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EU Strategic Autonomy Radar

Monitoring Europe's Control of Key Technologies

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Against the backdrop of growing geo-economic risks, the EU has adopted 'open strategic autonomy' as the guiding principle for its new approach to trade and industrial policy. In an era of fundamental technological change, this requires control over the supply chains of a large number of critical technologies. Clear and transparent metrics will be needed to evaluate the success of the EU's risky policy switch. This cepStudy proposes and applies a new index-based methodological approach to assess strategic autonomy distinguishing the dimensions of supply resilience and reliability. Instead of relying on macroeconomic performance measures, it takes a detailed look at trade flows in key future technologies for the EU's transformative goals.

- In a global comparison, the three economies with the highest autonomy scores are all located in Eastern and South-Eastern Asia, with China in first place. Asian economies dominate each of the eight technology fields considered, primarily due to their low import dependency and focus on reliable suppliers. In particular, China has increased its autonomy advantage over Western economies in recent years.
- The EU has lost ground to China over the past five years. At the same time, it still reaches a higher autonomy score than other developed economies, including the US, thanks to the breadth of its technological expertise and the size of its manufacturing base. However, apart from advanced engineering technologies, the EU is not among the global autonomy leaders in any of the single fields considered.
- From a policy perspective, global comparisons suggest that a high level of autonomy can result from a variety of development strategies, ranging from import substitution to market liberalization. In future, responsible policymaking will require more precise analytical tools to quantify the societal costs, risks and long-term benefits of different strategies.
- Given the heterogeneity of technologies and markets, a politically prescribed one-size-fits-all development strategy is unlikely to strengthen the EU's general level of autonomy. Rather than attempting to direct technological development, support measures should focus on cross-industry risk-sharing instruments that enable early-stage investors to benefit from the positive spillover effects of their pioneering role.

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1 Motivation

Pandemics, trade and military conflicts: Recently, a series of geoeconomic turbulences has revealed the fragility of Europe's business and social model towards global developments. In response, the EU has made a gradual but significant shift in its external economic policies, summarized by the goal of establishing open strategic autonomy.[1] Although the precise definition of this concept remains somewhat vague, it is evident that reducing external economic dependencies lies at the heart of the EU's ambitions. By reducing its reliance on third countries like China for mineral raw materials, energy carriers, and other hard-to-substitute resources, the EU aims to mitigate the impact of supply chain disruptions. This serves not only to reduce economic risks, but also to reduce the EU's susceptibility to political blackmail, thereby raising its autonomy at a geopolitical level. These ambitions have now materialized in a series of policy initiatives by the European Commission, most recently the Economic Security Doctrine, which defines key vulnerabilities and policy tools across various sectors of the European economy.[2]

Many of the policies discussed, such as the 'Made in Europe' criteria for public procurement and stricter regulation of foreign direct investment inflows, represent a clear departure from the EU's traditional principle of promoting unrestricted cross-border trade and capital flows. Their effectiveness is yet to be proven, and they pose a risk to other long-term EU policy goals. In such a situation, policy evaluation must be based on clear, transparent metrics. This begins with measuring the EU's overall degree of strategic autonomy, as well as its specific strengths and weaknesses. Commonly applied international competitiveness benchmarks, such as the WEF Competitiveness Index or the IMD Competitiveness Ranking, are not suitable for this purpose. They rely on a combination of macroeconomic indicators and results from cross-sector business surveys. Consequently, they reflect the current economic structure and do not adequately consider the fundamental structural changes fueled by digitization, decarbonization, and other associated long-term trends. What is needed instead is a metric that explicitly assesses the EU's autonomy with regard to the supply chains of emerging business areas and technologies that will define future global markets.

With the EU Strategic Autonomy Radar, this cepStudy proposes and applies for the first time such an approach. Rather than focusing on macroeconomic performance measures, it takes a detailed look at trade flows in key future technologies. The selection of analyzed technologies is directly linked to the EU's current list of critical technologies, ensuring consistency with strategic policy priorities. For each technology segment, the analysis considers supply security in two dimensions: resilience to disruption in global supply chains, and the reliability of current external suppliers. The analysis is based entirely on public trade and country data, ensuring transparency and enabling annual updates. The analysis produces both aggregate and technology-specific index values, enabling an evaluation of the EU's degree of strategic autonomy in comparison to other economic regions and over time. In the future, this framework can be the basis for a differentiated examination of the impact of economic security policies on various technology sectors and the EU's specific strengths and vulnerabilities.

The study begins with discussing the theoretical background to the chosen measurement technique. It then explains the choice of technology fields, indicators, and aggregation techniques. The results are

[1] European Commission (2021). Communication to the European Parliament, the European Council and the Council on the European economic and financial system: Fostering openness, strength and resilience. COM(2021) 32 final.

[2] European Commission/ High Representative of the Union for Foreign Affairs and Security Policy (2025). Strengthening EU economic security. Joint Communication to the European Parliament and the Council. JOIN(2025) 977 Final.

presented in the form of both aggregate rankings and a detailed analysis of the EU's current strengths and weaknesses in different technology fields. Finally, the study concludes with a discussion of the trade-offs between strategic autonomy goals and other EU policy goals, as well as their relationship to openness and innovation.

2 Strategic Autonomy as a New Policy Goal

2.1 The Paradigm Shift in EU Trade Policies

External trade policy is the exclusive competence of the EU. The increase in trade disputes and supply chain disruptions in recent years, even before the outbreak of the war in Ukraine, has led to a noticeable reorientation in this area. In its Trade Policy Review 2021, the European Commission introduced the concept of 'open strategic autonomy' as a new guiding principle for EU trade policy. On the one hand, it emphasizes that it will continue to work for open and rules-based global trade based on multilateral cooperation. But it also makes clear that the EU must be able to defend its strategic interests and values independently and confidently in the global trade order. This includes measures to increase the resilience and sustainability of its supply chains and the ability to tackle unfair trade practices by third countries. The Commission summarizes this reorientation in three medium-term trade policy objectives: 1) supporting the EU economy in the upcoming transformation towards decarbonization and digitalization, 2) influencing global trade rules towards a more sustainable and fairer form of globalization, 3) enhancing the EU's ability to pursue its objectives through autonomous action.[3]

2.2 The Role of Critical Technologies

In the power struggle of a multipolar world, the pursuit of technological leadership has become a cornerstone of geoeconomic strategies. It promises not only persistent productivity growth, but also a leading role in the design of new global markets through transnational processes that could redesign economic and political relationships. By aligning trade rules and technical standards with the technological expertise of domestic companies, long-term market dominance and monopoly rents can be secured.

The intensified technological competition represents a strategic challenge for Europe's model of economic growth. Third countries with a more dirigiste political control of their economic resources possess an institutional advantage in the development and scaling of disruptive technologies. They are able to reallocate resources faster to new applications for which yet no markets exist. They are also able to bear bigger fiscal risks in the public support of disruptive innovation processes, as their governments face lower political accountability. Keeping pace forces the EU to engage in a sensible balancing act: in order to shape future markets, it must increase the speed and determination of pre-market decision-making without undermining its historical identity as an advocate of individual freedom.

The strategic approach of the EU so far has been a cautious realignment of priorities, while keeping the overall framework of policy coordination intact. The logic behind recent legislative initiatives like

[3] European Commission (2021). Communication to the European Parliament, the European Council and the Council on the European economic and financial system: Fostering openness, strength and resilience. COM(2021) 32 final.

the Critical Raw Materials Act[4] and the Net-Zero Industry Act[5] is to channel the fiscal (support funds) and administrative (permit granting, monitoring) resources of the Union and its Member States to capacity-building (development, production, recycling) of technologies considered critical for achieving strategic autonomy. As a basis for future market monitoring, the Commission published a list of critical technologies in October 2023 (see Table 1).[6] In selecting these technology areas, the Commission applied three criteria. The first is the enabling and transformative nature of the technology. This relates to its potential of causing drastic changes in production conditions and thus stimulating long-term productivity improvements. This is the immediate economic aspect of the definition. The second criterion is the risk of military and civil fusion, i.e. the dual use potential of the technology. It reflects the risk that unintended knowledge outflows could enhance military threats for the EU. The third criterion is the potential of misusing the technology for the violation of human rights in third countries, e.g. the surveillance of the population and the suppression of free speech.

Table 1: EU List of critical technology areas

No.	Technology area	Examples specific technologies
1	**Advanced semiconductor technology**	Microelectronics; Photonics; High frequency chips; Manufacturing equipment at very advanced node sizes
2	**Artifical intelligence technologies**	High performance computing; Cloud and edge computing; Data analytics technologies
3	**Quantum technologies**	Quantum computing; Quantum cryptography; Quantum communications; Quantum sensing and radar
4	**Biotechnologies**	Techniques of genetic modification; New genomic techniques; Gene-drive; Synthetic biology
5	**Advanced connectivity, navigation and digital technologies**	Secure digital communications and connectivity; Cybersecurity technologies; Internet-of-Things and Virtual Reality; Distributed ledger and digital identity technologies; Navigation and control technologies
6	**Advanced sensing technologies**	Electro-optical, radar, chemical, biological, radiation and distributed sensing; Magnetometers; Underwater electric field sensors; Gravity meters and gradiometers
7	**Space and propulsion technologies**	Dedicated space-focused technologies; Space surveillance and earth observation technologies; Space positioning, navigation and timing; Secure communications; Propulsion technologies
8	**Energy technologies**	Nuclear fusion technologies; Hydrogen and new fuels; Photovoltaics; Smart grids and energy storage
9	**Robotics and autonomous systems**	Drones and vehicles; Robots and robot-controlled precision systems; Exoskeletons; AI-enabled systems
10	**Advanced materials, manufacturing and recycling technologies**	Technologies for nanomaterials; Additive manufacturing; Digital controlled micro-precision manufacturing; Technologies for extracting, processing and recycling critical raw materials

Source: European Commission (2023).

The formulation of this list intends to fill a monitoring gap in the EU's overall strategy of regaining control over international supply chains in critical technology areas. However, monitoring also requires

[4] European Union (2024a). Regulation (EU) 2024/1252 of the European Parliament and of the Council of 11 April 2024 establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending Regulations (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1724 and (EU) 2019/1020Text with EEA relevance.

[5] European Union (2024b). Regulation (EU) 2024/1735 of the European Parliament and of the Council of 13 June 2024 on establishing a framework of measures for strengthening Europe's net-zero technology manufacturing ecosystem and amending Regulation (EU) 2018/1724.

[6] European Commission (2023). Annex to the Commission Recommendation on critical technology areas for the EU's economic security for further risk assessment with Member States. C(2023) 6689 final.

a transparent analytical measurement approach. At the level of technologies, the EU still lacks an approach comparable to its established criticality monitoring for raw materials. In the following, the existing list of critical technologies is used as the starting point for constructing and applying a strategic autonomy index based on publicly available data.

3 Index Construction

3.1 Theory

Given the current presence of strong transformative forces in the realms of technology (digitization, phase-out of fossil technologies) and politics (geopolitical power shifts, new bloc building), macroeconomic output or trade indicators are a poor approximation of the concept of strategic autonomy. They are mostly a reflection of the performance of currently dominating economic sectors. As such, they say very little about the EU's competitiveness in fields that are key to future long-term economic growth. As many of these fields reach beyond conventional classifications of economic sectors, combining knowledge from a variety of existing production routes, statistical sector data is per se inadequate to monitor the EU's performance.

Indeed, some scholars argue that future welfare and, in consequence, the stability of Europe's model of society will not hinge on the fate of current mass production industries, but on the control of a limited set of critical technologies designed for cross-sectoral usage.[7] In this respect, the concept of controlling a technology is understood as multi-faceted. It goes beyond the ownership of specific technology patents or production facilities. Rather, it reflects the general ability of accessing a technology for productive use, and steering to a certain extent its application and future development by defining technical standards and gaining domestic research competence. A prerequisite for such a form of control is a minimization of supply chain risks, i.e. risks to the provision of raw materials, intermediate goods, equipment and skills needed for putting the critical technologies to use.

This supply chain perspective on technology access has recently gained increased attention both by economists and policy-makers. Much of the discussion centers on the concept of resilience, a term originally stemming from psychology. In general terms, it describes the ability of a system to rapidly return to its initial state when being disrupted by an external force.[8] In economic applications, it reflects an economy's ability to rapidly restore supply security as a response to supply interruptions in one or several stages of its value chains. The origin of such interruptions can be of a technical (blockage of transport routes), political (export restrictions by source country, political and military unrest) and/or economic (supply interruptions of key suppliers) nature. Likewise, a successful response can take different forms. It can consist of resorting to domestic reserve stocks and production capacities, accessing alternative external supply channels or replacing a missing intermediate by its technological substitutes. Typically, both the set of available response options and their costs will differ between short- and long-term perspective, causing time trade-offs in crisis response (see discussion in Section 5.2).

While the resilience concept is appealing in stressing the crucial role of flexibility in crisis response, it is only a partial measure of supply security. A more comprehensive perspective should not only reflect

[7] Gehrke, T. (2022). EU open strategic autonomy and the trappings of geoeconomics. European Foreign Affairs Review, 27 (Special).

[8] US Department of State (2009). What is resilience?.

the ability to respond to external supply disruptions, but also the likelihood of their incidence. Besides accounting for global risk factors, this requires an assessment of the reliability of existing supply routes. In sum, this view defines an economy to be strategically autonomous when it possesses secure access to a set of key cross-sector technologies, with supply security characterized both by reliable supply channels and the ability to flexibly respond to supply disruptions (resilience).

3.2 Indicators and Aggregation

The two-pillar theoretical concept is translated directly into measurable indicators. Observed international trade flows of goods at the country level form the essential framework. In contrast to trade in services or direct investment, external dependencies can be recorded at a very granular level here. Data on trade in goods is also more reliable in principle, as it is based directly on customs authorities' records and does not have to be estimated using top-down approaches. This allows for the differentiation of dependencies in certain critical technology fields.

The basis for selecting and categorizing the product groups is the EU list of critical technologies presented in Section 2.2. To identify the statistical codes of the Harmonised System Classification (HS) of traded goods attached to the different fields of critical technologies, we draw upon work conducted by the European Commission's Advanced Technologies for Industry (ATI) project.[9] We generally adopt the detailed lists of HS codes created for individual technology fields. In one case (Energy Technologies), the list was supplemented by our own product selection based on extensive research in the HS classification system. In another case (Connectivity Technologies), technology fields were combined into one aggregate category due to significant overlap between product groups. Another technology field was split in the interest of a more insightful comparison (Advanced Materials, Advanced Engineering Technologies). The detailed product assignment is shown in Table A1 in the Appendix (7.1.)

At the most aggregate level, the index is divided into two pillars: '**reliability**' and '**resilience**'. The **reliability** dimension comprises indicators that reflect the reliability of supplier countries. As the reliability of certain supply channels depends on various political, logistical and economic factors, it can only be measured indirectly. Based on the above theoretical considerations, we distinguish three dimensions of reliability: the regulatory quality and the institutional stability of the supplier economy, as well as the economic leverage/bargaining power of the importing economy towards the supplier economy. From the perspective of supply relationships, regulatory quality primarily concerns the trade policy of the supplier economy. The most relevant factor is the extent to which the supplier economy restricts exports through political intervention (e.g. export quotas) or indirectly increases their cost (e.g. export licenses). Therefore, the frequency with which such export-related trade barriers are applied by the supplier economy to the product groups considered serves as an indicator for measuring regulatory quality. The institutional stability of supplier countries affects the overall risk of supply chain disruption resulting from internal political conflicts and upheavals. As is common in many country indices, this is quantified using survey-based governance indicators, in this case specifically the level of political stability.

The degree of economic leverage vis-à-vis the supplier economy is closely related to the extent to which economic dependencies are unilateral or reciprocal in nature. If, for example, net imports of

[9] European Commission (2024). European Monitor of Industrial Ecosystems.

certain critical technologies are offset by net exports of other critical technologies, the dependency relationship is reciprocal in nature. This reduces the risk that the supplier economy will use existing trade relations for political coercion, e.g. by restricting exports. We therefore measure an economy's degree of economic leverage vis-à-vis a supplier as the share of critical technologies for which the economy is currently a net exporter to the supplier economy.

The three indicators are then multiplied. This reflects their limited substitutability. For instance, the current absence of trade barriers has little impact on reliability if the degree of economic leverage vis-à-vis suppliers is low. In this case, there is a high risk that suppliers will introduce export restrictions in future. Even with low institutional stability, the current trade policy regime has little significance for the future. Good values for all three indicators are therefore essential for a reliable assessment. The measure calculated for each supplier economy in this way is then averaged arithmetically on a product-specific basis, with the respective supplier countries' import shares as weights. This is then multiplied by the product-specific import dependency of the countries (i.e. the ratio of imports to domestic use). The resulting number is finally multiplied by 100. This produces a reliability measure ranging between 0 and 100.

The **resilience** dimension measures an economy's ability to fall back on alternative supply channels for critical technologies in the event of disruption to external supply channels, such as domestic production or alternative trading partners. This ability is typically assessed using a combination of import dependency measures and indicators of the spatial concentration of imports, as outlined in the EU methodology for identifying critical raw materials. Our approach goes one step further by also including the substitutability of different import channels in the resilience assessment. The more comparable the technological characteristics and quality of products supplied by different countries are, the higher the level of resilience associated with any given level of supply concentration.

To quantify this degree of substitution, we conduct our own econometric estimates of substitution elasticity based on a panel gravity model of global trade flows in various product groups (aggregation level: 2-digit level of HS classification). In doing so, we take advantage of the fact that, in the gravity model, when a sufficient number of control variables are selected for country- and time-specific influencing factors, the elasticity of trade volume in response to changes in tariff rates corresponds to the elasticity of substitution. The empirical model and the estimation results are presented in the Appendix (7.3).

We use the product-specific substitution elasticities as weighting factors in calculating a Herfindahl-Hirschman Index (HHI) for the spatial concentration of the origin of imports.[10] The lower the substitution elasticity, the higher the weighting of the HHI index value. This reflects the fundamental fact that sufficient diversification of supply relationships is all the more important when there are few short-term substitution options from alternative suppliers. The resulting measure of import diversification is then multiplied by the product-specific import dependency of the countries. The resulting number is finally multiplied by 100. This produces a resilience measure ranging between 0 and 100.

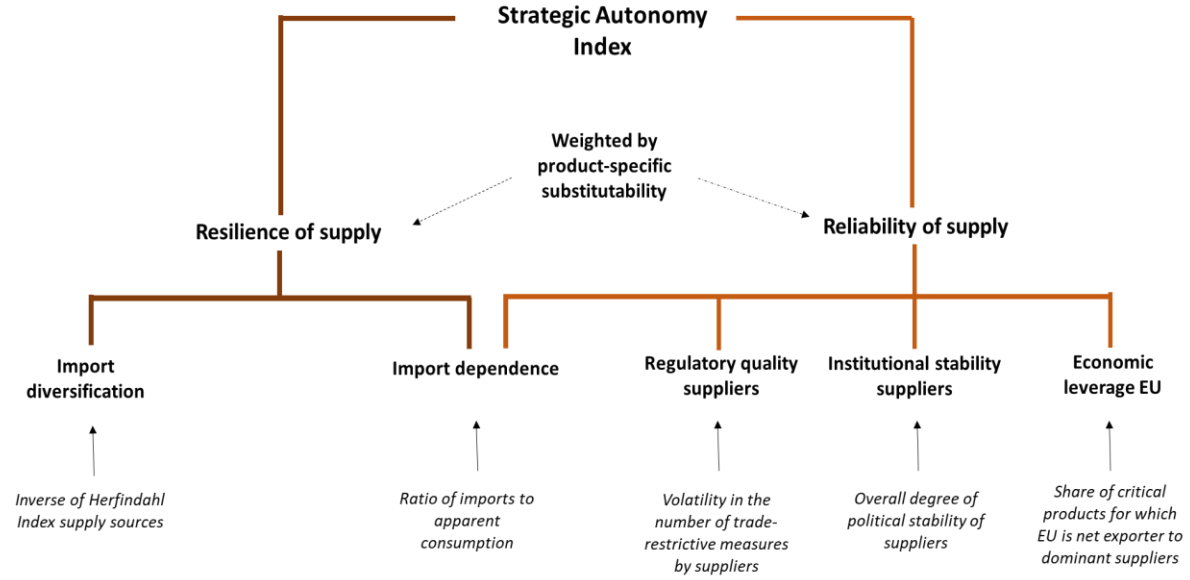
In this way, product-specific measures of the reliability and resilience of the supply channels of different countries/economic regions are derived for all products included. These are first summarized

[10] Rhoades, S. A. (1993). The Herfindahl-Hirschman index. Federal Reserve Bulletin, (Mar), 188-189.

to measures by technology field, by calculating weighted arithmetic means of the reliability and resilience values of all products assigned to the respective field. As weights, economy-specific import values of the products are applied. In this way, sub-indices by technology field are derived. The simple arithmetic mean of these sub-indices then yields the value of the overall index. In addition to this hierarchical structure, two transversal indices are calculated, each representing key policy areas: decarbonization technologies and dual-use goods. To this end, products from each of the eight technology fields are assigned to the two cross-sectional segments. The assignment is presented in Table A3 in the Appendix (7.4). The cross-sectional indices are then calculated as the arithmetic mean of the product-specific reliability and resilience measures

Figure 1 illustrates the structure of the index by indicator. The calculation formulas are shown in the Appendix (7.2). From a theoretical perspective, the index calculated in this way exhibits several desirable properties. All the included indicators lie within a value range between zero and one. Consequently, the aggregated index values also lie between zero and 100. A value of 100 represents the maximum level of strategic autonomy achievable for an economy. Given the construction of the index, this can be achieved in two ways: through complete self-sufficiency (zero import dependency for all critical technologies), or through a maximum diversification of imports and the greatest possible reliability of import channels. In this way, the index reflects the current European debate on whether to promote new domestic industries or enter into new external partnerships for critical technologies. Additionally, all included indicators have a measurement scale of at least the interval level. Calculated index values therefore have an absolute interpretation. This makes it possible to record progress in the degree of strategic autonomy by comparing index values over time, as well as making point-in-time comparisons between economies.

Figure 1: Index construction



Source: own illustration

Annual index values are calculated for the period 2015-2024 for a set of 30 economies in total, selected as the biggest economies worldwide in terms of Gross Domestic Product (GDP) in 2024.[11] In doing so,

[11] As the only exception to this rule, Taiwan had to be excluded from the index, due to the absence of reported data on bilateral trade with Taiwan by the UN.

the European Union is considered as one single economy, reflecting the existence of the internal market as a shield against supply threats.threats.

3.3 Technology Fields

The index is divided into eight technology fields, each of which aligns closely with the current EU definition of critical technologies (see Section 2.2).

- **Field 1 – Advanced Engineering Technologies**: New manufacturing principles, such as the Internet of Things and additive manufacturing, are recalibrating production methods towards system integration, automation, and data-driven design. This field covers access to the machines and machine tools required for the current industrial revolution.
- **Field 2 – Advanced Materials**: A wide range of industrial materials with specialized technical properties has been designed to fulfil the functional needs of future-oriented green and digital technologies. This field provides access to advanced materials in areas such as metal alloys, advanced polymers, and nanofibers.
- **Field 3 – Connectivity Technologies**: Advanced digital communication and connectivity technologies, including space technologies, form the foundation for the unrestricted and secure exchange of information across Europe. This is an essential prerequisite for innovation and future economic growth. This field covers access to digital communication equipment (e.g. optical fibers), as well as signaling and surveillance devices (e.g. radars and production meters).
- **Field 4 – Data Management Technologies**: Infrastructure for managing and storing large data flows is essential for training AI algorithms and ensuring Europe's digital competitiveness. This field encompasses the hardware necessary for processing such data-based technologies, including readers and storage devices.
- **Field 5 – Energy Technologies**: Technologies that convert the fossil-based energy system into more efficient, climate-friendly forms of energy are at the core of the EU's industrial transformation. This field covers access to sustainable energy technologies for generation (e.g. solar panels and wind turbines), conversion (e.g. electrolysis) and final consumption (e.g. heat pumps).
- **Field 6 – Industrial Biotechnologies**: Using living cells or their enzymes as raw materials or biocatalysts in industrial production can improve the sustainability of product cycles by reducing energy and fossil resource consumption. This field covers access to biogenic compounds used in industrial biotechnology applications.
- **Field 7 – Robotics**: Using robots and other autonomous systems for routine production tasks is a key driver of future productivity growth in manufacturing. This field covers access to industrial robots and their major electronic components.
- **Field 8 – Semiconductor Technologies**: Secure access to high-performance microchips with very small node sizes is a precondition for strategic autonomy in powering a range of technologies like wind turbines, electric cars and quantum computing. This field covers access to semiconductor devices as well as to the equipment needed in semiconductor production.

In addition, cross-field ("transversal") indices have been computed that cover a selection of critical technologies relevant to two strategic EU policy objectives: the green transformation and the control of dual-use technologies. Decarbonization technologies were selected based on their importance in the use of renewable energy sources and materials in manufacturing, energy conversion, and final

energy consumption. Dual-use technologies were identified based on their presence in the EU List of Common High Priority Items for export control (Version of February 2024).[12]

3.4 Data

The product-specific bilateral trade data is obtained from UN Comtrade.[13] For all products recorded, the annual trade volume between all countries worldwide is considered for the period 2015 to 2024. The data is used to calculate measures of import dependency, spatial concentration and economic leverage (see Section 3.2). It also forms the basis for estimating substitution elasticities. Information on export-related trade barriers (indicator: regulatory quality) is obtained from the UNCTAD TRAINS database.[14] Specifically, the occurrence of export-related non-tariff trade measures (Section P) valid for the respective period is recorded for the product groups included in the index. The World Bank Group's Worldwide Governance Indicators are used to measure institutional quality.[15] We use the indicator 'Political Stability and Absence of Violence' because it best reflects the concept of stability in our theoretical framework.

In order to determine import dependencies, internal consumption must be estimated in addition to import values. This is not usually recorded statistically. We therefore use the approach also employed by the EU, which is to determine consumption indirectly from the sum of domestic production and imports minus exports. For the EU, production data is obtained from Eurostat's PRODCOM database.[16] The PRODCOM codes associated with individual technologies are taken from the results of the ATI project, just like the HS codes, or (in the case of energy technologies) determined on the basis of our own research. For third countries, production data is provided by the UN Industrial Production Database (UN INDSTAT).[17] However, this data is incomplete and, in some cases, only available at a higher level of aggregation. Where necessary, the export quotas (i.e. the ratio of exports to domestic production) of countries that can be measured at a higher level have therefore been transferred to lower levels of aggregation or average values have been applied over the period under review.

To estimate substitution elasticities in the gravity approach, additional control variables are needed in the form of time series on bilateral product-specific import tariffs and the existence of regional free trade agreements. Tariff rates are obtained from the Tariff and Trade Analysis Database of World Integrated Trade Solutions (WITS).[18] Information on regional trade agreements is retrieved from the database of Mario Larch.[19]

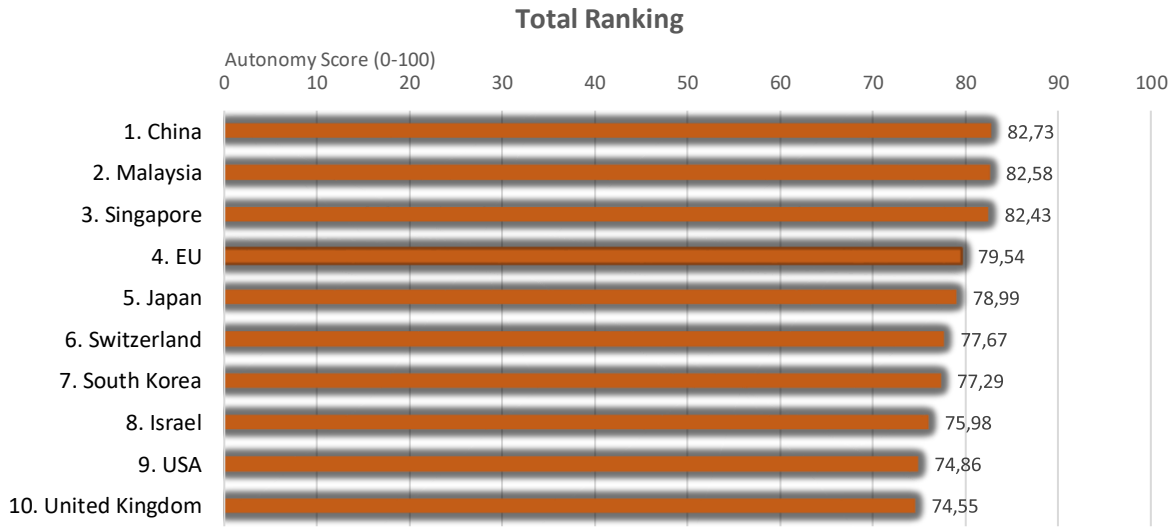
[12] European Commission (2024). List of Common High Priority Items (Version of February 2024).
[13] UN Comtrade (2025). UN Comtrade Database.
[14] UNCTAD (2025). TRAINS Portal.
[15] World Bank (2025). Worldwide Governance Indicators.
[16] Eurostat (2025). PRODCOM Database.
[17] WITS (2025). Tariff and Trade Analysis. World Integrated Trade Solutions.
[18] UN INDSTAT (2025). UN INDSTAT Database – Revision 4.
[19] Larch, M (2025). Mario Larch's Regional Trade Agreements Database.

4 Index Results

4.1 Current Global Ranking

The global ranking of scores for the most recent observation year shows three Asian countries at the top (see Figure 2). The top spot goes to the People's Republic of China, with Malaysia and Singapore close behind. The EU follows in fourth place, some way behind. Nevertheless, the EU is performing significantly better than other Western economies. The USA and the UK only just make it into the top 10. Most major emerging economies other than China have significantly lower scores and are only in the lower part of the ranking. India ranks 18th, South Africa 19th, and Brazil 22nd. Russia takes only the 27th position. The full ranking can be found in Table A5 in the Appendix (7.5).

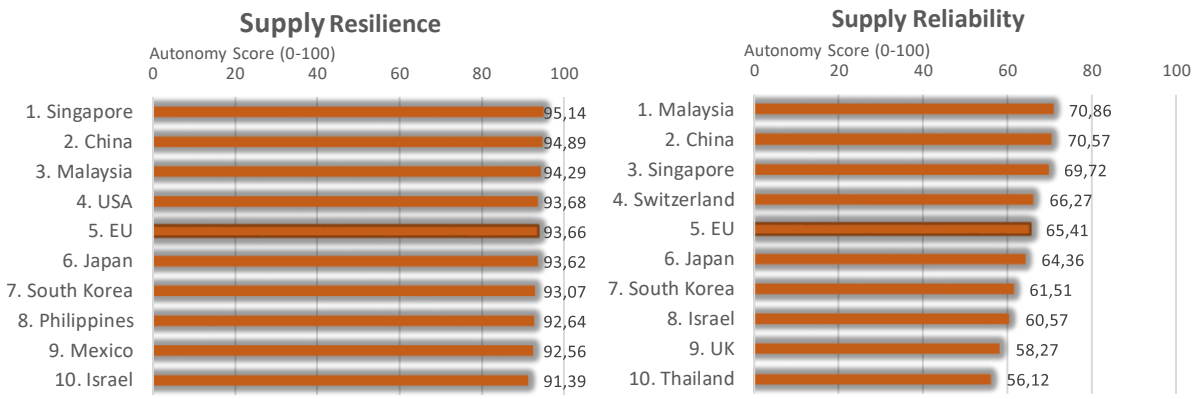
Figure 2: Top 10 economies in total index scores



Source: own calculations. Basis: most recent observation period (year 2024).

First insights in the reasons for these discrepancies can be found in the performance in the individual pillars (see Figure 3). China, Singapore and Malaysia form the top three in both pillars and also show a significant gap to all other economies, particularly in terms of supply reliability. This is primarily due to their low average import dependency for the technologies under consideration. However, there is another reason for their particularly outstanding performance in terms of supply reliability: their focus on export partners with high institutional quality, which in turn are dependent on imports from Asia. This points to an important aspect of the high strategic autonomy of China in particular. This autonomy consists not only of import substitution, but also of focusing remaining import needs on politically and economically stable trade channels. This strategy is mirrored by the poor performance of some Western economies, such as the United States, in the reliability pillar. Their relatively strong trade integration with China weighs on the assessment of the political risks of their existing import channels. The economy with the lowest score in the resilience pillar is Russia, mostly due to its strong import concentration on China and India.

Figure 3: Top 10 economies in resilience and reliability pillars



Source: own calculations. Basis: most recent observation period (year 2024).

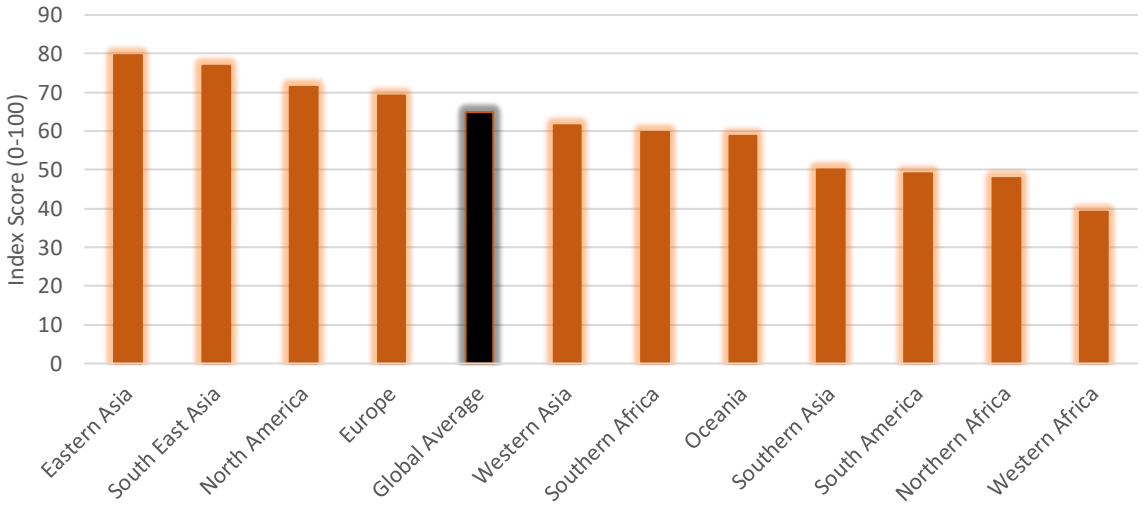
The most autonomous economies are characterized by a strong rating in all technology fields (see Table 2). For example, China is the frontrunner in four of the eight fields. Malaysia ranks among the top five globally in seven of the eight fields. By comparison, Japan's technological leadership is much more focused on individual fields. The EU's performance is less uneven, but still shows clear strengths and weaknesses (see Subsection 4.3 for a detailed discussion). The USA only ranks among the leaders in a few fields, and even here it lags behind dominant Asian countries. Other non-OECD countries that achieve top global scores in some fields besides China and Malaysia are the Philippines in robotics and semiconductor technologies and Thailand in data management and energy technologies. When categorized by world region, a clear geographic pattern emerges (see Figure 4). The average index scores of economies in Eastern and South-Eastern Asia are markedly higher than those in North America and Europe, with Europe dragged down mainly by the low score of Russia. South America, together with the Northern and Western parts of Africa, belongs to the regions with the lowest average level of autonomy. Even OECD member Chile performs well below the global average.

Table 2: Top 5 economies in subindices

Advanced Engineering		Advanced Materials		Biotech		Connectivity Technologies	
Economy	*Score*	*Economy*	*Score*	*Economy*	*Score*	*Economy*	*Score*
1. Japan	91.79	1. Japan	84.53	1. China	95.47	1. China	85.91
2. Singapore	88.19	2. China	82.29	2. Thailand	70.63	2. Malaysia	85.20
3. EU	84.53	3. Singapore	79.62	3. Malaysia	75.13	3. Israel	83.21
4. Malaysia	81.86	4. South Korea	77.99	4. Mexico	54.89	4. Singapore	83.17
5. USA	80.73	5. EU	72.09	5. Philippines	50.86	5. South Korea	80.11
Data Management		**Energy Technologies**		**Robotics**		**Semiconductor Technologies**	
Economy	*Score*	*Economy*	*Score*	*Economy*	*Score*	*Economy*	*Score*
1. China	92.96	1. China	83.60	1. Philippines	89.58	1. Japan	90.70
2. Vietnam	91.24	2. Thailand	83.00	2. Malaysia	89.47	2. Israel	90.52
3. Thailand	86.78	3. Japan	82.21	2. Japan	89.41	3. Malaysia	90.28
4. Malaysia	86.24	4. Malaysia	81.15	4. South Korea	88.81	4. Philippines	88.59
5. Mexico	85.65	5. Vietnam	81.12	5. Israel	88.66	5. Singapore	88.34

Source: own calculations. Basis: most recent observation period (year 2024).

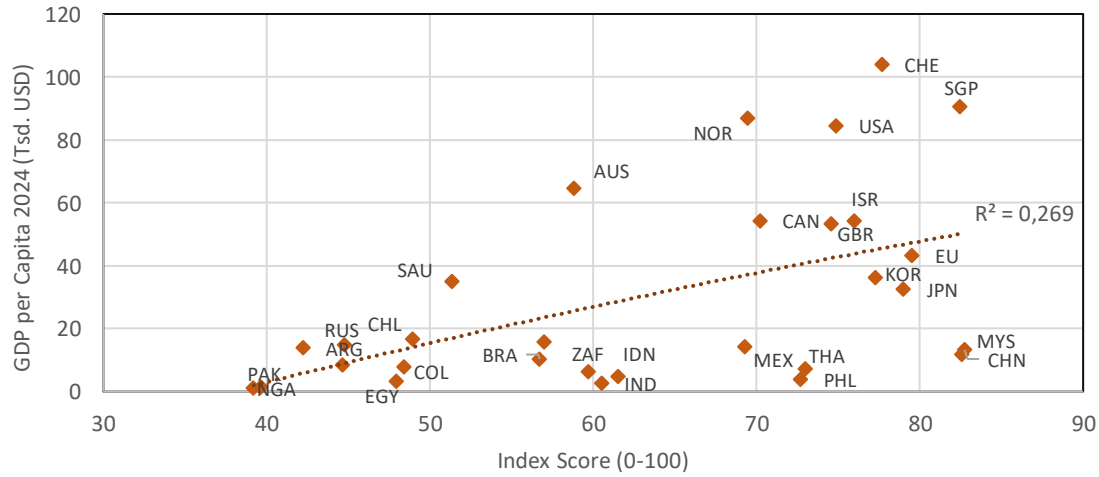
Figure 4: Average index scores by world region



Source: own calculations. Basis: most recent observation period (year 2024).

The results indicate that the relationship between economic prosperity and the degree of autonomy measured in a country or region is complex in nature. Figure 5 compares the current per capita income of the economies under review with their index score. Although there is a positive correlation between the two variables, it is rather weak. This is mainly due to a wide dispersion of index values at the lower end of the income scale. This remains true even when China and Malaysia are excluded from the picture. Although no causal relationships can be derived from this fact, it does correspond to an intuitive understanding of strategic autonomy. Economic prosperity can be regarded as a sufficient condition for achieving at least a certain degree of strategic autonomy, as it provides sufficient resources for restructuring the economy towards future technologies and/or diversifying import channels. However, it is not a necessary condition, as high autonomy can also be the outcome of a targeted long-term strategy by poorer countries, focusing initially scarce capital on greenfield investments in cutting-edge technologies.

Figure 5: Correlation between index scores and national income

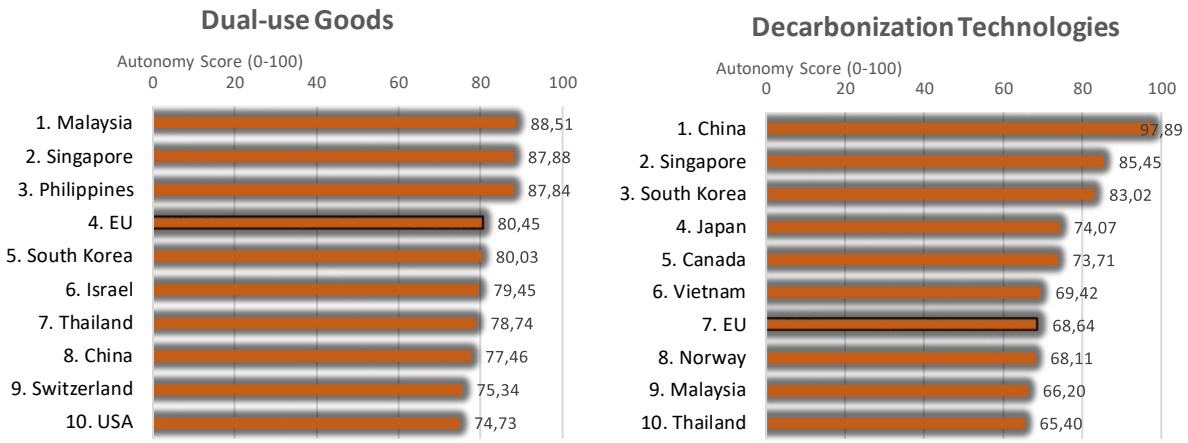


Source: own calculations; World Bank (2025)[20]. Basis: most recent observation period (year 2024).

[20] World Bank (2025). World Development Indicators Database.

Finally, the main results of the two transversal indices (dual-use technologies, decarbonization technologies) are presented (for a complete ranking, see Table A7 in the Appendix). In both indices, top positions are once again dominated by Asian economies (see Figure 6). China's dominance in decarbonization technologies is particularly striking. It extends to almost all single technology items included. Autonomy in dual-use technologies shows a slightly more balanced distribution, which makes sense given its criticality also in the military realm. In that case, other Asian countries than China exhibit the highest degrees of autonomy. The EU achieves a significantly better rating in this field than for decarbonization technologies, where EU import dependence in segments like lithium-ion batteries and photovoltaic cells is particularly high.

Figure 6: Top 10 economies in transversal indices

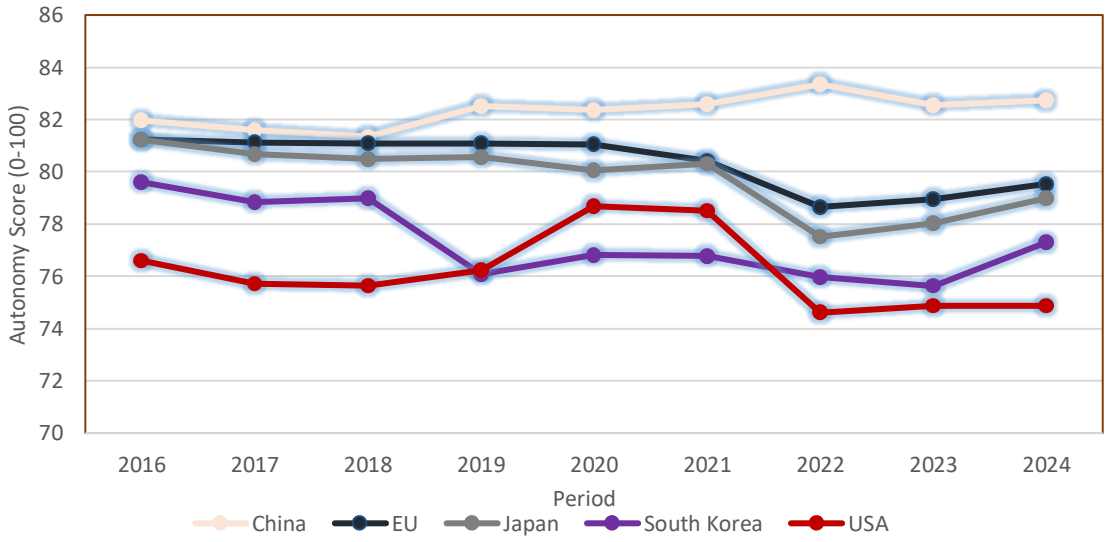


Source: own calculations. Basis: most recent observation period (year 2024).

4.2 Trends

The fact that the index scores can be interpreted in absolute terms allows for a comparison of autonomy ratings over time. The development of the annual index values over the years of the observation period does not show a clear general trend, but there are significant shifts between the economies (see Figure 7). China has been able to increase its degree of autonomy in recent years, significantly extending its lead over the other major economic powers. After a period of stagnation in 2021 and 2022, the EU's autonomy score experienced a significant decline and has since recovered slightly. Interestingly, the decline coincides with a significant increase in the importance of the resilience goal in EU policy, as reflected in legislative initiatives such as the Critical Raw Materials Act. The trend was similar for Japan. China's index score rose almost mirror-image during this phase. This suggests that China's new industrial strategy, which focuses on global market dominance in critical technologies, has reduced the economic leverage of its most important trading partners. In fact, the scores of developed economies in the reliability pillar have declined most prominently during this period. In the case of the US, after an upward trend at the end of the last decade, the decline in 2022 was particularly pronounced and has not been followed by a recovery as of the current data horizon. Among the other economies, the downfall of Russia since 2022 is particularly striking. With its current rating (44.79), the country has lost 15 index points compared to 2021 (59.25).

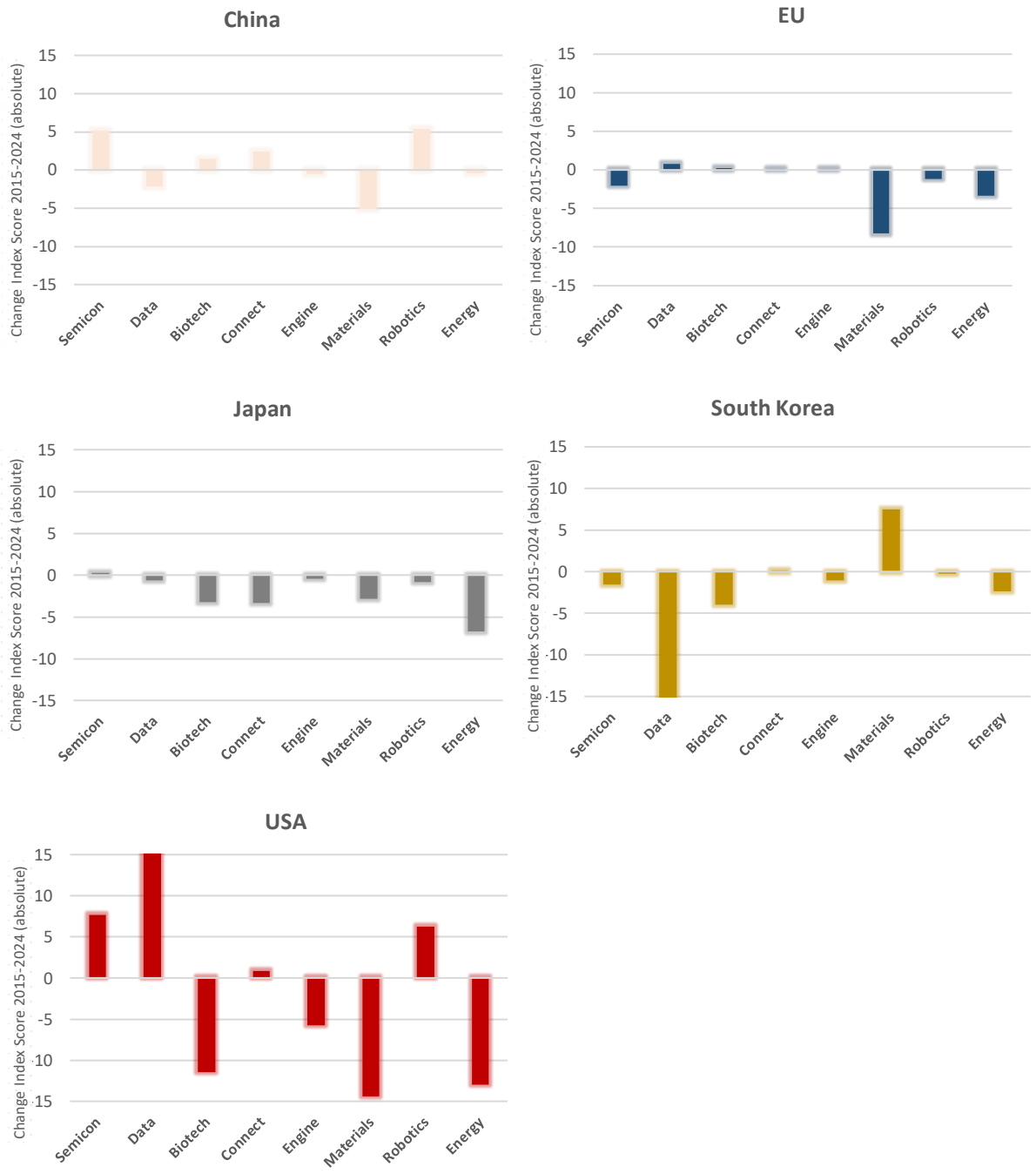
Figure 7: Evolution of index scores of major economies



Source: own calculations.

Trend development is also striking at the level of individual technology fields. Over a ten-year period, the degree of autonomy has not developed homogeneously in one direction in any of the major economies. Increases in the degree of autonomy in one field were often accompanied by a decline in another field, even in overall improving economies such as China (see Figure 8). This reflects both internal economic structural change and developments in the global trade networks for the technologies in question. Drastic changes are particularly evident in the fields of “Data Management” and “Advanced Materials”. Sharp declines in the autonomy scores of individual major economies were accompanied by similarly sharp increases in other major economies. Hence, the developments appear to be less an expression of a general change in the intensity of international trade, but rather of a geographical shift in the centers of global trade networks. Among the major economies, the changes are most pronounced in the case of the United States. The trade and industrial policy experiments of the first Trump and Biden administrations appear to have left their mark. The EU was unable to significantly increase its degree of autonomy in any of the analyzed fields. Notably, EU autonomy scores significantly declined for “Advanced Materials” and “Energy Technologies”.

Figure 8: Trends in sub-indices in major economies

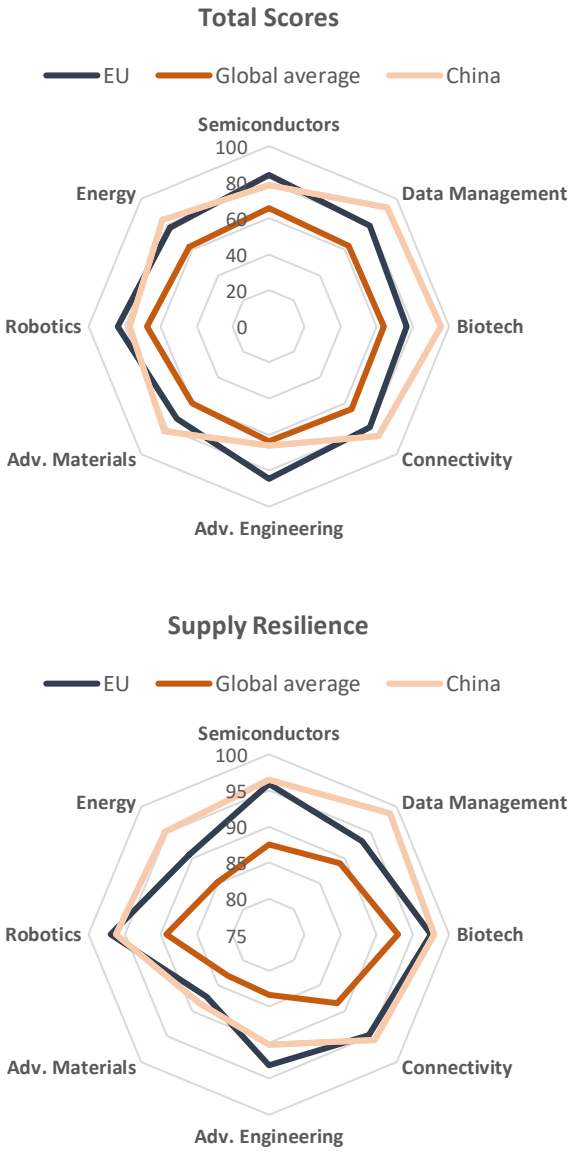


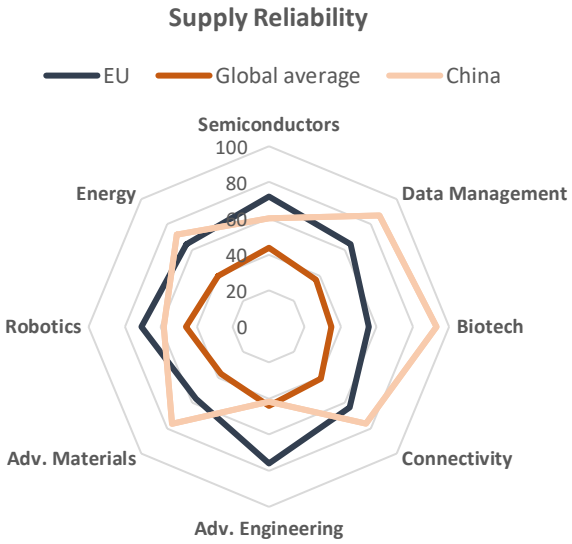
Source: own calculations. Semicon: Semiconductor Technologies; Data: Data Management Technologies; Biotech: Biotechnologies; Connect: Connectivity Technologies; Materials: Advanced Materials; Robotics: Robotics; Energy: Energy Technologies.

4.3 Strengths and Weaknesses of the EU

The structure of the index allows for further differentiation of the index results for individual economies according to driving factors. In this way, the root causes of differences in the degree of autonomy in individual fields can be identified. Such an analysis is provided below for the EU. Figure 9 first compares the current EU results for the sub-pillars in individual fields with the global average and the frontrunner, China. The fact that the EU achieves higher scores than China in the fields of "Semiconductor Technologies", "Robotics" and "Advanced Engineering Technologies" is primarily due to its better performance in the reliability pillar. In the case of "Engineering Technologies" is it also due to a higher degree of resilience. Overall, the EU reaches its highest score in the field of "Engineering Technologies" and its lowest score in the field of "Advanced Materials".

Figure 9: Comparison autonomy scores in technology fields EU - China





Source: own calculations. Basis: most recent observation period (year 2024).

Table 3: EU performance in technology fields by index components

Indicator	Total value	Import dependence	Supplier concentration
Technology field	*Autonomy score (0-100)*	*Ratio imports to apparent domestic consumption*	Herfindahl-Hirschman Index (HHI)
Adv. Engineering Technologies	**84.528**	0.331	0.248
Adv. Materials	**72.093**	0.417	0.297
Biotechnologies	**76.472**	0.445	0.288
Connectivity Technologies	**79.076**	0.354	0.278
Data Management Technologies	**78.858**	0.263	0.233
Energy Technologies	**77.493**	0.327	0.429
Robotics	**83.791**	0.342	0.244
Semiconductor Technologies	**83.990**	0.297	0.253

Indicator	Incidence trade barriers	Political stability supplier	Economic leverage over supplier
Technology field	*Share of product groups subject to export restrictions by supplier*	*WGI score for Political Stability and Absence of Violence for supplier*	*Share of product groups where EU is net exporter to supplier*
Adv. Engineering Technologies	72.10%	70.92	57.20%
Adv. Materials	67.70%	62.13	52.50%
Biotechnologies	72.90%	63.26	51.20%
Connectivity Technologies	69.10%	62.56	52.70%
Data Management Technologies	70.80%	62.79	53.20%
Energy Technologies	63.30%	59.13	53.90%
Robotics	77.20%	64.64	57.30%
Semiconductor Technologies	70.30%	65.96	54.20%

Source: own calculations. Basis: most recent observation period (year 2024). Green: Relative strengths; Red: Relative weaknesses.

Table 3 lists the components of the pillars by technology field, calculated as average values weighted by the import value of the individual products and (in the case of reliability indicators) the trading partners. Accordingly, the above-average result for “Engineering Technologies” is primarily based on a combination of relatively low geographical concentration of imports, relatively high institutional quality of the supplier countries and the EU's relatively strong economic leverage vis-à-vis its trading partners. In the case of “Semiconductor Technologies”, the strengths lie in a relatively low import

dependency and a high institutional quality. In contrast, the low score for “Advanced Materials” is mainly due to a generally high dependence on imports, while the low score for “Energy Technologies” is due to a relatively strong geographical concentration of imports and low institutional quality. This primarily reflects the particularly strong dependence on China in this field. An additional factor that shapes technology differences at the global level are the product-specific substitution elasticities (see index construction).

The identified weaknesses of the EU can provide an impulse for technology-specific policy recommendations. For instance, the goal to reduce the EU's overall reliance on imports requires a different policy approach than the diversification of trade relations or the strengthening of cooperation with existing suppliers. In this regard, the heterogeneous results suggest that an EU policy aimed at strengthening autonomy in a broad spectrum of critical technologies will require a flexible and balanced mix of policy instruments. Foremost, instruments should reflect differences in the global market environment of critical technologies.

5 Discussion

5.1 Strategic Autonomy, Openness and Innovative Strength

To correctly interpret the index results, it is important to bear in mind the fundamental differences between this index and conventional measures of macroeconomic performance. The index evaluates a country's or economic region's strategic autonomy based on the resilience and reliability of its supply chains for key technological goods. Therefore, it is not a direct measure of companies' performance in global markets or of macroeconomic productivity development. Rather, it considers the degree of autonomy to be fundamentally dependent on the size and structure of the economy under review. It recognizes that small countries and economies with less of a focus on high-tech sectors have lower demand for the technology goods under consideration. Even countries with low production capacities by international standards can have a high degree of autonomy if they can meet their needs from secure sources. Different sectoral focus areas in individual technology fields are also reflected in the weighting based on economy-specific import values.

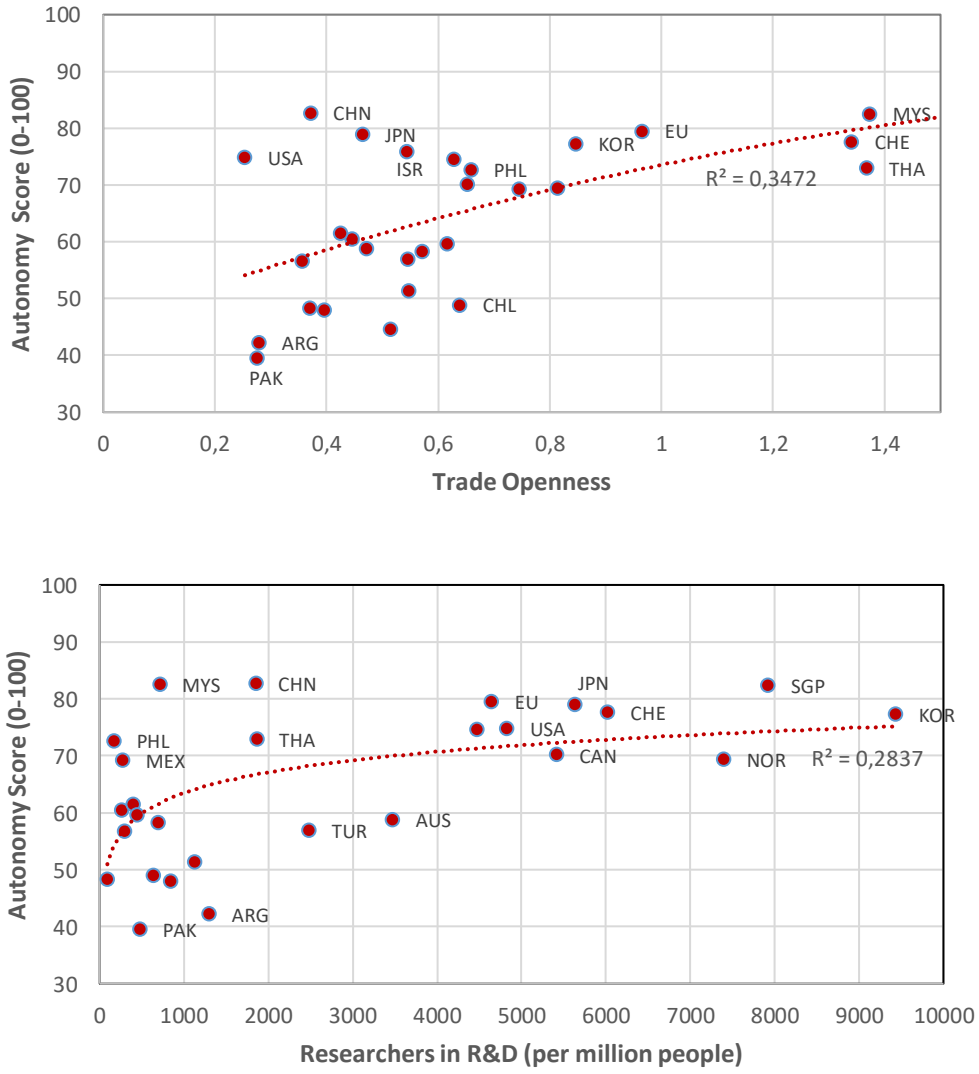
However, this does not negate the existence of a causal link between the degree of autonomy and the level of economic and technological development. The adoption of foreign technologies during modernization processes of developing countries can lead to a significant decline in their strategic autonomy during a transitional phase. In some cases, a temporary loss of autonomy may even be necessary for achieving sustainable growth. Opening domestic markets to increased imports from technologically advanced countries can facilitate knowledge spillovers through learning-by-importing, fueling productivity-enhancing structural change domestically.[21] China's success in this area demonstrates how this can contribute to a robust industrial strategy that fosters long-term economic growth and strategic autonomy. Nevertheless, this prospect must be weighed against the growing supply risks during the transition. In the absence of diversification opportunities, these risks can result in permanent unilateral technology dependencies (and thus a permanently low level of autonomy).

Therefore, the relationship between autonomy, openness and innovative strength of an economy is complex in nature. Figure 10 shows the current statistical correlation between the variables for the economies included in the index. There is a weakly positive correlation between the current index

[21] Keller, W. (2004). International technology diffusion. Journal of economic literature, 42(3), 752-782.

scores and macroeconomic trade openness[22]. Economies with a high level of trade openness tend to have above-average autonomy scores. Conversely, countries at the bottom of the autonomy ranking show a low degree of trade openness. However, not all countries with high autonomy scores also exhibit a high level of openness. Therefore, strong integration into global trade networks is not a fundamental obstacle, nor is it a sufficient prerequisite for strategic autonomy. The correlation between the index and countries' research intensity is also positive, albeit weakly. Countries with a strong focus on research also have above-average autonomy scores. However, China and Malaysia demonstrate that a very high level of autonomy can be achieved even with a small research sector by international standards. This highlights the potentially significant role of technology adoption alongside knowledge creation. Examining the possible causal relationships between these variables in more detail is an important future research topic.

Figure 10: Correlation of index scores with openness and research indicators



Source: World Bank (2025); own calculations. Basis: most recent observation period (autonomy score, trade openness: 2024; number of researchers: 2023 or older).

[22] Trade Openness is here measured in the traditional simplified ex-post manner: (Import value + Export value)/ GDP

5.2 The Social Costs and Benefits of More Autonomy

When deriving policy strategies, it is essential to understand that an autonomy indicator should never be regarded as the sole measure of welfare. This is because any measure aimed at increasing the autonomy of an economy generates opportunity costs and thus potentially conflicts with other policy objectives. This is most evident in trade policy measures that lead to higher product prices, such as customs duties and import quotas. Here, a potentially increasing degree of autonomy is offset by a loss of welfare for domestic consumers. However, government support for investment in domestic production capacities can also lead to short-term welfare losses by diverting capital to uncompetitive sectors, even if this is financed directly through reallocation at no net cost. Pareto improvements are therefore not to be expected for the short-term.

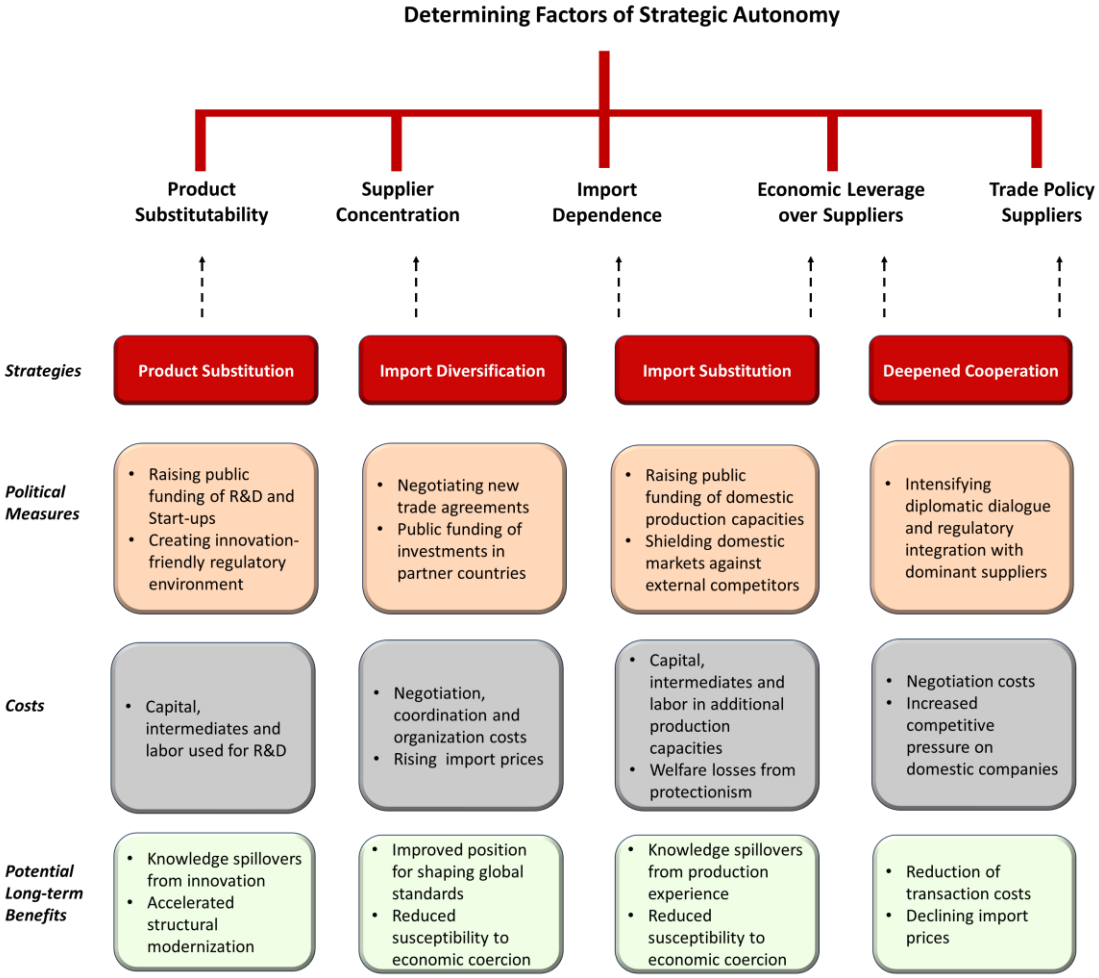
Matching the structure of our index, policy measures to increase autonomy can be differentiated according to four channels of action: import substitution, product substitution, import diversification and deepened cooperation. Table 4 lists the resulting economy-wide costs for the private sector and government budgets, as well as possible positive spillover effects. The substitution of imports with domestic production increases autonomy by reducing import dependencies. In the short term, it generates costs for the expansion and utilization of domestic production capacities (capital costs, operating costs). Initial cost disadvantages compared to foreign producers would have to be partially covered by government subsidies. In the long term, this is ideally offset by productivity gains from learning effects, which can spill over to other companies and sectors in the form of knowledge spillovers.

Substituting products with new, innovative goods sourced from more secure channels is an alternative strategy for reducing the importance of existing import dependencies. It generates direct costs for research and development. Uncertainty about research returns may also require government support in this case. In the best-case scenario, this leads to product innovation, which generates macroeconomic productivity gains and fuels structural modernization of the entire economy.

Import diversification involves establishing supply relationships with new trading partners. This strengthens autonomy by reducing geographical supply concentration. In the short term, however, it generates organizational and coordination costs for companies, as well as potentially higher import prices for domestic consumers, since new trading partners are not yet able to compete with dominant exporters on price. However, positive spillover effects can include a long-term improvement in the international market position of domestic companies, resulting from the geographical extension of their business networks. These include a reduction in the potential for economic blackmail by individual third countries and improved opportunities to enforce one's own technical standards and market rules in global markets.

The strategy of intensified cooperation attempts to reduce the risk of hostile measures on the part of dominant trading partners by strengthening economic and political ties. It strengthens strategic autonomy by increasing the reliability of existing supply channels. For companies, this generates additional communication costs for deepening contacts and potentially capital costs for their own investments in partner countries. For policymakers, it entails negotiation costs and, as a result of negotiations, potentially concessions on market access rules for companies from third countries. On the upside, domestic importers could benefit from regulatory integration through lower transaction costs and import prices (less trade barriers, scale economies from market harmonization).

Figure 11: Costs and benefits of autonomy strategies



Source: own illustration

The individual strategies are non-exclusive. Each of the strategies involves risks that, given the systemic importance of the technologies concerned, can only be hedged to a limited extent by private actors. At the same time, the cost-benefit ratio is highly technology-specific and can hardly be assessed a priori by policymakers. The task of policymakers should therefore be to create a level playing field between different solutions through government support. This requires a policy approach that is not narrowly focused on promoting individual technology fields, but rather reflects the challenge of strategic autonomy in its entirety.

Instead of a technology-focused approach, a risk-focused funding approach is needed. Funding instruments should aim to internalize the costs and benefits of autonomy strategies that are relevant across technologies. Firstly, this concerns protection against political and regulatory uncertainty, both with regard to the EU's future industrial, trade and climate policies and the policies of current and potential trading partners.[23] Secondly, support tools must be developed that enable companies investing in alternative supply channels to participate in the positive spillover effects of their pioneering role as early as possible, regardless of which autonomy strategy is pursued. The approaches pursued by the EU to date, in particular the prioritized promotion of strategic projects, are a step in

[23] Wolf, A. (2025). De-risking green supply chains. cepInput No.15/2025.

the right direction. However, they are still too centralized and rigidly organized, especially with regard to the political pre-selection of technologies to be promoted. A decentralized approach based on subsidizing cross-sector capital-pooling and privately managed capital market funds would allow for greater flexibility.

5.3 Avenues For Extension

Compared to other conceivable methodological approaches, the presented index has the advantages of strong technological differentiation and a data basis supported entirely by public sources from recognized international institutions. Focusing on goods trade flows as an indicator of autonomy also makes intuitive sense, as these flows are the most practical manifestation of technological leadership. Nevertheless, expanding the basic approach would provide additional benefits, as not all aspects of autonomy are reflected in trade relations. Firstly, this involves directly considering services associated with critical technologies, particularly digital services. However, current data on trade in services is still too undifferentiated and varies too greatly between sources to allow clear benchmarks to be derived.

Another dimension is the distribution of ownership of production capacities. Foreign direct investment will continue to be an indispensable source of capital, particularly for previously underdeveloped domestic technology sectors. However, as with trade, heavy reliance on multinational investors poses risks to Europe's strategic autonomy, particularly in terms of knowledge leakage, market concentration, and increasing political vulnerability to blackmail. Currently, information on the volume and origin of FDI flows in critical technology sectors is only available at an aggregated industry level and is incomplete. A third possible extension concerns tracking indirect supply chain dependencies. Trade relations with partners who depend on a small number of supplier countries for their intermediate inputs must be assessed more critically from an autonomy perspective. Such indirect dependencies can only be quantified at a country level based on highly differentiated international input-output tables. This would also require a significant improvement in the current data basis available at the international level.

6 Conclusion

Against the backdrop of growing geo-economic uncertainty, the EU has adopted 'open strategic autonomy' as the guiding principle for its trade and industrial policy. While remaining committed to the principle of open trade, the EU seeks to reduce its economic vulnerability and susceptibility to blackmail. In times of fundamental technological transformation, this primarily requires control over the supply chains of a range of critical future technologies. Clear and transparent metrics are needed to monitor the success of such a strategy. This is the motivation for the cep Strategic Autonomy Radar. Based on the EU list of critical technologies, it measures the degree of strategic autonomy of the EU compared to third countries worldwide in eight critical technology fields. It breaks down strategic autonomy into two components: the reliability of existing supply channels and the ability to fall back on alternative supply channels in the event of disruptions. The Strategic Autonomy Radar's key advantages over existing macroeconomic performance indicators are its high technological granularity, its ability to identify trends and the specific factors influencing index scores, and the fact that it is applicable based solely on official public data.

The initial findings for the largest global economies reveal a notable spatial disparity in autonomy levels between different regions of the world. The top three economies are all located in Eastern and South-

Eastern Asia, with China in first place. Almost all of the region's economies are in the top half of the ranking. They dominate each of the eight technology fields considered, primarily due to low import dependency and a focus on reliable suppliers for remaining imports. China in particular has extended its autonomy advantage over Western economies in recent years — a visible result of the new Chinese industrial strategy, which focuses on achieving leadership in critical technologies. By contrast, many developed regions, particularly North and South America, have experienced a significant decline in their autonomy levels. In particular, this concerns technologies essential for decarbonization.

The EU could maintain its leading position among developed economies thanks to the breadth of its technological expertise and the size of its manufacturing base. However, its overall autonomy score has declined compared to the previous decade, and the gap with China has widened. Currently, the EU can only claim to be among the global autonomy leaders in the field “Advanced Engineering”. Specific weaknesses constitute the fields “Advanced Materials”, “Biotechnologies” and “Energy Technologies”, despite the EU’s still remarkable innovation performance in these fields. This demonstrates that high research productivity alone is insufficient for ensuring supply chain security. Specific issues vary between technologies and include a generally high import dependence (“Advanced Materials”), a strong supply concentration (“Energy Technologies”) and a low institutional quality of suppliers.

The observed statistical correlations of autonomy scores with GDP per capita, trade openness and R&D intensity suggest the existence of mutual relationships and a multitude of development paths. A high autonomy level can be a consequence of economic prosperity, but also the result of a deliberate specialization strategy of economies in earlier development stages. Likewise, trade openness neither seems to be a fundamental obstacle nor a sufficient prerequisite for strategic autonomy. Moreover, economies like China and Malaysia demonstrate that a very high level of autonomy can be achieved even with a small research sector by international standards. This suggests a significant role of technology adoption alongside knowledge creation.

The multitude of paths towards autonomy entails a variety of policy options. Based on the construction of the index, these options can be broadly classified into four categories: import substitution, import diversification, deepened cooperation, and product substitution. None of these strategies are risk-free; each comes with specific societal costs and trade-offs with respect to other policy goals. Due to the heterogeneity of critical technologies and their markets, it is unlikely that a one-size-fits-all development strategy will guarantee a high general level of autonomy.

For the EU, this has two main implications. Firstly, industry-specific strategies should be based more than in the past on forward-looking, micro-level analyses of markets and technologies, focusing on identifying potential knowledge gains and other positive long-term externalities. The EU’s most recent initiatives on critical supply chains provide a good foundation. However, these initiatives are still too centralized and rigid, particularly with regard to the political pre-selection of critical technologies. Secondly, cross-industry support measures should take a risk-centered approach to compensate for the short-to-medium risks associated with reorganizing international supply chains. This primarily requires risk-sharing instruments that focus on country-specific political and institutional risks, thereby facilitating European investment in new supply sources both within and outside the EU. This would enable early-bird investors to benefit from the positive spillover effects of their pioneering role in establishing European autonomy, thereby reducing technology distortion and overcoming a 'wait-and-see' attitude.

7 Appendix

7.1 Technology Fields and Product Groups

Table A 1: List of product groups included in technology fields

HS-Code	Official description	HS-Code	Official description
Field: Advanced Engineering Technologies			
842870	Industrial robots	846221	Machine-tools; bending, folding, straightening or flattening machines, numerically controlled
8456	Machine-tools; for working any material by removal of material, by laser or other light or photon beam	846231	Machine-tools; shearing machines (including presses), numerically controlled
8457	Machining centres, unit construction machines for working metal	846241	Machine-tools; punching or notching machines (including presses), numerically controlled
8458	Lathes for removing metal	847950	Machinery and mechanical appliances; industrial robots, n.e.c. or included
845921	Machine-tools; for drilling by removing metal, numerically controlled	8486	Machines and apparatus of a kind used for the manufacture of semiconductor devices
845931	Machine-tools; for boring-milling by removing metal, numerically controlled	8515	Electric (electrically heated gas) soldering, brazing, welding machines and apparatus
845941	Machine-tools; for boring by removing metal, numerically controlled boring machines	9024	Machines and appliances for testing the hardness, strength, compressibility, elasticity of materials
845951	Machine-tools; for milling by removing metal, knee-type, numerically controlled	902730	Spectrometers, spectrophotometers and spectrographs; using optical radiations (UV, visible, IR)
845961	Machine-tools; for milling by removing metal, (not knee-type), numerically controlled	902750	Instruments and apparatus; using optical radiations (UV, visible, IR)
846011	Machine-tools; flat-surface grinding machines, numerically controlled	9028	Gas, liquid or electricity supply or production meters, including calibrating meters therefor
846021	Machine-tools; grinding machines (other than flat-surface), numerically controlled	903082	Instruments and apparatus; for measuring or checking semiconductor wafers or devices
846031	Machine-tools; sharpening (tool or cutter grinding) machines, numerically controlled	9032	Regulating or controlling instruments and apparatus; automatic type
Field: Advanced Materials			
281810	Aluminium oxide; artificial corundum	4005	Compounded rubber, unvulcanised, in primary forms or in plates, sheets or strip
2842	Salts of inorganic acids or peroxoacids, n.e.c. including aluminosilicates	5403	Artificial filament yarn (other than sewing thread), not put up for retail sale
2846	Compounds, inorganic or organic, of rare-earth metals	5405	Artificial monofilament of 67 decitex or more
2852	Inorganic or organic compounds of mercury	5502	Artificial filament tow
3005	Wadding, gauze, bandages, impregnated or coated with pharmaceutical substances	5504	Artificial staple fibres, not carded, combed or otherwise processed for spinning
300670	Pharmaceutical goods; Gel preparations designed to be used in human or veterinary medicine	7007	Safety glass, consisting of toughened (tempered) or laminated glass
3801	Artificial graphite; colloidal or semi-colloidal graphite	7603	Aluminium; powders and flakes
3802	Activated carbon; activated natural mineral products	850511	Magnets; permanent magnets and articles intended to become permanent magnets
3812	Prepared rubber accelerators; compound plasticisers for rubber or plastics	850519	Magnets; permanent magnets and articles intended after magnetisation
3818	Chemical elements doped for use in electronics, in the form of discs, wafers or similar forms	850730	Electric accumulators; nickel-cadmium, including separators,
382430	Metal carbides, non-agglomerated; mixed together or with metallic binders	850740	Electric accumulators; nickel-iron, including separators
390950	Polyurethanes; in primary forms	850750	Electric accumulators; nickel-metal hydride, including separators
3914	Ion-exchangers; based on polymers of heading no. 3901 to 3913, in primary forms	850760	Electric accumulators; lithium-ion, including separators
Field: Biotechnologies			
291811	Acids; carboxylic acids, lactic acid, its salts and esters	292241	Amino-acids,and their esters; lysine and its esters; salts thereof
291812	Acids; carboxylic acids, tartaric acid	292242	Amino-acids, glutamic acid and its esters; salts thereof
291813	Acids; carboxylic acids, salts and esters of tartaric acid	292243	Amino-acids, and their esters; anthranilic acid and its esters; salts thereof

291814	Acids; carboxylic acids, citric acid	292244	Amino-acids and their esters; tilidine (INN) and its esters; salts thereof
291815	Acids; carboxylic acids, salts and esters of citric acid	292249	Amino-acids, their esters; salts thereof, excluding lysine, glutamic acid, anthranalic acid and tilidine
291816	Acids; carboxylic acids, gluconic acid, its salts and esters	293621	Vitamins; vitamins A and their derivatives, unmixed
291818	Acids; carboxylic acids, chlorobenzilate (ISO)	293622	Vitamins; vitamin B1 and its derivatives, unmixed
291819	Acids; carboxylic acids, other than lactic, tartaric, citric, and gluconic acids	293623	Vitamins; vitamin B2 and its derivatives, unmixed
291829	Acids; carboxylic acids, their anhydrides, halides, peroxides, peroxyacids	293624	Vitamins; D- or DL-pantothenic acid (vitamin B5) and its derivatives, unmixed
291830	Acids; carboxylic acids, (with aldehyde or ketone function but without other oxygen function), their anhydrides, halides	293625	Vitamins; vitamin B6 and its derivatives, unmixed
291891	Acids; carboxylic acids, with additional oxygen function and their anhydrides, halides, peroxides and peroxyacids	293626	Vitamins; vitamin B12 and its derivatives, unmixed
291899	Acids; carboxylic acids, with additional oxygen function; their halogenated, sulphonated, nitrated or nitrosated derivatives	293627	Vitamins; vitamin C and its derivatives, unmixed
292221	Amino-naphthols and other amino-phenols, their ethers and esters;	293628	Vitamins; vitamin E and its derivatives, unmixed
292229	Amino-naphthols and other amino-phenols, their ethers and esters; salts thereof n.e.c. in item no. 2922.2	293629	Vitamins; n.e.c. in item no. 2936.2, and their derivatives, unmixed
292231	Amino-aldehydes, amino-ketones and amino-quinones; salts thereof	293690	Vitamins; n.e.c. in heading no. 2936, including natural concentrates
292239	Amino-aldehydes, amino-ketones and amino-quinones; excluding amfepramone, methadone, and normethadone	350790	Enzymes and prepared enzymes; other than rennet and concentrates thereof

Field: Connectivity Technologies

850650	Cells and batteries; primary, lithium	8530	Signalling, safety or traffic control equipment
851762	Communication apparatus; machines for the reception, conversion and transmission or regeneration of voice	8531	Signalling apparatus; electric sound or visual
851769	Communication apparatus; machines for the transmission or reception of voice, n.e.c. in item no. 8517.6	8534	Circuits; printed
852329	Magnetic media; other than cards incorporating a magnetic stripe, whether or not recorded	854320	Electrical machines and apparatus; signal generators
852340	Optical media	854470	Insulated electric conductors; optical fibre cables
852351	Semiconductor media; solid-state non-volatile storage devices	9001	Optical fibres and optical fibre bundles
852352	Semiconductor media; smart cards	9014	Navigational instruments and appliances; direction finding compasses
852359	Semiconductor media; other than smart cards	9028	Gas, liquid or electricity supply or production meters, including calibrating meters therefor
8526	Radar apparatus, radio navigational aid apparatus and radio remote control apparatus	9029	Revolution counter, production counters, taximeters, mileometers, pedometers and the like
8527	Reception apparatus for radio-broadcasting	903040	Instruments and apparatus; specially designed for telecommunications
852990	Reception and transmission apparatus; for use with the apparatus of heading no. 8524 to 8528		

Field: Data Management Technologies

8470	Calculating machines and pocket-size data recording, reproducing and displaying machines	8531	Signalling apparatus; electric sound or visual
8471	Automatic data processing machines and units thereof, magnetic or optical readers	854320	Electrical machines and apparatus; signal generators
852351	Semiconductor media; solid-state non-volatile storage devices	900710	Cameras, cinematographic
852352	Semiconductor media; smart cards	950410	Video game consoles and machines
852359	Semiconductor media; other than smart cards		

Field: Energy Technologies

8401	Nuclear reactors; fuel elements (cartridges), non-irradiated, for nuclear reactors	841912	Heaters; solar water heaters, non-electric
8410	Turbines; hydraulic water wheels and regulators therefor	850650	Cells and batteries; primary, lithium
8411	Turbo-jets, turbo-propellers and other gas turbines	854142	Electrical apparatus; photosensitive semiconductor devices, photovoltaic cells not assembled in modules

8412	Engines and motors; n.e.c. (e.g. reaction engines, hydraulic power engines, pneumatic power engines)	854143	Electrical apparatus; photosensitive semiconductor devices, photovoltaic cells assembled in modules
841861	Heat pumps; other than air conditioning machines of heading no. 8415	854330	Electrical machines and apparatus; for electroplating, electrolysis or electrophoresis
Field: Robotics			
842870	Industrial robots	8534	Circuits; printed
847950	Machinery and mechanical appliances; industrial robots, n.e.c. or included	8542	Electronic integrated circuits
8515	Electric (electrically heated gas) soldering, brazing, welding machines and apparatus	9032	Regulating or controlling instruments and apparatus; automatic type
Field: Semiconductor Technologies			
8456	Machine-tools; for working any material by removal of material, by laser or other light or photon beam	9010	Photographic (including cinematographic) laboratory apparatus and equipment
8531	Signalling apparatus; electric sound or visual	901120	Microscopes, compound optical; for photomicrography, cinephotomicrography or microprojection
8541	Semiconductor devices (e.g. diodes, transistors, semiconductor based transducers)	9013	Lasers, other than laser diodes; other optical appliances and instruments n.e.c. in this chapter
8542	Electronic integrated circuits	901820	Medical, surgical instruments and appliances; ultra-violet or infra-red ray apparatus
854470	Insulated electric conductors; optical fibre cables	902730	Spectrometers, spectrophotometers and spectrographs; using optical radiations (UV, visible, IR)
9001	Optical fibres and optical fibre bundles; optical fibre cables not of heading no. 8544	902750	Instruments and apparatus; using optical radiations (UV, visible, IR),
9002	Lenses, prisms, mirrors and other optical elements, of any material, mounted	903141	Optical instruments and appliances; for inspecting semiconductor wafers or devices

Source: UNSD (2025)[24]; own presentation

[24] UNSD (2025). Classifications on economic statistics. UN Statistics Division.

7.2 Index Construction

Table A 2: Index components

Symbol	Meaning	Calculation	Data sources
i, j	Economies	-	-
t	Technology field (see Appendix 7.1)	-	-
$p(t)$	Product group in technology field t (see Appendix 7.1)	-	-
$x_{ijp(t)}$	Value of exports of economy i to economy j in product group $p(t)$	-	UN Comtrade (2025)
$X_{ip(t)}$	Total value of exports of economy i in product group $p(t)$	$\sum_{j}^{J} x_{ijp(t)}$	UN Comtrade (2025)
$M_{jp(t)}$	Total value of imports of economy j in product group $p(t)$	$\sum_{i}^{I} x_{ijp(t)}$	UN Comtrade (2025)
$PD_{jp(t)}$	Total value of domestic production of economy j in product group $p(t)$	-	UN INDSTAT (2025); Eurostat (2025)
$IDP_{jp(t)}$	Import dependence of economy j in product group $p(t)$	$\frac{M_{jp(t)}}{PD_{jp(t)} - X_{jp(t)} + M_{jp(t)}}$	UN Comtrade (2025); UN INDSTAT (2025); Eurostat (2025)
$HHI_{jp(t)}$	Herfindahl-Hirschman-Index of import concentration of economy j in product group $p(t)$	$\sum_{i}^{I} \left(\frac{x_{ijp(t)}}{M_{jp(t)}}\right)^2$	UN Comtrade (2025)
$\sigma_{p(t)}$	Elasticity of substitution between suppliers in product group $p(t)$	Estimated coefficient from gravity approach (see Appendix 7.3)	UN Comtrade (2025)
$REG_{jp(t)}$	Regulatory quality of suppliers of economy j in product group $p(t)$ (with Dummy $EXB = 1$ if export barrier in place)	$1 - \sum_{i}^{I} \frac{x_{ijp(t)}}{M_{jp(t)}} \cdot \left(\sum_{p(t)}^{P(t)} EXB_{ip(t)} \cdot \frac{X_{ip(t)}}{\sum_{p(t)}^{P(t)} X_{ip(t)}} \right)$	UNCTAD (2025); UN Comtrade (2025)
$INT_{jp(t)}$	Political stability of suppliers of economy j in product group $p(t)$ (with POL $[0; 100]$ as WGI score for political stability)	$\sum_{i}^{I} \frac{x_{ijp(t)}}{M_{jp(t)}} \cdot POL_i$	World Bank (2025); UN Comtrade (2025)
$LEV_{jp(t)}$	Economic leverage of economy j over its suppliers in product group $p(t)$ (with Dummy $NET = 1$ if j net exporter to supplier i)	$\sum_{i}^{I} \frac{x_{ijp(t)}}{M_{jp(t)}} \cdot \left(\frac{\sum_{p(t)}^{P(t)} NET_{ijp(t)}}{P(t)} \right)$	UN Comtrade (2025)

Source: own presentation

Calculation Steps:

1. **Calculation of Resilience Score at product level (p) in each technology field (t):**

$$RES_{jp(t)} = 1 - IDP_{jp(t)} \cdot \frac{HHI_{jp(t)}}{\sigma_{p(t)}}$$

2. **Calculation of Reliability Score at product level (p) in each technology field (t):**

$$REL_{jp(t)} = 1 - IDP_{jp(t)} \cdot \frac{\sqrt[3]{REG_{jp(t)} \cdot INT_{jp(t)} \cdot LEV_{jp(t)}}}{\sigma_{p(t)}}$$

3. **Aggregation of Resilience and Reliability Scores by technology field:**

$$RES_{jt} = \sum_{p(t)}^{P(t)} \left(RES_{jp(t)} \cdot \frac{M_{jp(t)}}{\sum_{p(t)}^{P(t)} M_{jp(t)}} \right) \cdot 100$$

$$REL_{jt} = \sum_{p(t)}^{P(t)} \left(REL_{jp(t)} \cdot \frac{M_{jp(t)}}{\sum_{p(t)}^{P(t)} M_{jp(t)}} \right) \cdot 100$$

4. **Aggregation of Strategic Autonomy Radar Scores:**

$$SAR_{jt} = \frac{1}{2} \cdot \left(RES_{jt} + REL_{jt} \right)$$

$$SAR_{j} = \frac{1}{8} \cdot \sum_{t=1}^{T=8} SAR_{jt}$$

7.3 Estimation of Elasticities of Substitution

Estimated gravity regression equation:

$$\ln x_{ijgy} = \beta_{1g} \cdot \ln\left(1 + r_{ijgy}\right) + \beta_{2g} \cdot rta_{ijy} + \beta_{3g} \cdot eu_{ijy} + \gamma_{igy} + \delta_{jgy} + \eta_{ijg} + \varepsilon_{ijgy}$$

- $\widehat{\beta_{1g}}$: Elasticity of substitution between suppliers

Table A 3: Variables entering the elasticity estimation

Variable	Measurement	Source
x_{ijgy}	Value of exports of country i to country j in aggregate product group g (2-digit level HS) in year y	UN Comtrade (2025)
r_{ijgy}	Weighted effectively applied tariff rates by importing country j on products from exporting country i (product- and tariff-specific)	WITS (2025)
rta_{ijy}	Dummy variable: Existence of trade agreements between trading partners (RTA=1: agreement exists)	Larch (2025)
eu_{ijy}	Dummy variable: Intra-EU trade (eu=1: Both trading partners are EU members)	-
γ_{igy}	Exporter-time fixed effect	-
δ_{jgy}	Importer-time fixed effect	-
η_{ijg}	Exporter-importer fixed effect	-
ε_{ijgy}	Regression residuals	

Source: own presentation

Estimation results:

	Inorganic Chemicals (HS-Code: 28)			Organic Chemicals (29)		
Coefficient	Estimate	Std. error	p-value	Estimate	Std. error	p-value
ln (1+r)	-1.315	0.421	0.002	-6.877	0.632	0.000
rta	-0.092	0.033	0.005	0.101	0.033	0.002
eu	2.665	0.688	0.000	-1.927	0.557	0.001
Adj. R^2	0.867			0.884		
	Pharmaceutical Products (30)			Starches/Glues/Enzymes (35)		
Coefficient	Estimate	Std. error	p-value	Estimate	Std. error	p-value
ln (1+r)	-2.004	0.390	0.000	-1.237	0.157	0.000
rta	0.126	0.026	0.000	-0.008	0.031	0.788
eu	3.747	0.482	0.000	-0.768	0.649	0.237
Adj. R^2	0.903			0.882		
	Chemical Products n.e.c. (38)			Plastics (39)		
Coefficient	Estimate	Std. error	p-value	Estimate	Std. error	p-value
ln (1+r)	-0.662	0.313	0.035	-5.308	0.161	0.000
rta	-0.029	0.026	0.254	-0.019	0.019	0.321
eu	2.758	0.486	0.000	3.520	0.413	0.000
Adj. R^2	0.894			0.926		

	Rubber (40)			Wood (44)		
Coefficient	**Estimate**	**Std. error**	**p-value**	**Estimate**	**Std. error**	**p-value**
ln (1+r)	-2.469	0.173	0.000	-3.931	0.312	0.000
rta	0.012	0.023	0.599	0.041	0.035	0.000
eu	3.582	0.457	0.000	4.595	0.849	0.000
Adj. R^2	0.907			0.865		
	Filaments (54)			**Staple Fibres (55)**		
Coefficient	**Estimate**	**Std. error**	**p-value**	**Estimate**	**Std. error**	**p-value**
ln (1+r)	-3.931	0.312	0.000	-7.252	0.294	0.000
rta	0.041	0.035	0.253	-0.108	0.039	0.005
eu	4.595	0.849	0.000	-0.128	0.648	0.843
Adj. R^2	0.865			0.854		
	Glass (70)			**Aluminium (76)**		
Coefficient	**Estimate**	**Std. error**	**p-value**	**Estimate**	**Std. error**	**p-value**
ln (1+r)	-2.674	0.160	0.000	-7.106	0.189	0.000
rta	-0.060	0.025	0.014	-0.025	0.028	0.379
eu	-0.319	0.463	0.490	2.467	0.885	0.005
Adj. R^2	0.894			0.854		
	Mechanical Machinery (84)			**Electrical Machinery (85)**		
Coefficient	**Estimate**	**Std. error**	**p-value**	**Estimate**	**Std. error**	**p-value**
ln (1+r)	-2.363	0.241	0.000	-2.712	0.212	0.000
rta	-0.028	0.021	0.176	-0.040	0.021	0.062
eu	3.981	0.359	0.000	1.829	0.409	0.000
Adj. R^2	0.945			0.936		

	Optical and measuring instruments (90)		
Coefficient	**Estimate**	**Std. error**	**p-value**
ln (1+r)	-0.947	0.287	0.001
rta	-0.002	0.021	0.941
eu	3.508	0.382	0.000
Adj. R^2	0.936		

Source: own calculations. ***: p-value < 0.001; **: p-value < 0.01; *p-value < 0.05. Not listed: exporter-time fixed effects, importer-time fixed effects, bilateral fixed effects.

7.4 Composition of Transversal Indices

Table A 4: List of product groups entering the transversal indices

HS-Code(s)	Official description
Dual-use Goods	
8457	Machining centres, unit construction machines (single station) and multi-station transfer machines for working metal
8458	Lathes for removing metal
8471	Automatic data processing machines and units thereof, magnetic or optical readers
8486	Machines and apparatus of a kind used the manufacture of semiconductor boules or wafers, semiconductor devices
8526	Radar apparatus, radio navigational aid apparatus and radio remote control apparatus
8534	Circuits; printed
8541	Semiconductor devices (e.g. diodes, transistors, semiconductor based transducers); including photovoltaic cells assembled or not in modules or panels
8542	Electronic integrated circuits
9013	Lasers, other than laser diodes; other optical appliances and instruments n.e.c. in this chapter
9014	Navigational instruments and appliances; direction finding compasses
Decarbonization Technologies	
3801	Artificial graphite; colloidal or semi-colloidal graphite
8410	Turbines; hydraulic water wheels and regulators therefor
841861	Heat pumps; other than air conditioning machines of heading no. 8415
841912	Heaters; solar water heaters, non-electric
850511	Magnets; permanent magnets and articles intended to become permanent magnets after magnetisation; of metal
850519	Magnets; permanent magnets and articles intended to become permanent magnets after magnetisation, other than of metal
850650	Cells and batteries; primary, lithium
850730	Electric accumulators; nickel-cadmium, including separators, whether or not rectangular (including square)
850740	Electric accumulators; nickel-iron, including separators, whether or not rectangular (including square)
850750	Electric accumulators; nickel-metal hydride, including separators, whether or not rectangular (including square)
850760	Electric accumulators; lithium-ion, including separators, whether or not rectangular (including square)
854142	Electrical apparatus; photosensitive semiconductor devices, photovoltaic cells not assembled in modules or made up into panels
854143	Electrical apparatus; photosensitive semiconductor devices, photovoltaic cells assembled in modules or made up into panels
854330	Electrical machines and apparatus; for electroplating, electrolysis or electrophoresis

Source: own presentation

7.5 Complete Index Results

Table A 5: Index results for total scores and pillars

		Score Total	Score Pillars	
Rank Total	**Economy**		**Resilience**	**Reliability**
1	China	82.73	94.89	70.57
2	Malaysia	82.58	94.29	70.86
3	Singapore	82.43	95.14	69.72
4	**EU**	**79.54**	**93.66**	**65.41**
5	Japan	78.99	93.62	64.36
6	Switzerland	77.67	89.07	66.27
7	South Korea	77.29	93.07	61.51
8	Israel	75.98	91.39	60.57
9	USA	74.86	93.68	56.03
10	UK	74.55	90.82	58.27
11	Thailand	72.97	89.81	56.12
12	Philippines	72.67	92.64	52.69
13	Canada	70.19	90.25	50.14
14	Norway	69.46	88.75	50.16
15	Mexico	69.26	92.56	45.96
16	Vietnam	68.44	89.58	48.31
17	Indonesia	61.53	86.61	36.44
18	India	60.51	86.87	34.16
19	South Africa	59.67	84.19	35.15
20	Australia	58.84	85.96	31.72
21	Turkey	56.99	83.66	30.33
22	Brazil	56.72	85.55	27.90
23	Saudi-Arabia	51.35	81.14	21.55
24	Chile	48.92	84.24	13.60
25	Colombia	48.39	80.76	16.02
26	Egypt	47.97	80.97	14.96
27	Russia	47.97	71.99	17.59
28	Argentina	42.24	82.15	2.34
29	Pakistan	39.62	73.53	5.72
30	Nigeria	39.21	75.32	3.09

Source: own calculations. Basis: most recent observation period (year 2024).

Table A 6: Index results for single technology fields

		Score Technology Fields							
Rank Total	Economy	Adv. Engineering Technologies	Adv. Materials	Bio-technologies	Connectivity Technologies	Data Management Technologies	Energy Technologies	Robotics	Semiconductor Technologies
1	China	66.11	82.29	95.47	85.91	92.96	83.60	77.22	78.29
2	Malaysia	81.86	71.29	75.13	85.20	86.24	81.15	89.47	90.28
3	Singapore	88.19	79.62	69.12	83.17	83.99	79.11	87.93	88.34
4	**EU**	**84.53**	**72.09**	**76.47**	**79.08**	**78.86**	**77.49**	**83.79**	**83.99**
5	Japan	91.79	84.53	68.50	71.56	53.20	82.21	89.41	90.70
6	Switzerland	78.92	70.60	85.63	74.33	66.11	76.18	82.41	87.19
7	South Korea	71.98	77.99	66.86	80.11	64.82	79.42	88.81	88.31
8	Israel	71.53	52.35	74.39	83.21	72.64	74.52	88.66	90.52
9	USA	80.73	63.58	72.49	73.69	70.49	69.32	85.52	83.03
10	UK	77.20	59.54	78.77	72.54	68.53	80.52	76.87	82.39
11	Thailand	65.17	51.33	70.63	75.20	86.78	83.00	73.54	78.08
12	Philippines	62.44	62.73	50.86	72.61	84.88	69.64	89.58	88.59
13	Canada	76.97	71.83	59.11	70.79	64.48	64.82	79.12	74.42
14	Norway	72.99	67.83	67.90	70.25	59.40	67.07	80.68	69.55
15	Mexico	77.80	66.06	54.89	71.31	85.65	69.31	64.73	64.33
16	Vietnam	50.95	58.58	58.50	65.96	91.21	81.12	69.11	71.89
17	Indonesia	53.91	55.28	61.31	64.89	52.79	74.81	61.83	67.38
18	India	62.09	56.11	70.78	66.12	56.80	69.95	49.21	53.03
19	South Africa	60.71	57.68	60.22	61.06	55.41	57.48	64.20	60.62
20	Australia	59.63	54.13	62.73	61.65	56.64	49.55	64.18	62.22
21	Turkey	59.48	52.83	58.79	57.48	51.91	61.36	56.83	57.27
22	Brazil	58.11	56.97	63.04	63.06	74.15	40.16	52.63	45.63
23	Saudi-Arabia	49.82	47.63	72.84	50.85	47.87	46.41	55.82	39.56
24	Chile	47.58	49.79	50.87	49.66	49.36	44.55	52.25	47.32
25	Colombia	47.35	55.51	56.99	50.49	42.67	36.97	51.87	45.25
26	Egypt	52.74	49.21	47.73	45.06	52.12	40.25	50.77	45.86
27	Russia	33.43	47.36	51.01	47.62	41.93	47.07	36.52	53.40
28	Argentina	42.06	43.77	48.06	41.80	41.31	38.37	43.39	39.19
29	Pakistan	34.30	45.00	46.22	37.53	46.68	33.12	41.48	32.67
30	Nigeria	31.89	44.54	46.06	39.50	44.73	36.64	38.82	31.46

Source: own calculations. Basis: most recent observation period (year 2024).

Table A 7: Index results for transversal indices

Dual-use Goods			Decarbonization Technologies		
Rank Total	**Economy**	**Score**	**Rank Total**	**Economy**	**Score**
1	Malaysia	88.51	1	China	97.89
2	Singapore	87.88	2	Singapore	85.45
3	Philippines	87.84	3	South Korea	83.02
4	**EU**	**80.45**	4	Japan	74.07
5	South Korea	80.03	5	Canada	73.71
6	Israel	79.45	6	Vietnam	69.40
7	Thailand	78.74	**7**	**EU**	**68.64**
8	China	77.46	8	Norway	68.11
9	Switzerland	75.34	9	Malaysia	66.20
10	USA	74.73	10	Thailand	65.40
11	Japan	72.66	11	Mexico	64.08
12	Vietnam	72.64	12	Philippines	63.58
13	Mexico	70.54	13	Switzerland	61.99
14	UK	69.77	14	India	60.50
15	Canada	65.54	15	Indonesia	59.97
16	Brazil	63.21	16	USA	57.16
17	Norway	61.42	17	UK	54.53
18	Indonesia	58.38	18	Turkey	53.91
19	South Africa	55.80	19	South Africa	52.73
20	Turkey	54.46	20	Israel	47.34
21	Australia	54.06	21	Australia	45.66
22	India	52.68	22	Russia	39.48
23	Chile	45.82	23	Chile	39.24
24	Saudi-Arabia	43.32	24	Egypt	37.89
25	Egypt	43.21	25	Nigeria	37.61
26	Pakistan	42.28	26	Brazil	35.12
27	Nigeria	42.14	27	Colombia	34.59
28	Colombia	42.01	28	Argentina	34.30
29	Russia	41.58	29	Saudi-Arabia	34.07
30	Argentina	38.46	30	Pakistan	32.43

Source: own calculations. Basis: most recent observation period (year 2024).

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