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Research Report

Enhancing German innovation through international trade in services

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Bastian Krieger (ZEW)

Enhancing German Innovation through International Trade in Services

The access to foreign knowledge via service imports fosters the success of innovations in Germany. The probability of firms introducing new or significantly improved products, services, or processes is more than twice as high for those that import knowledge services than for non-importers (68 per cent vs. 33 per cent). Furthermore, knowledge importers experience a greater average percentage reduction in their unit costs due to new processes (three per cent vs. one per cent), and a larger revenue share from new products and services (18 per cent vs. eight per cent).

Over the course of the previous decade, Germany witnessed a notable surge in the importation of knowledge services, with the value of such imports more than doubling from \$16,949 million in 2010 to \$46,392 million in 2022. Moreover, Germany's focus on the European Union as a trade partner significantly increased. The European Union's share of Germany's total imports of knowledge services rose from 35 per cent in 2010 to 44 per cent in 2019.

This trend follows the proposed strategy of the German Federal Ministry of Education and Research (BMBF) to focus on a specific selection of countries as knowledge sources to enhance Germany's technological sovereignty and resilience to global challenges. However, to compensate for rising protectionism worldwide, trade barriers between Germany and its selected countries – in particular the EU single market – have the potential to be further reduced.



KEY MESSAGES

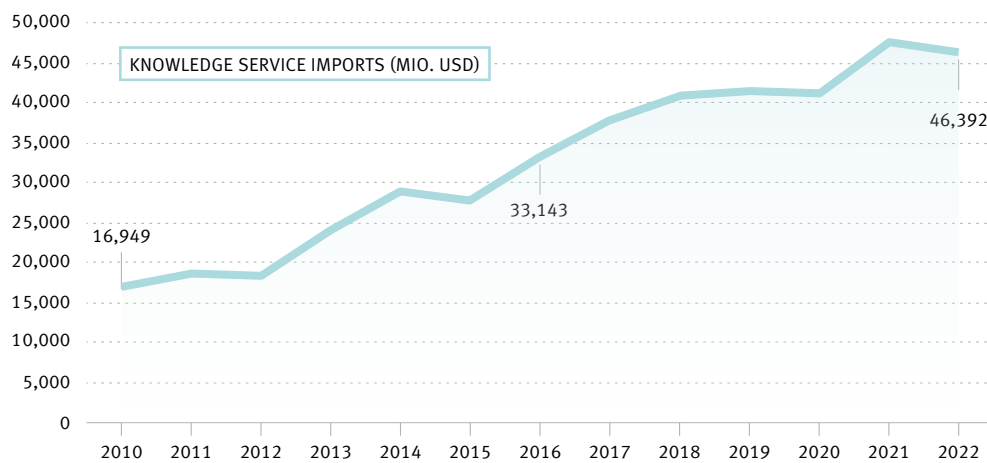
- Access to foreign knowledge via service trades makes innovation by German firms more successful and increases their domestic innovation efforts.
- There is no evidence that trade in knowledge services is being used for profit shifting. Consequently, there is no need for further action in this regard.
- Tackling trade barriers – in particular those of an administrative nature within the EU – has the potential to facilitate trade in knowledge services and to offset global protectionist trends.
- Fostering the participation of SMEs in knowledge service trade can lead to innovation gains, as they rarely import foreign knowledge

GERMANY'S IMPORTS OF KNOWLEDGE SERVICES ON THE RISE

Trade in services has the potential to foster innovation in Germany by providing its firms with better access to foreign knowledge. The importation of foreign knowledge has become increasingly important for Germany over the last decade. From 2010 to 2022, service imports related to foreign knowledge more than doubled \$16,949 million to \$46,392 million (Figure 1). Furthermore, their share in total service imports to Germany reached values between six and 14 per cent over the same period, further highlighting their significant relevance for the German economy (Figure 2).

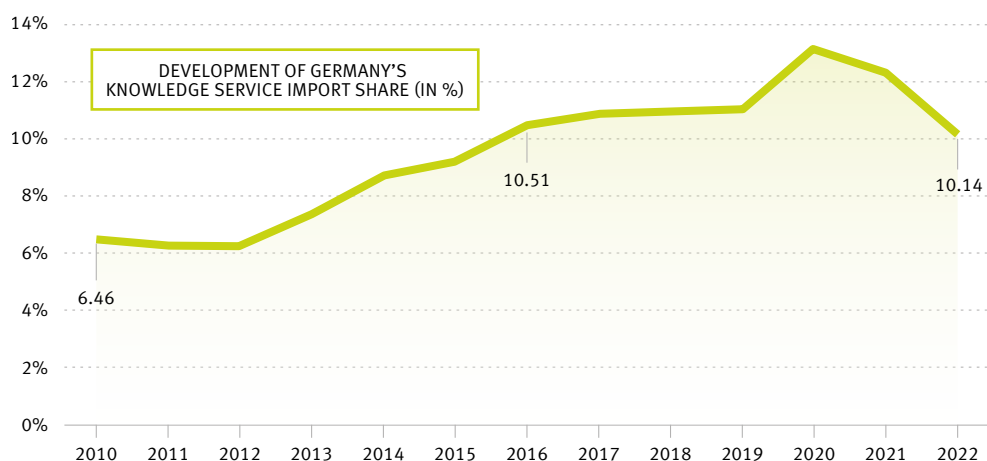
Knowledge service imports more than doubled between 2010 and 2022

FIGURE 1: DEVELOPMENT OF GERMANY'S TOTAL KNOWLEDGE SERVICE IMPORTS



Note: Knowledge services imports are calculated from the WTO Stats Dashboard by adding Germany's commercial service imports related to "research and development" and "charges for the use of intellectual property". Source: WTO Stats (2024)

FIGURE 2: DEVELOPMENT OF GERMANY'S KNOWLEDGE SERVICE IMPORT SHARE



Note: The import share of knowledge services is calculated from the WTO Stats Dashboard by dividing the sum of Germany's commercial service imports related to "research and development" and "charges for the use of intellectual property" by Germany's total commercial service imports. Source: WTO Stats (2024)

COMPONENTS OF KNOWLEDGE SERVICE IMPORTS

Imports related to foreign knowledge include i) “research, development, and testing”, ii) “patents, licenses, inventions, and processes,” iii) “artistic copyrights”, and iv) “other rights, such as franchise fees, trademarks, and marketing rights”. Krieger and Trottner (2024) demonstrate that “research, development, and testing” accounted for the largest share of German knowledge imports, making up 46 per cent of knowledge-related service imports. Furthermore, the second largest category corresponded to payments related to “patents, licenses, inventions, and processes” with 35 per cent, while expenditure on services related to “other rights” and “artistic copyrights” are less substantial at 19 and five per cent respectively. Examples for each component are provided in the Box on page 8 at the end of this policy brief.

Research, development, and testing is the major component of knowledge imports

KNOWLEDGE IMPORTS AND FIRM INNOVATION

Krieger and Trottner (2024) show that the import of knowledge services – as the import of services in general (Abel-Koch, 2018) – is concentrated on a selected number of firms. They use a representative survey of the German enterprise sector for firms with at least five employees covering the years 2005 to 2012. Five per cent of their sample imports knowledge-related services.

Few firms import knowledge services

Moreover, they demonstrate that the innovation success of knowledge-importing firms is markedly higher than that of non-importing firms. Their probability of introducing new or significantly improved products, services, or processes within the last three years is more than twice as high with 68 per cent, compared to 33 per cent. At the same time, they experience a larger average percentage reduction in their unit costs due to new processes (three per cent vs. one per cent), as well as a larger revenue share from new products and services (18 per cent vs. eight per cent). However, these results do not emerge solely due to importing activities, as importers and non-importers differ structurally. In particular, importers engage more extensively in in-house R&D, have more employees, are older, and more internationally active. Finally, knowledge importers are naturally more prevalent in more innovative industries, such as the chemical, vehicle, and electric machinery industries.

Knowledge importers innovate more successfully

FACILITATING ACCESS TO KNOWLEDGE SERVICE IMPORTS FOSTERS INNOVATION

However, even after taking these differences into account, Krieger and Trottner (2024) find that an easier access to foreign knowledge imports fosters a firm’s innovation success. On top of that, they show that access to foreign knowledge not only increases innovation success, but also complements firms’ domestic knowledge production; firms with greater access to foreign knowledge increase their domestic R&D spending. Thus, there is no evidence of domestic crowding out resulting from facilitating trade in services.

Access to foreign knowledge increases domestic knowledge production

Furthermore, there is no evidence of knowledge trade being used for profit shifting. Due to the intangible nature of services, multinationals may report de facto non-existent cross-border service transactions to minimise their global tax burden by strategically shifting profits from high- to low-tax countries. However, Krieger and Trottner (2024) show that their results hold for firms that are not part of a multinational company group. Additionally, Hebous and Johannesen (2021) also find no direct evidence of knowledge services being used for profit shifting in Germany.

Knowledge services are not used for profit shifting

CHANGING RELEVANCE OF SOURCE COUNTRIES

Figures 3a and 3b show the most relevant source regions for German firms as of 2017, the last year with a detailed coverage of most source countries for knowledge services in the WTO Dashboard database. Together, the two figures cover 94.1 per cent of German knowledge service imports in 2017. Figure 3a encompasses regions with a knowledge import share of at least five per cent, while Figure 3b encompasses regions with a knowledge import share smaller than five per cent but larger than one per cent.

INCREASING IMPORTANCE OF EU, DECREASING IMPORTANCE OF US

The European Union has been the largest source of knowledge imports for Germany since 2012, with a share of 44 per cent in 2019. Furthermore, its importance increased significantly from 35 per cent in 2010. The largest single country exporting knowledge services to Germany was the United States. However, in contrast to the increasing importance of the European Union, its share of Germany's knowledge imports decreased from 36 per cent in 2010 to 23 per cent in 2019. For other major non-EU source countries, import trends were less pronounced, however, the share of the United Kingdom tended to increase, while that of Switzerland tended to decrease.

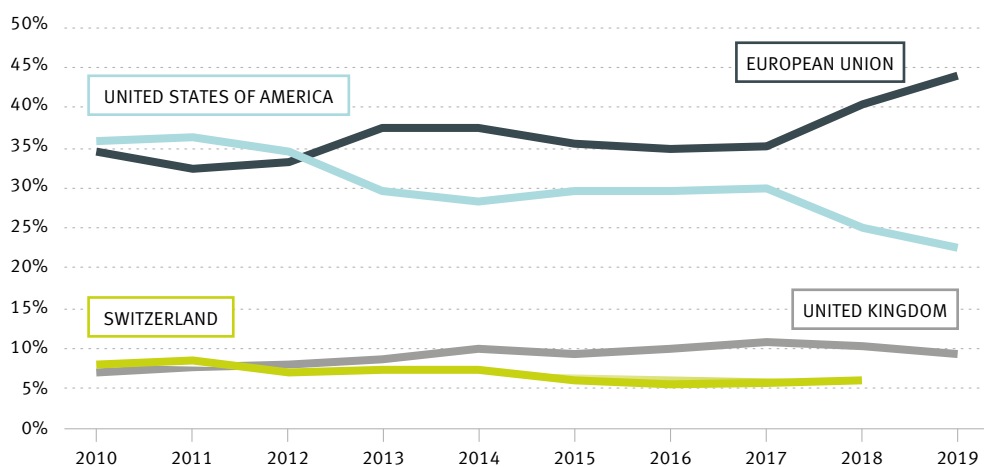
EU increased, US decreased

CHINA AND INDIA INCREASE THEIR IMPORTANCE

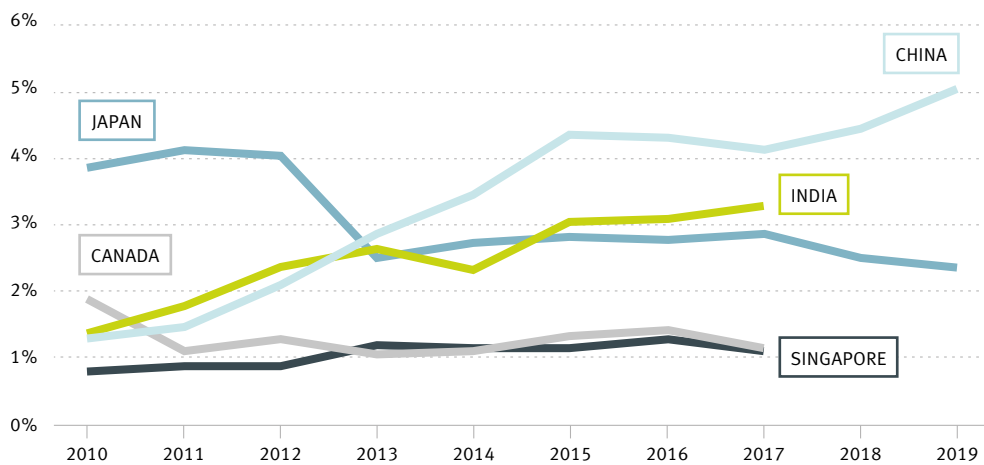
Looking at important smaller non-EU source countries, significant trends can be identified. In particular, the shares of up-and-coming countries such as China and India increased. China's share rose from one per cent in 2010 to five per cent in 2019, and India's from one per cent in 2010 to three per cent in 2017. In contrast, the relevance of the established industrial countries Japan and Canada decreased from two to one, and from four to two per cent between 2010 and 2017. Singapore's share remained fairly stable at around one per cent.

Chinese and Indian knowledge imports on the rise

FIGURE 3A: SHARE OF GERMANY'S KNOWLEDGE IMPORTS – MAJOR SOURCE COUNTRIES



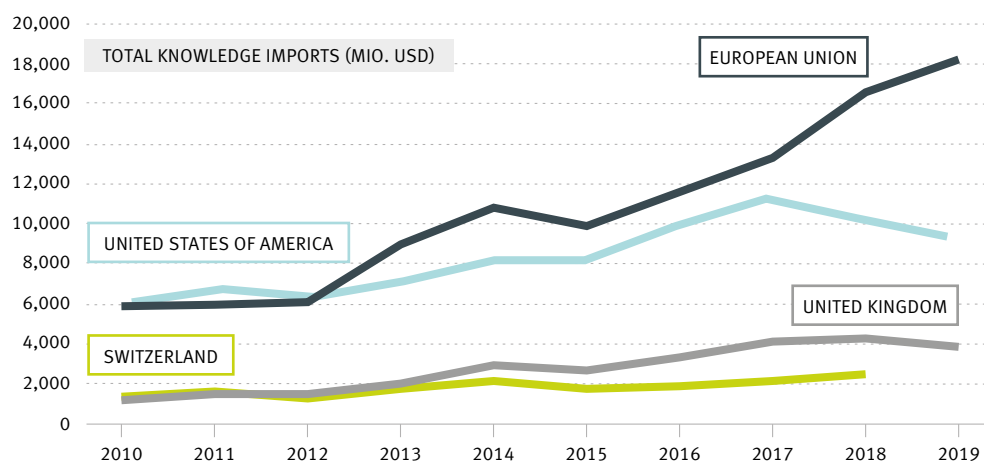
Note: Knowledge services import shares are calculated from the WTO Stats Dashboard by dividing Germany's commercial service imports related to "research and development" and "charges for the use of intellectual property" from a specific country by Germany's total commercial service imports related to "research and development" and "charges for the use of intellectual property". Source: WTO Stats (2024)

FIGURE 3B: SHARE ON GERMANY'S KNOWLEDGE IMPORTS – MINOR SOURCE COUNTRIES

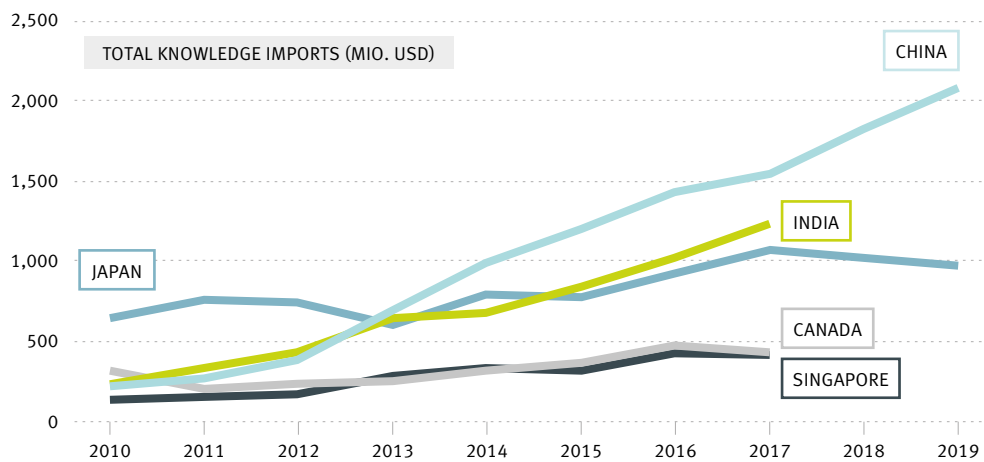
Note: Knowledge services import shares are calculated from the WTO Stats Dashboard by dividing Germany's commercial service imports related to "research and development" and "charges for the use of intellectual property" from a specific country by Germany's total commercial service imports related to "research and development" and "charges for the use of intellectual property". Source: WTO Stats (2024)

KNOWLEDGE IMPORTS FROM ALL RELEVANT SOURCE COUNTRIES INCREASE IN ABSOLUTE TERMS – ON AVERAGE

Finally, Figures 4a and 4b show that the total value of knowledge imports increased on average for all major and minor source countries, except for a dip in the most recent years from 2017 to 2019 in the imports of the US, the UK, Japan, and Canada. This may further contribute to their declining relevance compared to the EU and the up-and-coming countries China and India, which exhibited a particularly strong growth in these years.

FIGURE 4A: TOTAL KNOWLEDGE IMPORTS OF GERMANY – MAJOR SOURCE COUNTRIES IN 2017

Note: Knowledge services imports are calculated from the WTO Stats Dashboard by adding Germany's commercial service imports related to "research and development" and "charges for the use of intellectual property" from each country. Source: WTO Stats (2024)

FIGURE 4B: TOTAL KNOWLEDGE IMPORTS OF GERMANY – MINOR SOURCE COUNTRIES IN 2017

Note: Knowledge services imports are calculated from the WTO Stats dashboard by adding Germany's commercial service imports related to "research and development" and "charges for the use of intellectual property" from each country. Source: WTO Stats (2024)

TRADE BARRIERS CAN HAMPER DOMESTIC INNOVATION

Due to its high degree of internationalisation, Germany has benefited significantly from growing global markets. Focusing on the import of knowledge services, its total value of commercial R&D imports was the fourth largest of a single country worldwide in 2017, and the ninth largest for the import of commercial intellectual property (WTO Stats, 2024). At the same time, however, Germany remained relatively dependent on international supply chains, making it potentially less resilient to geopolitical challenges (Dorn et al., 2024).

Germany is one of the largest knowledge service importers worldwide

THE IDEA OF GERMANY'S TECHNOLOGICAL SOVEREIGNTY

As a result of this trade-off, the concept of technological sovereignty is increasingly being discussed in Germany. The German Federal Ministry of Education and Research (BMBF) published an impulse paper on the subject as early as 2021 (BMBF, 2021). It highlights the importance of Germany and Europe becoming more independent in key technologies in order to stay competitive and innovative in the long run. This means investing in critical areas such as advanced electronics, artificial intelligence, data technologies, quantum computing, and sustainable technologies.

Another important point of the paper targets international collaboration. In this part, the BMBF considers international collaboration as essential for access to cutting-edge knowledge and focuses on the European single market as well as countries with a value partnership, such as the members of the G7 and selected countries from Pacific Asia.

Developing key technologies

International collaboration with selected countries

EU SINGLE MARKET AS SOURCE OF FOREIGN KNOWLEDGE

Based on the descriptive figures presented, Germany's knowledge trade has largely followed the BMBF's call to focus on a selection of specific knowledge importers. This is particularly true with regard to Germany's increasing focus on the EU single market for knowledge services, which is also proposed by Dorn et al. (2024) for trade in services in general. However, Dorn et al. (2024) present suggestions to further improve the EU single market for service trade, as significant trade barriers remain at this point.

In particular, they present the results of an analysis by the ifo Institute indicating that administrative barriers are the greatest obstacles to the smooth provision of cross-border services (Dorn et al., 2024, Fig. 4). More precisely, due to national regulations, many member states impose different requirements on foreign companies before allowing them to provide services within their own country. These administrative hurdles include reporting obligations, the need for prior approvals, additional insurance requirements, the protection of professional titles, and the lack of recognition of professional qualifications, all of which hinder the smooth provision of services in other EU countries.

Knowledge trade patterns mostly follow the suggestions by the BMBF

Administrative barriers as the most important obstacle

SUPPORTING SMES TO INCREASE THE GAINS FROM SERVICE TRADE

The BMBF (2021) and Abel-Koch (2018) identify German small and medium-sized enterprises (SMEs) as having a particular potential to further reap the benefits of (knowledge) service trade. Krieger and Trottnner (2024) demonstrate that larger firms with more than 250 employees are about six times more likely to import knowledge services, than firms with fewer employees. Thus, although SMEs make up a major part of the German economy, they profit relatively less often from access to foreign knowledge. One potential reason for this is the particularly negative effect of restrictive trade service regulations on them (Abel-Koch, 2018). In order to foster their participation in international knowledge trade, the ministry is therefore expanding its "KMU international" initiative. This initiative supports the integration of SMEs into global knowledge and innovation networks, facilitating the transfer of research to industry and improving competitiveness.

SMEs rarely import knowledge services

In sum, access to foreign knowledge via service imports is conducive to the success of innovations in Germany. Germany has increasingly imported knowledge over the last decade, whereas its focus on the European Union as a trading partner has grown over time. This trend follows the proposed strategy of the BMBF to focus on a specific selection of countries as knowledge sources to increase Germany's technological sovereignty and resilience to global challenges. However, to compensate for increasing protectionism worldwide, trade barriers between Germany and its selection of countries – in particular the EU single market – have the potential to be further reduced, especially administrative barriers. Finally, fostering the participation of SMEs in knowledge service trade can result in further innovation gains, as they rarely access foreign knowledge via service trade at this point.

Examples of knowledge service trades

Research, development, and testing services: from BioNTech (Germany) to Pfizer (US)

Pfizer and BioNTech entered a detailed research collaboration and license agreement in 2018 to develop mRNA-based vaccines for the prevention of influenza. The agreement covered the eligibility of BioNTech to receive up to \$305 million in potential development, regulatory, and commercial milestone payments as well as up to double-digit royalties. The amounts of potential development payments are not disclosed in the published agreement. However, the list of development milestones provides an example of Pfizer's import of foreign development services. The milestones covered, inter alia, payments for the initiation of the first, second, and third phase of the vaccine's clinical trials.

Patents, licenses, inventions, and processes: from Ballard Power Systems (Canada) to Audi (Germany)

Audi bought a package of patents from Ballard Power Systems in 2015. The trade involved a €40 million purchase of fuel cell technology patents from Ballard Power Systems by Audi, and is an example of the importation of patent services by Audi.

Artistic copyrights: from Rodd Industrial Design (United Kingdom) to Motorola (United States), Philips (Netherlands), and Panasonic (Japan)

Rodd Industrial Designs is a design studio founded in the United Kingdom in 2000. It delivers design directions to a variety of foreign companies. Examples include designs for phones, monitors, electric razors, and shower heads. Customers listed on their website are, for example, Motorola, Philips, and Panasonic. Rodd Industrial Designs usually retains the copyright to their design until payment of the final invoice. After the payment, the copyright is transferred to their customer. The international transfer of copyright for designs developed by Rodd Industrial Designs represents an import of copyright services by their customers.

Other rights, such as franchise fees, trademarks, and marketing rights: from Novartis (Switzerland) to Eris Lifesciences (India)

Eris Lifesciences acquired the Zomelis trademark from Novartis for the Indian market in 2019. Zomelis is used in the treatment of type 2 diabetes and belongs to a class of drugs relying on the novel technology of DPP4 inhibitors. The acquisition of Eris Lifesciences, valued at approximately \$13 million, represents a trademark service import. It enabled Eris Lifesciences to add Novartis to its product portfolio and sell it in the Indian market from December 2019.

Source: Krieger and Trottner (2024)

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