and in Austria 5.2 percent, while in Germany it was only 4.0 percent. The percentage of German companies out-licensing technologies was also only about half as high as that of the top performers France and Sweden in the period under review. The share of companies that acted as sellers on markets for technology in the period under review was also significantly lower in Germany at 0.9 percent than in Sweden at 2.7 percent. Only 0.4 percent of German companies were involved in a technology exchange. It should be noted that only realized and thus successful activities are considered in these observations. A statement on the extent to which companies have unsuccessfully attempted to offer or request IP rights is therefore not possible.

### Transfers of DE Patents Declining

Since 1980, markets for technology in the US have grown significantly in importance.<sup>230</sup> For example, the number of transfers of patents filed at the US Patent and Trademark Office (USPTO) between companies has increased from around 1,000 transactions in 1980 to around 55,000 transactions in 2019 (see figure B 2-4).<sup>231</sup> The ratio of transferred

patents to the number of existing patents increased, particularly in the late 1990s. Since then, the ratio has remained relatively constant.<sup>232</sup>

The number of transfers of patents applied for at the EPO (EP patents)<sup>233</sup> declined in the period from 2000 to 2020 (see figure B 2-5).<sup>234</sup> While it was quite stable at about 4,500 per year until 2011, the number has settled at a lower level of about 3,500 transfers per year since 2014 after a brief increase. In all years, the number of transfers of patents applied for at the DPMA (DE patents) was lower than that of EP patents.<sup>235</sup> At the same time, the decrease in transfers of DE patents was also greater than that of EP patents. The number of transfers of DE patents in 2020, for example, decreased by more than two thirds to approx. 570 compared to approx. 2,700 in 2000.<sup>236</sup> The number of transfers of DE and EP patents also decreased in relation to the respective patent applications.<sup>237</sup> In contrast, the number of transfers of DE and EP patents in the course of M&A activities increased significantly.<sup>238</sup>

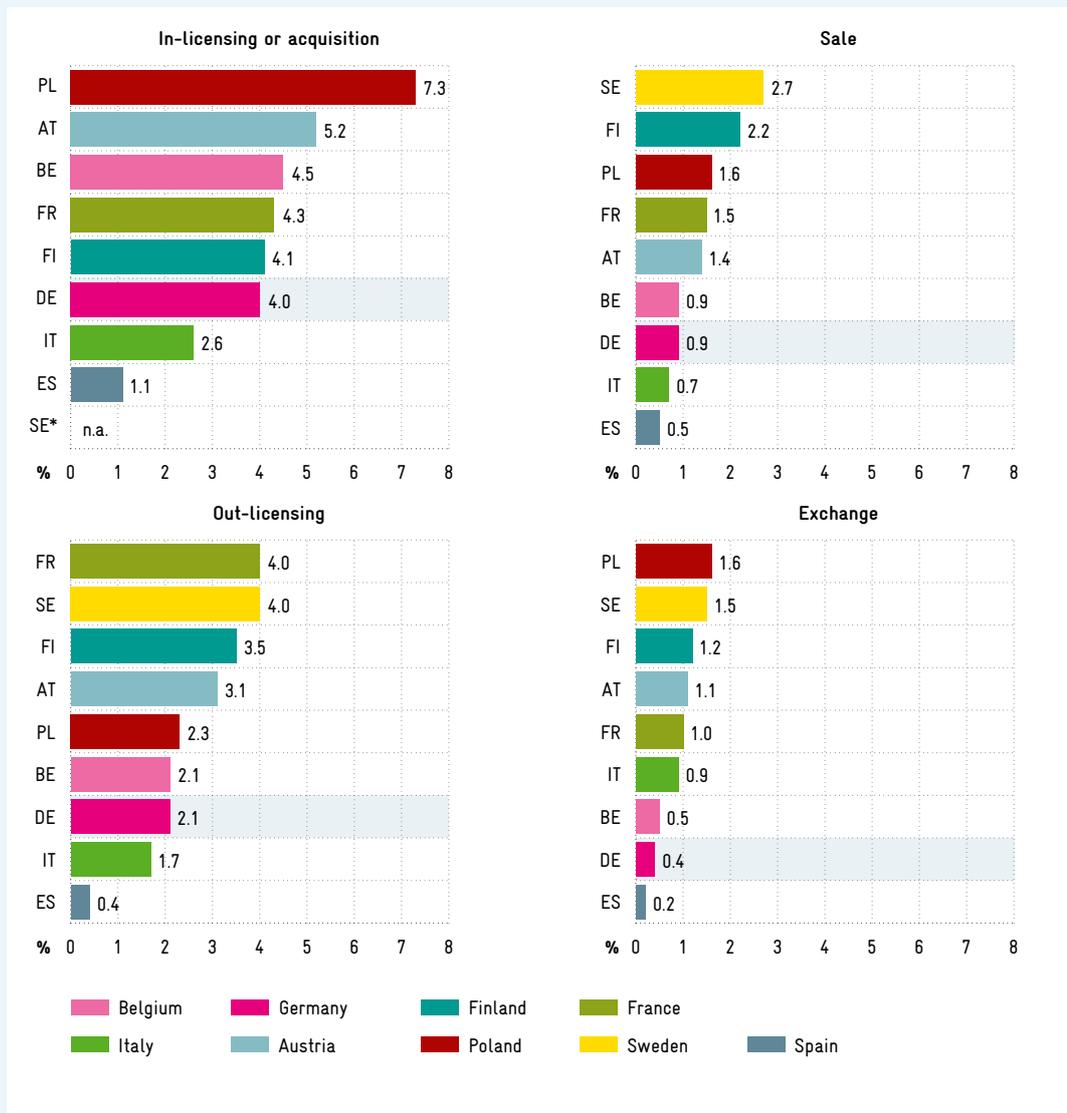
German companies<sup>239</sup> rank first by far among the seller countries of patent transfers recorded at the DPMA.<sup>240</sup> The decline in patent transfers recorded at the DPMA is primarily due to a decrease in sales by German companies. In contrast, the number of patent sales by US companies recorded at the DPMA has only slightly decreased during this period, while patent sales by French and Japanese companies have trended upwards since 2016. Patent purchases by German companies recorded at the DPMA have also decreased significantly recently, while purchases by companies from France, Japan, the USA and Switzerland have increased trend-wise in the same period. A remarkable development over time is the number of patent purchases by Chinese companies recorded at the DPMA. China's importance as a buyer has only increased significantly since the mid-2010s. In 2019, China already occupied sixth place in the ranking of buyer countries.<sup>241</sup>

The trade flows of patent transfers recorded at the DPMA have a predominantly national character.<sup>242</sup> Since 2000, 90.2 percent of German sellers sold their patent to buyers from Germany.<sup>243</sup> Similarly, 96.5 percent of German buyers acquired their patent from a seller from Germany.<sup>244</sup> A similar picture emerged for transfers of patents at the USPTO. For instance, 94.3 percent of German sellers sold their US patent to buyers from Germany and 91.8 percent



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**Fig. B2-3 Percentage of companies active in markets for technology in selected countries 2016–2018**



\*In-licensing and acquisition data not available.  
Source: Eurostat, Community Innovation Survey 2018. Calculations by ZEW in Peters et al. (2023a).  
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of all US patents acquired by German buyers came from a German seller.

The activities of companies on markets for technology differ depending on the industry. The company-level analysis based on MIP data shows that between 2018 and 2020, markets for technology were most frequently used by companies in research-intensive industries.<sup>245</sup> Within research-intensive industries, activities on markets for technology were most prevalent in the pharmaceutical industry, where 27.0 percent of all companies traded on markets for technology, followed by the chemical indus-

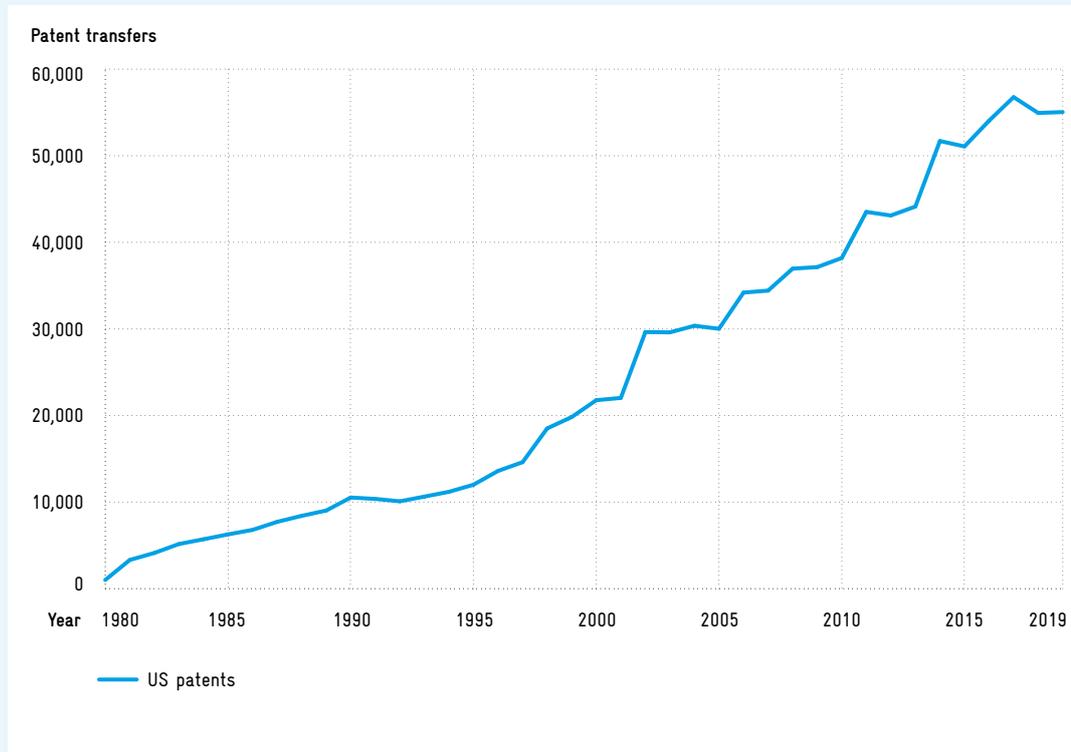
try (18.0 percent) and electronics, metrology and optics (14.5 percent).<sup>246</sup> In comparison, companies in the automotive and other vehicle manufacturing industries were significantly less active (4.4 and 7.3 percent, respectively).

A similar picture emerges from the patent-level analysis based on Orbis IP data. Between 2000 and 2020, EP patents were transferred most frequently in the fields of pharmaceuticals at 7.6 percent, medical technology at 7.1 percent and electrical machinery at 5.6 percent. Together with patents in the fields of organic fine chemicals at 4.8 percent,

**Fig. B2-4** Number of transfers of patents filed at the United States Patent and Trademark Office 1980–2019



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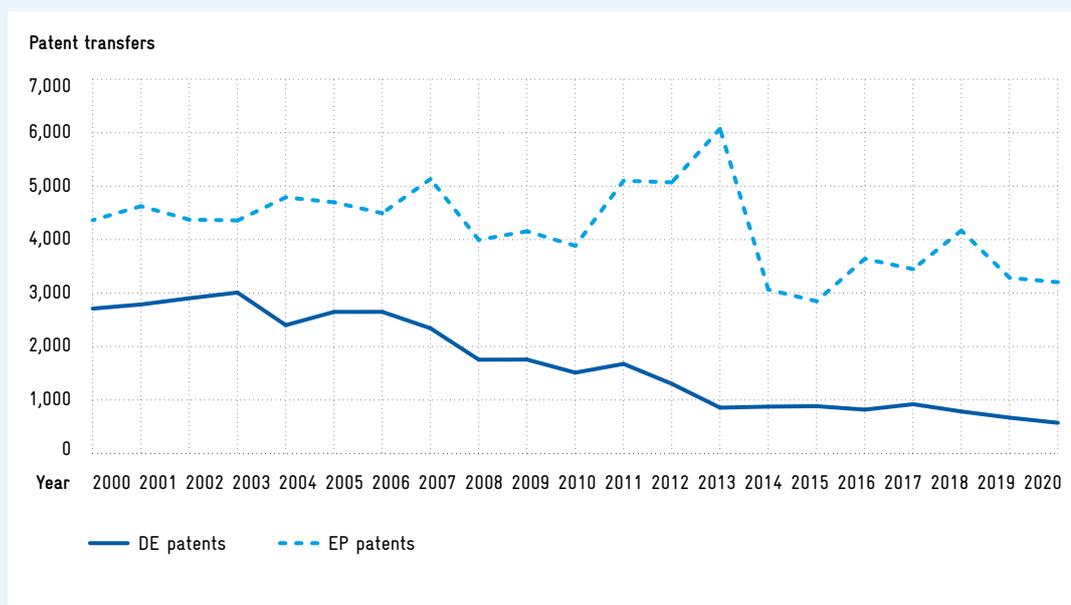


Patent transfers between independent companies.  
Source: <https://www.uspto.gov/ip-policy/economic-research/research-datasets/patent-assignment-dataset> (accessed on 25 October 2022) and Marco et al. (2015). Own calculations.  
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**Fig. B2-5** Number of transfers of patents filed at the German Patent and Trade Mark Office and the European Patent Office 2000–2020



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Patent transfers between independent companies.  
DE patents: Patents filed at the German Patent and Trade Mark Office. EP patents: Patents filed at the European Patent Office.  
Source: Orbis IP. Calculations by ZEW in Peters et al. (2023a).  
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biotechnology at 4.4 percent, digital communication and computer technology each at 4.3 percent, they accounted for more than a third of all patent transfers.<sup>247</sup>

Apart from the fields of digital communication, IT methods for management, semiconductors, computer technology, pharmaceuticals and medical technology, patent transfers in the other fields of technology have declined over the past 20 years – similar to the decline in EP patent transfers overall (see figure B 2-6). Sharp declines were also recorded in technology fields in which technology trade

was extensive in the past, such as macromolecular chemistry. Moreover, the decline in patent transfers in most of the technology fields is not due to declining patent applications.

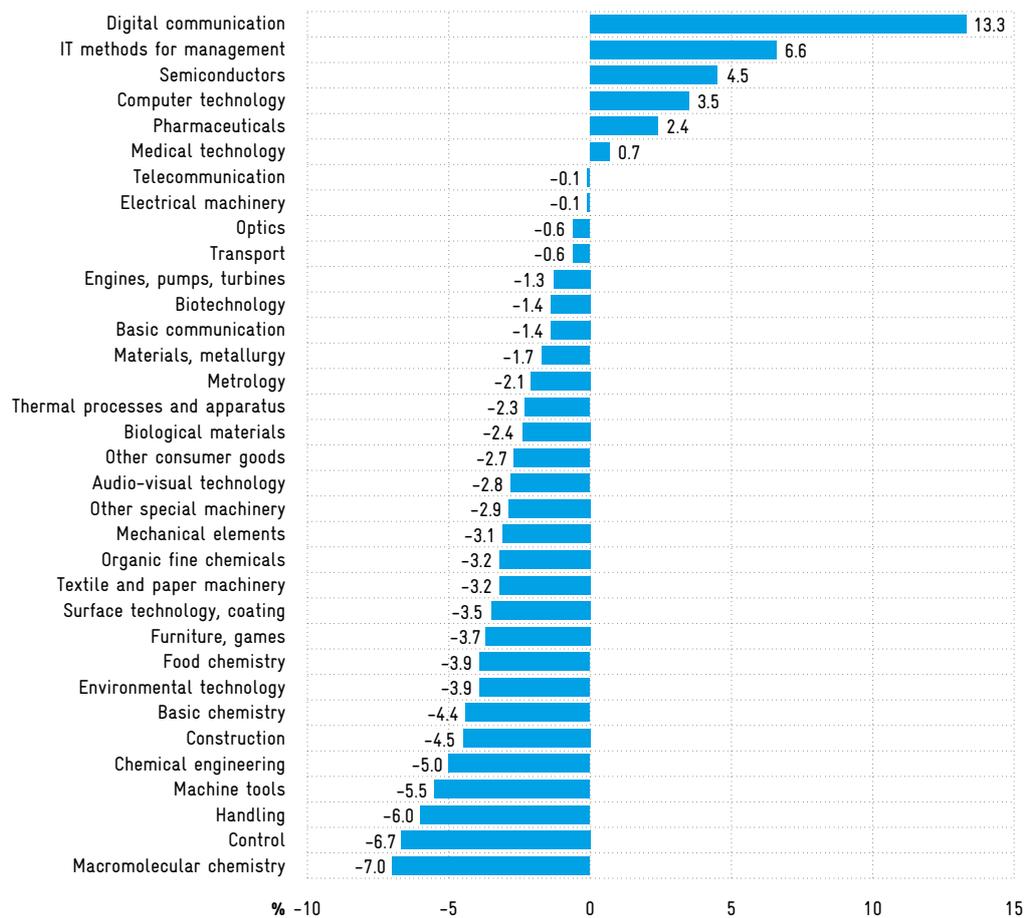
### Strong Growth in the Transfer of EP Patents from Tertiary Education Institutions

Annual EP patent applications from tertiary education institutions<sup>248</sup> more than doubled from around 2,500 to around 5,600 between 2000 and 2018.<sup>249</sup> In the same period, albeit with more significant fluctuations, the number of transferred EP patents from

**Fig. B2-6 Average annual growth rates of transfers of patents filed at the European Patent Office by field of technology 2000/2001–2019/2020 in percent**



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Calculation of the average annual growth rates using the geometric mean. The calculation is based on transfers between independent companies. To make the growth rate more robust against outlier values at the beginning and end of the period, the average of the patent transfers from two years was formed as the start and end value in each case, i.e. the average value from the years 2000 and 2001 and the average value from the years 2019 and 2020. Distinction of technology fields after Schmoch (2008). Micro and nanotechnology: no information due to very low number of transfers.

Source: Orbis IP. Calculations by ZEW in Peters et al. (2023a).

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tertiary education institutions increased even more: from around 240 to around 1,700 (see also figure B 2-7). The ratio of EP patents from tertiary education institutions transferred in one year to EP patents from tertiary education institutions applied for has increased from 9.6 percent in 2000 to 30.7 percent in 2018.<sup>250</sup> Transfers of DE patents from tertiary education institutions show an opposite development to EP patents from tertiary education institutions (see figure B 2-7),<sup>251</sup> despite a stable number of DE patent applications from tertiary education institutions. A similar picture emerges when NURI are taken into account in the analysis.

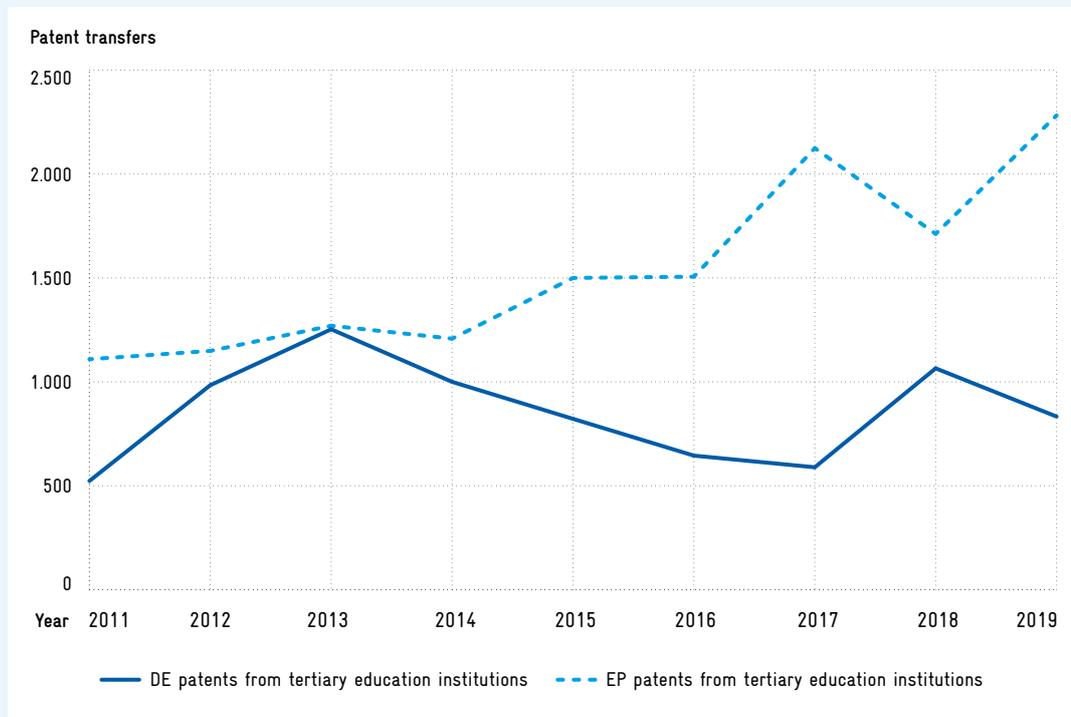
An examination at the company level shows that 7.4 percent of companies obtained IP rights from tertiary education institutions or NURI.<sup>252</sup> In research-intensive industry, the share was significantly higher at 16.1 percent. Across all industries, 90.4 percent of the companies that licensed or acquired IP rights in the period from 2016 to 2018 obtained them from other companies or private individuals.

Analyses by the EPO show that it is more difficult for research institutions than for companies to identify potential buyers for their inventions, as their inventions are often still at a very early technological stage.<sup>253</sup> However, according to additional studies, the probability of a successful transaction is higher than for companies, provided that potential buyers can be identified.<sup>254</sup>

### Transferred Patents of Higher Quality

Since the term of patents is limited to 20 years,<sup>255</sup> the economic value of a patent decreases over time. Accordingly, it is to be expected that more trade takes place in younger patents than in older ones. In keeping with this, 46.3 percent of the DE patents transferred since 2000 were five years old or less at the time of transfer.<sup>256,257</sup> Only 5.0 percent of the patents were older than 15 years at the time of transfer.

**Fig. B2-7** Number of transfers of patents filed by tertiary education institutions at the German Patent and Trade Mark Office and the European Patent Office 2011–2019



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DE patents from tertiary education institutions: patents filed by tertiary education institutions at the German Patent and Trade Mark Office.  
 EP patents from tertiary education institutions: patents filed by tertiary education institutions at the European Patent Office.  
 Source: PATSTAT-INPADOC. Calculations by ZEW in Peters et al. (2023a).  
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Not only patents that have already been granted are transferred on markets for technology, but also patents that have not yet been granted, i. e. patents that have only been applied for. The technological and economic value of a patent that has not yet been granted is associated with greater uncertainty, as the examination of patentability is still pending. The risk that an EP patent not yet granted at the time of transfer will not be granted after the transfer is 42.3 percent.<sup>258</sup> For DE patents, the risk is significantly higher at 68.1 percent.<sup>259</sup>

Various quality indicators were calculated for each EP patent to assess the quality of the transferred patents.<sup>260</sup> It turns out that EP patents transferred since 2000 have a higher overall quality than EP patents filed in the same year and in the same technology field, regardless of whether they were transferred or not.<sup>261</sup> In particular, the transferred EP patents have a broader technological applicability and are cited more frequently than the EP patents of the respective comparison group.<sup>262</sup>

### B 2-3 Markets for Technology and Innovation

The factors that favour participation in markets for technology and the importance of technology trade for the innovation activities and innovation success of companies in Germany can be examined using the MIP data (see box B 2-2). Activities on markets for technology in this context include the acquisition and sale as well as the in-licensing, out-licensing and cross-licensing of IP rights.

Between 2018 and 2020, a total of 4.9 percent of German companies were active on markets for technology.<sup>263</sup> The share of companies that demanded IP rights was 3.2 percent.<sup>264</sup> Of all companies, 2.1 percent acquired IP rights from third parties and 1.8 percent in-licensed IP rights from third parties. At 1.8 percent, the share of companies that offered IP rights was smaller than the share of companies that demanded IP rights in the period under review.<sup>265,266</sup> At 1.3 percent, the share of companies that licensed out IP rights was the highest, followed by 0.7 percent of companies that sold IP rights and 0.1 percent that exchanged IP rights with third parties.

### Companies Active in Innovation Collaborations Are Active on Markets for Technology

Both willingness to invest in innovation and participation in innovation collaborations positively correlate with a company's likelihood of being active on markets for technology.<sup>267</sup> Between 2018 and 2020, the share of innovative companies as suppliers (2.8 percent) and demanders (3.9 percent) of IP rights in markets for technology was higher than the share of all companies (1.8 percent and 3.2 percent, respectively) (see figure B 2-8).<sup>268</sup> In this context, the percentage of innovative companies with innovation collaborations that were active on markets for technology was significantly higher than the percentage of innovative companies without innovation collaborations. Between 2018 and 2020, 8.1 percent of innovative companies involved in innovation collaborations demanded IP rights and 6.4 percent of them offered IP rights. For innovative companies without innovation collaborations, these figures were 3.0 percent and 2.1 percent, respectively.<sup>269</sup>

### Mixed Picture for SME Participation in Markets for Technology

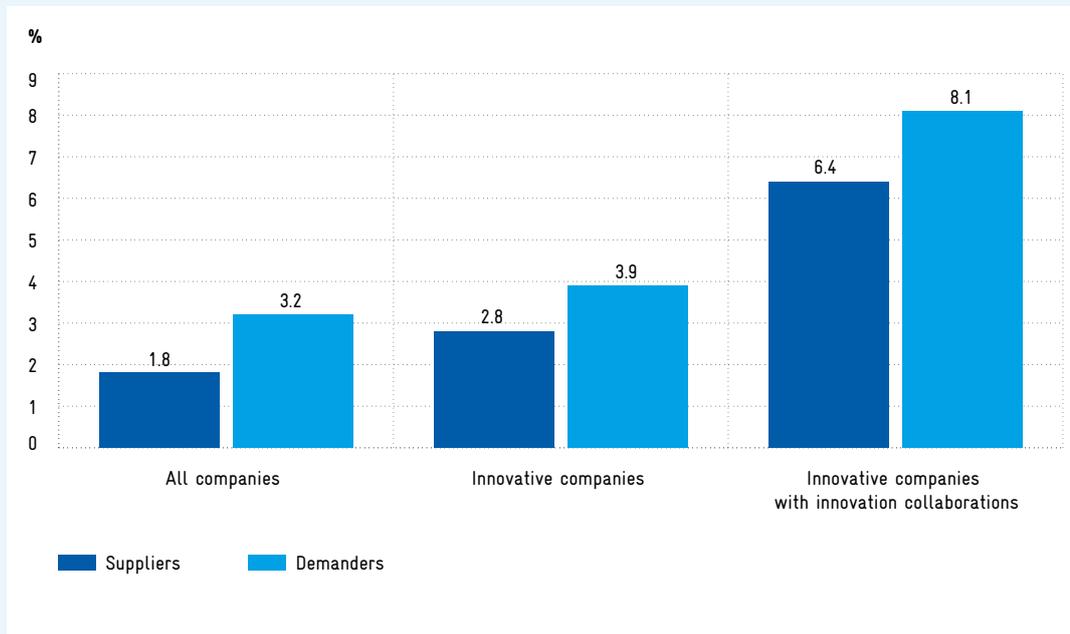
Looking at participation in markets for technology at the company level it becomes apparent that large companies with 1,000 or more employees are more active in markets for technology than SMEs, i. e. companies with fewer than 250 employees. For example, between 2018 and 2020, 19.3 percent of large companies demanded IP rights and 11.7 percent offered IP rights, while the corresponding percentages for SMEs were 2.9 percent and 1.6 percent, respectively (see figure B 2-9).<sup>270</sup> The same pattern emerges when only innovative companies are considered.

To measure the difficulties companies face in exploiting IP rights by means of markets for technology, potential participation in markets for technology can be examined in addition to actual participation. The percentage of potential suppliers is approximated here by the percentage of companies that filed IP rights in the period from 2018 to 2020. A comparison of the shares of actual and potential providers shows that just under one in five large companies with IP rights applications also actually acted as a supplier (19.7 percent), while among SMEs it was only around one in nine companies (11.8 percent).<sup>271</sup>

**Fig. B2-8 Percentage of German companies active in markets for technology by innovation activities 2018–2020**



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Source: Mannheim Innovation Panel, Survey 2021. Calculations by ZEW in Peters et al. (2023a).  
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An examination of participation in markets for technology at the patent level, on the other hand, indicates that SMEs are more active as suppliers in markets for technology than large companies.<sup>272</sup> A survey of inventors from 20 European countries, Israel, Japan and the USA shows that small companies with fewer than 100 employees licensed out or sold a total of almost 30 percent of their patents filed at the EPO, while the figure for companies with more than 250 employees was only just under 7 percent. Medium-sized companies with 100 to 250 employees reported licensing or selling about 13 percent of their EP patents.<sup>273</sup>

SMEs account for 99.8 percent of European companies.<sup>274</sup> However, they are less likely to file patents than large companies. In 2018, for example, only one in five patent applications to the EPO was filed by an SME or individual from Europe.<sup>275</sup> SMEs consequently have fewer patents to trade on average. This may explain the lower supply-side activity of SMEs in markets for technology when considered at the company level. Nevertheless, SMEs offer a higher percentage of their patents in markets for technology than large companies. There may be several reasons for this. Especially for small companies, which often have a low market share, the

advantages associated with out licensing outweigh the potential risks from the emergence of another competitor. For companies with higher market shares, on the other hand, additional competitors constitute a greater risk. In addition, SMEs are generally less likely than large companies to have the necessary complementary resources and assets to further develop the technology themselves and introduce it to the market.<sup>276</sup> In addition, the percentage of patents that remain unused for strategic and other reasons, and are therefore not eligible for patent trading, is almost twice as high for large companies as for SMEs.<sup>277</sup>

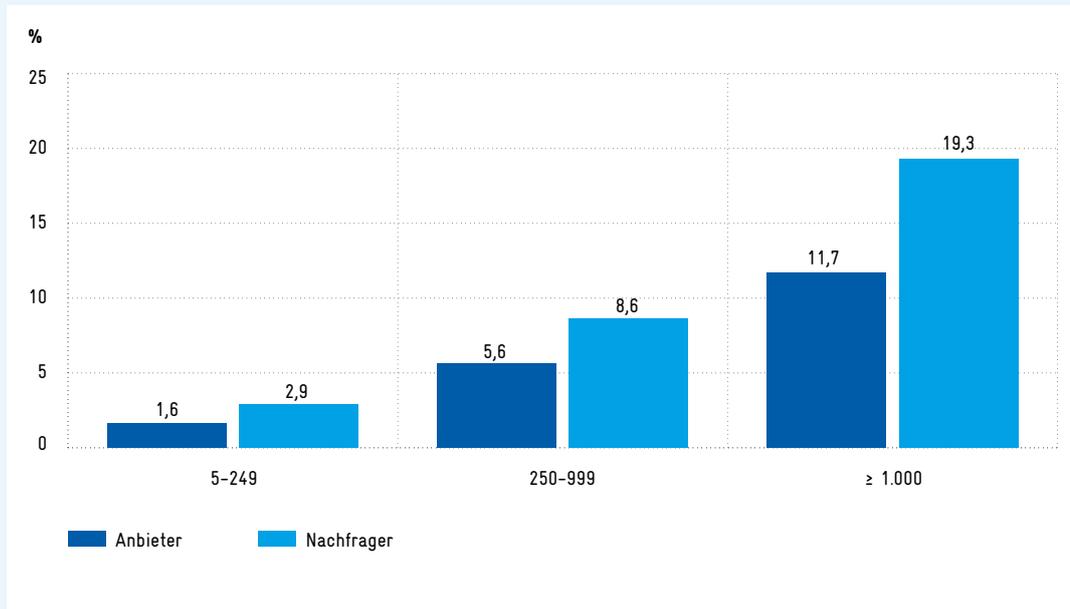
### High Significance of Markets for Technology for Innovation Success

Access to IP rights from third parties allows companies to access external knowledge. This external knowledge can increase the innovation success of companies, e.g. by helping to develop a new product, improve an existing product or accelerate innovation processes. The innovation success of companies can be measured by the share of turnover they generate with product innovations or market novelties in the first three years after their market launch. Product innovations are new or improved

**Fig. B2-9 Percentage of German companies active in markets for technology by size category 2018–2020**



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Source: Mannheim Innovation Panel, Survey 2021. Calculations by ZEW in Peters et al. (2023a).  
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products of the company. Market novelties are those product innovations that companies are the first to introduce to the market.

Companies that have obtained IP rights from third parties through acquisition, in-licensing or exchange achieve significantly higher success with their innovations than otherwise comparable companies.<sup>278</sup> Thus, innovative companies that have obtained IP rights in this way have a 4.5 percentage point higher share of turnover with product innovations than comparable companies without such IP rights. The difference in the share of turnover with market novelties is 2.4 percentage points on average. In relation to the average share of turnover that companies achieve with their product innovations (23.4 percent) or market novelties (13.1 percent), these differences are comparatively large. In particular, the exchange of IP rights is associated with a significantly higher success of companies with product innovations and market novelties.

### Lack of Access to IP Rights a Frequent Cause of Innovation Abandonment

Lack of access to IP rights is considered by companies to be a major obstacle to innovation.<sup>279</sup> In

2018, 63.6 percent of companies affected by lack of access to IP rights abandoned planned innovations because of it – no other obstacle to innovation led to abandonment more often as a result. Conversely, almost every fifth company that refrained from innovation projects due to obstacles saw a reason in the lack of access to IP rights (18.3 percent).<sup>280</sup> While large companies tended to respond more to the lack of access to IP rights by prolonging innovation projects as their size increased, small companies were more likely to respond by refraining from innovation altogether.<sup>281</sup>

Lack of access to IP rights can be caused by the fact that too few IP rights are filed and offered on markets for technology or that the IP rights offered do not match those in demand. Another conceivable reason is that the matching of suppliers and demanders does not work, for example because the companies making the demand do not have the resources and skills required to find the right IP right.

### B2-4 Barriers in Markets for Technology

To generate value from new technological knowledge, a company must be able to combine this

knowledge with complementary competences and resources, e.g. manufacturing and marketing capacities. In principle, markets for technology can create significant economic and societal benefits by enabling efficient and timely matching between new technological knowledge and companies with the respective complementary competences and resources. In practice, however, markets for technology are characterized by various imperfections and inefficiencies, in particular low market participation, information asymmetries, lack of trust and complex contracts.<sup>282</sup> These imperfections make it difficult for markets for technology to develop spontaneously and without coordination.

### Difficulties in Identifying Suitable Trading Partners

An important criterion for the functioning of markets is market thickness. A market is said to be thick if it attracts a sufficient number of potential market participants who are willing to trade with each other and, as a result, numerous transactions take place.<sup>283</sup> Since IP rights are usually very specific goods, there are usually only a few matching suppliers and demanders.<sup>284</sup> Accordingly, a market for technology often comprises many individual markets for specific technologies involving only a few participants on both sides of the market.<sup>285</sup> In this case, each of these are so-called thin markets where the search for suitable trading partners, especially from other regions and fields of technology,<sup>286</sup> is associated with high costs.<sup>287</sup>

Due to the low market thickness, competitive prices do not form in these markets. Rather, prices are often the result of bilateral negotiations in which the bargaining power of the trading partners plays a key role. Here, there is often a lack of comparative and empirical values that would otherwise provide guidance in setting prices.<sup>288</sup> That means uncertainty prevails about the economic value of the technology, which must be estimated accordingly.<sup>289</sup> This can further limit the willingness to use such a market.<sup>290</sup>

### Information Asymmetries between Suppliers and Demanders

Information asymmetries between suppliers and demanders of a technology exist when one trading party is better informed about the functioning and potential of a technology than the other.<sup>291</sup> As a rule, suppliers of a new technology are better informed

about it than demanders because they possess additional information about the technology that is not publicly available.<sup>292</sup> This leads, among other things, to suppliers of less valuable technologies trying to market them as high-value.<sup>293</sup> Suppliers of technologies with above-average value, on the other hand, have problems convincing demanders of the high value, as demanders are guided by the average value of new technologies due to high uncertainty about the actual value. This leaves the suppliers facing a dilemma. On the one hand, they have incentives to disclose the details necessary to convince demanders of the quality of the new technology. On the other hand, they run the risk that demanders will use this information for free and reproduce the new technology in a slightly modified form. However, if demanders do not fully understand the value of the technology and the other necessary information, they will not be willing to pay the price asked for by suppliers.<sup>294</sup> This can lead to potential suppliers not even offering their technologies of above-average value on the market.

For actors without knowledge and prior experience of technology trade, dealing with information asymmetries may be particularly difficult. Information asymmetries are less problematic if the trading partners are active in the same product market or industry and have similar technical expertise.<sup>295</sup>

### Lack of Trust in Markets for Technology

The functioning of a market also depends on the trust of market participants in its ability to ensure safe and fair transactions (market safety).<sup>296</sup> The safety of a market for technology depends in particular on the effectiveness of patent protection, i. e. on the extent to which patent holders can enforce their rights.<sup>297</sup>

A lack of trust makes actors reluctant to engage in markets for technology and to disclose the knowledge necessary for a transaction to take place. In secure markets, market participants are more willing to share their information and preferences in search of other market participants. This increases the likelihood that technology trade will occur.

### Potential and Limitations of Market Intermediaries

Market intermediaries can reduce the inefficiencies that arise in markets for technology (see box

B 2-10).<sup>298</sup> A number of new types of market intermediaries emerged in the 2000s, including digital technology platforms,<sup>299</sup> which are being used by an increasing number of companies.<sup>300</sup> Digital technology platforms list available technologies, thereby facilitating the search for and trade in technologies – especially across regional borders and beyond own networks.<sup>301</sup> By systematically evaluating patent data, for example using AI-based methods, they enable participants in digital markets for technology to reduce search costs and to better assess the value of a technology and its applicability and compare it with other technologies. They thus go beyond the functionalities of the public and freely accessible databases of the DPMA and the EPO. The features of digital technology platforms help to increase market thickness and identify more potential matches. However, they cannot eliminate information asymmetries and the associated risk that suppliers try to market less valuable technologies as high value ones.

Another factor limiting the functioning of technology platforms is that due to the exceedingly high

specificity of technologies, trading partners mostly prefer bilateral, face-to-face negotiations, which usually take place offline.<sup>302</sup> This leads to the fact that the business model of technology platforms can only be scaled at relatively high costs<sup>303</sup> and the transaction costs of market actors are not significantly reduced. Also, digital technology platforms thereby fail to significantly increase the transparency of the market.<sup>304</sup> Furthermore, the publication of a detailed description of a technology, including its functionalities and potential uses, in a standardized form that goes beyond the patent, as is often required by technology platforms, increases the risk of circumvention of the patent for suppliers with valuable technologies.

To counter the risk of suppliers marketing less valuable technologies as high-value ones, digital technology platforms use various screening mechanisms such as upfront payments and disclosure requirements.<sup>305</sup> However, such screening mechanisms may in turn deter potential market entrants if they are not willing to make upfront payments or disclose extensive information. According to ex-

### Box B 2-10 The Silicon Valley Brokered Patent Market<sup>306</sup>

The Silicon Valley Brokered Patent Market (BPM) is a patent market that has been active since 2014. It emerged after the failure of the US patent trading platform IPXI (Intellectual Property Exchange International, Inc.). In late 2020, the BPM comprised 220,000 patents with offer prices worth a total of US\$36 billion. Of these, patents worth US\$10.4 billion have already been traded. Most trades are in a price range of US\$0.5 million to US\$2 million.<sup>307</sup> The average time required to complete a transaction is approximately one year.

Key players in the BPM are around 130 patent brokers. These freelance patent brokers analyze companies' patent portfolios, identify patents that could be sold, examine patents and important claims and determine appropriate price ranges. They also define terms of sale, due diligence and bidding procedures, develop evidence of use and

support companies in identifying and approaching potential buyers as well as in price negotiations. Experienced brokers have a particularly important role to play in quantifying fair price ranges. In return, the patent brokers, many of whom are former patent attorneys, receive a commission of about 20 percent of the sales price.

On the BPM, mostly patent families or patent bundles consisting of ten to 15 patents are traded. For the patent bundle to be sold, the description of a single representative patent is usually sent to the market participants by email. The information about the patent bundle is supplemented with additional information based on a due diligence conducted by the patent brokers. This check also establishes, among other things, evidence of use, which constitutes an important signal for potential buyers regarding the value of a patent. Patents with specific evidence of use are more likely to be traded.

perts, the maintenance of IP databases is often very time-consuming and cost intensive.

These difficulties may have contributed to the fact that no platform with a high transaction volume has yet emerged for the market for technology<sup>308</sup> and that some digital technology platforms have adapted their business model over time, moving from offering a transaction infrastructure with matching mechanisms to a more interactive service provision.<sup>309</sup> More recently established providers such as PatentPlus (see box B 2-11) have a somewhat broader scope and, in addition to technology transactions, also pursue the initiation of collaborations and consultancy.

From a broader economic perspective, increased transparency about activities on markets for technology can reduce information asymmetries, but it also carries risks. Detailed information on new technologies can make it easier for foreign companies to imitate technologies and circumvent patents. Transparency about the totality of all transactions allows insights into the strategic decisions of individual actors and the resulting technological development. This in turn can jeopardize the tech-

nological sovereignty of an economy and its competitiveness regarding key enabling technologies.<sup>310</sup>

## B 2-5 Recommendations for Action

On markets for technology, technological knowledge is traded in the form of IP rights. Markets for technology enable better exploitation of IP rights and thereby create incentives to invest in R&D. However, the functioning of markets for technology is limited by several obstacles. Actors in markets for technology often find it difficult to find suitable trading partners or to reliably assess the value of an IP right. This is due to information asymmetries between market actors and a lack of trust among actors in the ability of markets for technology to ensure safe and fair transactions. The Commission of Experts recommends the following measures to leverage the potential of innovation and value creation associated with greater participation in technology trade and improved functioning of markets for technology:

### Box B 2-11 PatentPlus<sup>311</sup>

PatentPlus is a German-based knowledge and technology transfer platform established in 2021. PatentPlus focuses on research institutions as providers of technologies that are sold or licensed through the platform. The platform helps to connect research institutions and companies looking for relevant and available patents.

PatentPlus thus attempts to mitigate or completely overcome various existing market failures. For companies, the aggregation of different providers, simple filter mechanisms and search ads ordered by relevance reduces search costs for identifying suitable technologies and cooperation partners. AI-supported methods are also used here to

analyze portfolios and identify suitable matching partners. Potentially interested parties are informed about the details of various technologies by means of descriptions of the individual research institutions and their patent portfolios. Providers can present their profile and find not only transaction partners for their patents but also potential partners and investors for cooperative research projects and contract research. The platform also provides other services such as trend analyses and benchmarking, i.e. the comparison and evaluation of spin-offs. Since its establishment, PatentPlus has also been successful in acquiring funding.<sup>312</sup> However, it remains to be seen whether the business model will prove sustainable in the medium to long term.

### Encourage Further Development of Patent Office Databases

- To reduce search and transaction costs and enable better matches, R&I policy should drive the further development of the public and freely accessible databases of the patent offices (DPMA and EPO). AI-assisted methods can help to match relevant patent-protected technologies and partners. At the same time, a well edited and up-to-date database offers scientists the opportunity to conduct research on markets for technology using the data.<sup>313</sup>
- Under the new EU Unitary Patent, which will be applied from the beginning of April 2023, applicants should be given the opportunity to add a description of the technology or of complementary IP rights in the EPO's Espacenet database, in addition to the option of indicating their willingness to license.
- Moreover, the deal database envisioned in the Federal Government's Startup Strategy, which is to document transfers of IP rights, should be established at the patent offices. By linking this to the existing databases at the patent offices, information on transfers of IP rights could be efficiently bundled and made available in a user-friendly manner.
- The Federal Government should initiate and promote an information campaign to provide potential market participants with more information about these databases.

### Improve the Information Base on Markets for Technology

- To improve transparency of ownership of IP rights and thus reduce search costs for potential buyers, greater incentives should be provided for reporting transfers of ownership centrally and quickly to the DPMA. In addition, the Commission of Experts suggests examining whether contracting parties can be obliged to publish transfers of ownership.<sup>314</sup>
- Financial incentives in the form of a reduced renewal fee for patents should be provided for the non-binding declaration of willingness to license.

- Uniform standards should be developed and applied to record patent transfers at national patent offices.

### Support SMEs in Activities on Markets for Technology

- Low-threshold information and advisory services are particularly important for SMEs. Existing initiatives to promote the patenting and exploitation of inventions, such as the support programme WIPANO – Knowledge and Technology Transfer via Patents and Standards, should be continued and expanded.
- To facilitate rapid technology transfer, contractual standards should be established<sup>315</sup> that take into account the interests of all actors involved in technology trade. Existing initiatives such as the German Standards Setting Institute (GESSI) can contribute to this by promoting the drafting of standard contracts for the transfer of IP rights.

### Further Professionalize Technology Transfer and Exploitation of Patented Inventions

- To promote the transfer and economic utilization of research results, existing utilization structures at tertiary education institutions and NURI, especially technology transfer and exploitation of patented inventions, should be further professionalized and made more entrepreneurial and competitive. To this end, the organizational and incentive structures must be sufficiently flexible, for example by enabling performance-based remuneration.<sup>316</sup>

