Future-Proofing the Dutch Economy:

Key Industries for Resilient Growth

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Foreword

Over the last three decades, the Dutch economy has fared reasonably well compared to other OECD countries, increasing living standards by around 50%.[1] However, recently it has become apparent that the old economic model that worked previously might not anymore be fit for the future. As companies are feeling the need to reinvent their business models amidst rising pressures,[2] the Dutch economy needs to structurally change to deliver on the societal ambitions of the Netherlands.[3]

The Dutch economy faces several bottlenecks that limit economic growth. Several of them are global in nature. Think of population ageing, climate change, technological disruption and recent geopolitical trends. However, many challenges are also specific to the Netherlands, such as decreasing available physical space,[4] acidification (damage caused by excess nitrogen)[5] and water quality[6] challenges. Because the Netherlands is a small country in terms of surface area, while having the 17th largest economy globally,[7] the economy is reaching its limits and is at risk of getting stranded in an inefficient distribution of scarcity.

To maintain high levels of prosperity and well-being and fulfill our ambitions in, for instance, housing, defense, healthcare and climate change, the Dutch economy will have to change. The Dutch government needs to make choices that help reallocate the scarcity of production resources to create more growth space for highly productive activities with a limited spatial and environmental footprint. With the right government steering, companies will grow their sustainable research and development (R&D) and innovation efforts, boosting their own productivity growth and, at the same time contributing to the growth of the entire economy.

This is not a novel insight. In 2023, DenkWerk, a think tank, outlined a trade-off framework for reallocating scarce productive resources for the benefit of long-term growth potential.[8] The secretary-general of the Ministry of Economic Affairs even devoted his 2024 New Year article published in the economic journal ESB to the need to reallocate scarcity.[9]

To date, however, no choices have yet been made to create growth space for highly productive activities.[10] This report seeks to provide the insights to help make the necessary choices. Making these necessary choices requires an understanding of the structure of the Dutch economy. Which activities generate a high value added, use a limited proportion of scarce production resources and have high labour productivity growth? If we know that, we can also target them better. We hope this report encourages policy choices that increase the Netherlands' structural capacity for growth and resilience so that we will also see a steady improvement in living standards over the next three decades.

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Content

Main outcomes

The current set-up of the Dutch economy is not future-proof. Long-term growth is under pressure, projected to drop to less than 1% after 2030.[11] How should we reallocate scarce production resources to maintain our current broad-based welfare position?

In this report, we illuminate the direction of where to start the steering by the government and what considerations companies should take to increase the Dutch growth potential. Based on their economic activities, some industries are better equipped for modern transformations than others. Hence, we ask the question: ***Which industries are best positioned for future growth potential of the Dutch economy?***

To do so, we zoom in on the economic structure of the Dutch economy over the last three decades. Our focus is on the industries that make up the commercial part of the Dutch economy. The analysis covers 15 commercial industries for the period from 1995 to 2023. We look through three different lenses: **centrality**, **economic importance** and **utilisation of scarce production resources**. In Table 1, the three lenses are summarised.

First, we look at which industries have been more **central to the economy**. That is, the industries that are **more influential based on their trade relationships** with the rest of the economy. These industries are positioned in a more strategically important place in the economy. If they experience positive or negative shocks, for example, in terms of their economic size or productivity growth, that impacts the rest of the economy disproportionately more.

Second, we consider **standard economic indicators** that allow us to compare different industries. For example, industries that make up a larger **share of the gross domestic product** (GDP), have a **higher productivity growth** and **spend more on R&D**, have more economic importance for the structural growth potential.

Third, we also pay attention to several **scarce production factors** that the Dutch economy must consider: **labour, capital, environmental (greenhouse gases, nitrogen** and water) and **physical space**. After the analysis of each production factor, we combine them in an index for each industry. This gives us an overview of the scarce production factors used per industry.

Each industry is given a certain score, which we explain in the main text of the report. The darker yellow a box, the more central the industry is (first lens), the higher the share in GDP, the higher the labour productivity growth and the higher the share in R&D investments (together these three factors are the second lens), and the lower the use of scarce production resources (the third lens). In the last column, the **three lenses come together in an overall index.**

Table 1 High/medium-high tech manufacturing (C3), other specialised business services (M), and wholesale and retail trade (G) are top performing industries when combining all factors in 2023

Industry	Centrality score	GDP share	Labour productivity growth	R&D share	Scarce production factors index	Sum of all factors
High/medium-high tech manufacturing (C3)	100.0	42.5	71.2	100.0	49.3	363.0
Other specialised business services (M)	33.6	70.1	72.9	40.9	84.6	302.1
Wholesale and retail trade (G)	42.2	100.0	66.1	11.9	54.4	274.6
Construction (F)	76.4	35.6	72.9	1.7	86.4	273.0
Low tech manufacturing (C1)	38.7	27.2	100.0	8.4	79.0	253.3
Information and communication (J)	25.0	34.1	64.4	33.0	86.2	242.7
Renting and other business support (N)	13.5	53.4	81.4	2.6	67.6	218.5
Financial institutions (K)	12.7	38.1	55.9	8.4	89.2	204.3
Accommodation and food serving (I)	6.3	11.1	83.1	0.0	100.0	200.5
Medium-low tech manufacturing (C2)	30.1	12.4	50.8	5.8	71.7	170.8
Water supply and waste management (E)	1.5	0.0	64.4	0.4	85.9	152.2
Transportation and storage (H)	23.3	30.9	54.2	2.4	16.7	127.5
Energy supply (D)	1.8	11.6	76.3	1.0	23.7	114.4
Agriculture, forestry and fishing (A)	9.2	10.7	83.1	5.1	0.0	108.1
Mining and quarrying (B)	0.0	4.7	0.0	0.3	96.9	101.9

Note: All scores, except for the sum of all scores, are min-max normalised and scaled to be from 0 to 100.

This shows that the high/medium-high tech manufacturing (C3) scores well when looking through all three lenses. At the bottom of the table, we see industries such as transportation and storage (H), and agriculture, forestry and fishing (A) score poorly, based on the three lenses. This means that these industries will have to create economic space by making a significant productivity leap, emitting less nitrogen and greenhouse gases and occupying less land. For those parts of the industries where these improvements are not implemented or where they fail to a sufficient extent, scaling down or relocation is the course of action. This will free up space for highly productive activities.

When considering scarcity reallocation, not just the absolute but also the relative economic importance and utilisation of scarce factors of production are important. To know which industries should be given the most leeway for growth, we consider which industry per euro of value added (per euro of GDP) has the highest centrality score, labour productivity growth and R&D investment, and the lowest use of scarce production factors. We multiply each of the factors in Table 1 (except for GDP share) by each industry's share of total GDP. The ranking based on this relative view (i.e., per euro of GDP) is presented in Table 2.

Table 2 Transportation and storage (H), renting and business support (N), and wholesale and retail trade (G) score slightly higher when adjusting for their economic size

Industry	Centrality score	Labour productivity growth	R&D share	Scarce production factors index	Sum of all factors
Wholesale and retail trade (G)	5.6	8.7	1.6	7.2	23.0
Other specialised business services (M)	3.2	6.8	3.8	7.9	21.8
High/medium-high tech manufacturing (C3)	5.9	4.2	5.9	2.9	19.0
Renting and other business support (N)	1.0	5.9	0.2	4.9	12.0
Construction (F)	3.9	3.7	0.1	4.4	12.0
Information and communication (J)	1.2	3.1	1.6	4.2	10.1
Low tech manufacturing (C1)	1.5	4.0	0.3	3.1	9.0
Financial institutions (K)	0.7	3.0	0.4	4.8	8.9
Transportation and storage (H)	1.0	2.4	0.1	0.7	4.3
Accommodation and food serving (I)	0.1	1.6	0.0	2.0	3.7
Medium-low tech manufacturing (C2)	0.6	1.1	0.1	1.5	3.4
Energy supply (D)	0.0	1.5	0.0	0.5	2.1
Agriculture, forestry and fishing (A)	0.2	1.6	0.1	0.0	1.9
Mining and quarrying (B)	0.0	0.0	0.0	1.1	1.1
Water supply and waste management (E)	0.0	0.4	0.0	0.5	0.8

Note: All scores are min-max normalised and scaled to be from 0 to 100. After that, they are weighted by each industry's GDP share.

We see that the top three highest-scoring industries remain the same. Industries, such as transportation and storage (H), renting and business support (N), and wholesale and retail trade (G), score slightly higher when adjusting for their economic size. Apart from transportation and storage (H), the same industries are also in the five lowest-scoring industries. Remarkably, utilities (energy supply (D), and water supply and waste management (E)) score low. These industries may not be large in terms of GDP but are critical to the ability of other industries to produce.

Policy implications and conclusions

In terms of policy conclusions, there are general policies aimed at increasing labour productivity and structural policies aimed at adjusting the mix of activities to increase the value added per unit of scarce production factor used. Now, low-productivity activities disproportionately use scarce production factors.

General policies

First, **boosting labour productivity growth within industries and companies is 'the silver bullet'**. For that, the government will have to invest more in education and knowledge development and in R&D and the application of innovations in companies.[12] Companies that want to grow their labour productivity faster are focusing on automation and digitalisation, internationalisation,[13] improving their management practices and adapting their business model to the external environment.[14] Moreover, when investing in labour productivity, companies should be aware of their interdependence with other companies. For this, they can use the results of this centrality analysis. This shows that their labour productivity is not only related to the industry in which they operate but also to how their industry connects to the rest of the economy. For example, if a close partner industry improved its productivity growth, that would have larger positive productivity growth effects on the industry itself.

Second, for future growth potential, **it is important that the productivity gap between leading and lagging companies does not widen**. This requires facilitating the application of innovations in small and medium-sized enterprises, which do not have the same resources as large companies, potentially leading to more knowledge spillovers. An effective competition policy is also essential because it prevents dominant positions and drives market dynamics.[15] Together with regional governments, clustering of cooperating companies, knowledge institutions and authorities should be encouraged. Through knowledge exchange within these innovative ecosystems, laggards and middle groups can catch up with the frontrunners.[16]

Structural policies

The Dutch economy has to change because it is unlikely to achieve sufficient productivity growth with the current industrial structure. **The government should steer the economy with policies aimed at growing the leading industries in terms of centrality, GDP share, labour productivity growth, R&D share and lower use of scarce production factors**. Examples could be policies that make it more expensive to pollute and use a lot of water and spatial planning aimed at more productive activities. Also, existing laws on the environment and labour exploitation should be more strictly enforced. Increasing the legal minimum wage could help to steer employment towards companies with higher labour productivity and potential for productivity growth. Hence, it is **not about policies where the government favours certain industries over others, but rather about general policies** that create the framework conditions for highly productive activities with a limited environmental and spatial footprint.

From the centrality analysis, we find that the construction (F) industry is highly central in the economy, meaning that many other industries have production relations with it. Therefore, it is important that the construction (F) industry has high labour productivity growth. After all, this affects other industries through those many relations. Where the other high centrality industry, high/medium-high tech manufacturing (C3) has high labour productivity, the same is not true for construction (F). The government would therefore do well to set up a productivity agenda with the construction (F) industry. The same goes for wholesale and retail trade (G), an industry that is central and has relatively low labour productivity.

It is important for industries that have a large share in the economy to invest in labour productivity growth. Besides wholesale and retail trade (G), these are other specialised business services (M), and renting and other business support (N). Because of the size of these industries, this has a major impact on labour productivity growth at the macro level.

The industries where R&D lag significantly are construction (F), transportation and storage (H), and accommodation and food serving (I). The government could look specifically at how to boost innovation in these industries. Yet, as private R&D is lagging the Lisbon targets, a general policy aimed at boosting private R&D is crucial to increase long-term growth potential. Looking at the use of scarce production factors, it is striking that agriculture, forestry and fishing (A), and transportation and storage (H) make disproportionate use of scarce production factors. To increase the growth capacity of the Dutch economy, it is necessary to reduce this draw and reallocate scarcity to industries that can add more value per production factor, such as other specialised business services, and wholesale and retail trade (G).

Reallocation of scarcity and restructuring of industries will lead to difficult trade-offs. With low unemployment and job abundance, now is the time to future-proof the Dutch economy. It is better to make changes now, while the economy is still growing and labour market opportunities abound, than to wait until the economy comes to a standstill. We better fix the roof while the sun is still shining. After all, the sky is rapidly becoming cloudy.

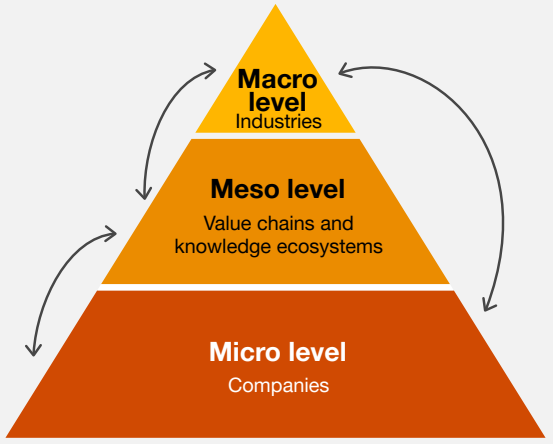
1. Introduction

In this report, we focus on the commercial sector of the economy, which can be dissected in three distinct levels that are connected through constant feedback loops (Figure 1).

First, companies are the primary agents that produce and sell goods and services. This is the micro level, where businesses have their own strategy, direct suppliers, consumers, competitors and partners. However, there are two other important levels that severely impact the micro level.

Second, companies tend to be clustered in symbiotic relationships with other companies in their supply chains and with non-profit institutions, such as universities and other knowledge institutions, and with governmental bodies. These knowledge ecosystems make up the meso level.

Figure 1 Three levels of the economy



Labour productivity growth originates both at the micro and meso levels. Technological innovations, which are primary drivers of economic growth by making goods and services cheaper and better, spread through production networks and knowledge ecosystems. This mechanism allows companies that are connected in one way or another to benefit from productivity growth in other companies, driving overall economic growth.[17]

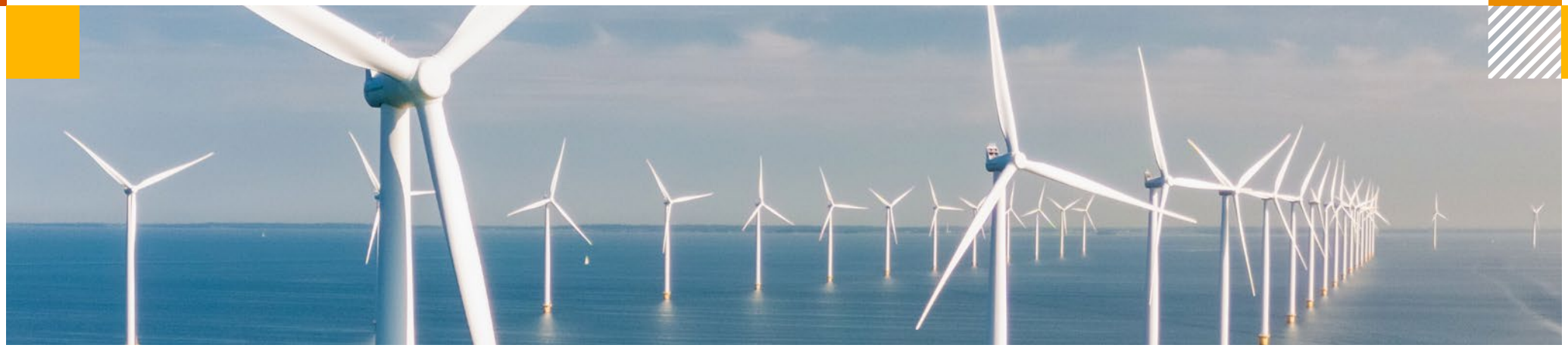
Lastly, all companies that engage in similar activities make up industries that add up to the macro level.

Industries in scope

For statistical purposes, companies that engage in similar activities are grouped into industries at five levels of aggregation. Each company is assigned a code by the Dutch Chamber of Commerce (KvK) that indicates how the main economic activities of that business are classified.[18] See Table 3 for an illustrative example for the agriculture, forestry and fishing (A) industry.

Table 3 Example of statistical disaggregation of the agriculture, forestry and fishing (A) industry

A	Agriculture, forestry and fishing
1	Crop and animal production, hunting and related service activities
1.1	Growing of non-perennial crops
1.11	Growing of cereals, other than rice, leguminous crops and oil seeds
01.11.0	Growing of cereals, other than rice, leguminous crops and oil seeds
1.12	Growing of rice
01.12.0	Growing of rice
1.13	Growing of vegetables and melons, roots and tubers
01.13.1	Growing of open-field vegetables
01.13.2	Growing of vegetables in greenhouses
01.13.3	Growing of mushrooms
01.13.4	Growing of potatoes and other roots and tubers
1.14	Growing of sugar cane
01.14.0	Growing of sugar cane
1.15	Growing of tobacco
01.15.0	Growing of tobacco
1.16	Growing of fibre crops
01.16.0	Growing of fibre crops
1.19	Growing of other non-perennial crops
01.19.1	Growing of cut flowers and shrubs in open fields
01.19.2	Growing of cut flowers and shrubs in greenhouses
01.19.3	Growing of fodder crops
01.19.9	Growing of other non-perennial crops (rest)



In this report, we focus on the most aggregated level of the industry classification, which is also used by Statistics Netherlands, namely, the industries that have only a letter code.[19] More specifically, we focus on industries that are part of the commercial sector, those are A-N, excluding renting, buying, selling real estate (L).[20] Table 4 shows all 15 industries that are in our scope.

We separate the business services sector (M-N) into two industries. Other specialised business services (M) that combine, among others, legal, accounting, consulting, architectural, engineering and scientific activities. And, renting and other business support (N) that includes employment services, travel agencies, security, and administrative and office support.

Furthermore, we also split the manufacturing industry (C) into three subindustries, depending on how technologically advanced the production process is (see Appendix on page 39 for more details). Low tech manufacturing combines activities such as food and beverages, textile, wood and paper production, among others. Medium-low tech manufacturing includes, for example, production of metal, mineral, rubber and plastic products. High/medium-high tech manufacturing incorporates the production of pharmaceuticals, computers and electronics, chemicals, electric equipment, machinery and vehicles, among others.

Industries and sectors

The 15 industries that we consider can also be grouped into the three sectors of the economy:

- Primary sector or the extraction of raw materials, which includes agriculture, forestry and fishing (A), and mining and quarrying (B);
- Secondary sector or the goods-producing industries, which include manufacturing (C1, C2 and C3), energy supply (D), water supply and waste management (E) and construction (F);
- Tertiary sector or the commercial services, which includes all of the remaining industries from G-N in Table 4.

Table 4 Industries in the scope of our analysis

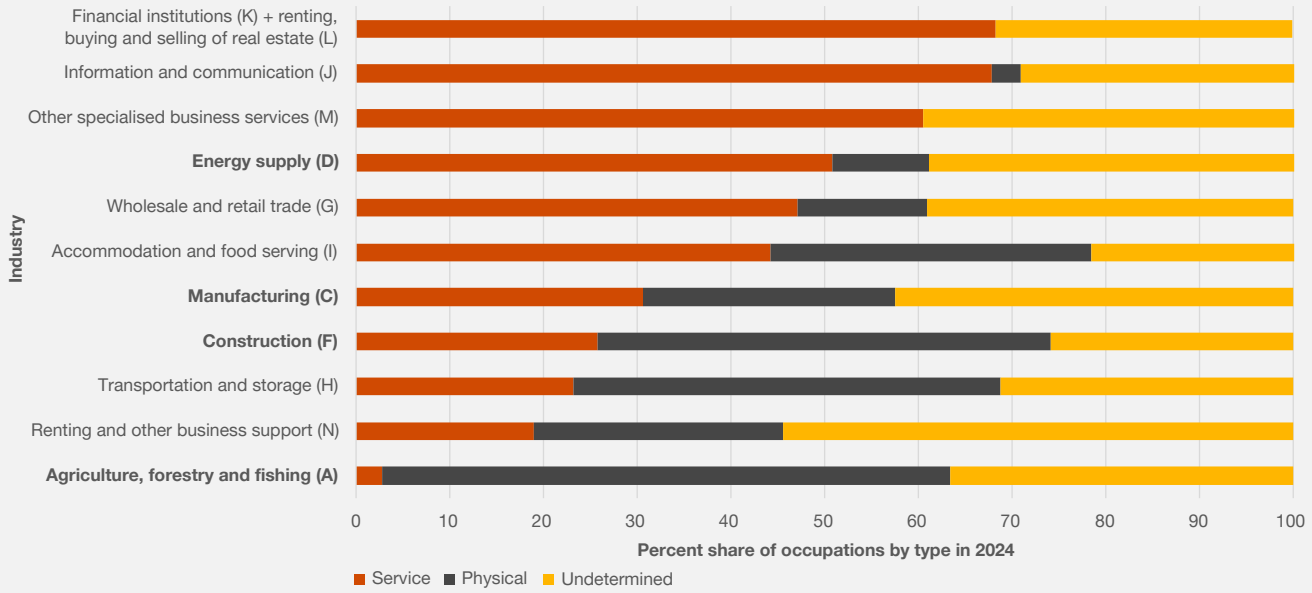
Primary sector	A	Agriculture, forestry and fishing
	B	Mining and quarrying
Secondary sector	C1	Low tech manufacturing
	C2	Medium-low tech manufacturing
	C3	High/medium-high tech manufacturing
	D	Energy supply
	E	Water supply and waste management
	F	Construction
Tertiary sector	G	Wholesale and retail trade
	H	Transportation and storage
	I	Accommodation and food serving
	J	Information and communication
	K	Financial institutions
	M	Other specialised business services
	N	Renting and other business support

Services play a bigger role than it seems
The Dutch economy is highly services-oriented. Services, including healthcare and government with the commercial services, account for more than 80% of employment, while the secondary sector accounts for less than 18% and agriculture 2%.[21]

Nevertheless, the classification of industries in this way still underestimates the importance of services. For example, a significant share of employment in the primary and secondary sectors is taken by service-type jobs. In manufacturing (C), energy supply (D) and construction (F), at least 20% of jobs are service-type jobs. We have highlighted those industries in Figure 2.

Think of a modern manufacturing company. Besides jobs that are physical in nature, companies in those sectors also hire accountants, human resources professionals, marketers, sales representatives, legal professionals and other service jobs. This is even more the case in the Netherlands than elsewhere, as many companies outsource more physical activities to other countries due to more competitive wages, better talent matches or more physical space available, with service jobs primarily remaining in the Netherlands.[22] Hence, the true role of services in the Dutch economy is even larger. This also shows that the boundaries between traditional industries are blurring.

Figure 2 Service-type jobs play an increasingly larger role also in other Dutch sectors



Sources: ROA, 2024, PwC analysis.
Note: Manufacturing (C) is an average of 'food and beverage industry, chemical industry, metal industry and other industries'.
Wholesale and retail trade (G) is an average of retail trade and wholesale. No data for mining and quarrying (B), and waste management and water supply (E). Financial institutions (K) is combined with renting, buying, selling real estate (L).

Industry instead of meso and micro data
Ideally, we would have done the analysis at the level of individual companies (the micro level) because scarcity reallocation is about activities and not about entire industries (macro level). After all, the difference in labour productivity is greater within industries than between industries.[23]

When it comes to the level of pollution, innovation and space occupation, you cannot lump all companies in an industry together: there are also big differences within industries. More growth space should be created for the best-performing activities, while the laggards should scale down, quit or relocate. The same applies at the meso level. At the ecosystems and value chain level, too, there are differences, and policy should aim at creating space for the most innovative ecosystems. Unfortunately, the data are not available at the micro and meso levels.

Hence, we conduct our analysis at the macro level. Nevertheless, looking at the macro or industry level does provide a good starting point for governments and policymakers to advance productivity change and growth potential. Similarly, for companies, it might be important to understand not only how their industry has been faring but also how it relates to other industries and companies in the economy.

Data and methodology

We look at the Dutch economy for the period of 1995 to 2023, capturing almost 30 years of data from Statistics Netherlands and the OECD. Our aim is to understand how the industrial structure of the Dutch economy has evolved during this time and which industries are more crucial to value chains and the rest of the economy. In this analysis, we adopt three lenses.

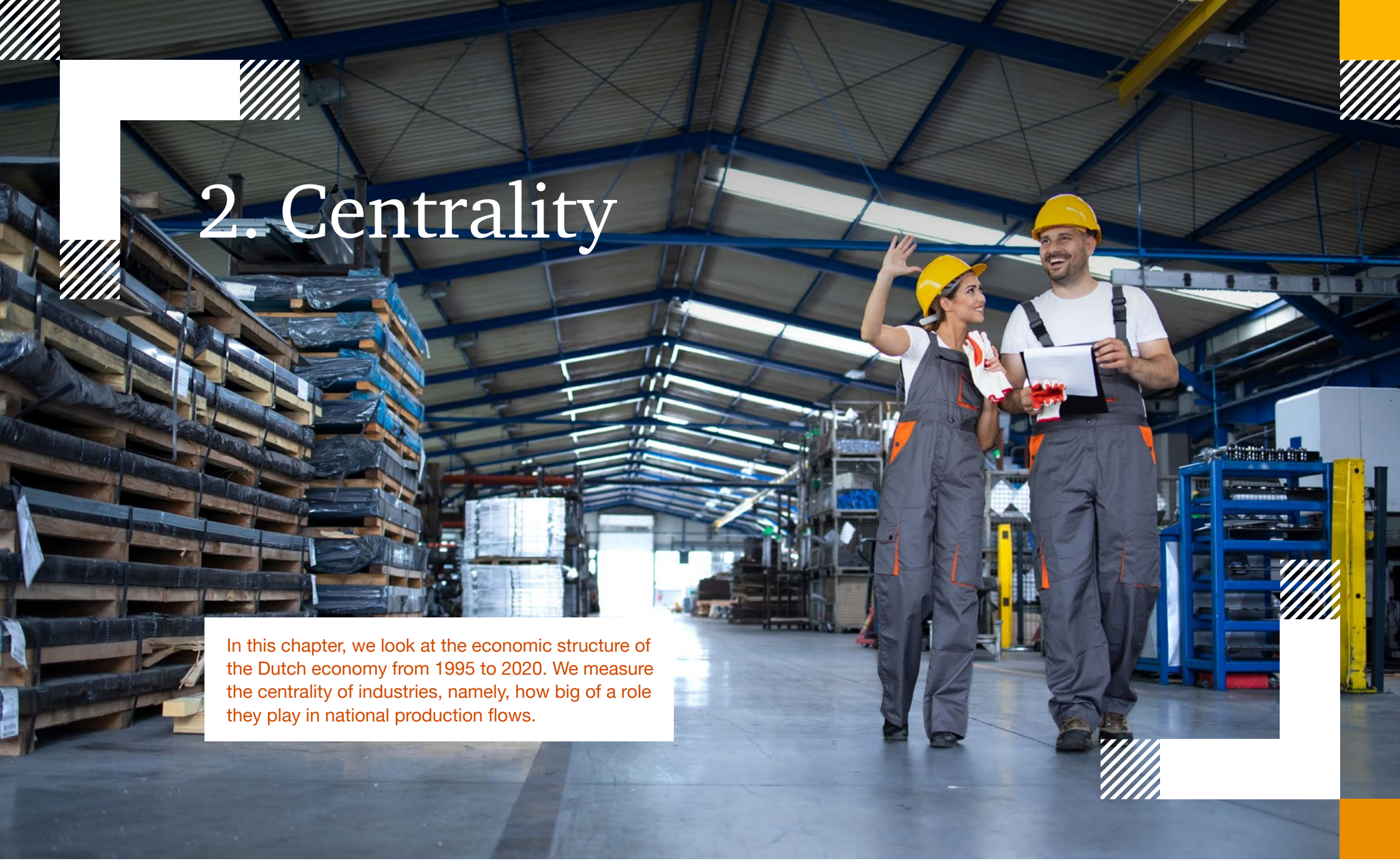
First, we consider the industrial structure of the Netherlands. We calculate which industries are 'central'. In other words, industries that are more influential based on their trade relationships with the rest of the economy. These industries are positioned in a more strategically important position in the economy. If they grow, that impacts the rest of the economy disproportionately more, and vice versa.

Second, we look at indicators that allow us to understand the economic importance of industries. For example, industries that make up a larger share of GDP, have higher productivity growth and spend more on R&D are playing a larger macroeconomic role.

Third, we pay attention to several scarce production factors that the Dutch economy must consider: labour, capital, environmental (greenhouse gases, nitrogen and water) and physical space. We combine those factors in an index to show how industries rank in terms of using these scarce production factors.

To get a full picture of how industries compare to each other in terms of centrality, economic importance and scarce production factors, we combine those factors in a heatmap.

2. Centrality



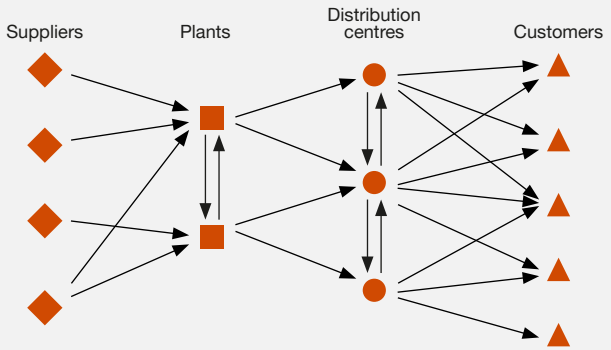
In this chapter, we look at the economic structure of the Dutch economy from 1995 to 2020. We measure the centrality of industries, namely, how big of a role they play in national production flows.

Centrality in national supply networks

Modern economies can be viewed as complex networks of production and trade relationships. First, companies in each industry buy input goods and services from other companies both domestically and abroad, converting them into other goods and services. Then, they sell the end products to either households, the government or other producers in their country or export them abroad.[24]

A company might primarily focus on its direct suppliers and customers, therefore making it seem that its production relationships form a linear chain. However, when aggregating many supply chains together in an economy, they create supply networks (Figure 3).[25]

Figure 3 From supply chains to supply networks[26]



Source: Melo et al. (2008): Network Design Decisions in Supply Chain Planning.

In practice, these relationships are extremely complex. For example, ASML, a leading Dutch high tech manufacturing company producing extreme ultraviolet lithography machines for semiconductor production, requires around 100,000 parts for its machines. In addition, the parts for its machines come from over 5000 different suppliers all over the world, in Europe, the United States and Asia.[27] These are only tier one suppliers, as those suppliers have suppliers and so on, tying production relationships in a complex supply network.

The awareness of those network interconnections has grown recently. Economists and policymakers realised during the financial crisis of 2008-2009 and the Covid-19 pandemic that shocks in one seemingly isolated industry can propagate to other industries due to their interconnections.[28] Divisions between industries are blurring, and many value chains traverse industries.

Furthermore, it has been shown that shocks in one industry, both positive and negative, largely determine the fluctuations in GDP.[29] Therefore, studying these connections between industries is becoming increasingly important, not only for companies in understanding how a positive or negative shock in a connected industry would impact them, but also for policymakers to know where and how to apply industry-specific measures.[30]

Network structures
A national economy can be characterised as a production network with each industry representing a node. Each node has two parameters. First, how many connections or production relationships it has with other industries. Second, how strong these connections are. The strength of connections is measured by how much gross value added one industry sells to another as input for production. In addition, there is intra-industry trade when an industry trades with others in the same industry.

Furthermore, it largely depends on the network structure how a shock to one industry affects the wider economy.[31] In Figure 4, we schematically show an example of how four different nodes can be connected in an industry.

An important parameter that characterises a network is its density, namely the ratio of actual total connections between nodes to all possible connections. For example, network 1a) of Figure 4 has a density of 1, as all industries are connected in all possible ways. However, for network 1d) of Figure 4, the density is 4/16 = 0.25, as there are only self-loops within industries and no industries are connected to each other.[33]

Second, network distance is important: the number of steps or connections required to move from one industry to another. In figure 1a), all industries are one step away from each other. Hence, a shock to any industry directly impacts the rest of the economy.

The Dutch economy has a hub network structure with a density of 0.7, meaning that the distance between some industries is greater than one.[34] In such economic structures, some industries are more central than others. This implies that either positive or negative shocks to more central industries disproportionately impact their immediate connections or neighbours and the rest of the economy.[35]

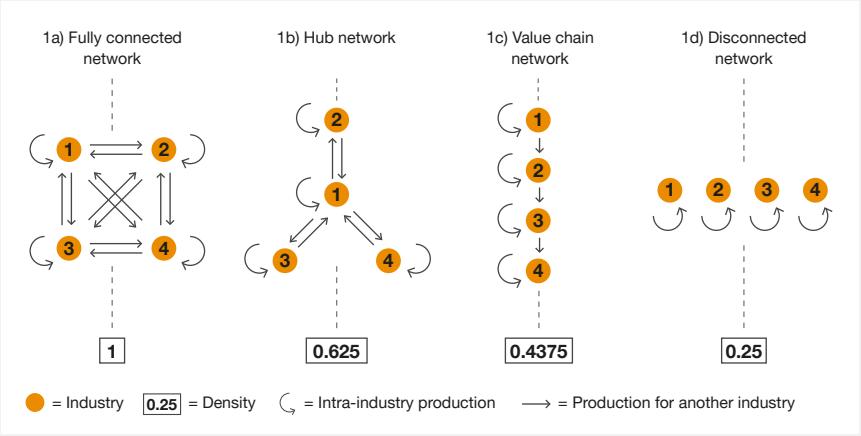
Centrality measures
There are several metrics that can measure the centrality of nodes (industries in our case) in networks. First, counting how many input or output connections a node has. This is called 'degree centrality' (A in Figure 5). Second, measuring how often a node is in the middle of a route between two other nodes. This is called 'betweenness centrality.' Third, the 'closeness centrality' measure, indicates that a more central node is the one that has to travel the shortest distance to reach the other nodes.[36]

The measures in Figure 5 focus on the number of connections but not on the strength of those connections. A measure that incorporates the strength of connections is called 'eigenvector centrality',[37] which is what we base our analysis on. It has been shown that eigenvector centrality is a good method for determining central industries.[38]

In this measure, the centrality of a node is proportional to the sum of the centrality of its neighbours. This measure focuses not only on the quantity of connections but also on the quality, quantifying each node's influence.[39] For example, someone with 100 relatively unpopular friends on social media would have lower eigenvector centrality than someone with 100 very popular friends who are celebrities themselves.[40] This way, if an industry has a strong connection to other important industries, it also becomes more important.[41]

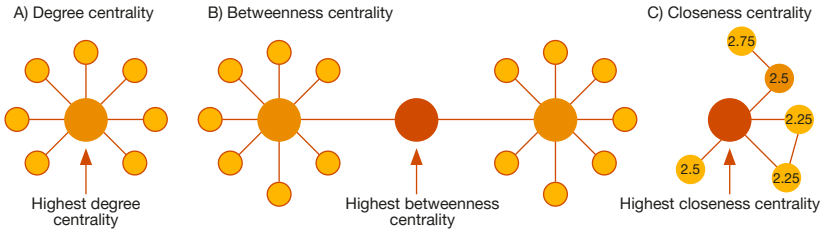
In our analysis, we use data from 1995-2020 and calculate the centrality scores, by applying eigenvector centrality.[42]

Figure 4 Schematic overview of different network compositions[32]



Sources: Choi and Foerster (2017); Dieteren & Nauta (2020).

Figure 5 Different measures of centrality



Sources: VisibleNetworkLabs (2021-04): Network Centrality: Understanding Degree, Closeness & Betweenness Centrality, PwC analysis.

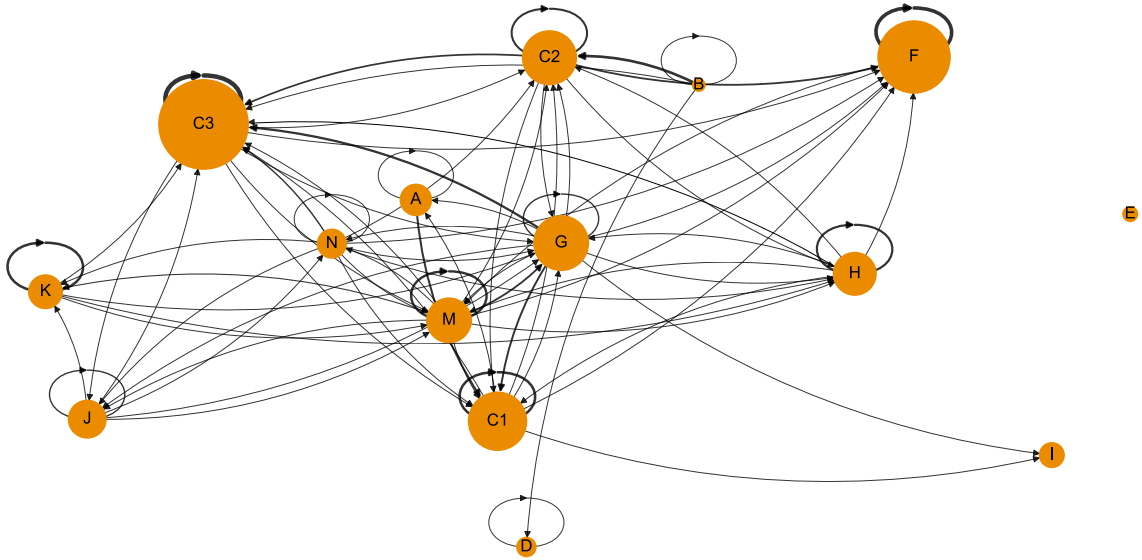
Measuring the centrality of Dutch industries

As company-level production data is scarce,[43] we focus on an industry level in the Netherlands, using input-output data for Dutch industries. Following Dieteren & Nauta (2020), we exclude potential import or export relationships when calculating the centrality scores,[44] as we are interested in which industries are most central for the Dutch economy. However, it is worth keeping in mind that there might be some industries that would not show as central in our analysis but would be more central to global value chains than to the Dutch economy.

First, we obtain the density of the industry network, which is 0.64, in line with Dieteren & Nauta (2020), indicating that some industries are more central than others. For the calculation details, see Appendix on page 39.

Second, in Figure 6, we have calculated the centrality scores for 15 industries in the Dutch economy from 1995 to 2020. As discussed above, we base our calculations on eigenvector centrality. To improve the visual display of Figure 6, we have only included the strongest connections – those exceeding the average connection strength in our network or US$1.5 billion of value added (see Appendix on page 39 for more details).

Figure 6 Goods sector industries have been the most central within the Dutch economy from 1995 to 2020



		Industry	Centrality score 1995-2020
Primary sector	A	Agriculture, forestry and fishing	0.08
	B	Mining and quarrying	0.01
Secondary sector	C1	Low tech manufacturing	0.29
	C2	Medium-low tech manufacturing	0.25
	C3	High/medium-high tech manufacturing	0.68
	D	Energy supply	0.03
	E	Water supply and waste management	0.02
	F	Construction	0.44
Tertiary sector	G	Wholesale and retail trade	0.25
	H	Transportation and storage	0.16
	I	Accommodation and food serving	0.05
	J	Information and communication	0.12
	K	Financial institutions	0.10
	M	Other specialised business services	0.17
	N	Renting and other business support	0.07

Source: OECD Input-Output Tables 2021 ed., PwC analysis.
Only trade flows that exceed the average (or US$1.5 billion) from 1995-2020 are included. We exclude non-commercial industries.

We find that high/medium-high tech manufacturing (C3), construction (F), low tech manufacturing (C1), wholesale and retail trade (G) and medium-low tech manufacturing (C2) have been the top five most central industries from 1995 to 2020 (see Appendix on page 39 for the full ranking). All of these industries are part of the goods-producing sector. The three most central services industries are specialised business services (M), transportation and storage (H), and information and communication (J).

Looking at the production flows among industries, it is notable that many industries have strong intra-industry flows: companies buying production inputs from other companies within the same industry. The strongest annual value-added flows between and within industries in the 1995 to 2020 period are:

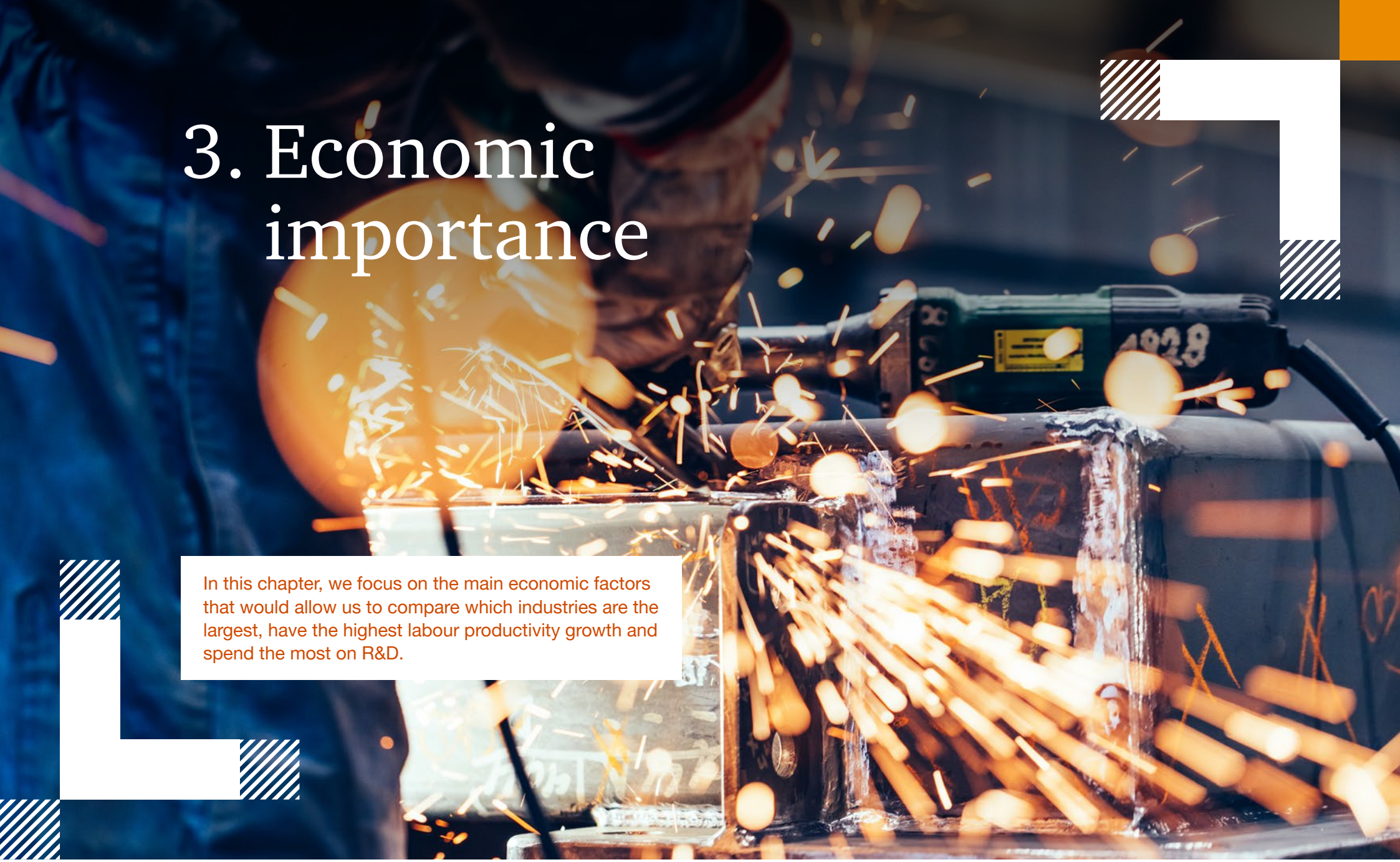
- Intra-industry flows for wholesale and retail trade (G) of US$31.8 billion,
- Construction (F) with US$25.8 billion,
- Mining and quarrying (B) to medium-low tech manufacturing (C2) of US$19.2 billion.

The top three strongest connections, excluding intra-industry flows, are:

- Mining and quarrying (B) to medium-low tech manufacturing (C2) of US$19.2 billion,
- Wholesale and retail trade (G) to high/medium-high tech manufacturing (C3) of US$16.4 billion,
- Agriculture, forestry and fishing (A) to low tech manufacturing (C1) of US$14.5 billion.[45]

Shocks to the more central industries in this list would lead to disproportionate impacts on the rest of the economy. For example, if any of those industries improved their productivity growth, that would have larger spillover effects. Similarly, if these industries were to shrink or even leave the Dutch economy, that would impact not only the production flows but also the centrality of other industries with close connections.[46]

3. Economic importance

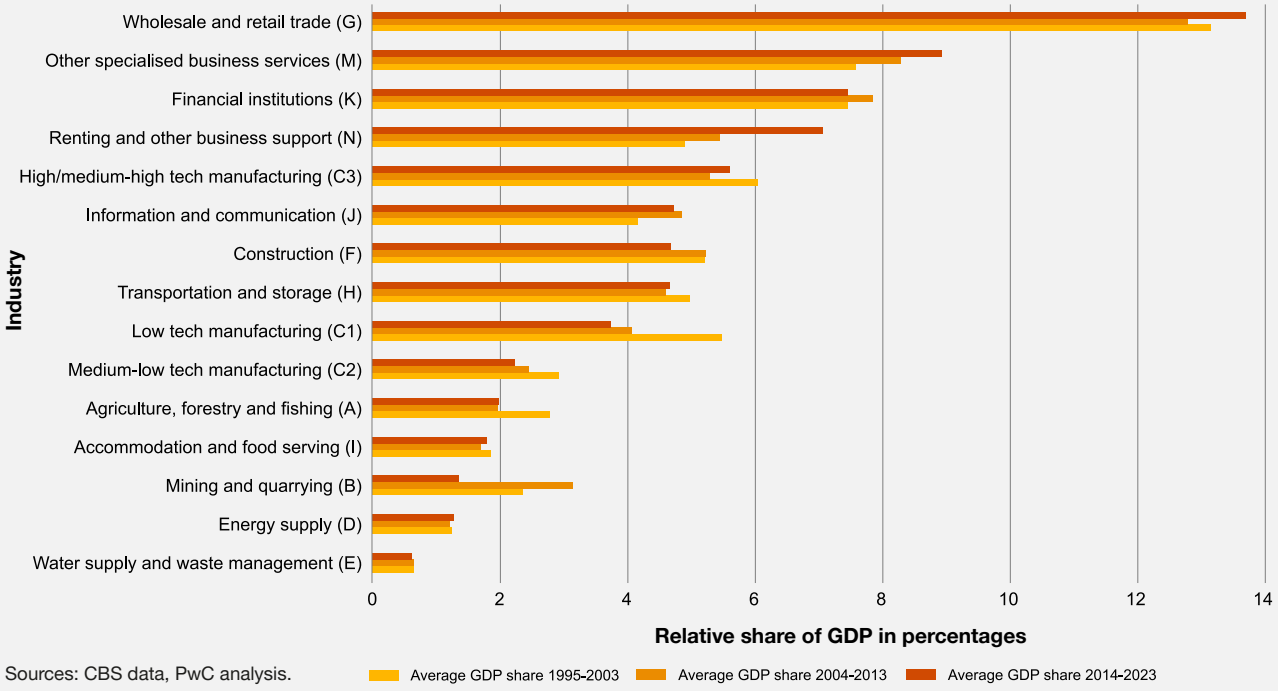


In this chapter, we focus on the main economic factors that would allow us to compare which industries are the largest, have the highest labour productivity growth and spend the most on R&D.

Economic size (share of GDP)

Figure 7 ranks industries by their economic size (value added). We can see that in the period from 1995 to 2023, the three largest industries have been wholesale and retail trade (G), other specialised business services (M) and financial institutions (K).

Figure 7 Wholesale and retail trade (G), other specialised business services (M) and financial institutions (K) have been the largest industries in the past decade



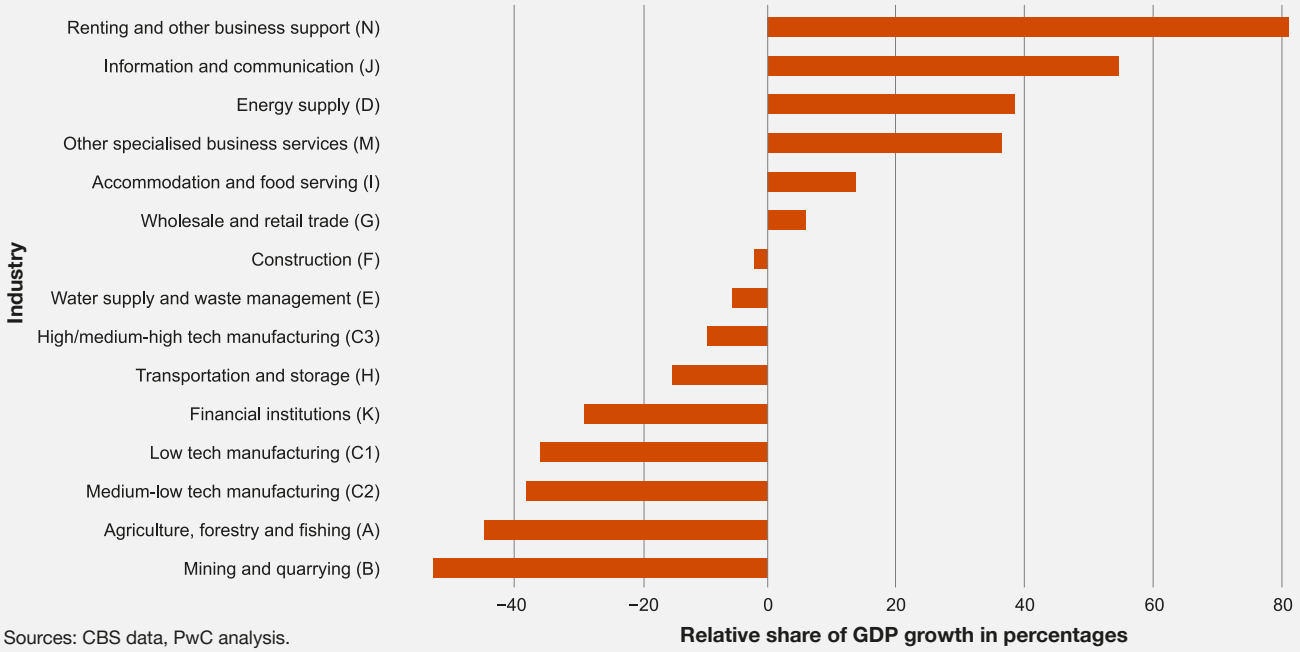
Sources: CBS data, PwC analysis.

We also look at which industries have increased or decreased their relative share of the economy, indicating where the transformation of the Dutch economy has largely taken place in terms of economic production. In Figure 8, we can see that industries in the Dutch economy that have increased their relative economic size the most are renting and other business support (N), information and communication (J) and energy supply (D).

The economy can grow either because more hours are worked or because more value is created per hour worked. Economic growth over the past decade in the Netherlands has been achieved primarily through an increase in the number of hours worked.[47]

However, due to population ageing, labour is becoming increasingly scarce, and the Netherlands is approaching one of the highest employment ratios in the European Union (EU).[48] Although the Dutch labour participation rate ranks amongst the highest in the EU, the average hours worked per week are one of the lowest in Europe.[49] Because the societal trends are against increasing this number, the Netherlands will have to focus on another way to grow GDP: labour productivity growth.

Figure 8 Renting and other business support (N), information and communication (J) and energy supply (D) have grown their relative GDP share the most from 1995 to 2023



Sources: CBS data, PwC analysis.

Labour productivity growth

Labour productivity in the Netherlands, measured as gross value added per hour worked, is high overall when compared to other countries.[50]

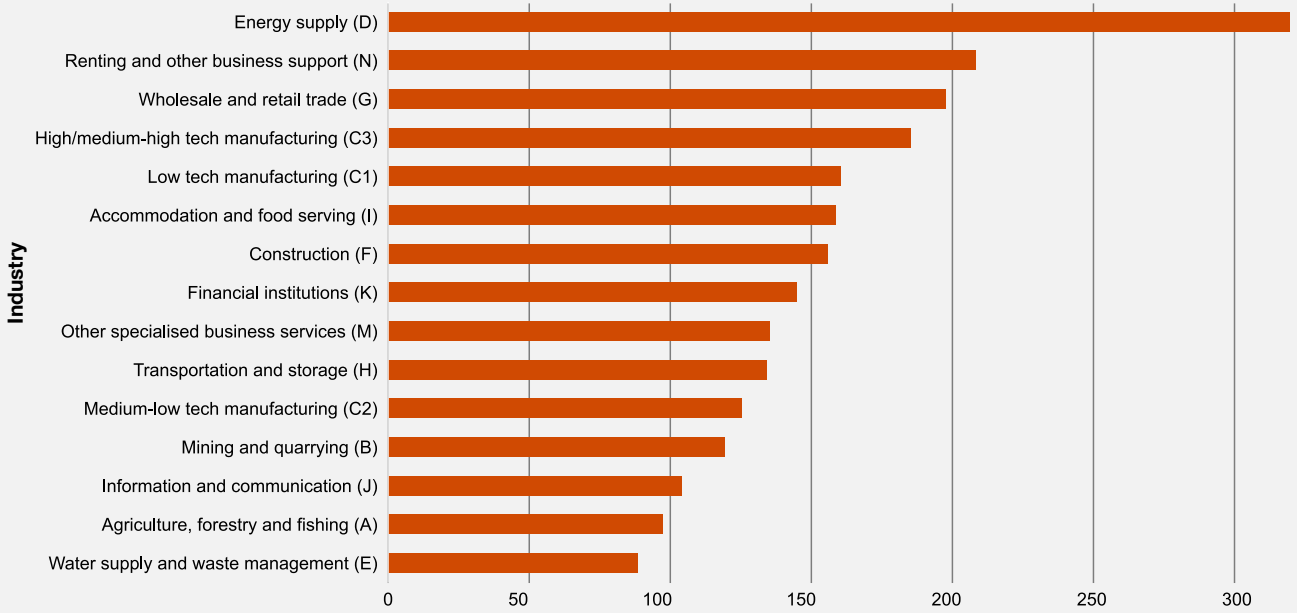
However, the labour productivity growth rate in the past decades has been sluggish. Labour productivity has more than doubled over the past 50 years, but most of that increase was achieved between 1974 and 2013, when labour productivity increased at an average annual rate of 1.5%. Over the past decade, average yearly growth in labour productivity has been only 0.4%.[51]

In addition, Dutch labour productivity growth has stagnated compared to other EU countries, with only five countries having lower growth in the last decade.[52] This is partly due to the structure of the Dutch economy,[53] but it is also the result of the phasing out of gas extraction in Groningen.[54] Gas production in the Groningen gas fields has been stopped from 1 October 2024. That means the effect on productivity growth phases out in 2025-2026.

In Figure 9, we look at labour productivity growth from 1995 to 2023. Energy supply (D), renting and other business support (N), and wholesale and retail trade (G) have been the frontrunners.

Looking at both the GDP and labour productivity growth, it becomes clear that not all industries that have had high labour productivity growth have also been the leaders in terms of GDP growth.

Figure 9 Energy supply (D), renting and other business support (N), and wholesale and retail trade (G) have grown their productivity the most from 1995 to 2023



Sources: CBS data, PwC analysis.

For example, high/medium-high tech manufacturing (C3) ranked number four from 1995 to 2023 in terms of cumulative labour productivity growth, while it actually decreased its relative share of GDP. It has been shown that instead of high productivity industries being the primary means of GDP growth, the Dutch economy has relied more on increasing hours worked in lower value-added activities as a driver of economic growth over the past decades.[55]

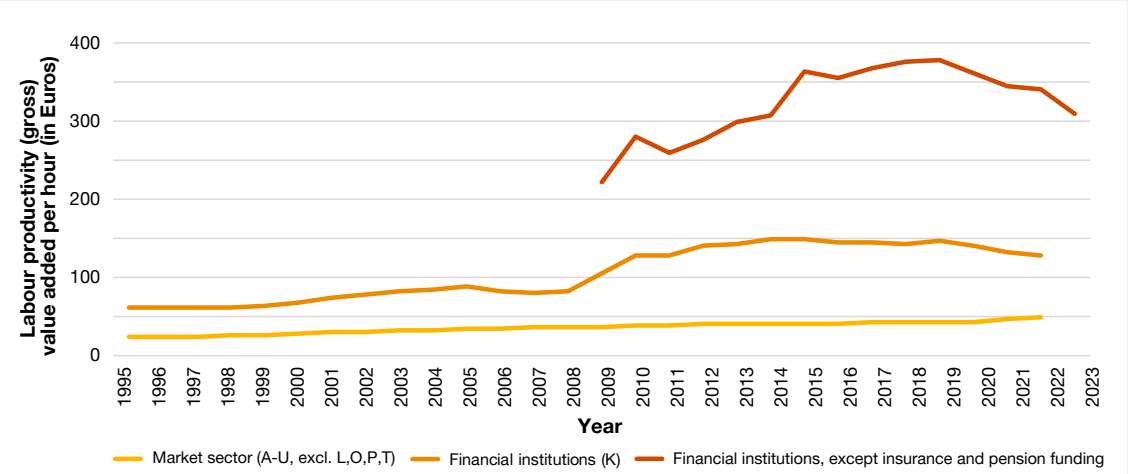
Productivity in financial institutions (K)

We have recently written about stagnating labour productivity growth in the construction (F), and transportation and storage (H) industries.

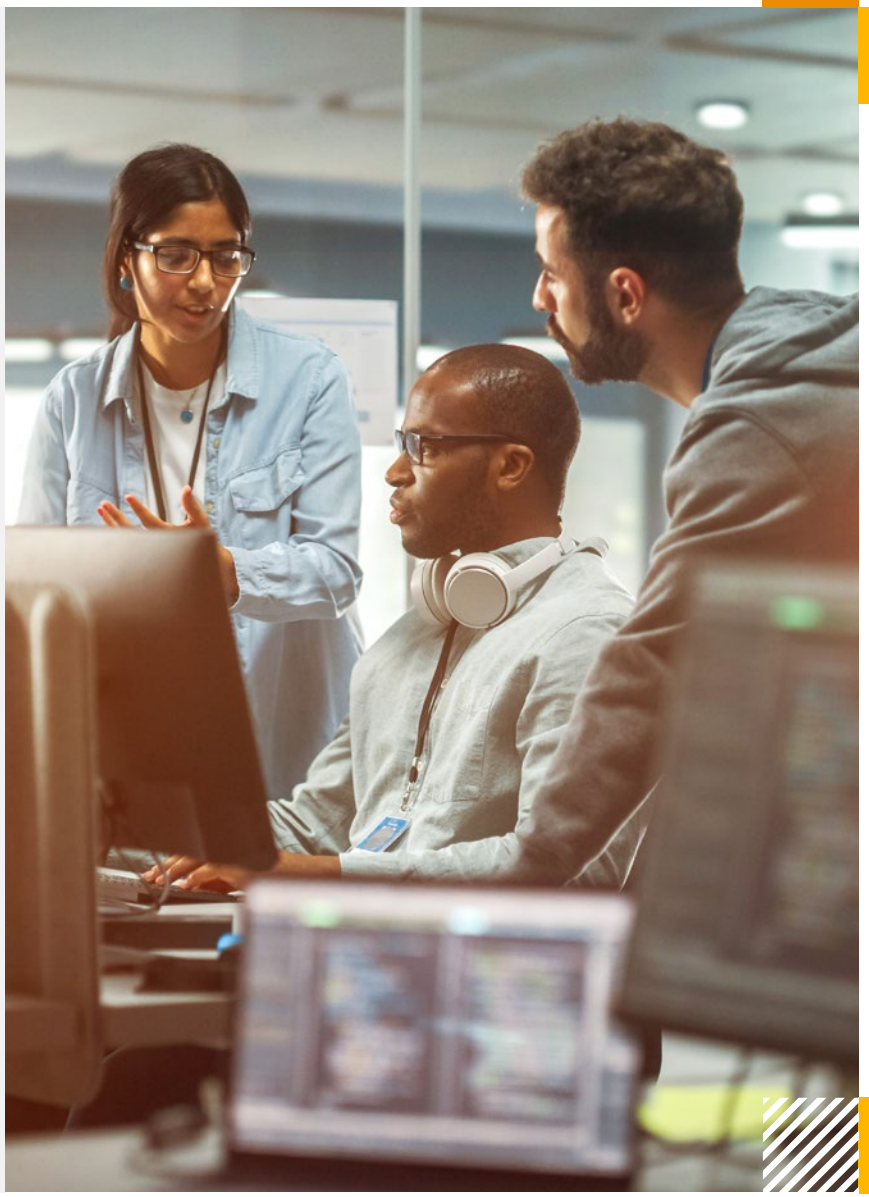
Financial institutions (K) is also an industry that has experienced stagnating labour productivity growth since 2008, even slower than average. For banks, there even has been a decline since 2019. Dutch banks have since invested heavily in their gatekeeper function in recent years. By 2023, more than 13,000 bank employees - one in five - were engaged in customer due diligence, ongoing monitoring of relationships and transactions and reporting unusual transactions.[56]

Dutch banks have started strengthening their gatekeeper function since the introduction of the Money Laundering and Terrorist Financing (Prevention) Act (Wwft) in 2008. Over the years, the requirements and obligations under the Wwft have tightened, especially after amendments in 2018 and 2020. As a result, banks started hiring more and more staff in those years to comply with these stricter regulations and to better manage risks, and we have seen labour productivity decline since 2019.

Figure 10 Labour productivity in financial institutions (K) has stagnated since 2008



Source: CBS
Note: Financial institutions, except insurance and pension funding, most monetary intermediation, financial holdings, investment funds, credit granting and other financial intermediation. Most companies in this sector are banks.

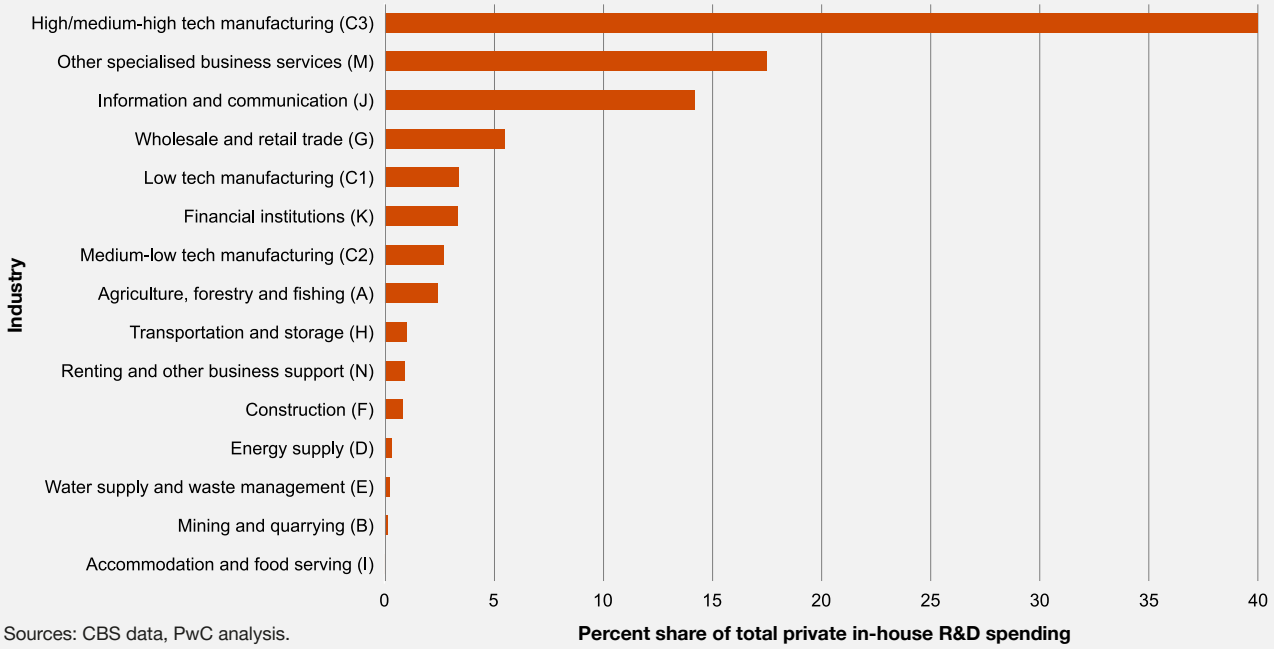


R&D spending

The third economic factor we consider is R&D spending. For R&D spending, we look at private in-house R&D spending from 2013 to 2022. It is an important proxy for innovation potential that is key to boosting labour productivity growth.[57] In addition, technological progress is an important driver of GDP growth. Hence, industries that have high R&D spending are not only benefitting themselves but also leading to positive spillover effects to other industries.

In Figure 11, high/medium-high tech manufacturing (C3) accounts for more than 40% of total private in-house R&D spending in the Netherlands. Other services sector industries, such as other specialised business services (M), and information and communication (J) make up more than 10% of the total. These industries are important drivers of total R&D spending and innovation potential.

Figure 11 High/medium-high tech manufacturing (C3) contributed more than 40% of total private in-house R&D spending from 2013 to 2022

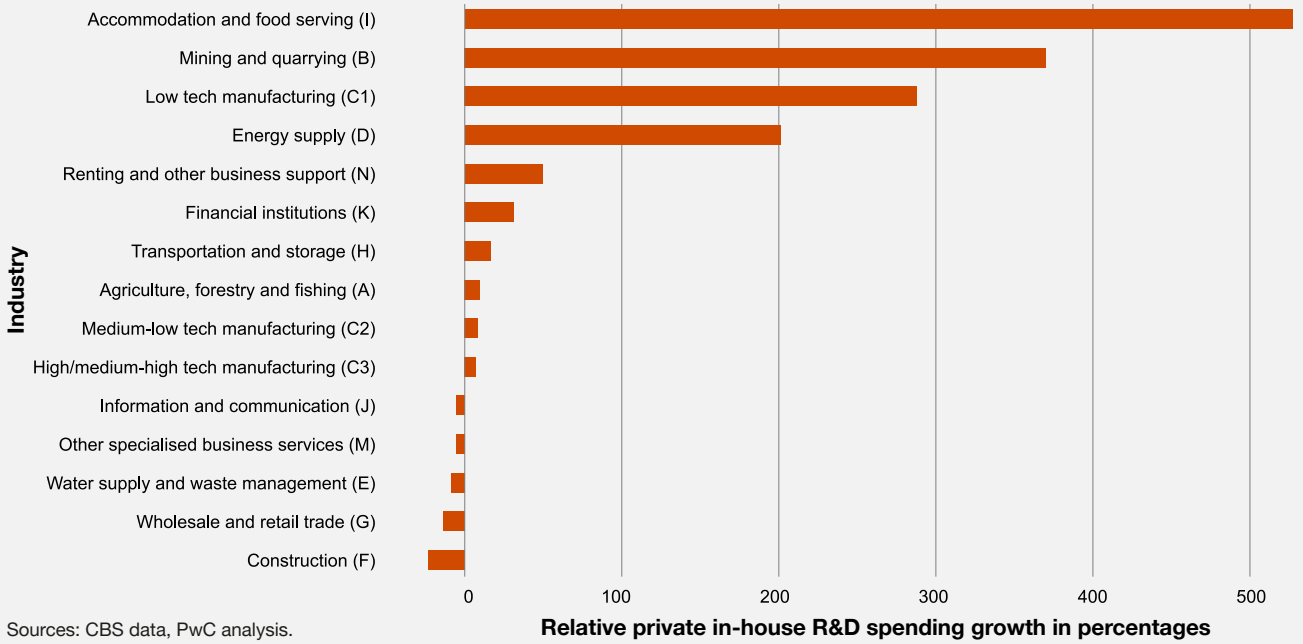


Sources: CBS data, PwC analysis.

If we look at the R&D spending growth rates, accommodation and food serving (I), mining and quarrying (B) and low tech manufacturing (C1) have grown the most (Figure 12).

However, as can be seen in Figure 11, except for low tech manufacturing (C1), these industries have had the lowest relative shares of private in-house R&D spending. Hence, when comparing with other factors, as we are interested in understanding which industries spend the most on R&D, we use the share of R&D spending and not the growth rate. Looking at the growth rate in relative R&D spending would skew the comparison, as industries leading in this aspect tend to be those who spend very little on R&D.

Figure 12 Accommodation and food serving (I), mining and quarrying (B) and low tech manufacturing (C1) have grown their relative share of R&D spending the most, but remain at low levels



Sources: CBS data, PwC analysis.

4. Scarce production factors

In this chapter, we apply a third lens to look at the six main ‘budgets’ or scarcities in terms of production factors that the Dutch economy must deal with, namely labour, capital, environmental space, acidification (damage caused by excess nitrogen), water and physical space.

We look at the utilisation of six scarce production factors by each sector: labour, capital, environmental space, acidification, water and physical space. Even though these are important factors, this is not an exhaustive list of factors that are scarce and important for production. For example, due to a lack of data, we do not look at prices and availability of electricity, which has been an important issue for many companies in the Netherlands as the grid capacity has been strained.[58] In addition, we do not differentiate between the relative importance of production factors between industries. However, to some extent, these six scarce production factors are relevant for all industries in the Netherlands.

Index of scarce production factors

Before describing each of the scarce production factors, we combine them in an index (see Appendix on page 39 for more details). The higher the score in the index, the less each industry uses the scarce production factors. The results for 2023 are in Table 5.

We can see that agriculture, forestry and fishing (A), transportation and storage (H) and energy supply (D) use relatively more of the scarce production factors. Mining and quarrying (B), on the other hand, scores relatively well. However, the negative externalities from the gas extraction in the northern part of the Netherlands (i.e., earthquakes) were not included in the analysis.

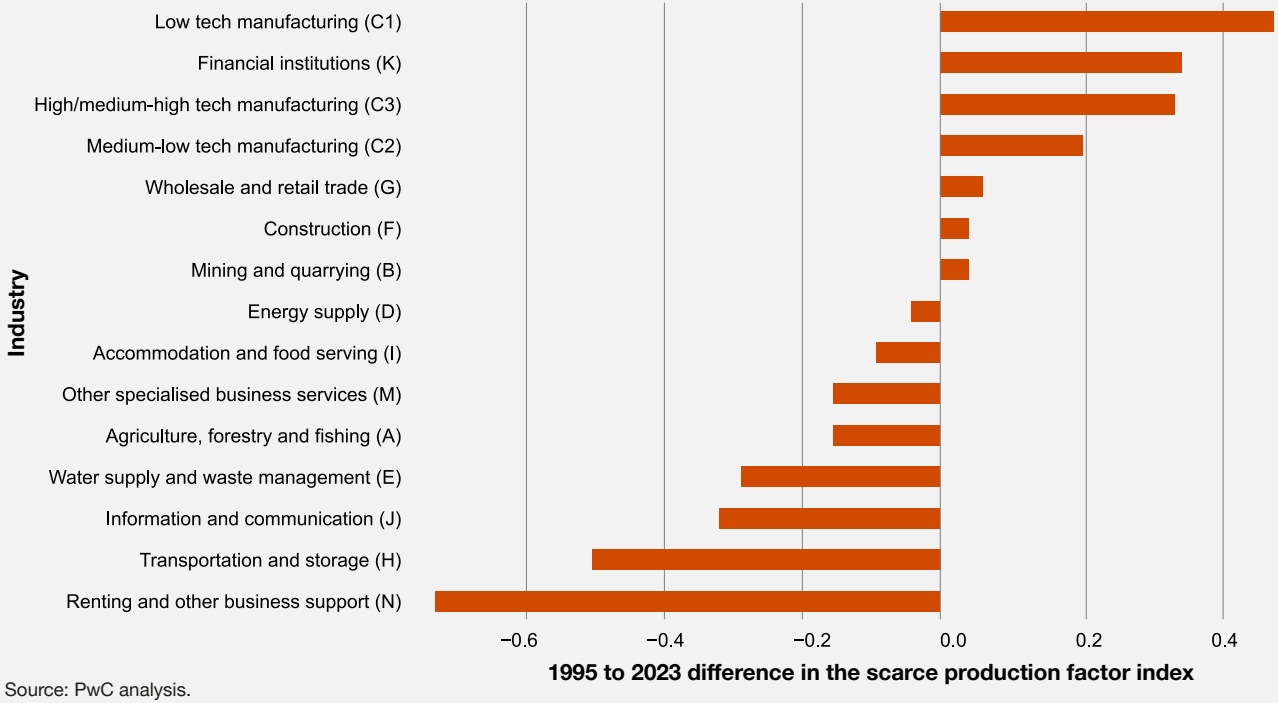
Table 5 After combining the scarce production factors, agriculture, forestry and fishing (A), transportation and storage (h) and energy supply (D) rank the lowest relative to other industries

Industry	Scarce production factors index in 2023	Rank in 2023 (1 is the best)
Accommodation and food serving (I)	5.7	1
Mining and quarrying (B)	5.6	2
Financial institutions (K)	5.4	3
Construction (F)	5.3	4
Information and communication (J)	5.3	5
Water supply and waste management (E)	5.3	6
Low tech manufacturing (C1)	5.0	7
Medium-low tech manufacturing (C2)	4.8	8
Other specialised business services (M)	4.8	9
Renting and other business support (N)	4.7	10
Wholesale and retail trade (G)	4.2	11
High/medium-high tech manufacturing (C3)	4.1	12
Energy supply (D)	3.2	13
Transportation and storage (H)	3.0	14
Agriculture, forestry and fishing (A)	2.4	15

Additionally, we focus on 2023, as we are mostly interested in the recent performance of industries in using scarce production factors. For most industries, their relative position in 2023 stayed the same, increased or decreased by one position compared to 1995. However, there are some differences, as can be seen in Figure 13. Manufacturing industries and financial institutions (K) have most improved their performance in using scarce production factors from 1995 to 2023. In terms of industries that declined, for example, information and communication (J) would have scored second in 1995, while fifth in 2023, and renting and other business support (N) decreased from sixth to tenth position over the 1995 to 2023 period.

Next, we focus on the individual factors that make up the scarce production factors index.

Figure 13 Manufacturing industries and financial institutions (K) have most improved their performance in using scarce production factors from 1995 to 2023



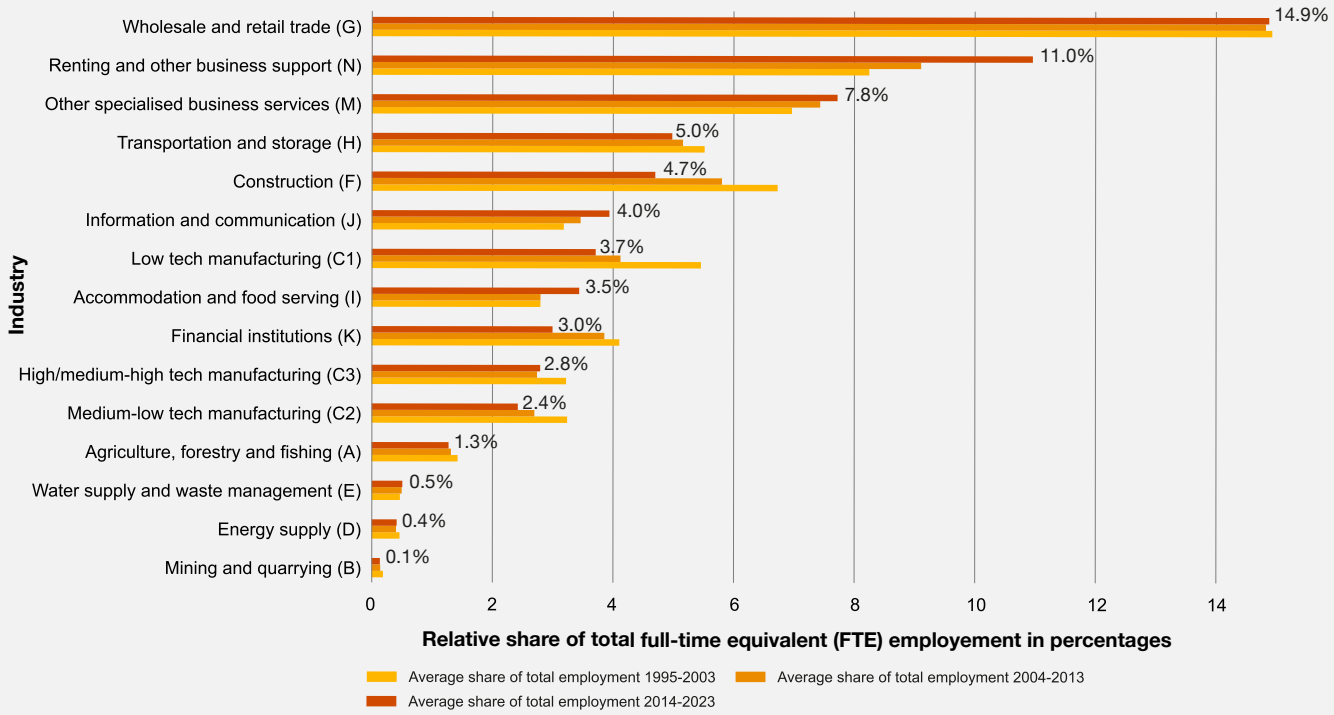
Source: PwC analysis.

Labour (share of total employment)

First, we start with labour, which is a scarce resource in an ageing society that has already increased the state pension age and linked it to life expectancy. In Figure 14, we show which industries have been the largest employers from 1995 to 2023.

We find that wholesale and retail trade (G), renting and other business support (N) and other specialised business services (M) have been relatively the largest employers over the last decade. In Figure 14, we can also see that information and communication (J), renting and other business support (N), and accommodation and food serving (I) have grown their relative employment shares the most.

Figure 14 Wholesale and retail trade (G), renting and other business support (N) and other specialised business services (M) have been the largest employers over the last decade



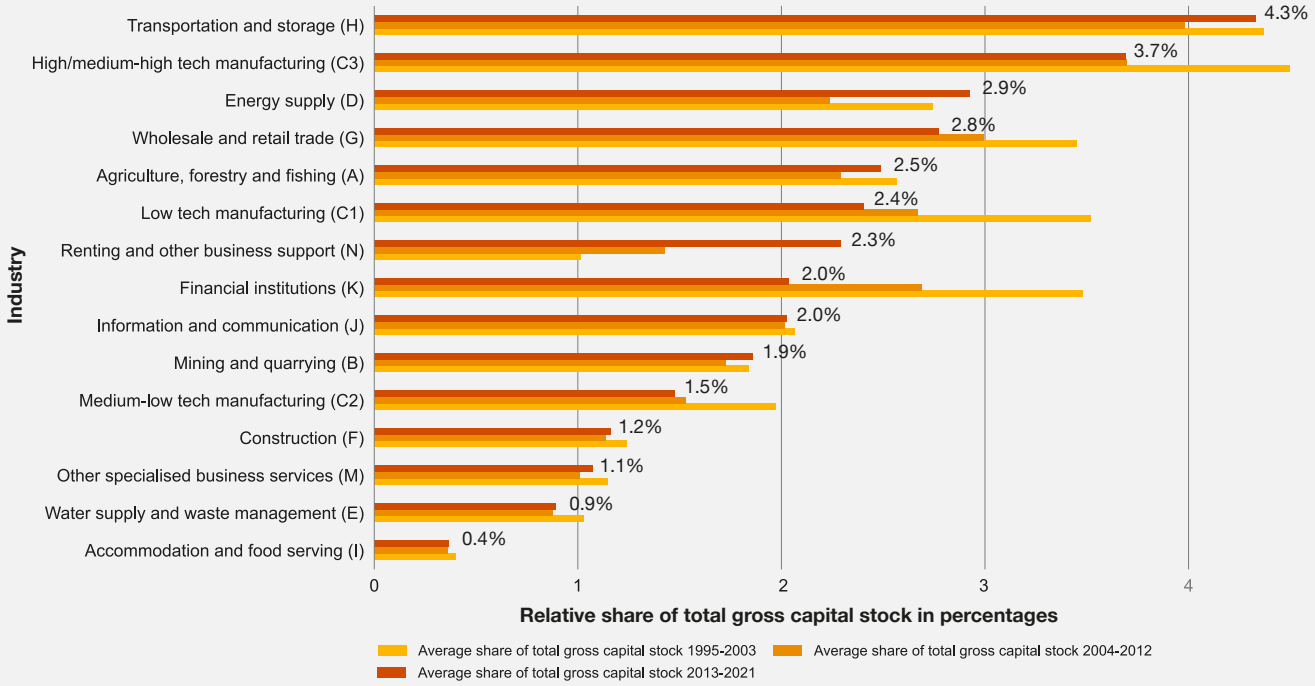
Sources: CBS data, PwC analysis. Percentage labels for 2014 to 2023.

Capital (share of total gross capital stock)

Next, we look at capital. Similar to labour, capital is also a scarce resource. Without considering other factors, industries that use less capital are making it more available to the rest of the economy. We look at total capital stock that includes all tangible and intangible fixed assets like buildings, machinery, transport equipment and software.

In Figure 15, we look at the share of capital stock by industries from 1995 to 2021 (see Appendix page 39 for more details). We can see that transportation and storage (H), high/medium-high tech manufacturing (C3) and energy supply (D) have had the largest relative shares of total gross capital stock. Furthermore, only renting and other business support, information and communication (J) and construction (F) have increased their gross capital stock share over this period.

Figure 15 Transportation and storage (H), high/medium-high tech manufacturing (C3) and energy supply (D) have had the largest gross capital stock shares over the past decade



Sources: CBS data, PwC analysis. Percentage labels for 2013 to 2021.

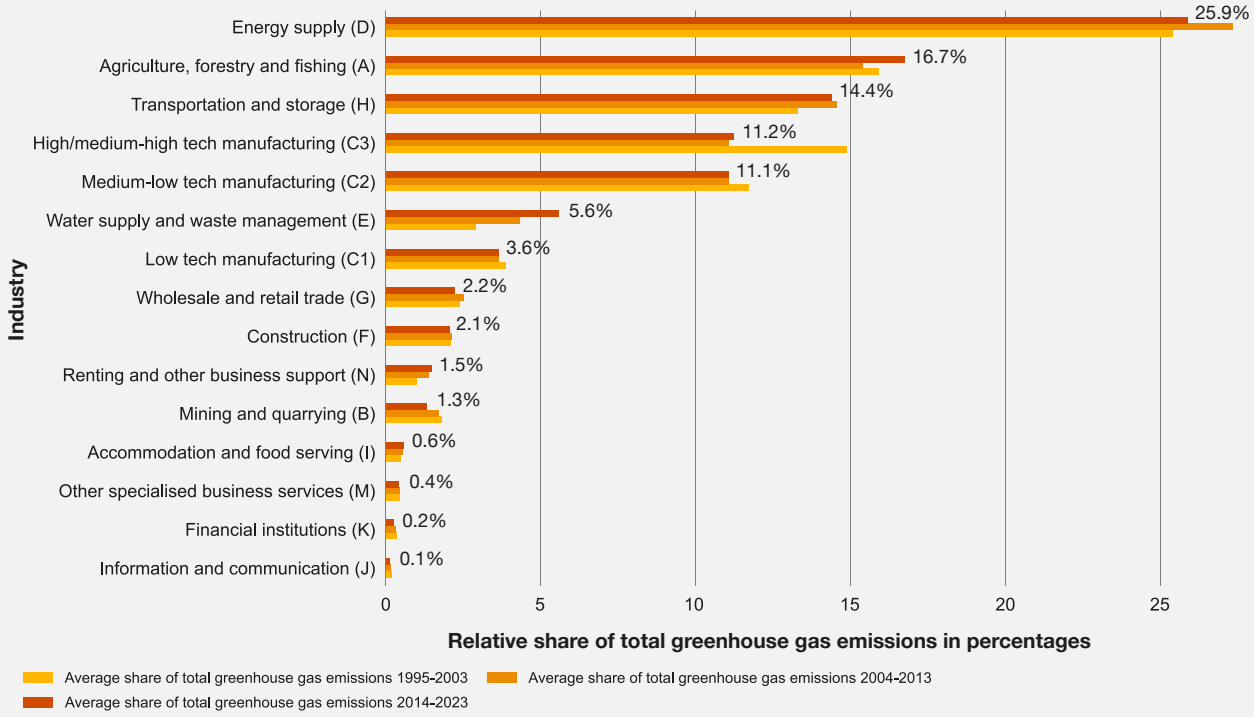
Greenhouse gas emissions

Next, we focus on those environmental factors that are particularly important for the Dutch economy. We are interested in how each industry performs in relation to other industries when using parts of the 'shared budget' for each environmental resource. We start with greenhouse gas (scope 1) emissions.

In Figure 16, we show industries that have been the largest emitters of greenhouse gases in the Netherlands from 1995 to 2023.

Energy supply (D), agriculture, forestry and fishing (A), and transportation and storage (H) have been the most polluting industries, accounting for at least more than 10% of total greenhouse gas emissions. In addition, water supply and waste management (E), transportation and storage (H), and agriculture, forestry and fishing (A) have slightly increased their relative share of total greenhouse gas emissions.

Figure 16 Energy supply (D), agriculture, forestry and fishing (A), and transportation and storage (H) have relatively been the largest emitters of greenhouse gases over the past decade



Sources: CBS data, PwC analysis. Percentage labels for 2014 to 2023.

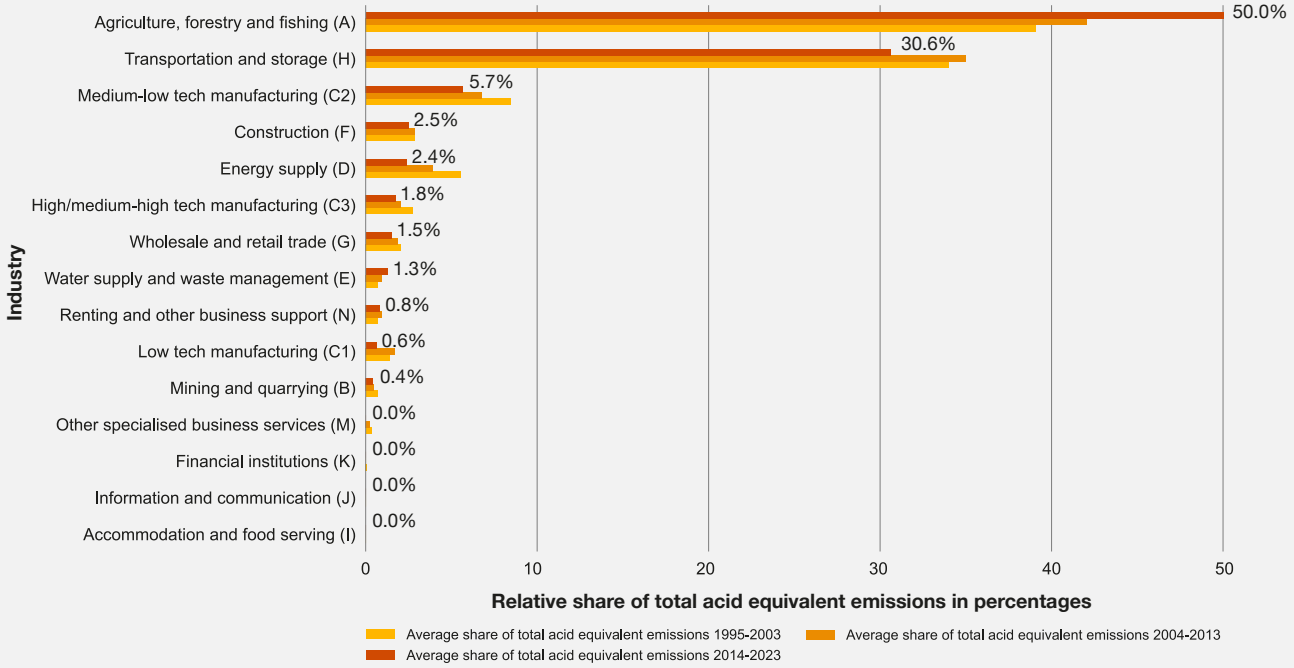
Acidification (damage caused by excess nitrogen)

Another important factor to consider is the nitrogen (stikstof) issue. This causes acidification of soils and water bodies, as well as eutrophication (overgrowth of algae in water bodies), change in plant species composition and damage to ecosystems. We include not only nitrogen but also other gases that lead to acidification issues (see Appendix on page 39 for more details).

The Netherlands must adhere to the standards in the Nitrates Directive, one of which is a maximum of 170 kilograms of nitrogen per hectare for the use of animal manure.[59] This means that for all economic activities, there is a 'shared budget' for acidifying activities.

Agriculture, forestry and fishing (A) and transportation and storage (H) emit, on average, the most acid equivalents in the last decade, nearly 80% of all acidification equivalents (Figure 17).

Figure 17 Agriculture, forestry and fishing (A), and transportation and storage (H) have been emitting the most acid equivalents in the last decade, totaling nearly 80% of all emissions



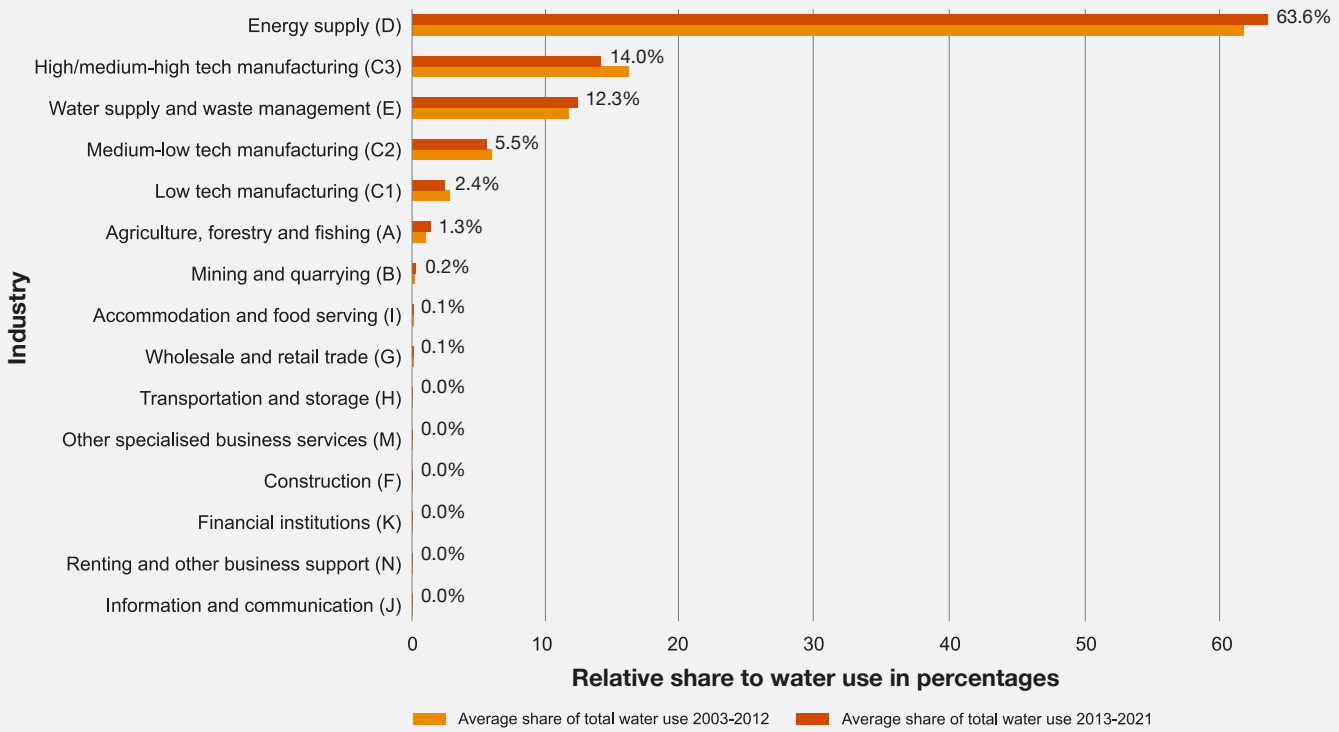
Sources: CBS data, PwC analysis. Percentage labels for 2014 to 2023.

Water

Next, we consider another important factor, namely, the total use of surface, groundwater and tap water. We have data available from 2003 to 2021 for this indicator (see Appendix on page 39 for more details).

Figure 18 shows that energy supply (D) dominates the relative share of total water use, taking up more than 60% of the total. Only high/medium-high tech manufacturing (C3), water supply and waste management (E), medium-low tech manufacturing (C2), low tech manufacturing (C1), and agriculture, forestry and fishing (A) make up significant water use shares. Services industries use much less water.

Figure 18 Energy supply (D) dominates water usage, accounting for about 60% of total water use over the last two decades



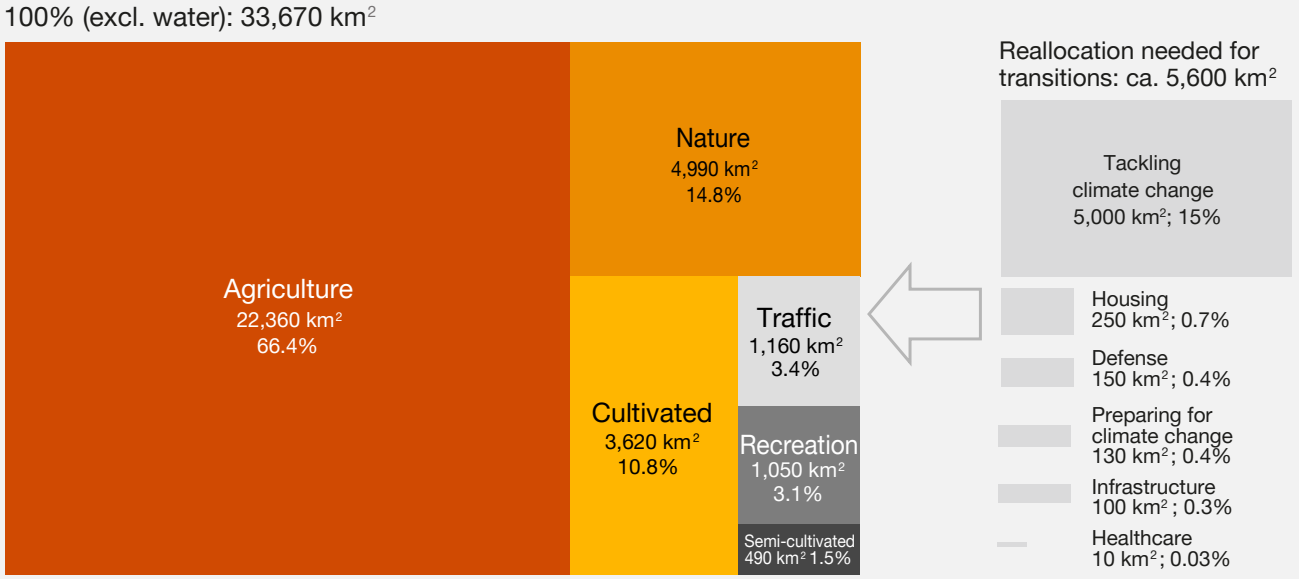
Sources: CBS data, PwC analysis. Percentage labels for 2013 to 2021.

Physical space

Lastly, we also look at the share of total available physical space that industries take up. We use data from the LUCAS survey from the European Commission (see Appendix on page 39 for more details).

In the Netherlands, land is very scarce as agriculture takes up more than 66% of the available surface area, excluding water. Nature takes up almost 15%.[60] Very little remains for other economic and non-economic activities. In addition, there is a lot of physical space needed to reach societal ambitions in expanding the housing supply, defense and healthcare industries, and tackling issues with climate change and infrastructure (Figure 19).

Figure 19 Land distribution by types of activities in the Netherlands

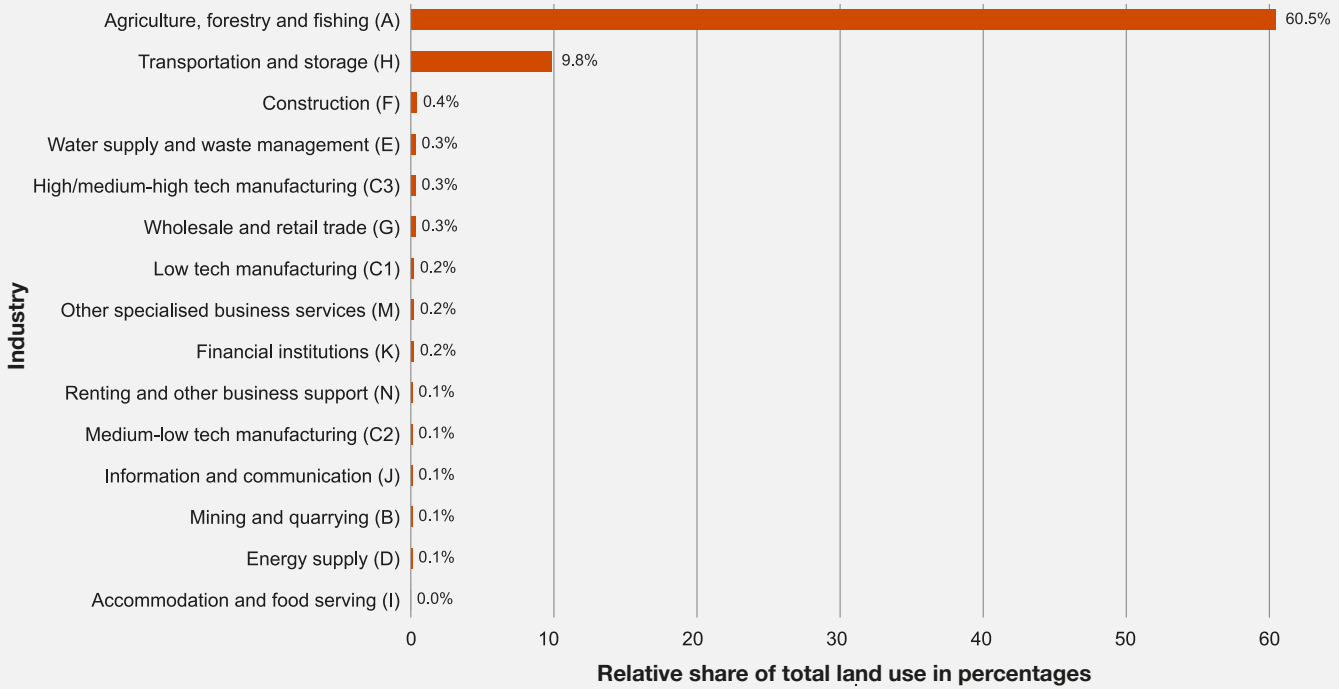


Source: DenkWerk analysis on the basis of CBS 2021 data.

This is also clear from Figure 20, which differentiates across industries. Due to data availability, we only consider the period from 2009 to 2018.

Agriculture, forestry and fishing (A) takes up the bulk of physical space, accounting for more than 60% of land use in the Netherlands. Based on our calculations, transportation and storage (H) is the only other industry that takes up a large part of total land, exceeding 10%. Other industries take up less than 1%.

Figure 20 Agriculture, forestry and fishing (A) use more than 60% of land in the Netherlands



Sources: Eurostat land use/cover area frame survey (LUCAS) and CBS data, PwC analysis.

5. Overall comparison

In this chapter, we combine the results of our analysis in a heatmap.

To construct the overall index, we use five factors for the year 2023, namely the normalised centrality score, GDP share, labour productivity growth, R&D share and scarce production factors index. Each of those factors is normalised so that 0 is the minimum value and 1 is the maximum value for that factor in 2023. Then, we rescale this range to be from 0 to 100. We sort the heatmap by industries that score the best on all factors. The higher the score within each factor, the better the performance, compared to other industries in this area. Table 6 gives the ranking based on absolute numbers.

This ranking is relevant because reallocation and restructuring cannot abstract from the current economic structure. Hence, it is important to understand which industries currently make the highest economic contribution and which place the greatest demand on scarce factors of production. Based on Table 6, the government can assess which industries still contribute so much to GDP in absolute terms that phasing out activities within these industries will have major consequences, especially if they are central industries such as transportation and storage (H) and medium-low tech manufacturing (C2).

Table 6 High/medium-high tech manufacturing (C3), other specialised business services (M), and wholesale and retail trade (G) are top performing industries when combining all factors in 2023

Industry	Centrality score	GDP share	Labour productivity growth	R&D share	Scarce production factors index	Sum of all factors
High/medium-high tech manufacturing (C3)	100.0	42.5	71.2	100.0	49.3	363.0
Other specialised business services (M)	33.6	70.1	72.9	40.9	84.6	302.1
Wholesale and retail trade (G)	42.2	100.0	66.1	11.9	54.4	274.6
Construction (F)	76.4	35.6	72.9	1.7	86.4	273.0
Low tech manufacturing (C1)	38.7	27.2	100.0	8.4	79.0	253.3
Information and communication (J)	25.0	34.1	64.4	33.0	86.2	242.7
Renting and other business support (N)	13.5	53.4	81.4	2.6	67.6	218.5
Financial institutions (K)	12.7	38.1	55.9	8.4	89.2	204.3
Accommodation and food serving (I)	6.3	11.1	83.1	0.0	100.0	200.5
Medium-low tech manufacturing (C2)	30.1	12.4	50.8	5.8	71.7	170.8
Water supply and waste management (E)	1.5	0.0	64.4	0.4	85.9	152.2
Transportation and storage (H)	23.3	30.9	54.2	2.4	16.7	127.5
Energy supply (D)	1.8	11.6	76.3	1.0	23.7	114.4
Agriculture, forestry and fishing (A)	9.2	10.7	83.1	5.1	0.0	108.1
Mining and quarrying (B)	0.0	4.7	0.0	0.3	96.9	101.9

Note: All scores, except for the sum of all scores, are min-max normalised and scaled to be from 0 to 100.

When considering scarcity reallocation, not just the absolute but also the relative economic importance and utilisation of scarce factors of production are important. To know which industries should be given the most leeway for growth, we consider which industry per euro of value added (per euro of GDP) has the highest centrality score, labour productivity growth and R&D investment, and the lowest use of scarce production factors. We multiply each of the factors in Table 6 (except for GDP share) by each industry's share of total GDP. The ranking based on this relative view (i.e., per euro of GDP) is presented in Table 7.

We can see that the top three highest-scoring industries remain the same. Industries, such as transportation and storage (H), renting and business support (N), and wholesale and retail trade (G), score slightly higher when adjusting for their economic size. Apart from transportation and storage (H), the same industries are also in the five lowest-scoring industries. Remarkably, utilities (energy supply (D), and water supply and waste management (E)) score low. These industries may not be large in terms of GDP but are critical to the ability of other industries to produce.

In both tables, we use an overall index combining all underlying factors. The resulting ranking makes it easier for the reader to consider the various factors in relation to each other. However, we do not use the ranking to base policy recommendations on, because the ranking depends on, for instance, the weight assigned to each of the factors when adding them up in the overall index. Additionally, Tables 6 and 7 show the results for 2023. We also looked at the results for the past 5 years, and the rankings we find for 2023 are robust over this period.

Table 7 Transportation and storage (H), renting and business support (N), and wholesale and retail trade (G) score slightly higher when adjusting for their economic size

Industry	Centrality score	Labour productivity growth	R&D share	Scarce production factors index	Sum of all factors
Wholesale and retail trade (G)	5.6	8.7	1.6	7.2	23.0
Other specialised business services (M)	3.2	6.8	3.8	7.9	21.8
High/medium-high tech manufacturing (C3)	5.9	4.2	5.9	2.9	19.0
Renting and other business support (N)	1.0	5.9	0.2	4.9	12.0
Construction (F)	3.9	3.7	0.1	4.4	12.0
Information and communication (J)	1.2	3.1	1.6	4.2	10.1
Low tech manufacturing (C1)	1.5	4.0	0.3	3.1	9.0
Financial institutions (K)	0.7	3.0	0.4	4.8	8.9
Transportation and storage (H)	1.0	2.4	0.1	0.7	4.3
Accommodation and food serving (I)	0.1	1.6	0.0	2.0	3.7
Medium-low tech manufacturing (C2)	0.6	1.1	0.1	1.5	3.4
Energy supply (D)	0.0	1.5	0.0	0.5	2.1
Agriculture, forestry and fishing (A)	0.2	1.6	0.1	0.0	1.9
Mining and quarrying (B)	0.0	0.0	0.0	1.1	1.1
Water supply and waste management (E)	0.0	0.4	0.0	0.5	0.8

Note: All scores are min-max normalised and scaled to be from 0 to 100. After that, they are weighted by each industry's GDP share.

6. Policy implications and conclusions

The Dutch economy has been successful over the past few decades, but it needs to change its course to deal with upcoming challenges. The Netherlands, like other EU countries, has been stuck in a mid-tech trap,[61] and a significant share of economic growth has recently come from focusing on boosting employment in low value-added economic activities.[62]

To reach its societal ambitions, the Dutch economy needs to transform. To cite Mario Draghi's speech at the European Parliamentary Week 2025: *'The European economy is stagnating, while much of the world grows. The response must be commensurate with the size of the challenges, and it must be laser-focused on the sectors that will drive the growth. Speed, scale and intensity will be essential.'*[63] These words can be applied not only to the European but also the Dutch economy.

Enhancing the structural growth capacity of the Dutch economy requires general government policies. In addition, structural policies are needed to reallocate scarcity from low-productivity sectors that make heavy use of scarce production factors to high-productivity sectors. This report provides insights for both the general and structural policies through three lenses. The first lens is centrality: the role of each industry in economic output. The second lens is the economic importance of industries measured by their share of GDP, R&D and their labour productivity growth. Finally, the third lens shows how each industry is positioned given the scarcities facing the economy, such as labour, capital, environmental space (greenhouse gas emissions and acid equivalents), water use and physical space.

General policies

First, labour productivity growth is the 'silver bullet'. Boosting productivity growth within industries and companies should be the priority of the government and businesses. On a macro level, that can be done by investing more in the quality of education and in the application of research, knowledge and technologies within companies, among other measures.[64]

Second, for future growth potential, it is important that the productivity gap between leading and lagging companies does not widen, as that could negatively impact competition and long-term economic growth. This requires facilitating the application of innovations in small and medium-sized enterprises, which do not have the same resources as large companies, leading to more knowledge spillovers.[65] Together with regional governments, clustering of cooperating companies, knowledge institutions and authorities should be encouraged. Through knowledge exchange within these innovative ecosystems, laggards and middle groups can catch up with the frontrunners.[66]

The increase in market concentration and a weakening of business dynamism may also have played a role in the increased productivity gap.[67] To counter that, effective competition policies are necessary.[68] Dominant firms that face little competition experience fewer incentives to become more productive. They can extract sufficient rents from existing innovations and have deep pockets to buy up new entrants at an early stage so that their dominance remains unaffected. For this reason, it is important that economic dominance is effectively addressed, without hampering economies of scale necessary for R&D investments and implementation of new technologies, and entry barriers for innovation startups are low. Such policies would increase dynamism and labour productivity growth.

Structural policies
It is important for industries that have a large share in the economy to invest in labour productivity growth. Besides wholesale and retail trade (G), these are other specialised business services (M), and renting and other business support (N). Because of the size of these industries, their investment has a major impact on labour productivity growth at the macro level.

In general, private R&D lags the Lisbon target of 2% of GDP (total 3% if the government invests 1% in R&D). Therefore, generic policies aimed at boosting private R&D are very important to increase long-term growth potential. The industries where R&D lag significantly are construction (F), transportation and storage (H), and accommodation and food serving (I). The government could look specifically at how to boost innovation in these industries. Moreover, utilities (energy supply (D), and water supply and waste management (E)) are also lagging. This requires more public investment in R&D.[69]

Looking at the use of scarce production factors, it is striking that agriculture, forestry and fishing (A), and transportation and storage (H) make disproportionate use of scarce production factors. To increase the growth capacity of the Dutch economy, it is necessary to reduce this draw and reallocate scarcity to industries that can add more value per production factor, such as other specialised business services, and wholesale and retail trade (G).

In practice, that would mean focusing on policies that make it more expensive to pollute, use a high volume of water and facilitate spatial planning for more productive activities. These would not be policies favouring certain industries over others, but rather general policies that create the conditions for highly productive activities with a limited environmental and spatial footprint.

Other policy actions that would help, such as raising the legal minimum wage. Despite recent increases, the minimum wage has not increased in real terms in the last five years. Raising it would render business models that rely on low-paid labour unattractive. It would also steer employment towards companies with higher labour productivity and potential for productivity growth.[70] Additionally, the existing environmental laws and labour exploitation rules should be more strictly enforced.

Even though we conduct our analyses at an industry level, we should not overlook the fact that differences within an industry are often greater than between industries. For instance, some companies in the agriculture, forestry and fishing (A) industry are very innovative, climate-friendly and technologically advanced. The same goes for some companies in the construction (F), and transportation and storage (H) industries. So, even within industries that perform worse in the aspects that we have considered, there are high productivity economic activities and companies that could help increase the Dutch structural growth potential.

Business policies
Companies that want to grow their labour productivity faster are focusing on automation and digitalisation, internationalisation,[71] improving their management practices and adapting their business model to the external environment.[72]

Moreover, when investing in labour productivity, companies should be aware of their interdependence with other companies. In doing so, they can use the results of centrality analysis. This shows that their labour productivity is not only related to the industry in which they operate, but also to how their industry connects to the rest of the economy. For example, if a close partner industry improved its productivity growth, that would have larger spillover effects. Similarly, if these industries were to shrink or even leave the Dutch economy, that would impact not only the production flows but also the centrality of other industries and companies.

Lastly, companies should assess whether they are in an industry that has the potential to be the focal point of future structural growth, i.e., high productivity industries that have a high added value per square meter of surface area used and low external costs. If their activities do not meet these criteria, companies would do well to invest in new products and to enter new markets that do fit within the growth agenda. Business model reinvention increases resilience when the government reallocates scarcity.

Now is the right time
Reallocation of scarcity and restructuring of industries will lead to difficult trade-offs that need to be reconciled. This will require redistribution and public funds (‘change’).

With unemployment low and jobs in abundance, it is possible to future-proof the economy. Agriculture, forestry and fishing (A) and transportation and storage (H) can be reformed, and utilities can invest more in productivity. In general, companies can be held more accountable for social costs they cause. Consider companies that rely on cheap migrant labour without taking responsibility for their housing. Or take companies that pollute water and emit lots of nitrogen and greenhouse gases without paying a fair share of the social cost.

It is better to make changes now, while the economy is still growing and labour market opportunities abound, than to wait until the economy comes to a standstill. Then there will not be much left in supporting those negatively impacted by the transformation to move to other work and for companies to adjust their business models. We should fix the roof while the sun is still shining. After all, the sky is rapidly becoming cloudy.

Appendix

Methodology and data

Manufacturing classification
We combine manufacturing subindustries in high/medium-high, medium-low and low tech manufacturing, according to a Eurostat classification.[73] We combine high and medium-high technology industries in high/medium-high tech manufacturing because it is not possible to isolate the data for some indicators for only high tech manufacturing. Additionally, unlike Eurostat, we include repair and installation of machinery and equipment (33) in low tech manufacturing instead of medium-low tech manufacturing.

Missing data
For all indicators, whenever we have data gaps, we fill those with the last available data:

- For R&D share:
  - For values from 1995 to 2012, we use the 2013 value,
  - For 2022 and 2023, we use the 2021 value.
- For gross capital stock:
  - For 2022 and 2023, we use the 2021 value.
- For water use:
  - For values from 1995 to 2002, we use the 2003 value,
  - For 2022 and 2023, we use the 2021 value.
- For physical space:
  - For values from 1995 to 2008, we use the 2009 value,
  - For values from 2010 to 2011, we use the 2012 value,
  - For values from 2013 to 2014, we use the 2015 value,
  - For values from 2016 to 2017, we use the 2018 value,
  - For values from 2019 to 2023, we use the 2018 value.

Network density
We follow Dieteren & Nauta (2020) and Foerster & Choi (2017) to calculate the density of our network, using the formula:

$$\text{Network density} = \frac{\text{Number of actual connections}}{\text{Number of possible connections}}$$

We set *n* equal to the number of nodes in the network. In this case, *n* is the number of industries (21 for our network). The number of possible connections, allowing intra-industry production (self-looping), is given by: *n*n*. . We obtain 441 possible connections.

To calculate the number of actual connections, we follow the approach from Foerster & Choi (2017), including all connections from industry *i* to industry *j* if industry *i* supplies at least 1% of industry *j*'s input bundle. We obtain 284 possible connections.

Hence, our network density is 284/441= 0.64.

Measuring the centrality of Dutch industries
To calculate the centrality scores for Dutch industries, we use an input-output table that is an average of the input-output tables from 1995 to 2020. We follow the methodology in Dieteren & Nauta (2020). From that, we obtain an adjacency matrix *G* that indicates whether and with what strength two industries (nodes) are connected to each other. *G* is the average of input-output tables from 1995 to 2020, and the contents of each cell show the amount of inputs flowing from node *u* to node *v*. The centrality of c_u of node *u* with adjacency matrix *G* can be calculated then following this formula, with *a* being the eigenvalue:

$$c_u = a \sum_{v \in G} g_{uv} c_v$$

this formula can also be rewritten in vector notation as $\boldsymbol{Gc} = \boldsymbol{ac}$.

In Figure 6, we only include links that exceed the average value (US$1.5 billion) of all input flows in the 1995 to 2020 averaged input-output table.

Physical space calculations
To estimate physical space, we use data from the Eurostat LUCAS survey, which approximately corresponds to the standard industry classification:

- 'Mining and quarrying' in LUCAS we use as the value for mining and quarrying (B),
- 'Water and waste treatment' in LUCAS we use as the value for water supply and waste management (E),
- 'Construction' in LUCAS we use as the value for construction (F),
- 'Energy production' in LUCAS we use as the value for energy supply (D),
- 'Transport, telecommunication, energy distribution, storage, protective works' in LUCAS we use as the value for transportation and storage (H),
- For 'industrial production and manufacturing' in LUCAS, we split it between low tech manufacturing (C1), medium/low tech manufacturing (C2) and high/medium-high tech manufacturing (C3) based on their shares of gross value added within manufacturing (C).

Acidification calculations
We follow the data and methodology from Statistics Netherlands. 'Acid equivalent' is a measure that indicates to what extent a substance contributes to environmental acidification. The emission of 1 kg of nitrogen oxides (NOx) is equal to 21.7 acid equivalent, the emission of 1 kg of sulfur dioxide (SO2) is equal to 31.3 acid equivalent and the emission of 1 kg of ammonia (NH3) is equal to 58.8 acid equivalent. An acid equivalent (zeq) is equal to one mole of H+.

Scarce production factors index
We construct the scarce production factors index according to this formula (where *i* is industry and *t* a year):

$Index_{it} = Labour\_Share_{it} + Gross\_Capital\_Stock_{it} + Greenhouse\_Gas\_Emission_{it} + Water\_Use\_Share_{it} + Acidification_{it} + Physical\_Space_{it}$

The values then range from *min Indexit = 0* to *max Indexit = 6*, as each individual variable is normalised from *0* to *1*.

Overall heatmap
We normalise each indicator-industry-year observation using the min-max normalisation method. This method allows us to compare all variables against each other, and it also preserves the variance between industry observations. For each industry-indicator-year observation (x), we rescale it to be between 0 and 1 according to this formula, where min (x) (max (x)) is the minimum (maximum) value for this indicator each year:

$$x = \frac{(x - Min(x))}{(Max(x) - Min(x))}$$

For example, with GDP share in 1995, we normalise each industry's value following the formula where X is each industry's GDP share in 1995. In this way, the minimum observation for each factor in a year scores 0 and the maximum scores 1.

Third, for all centrality and economic indicators, the higher the score, the better performance they imply for industries. However, for the scarcity indicators, the opposite is true. For example, if an industry emits more greenhouse gases than others, we see that as a negative. Hence, for all scarcity indicators, we reverse the normalisation so that a lower score is better.

In the heatmap, we report the normalised values 2023 for all industries and in the included categories for 2023. The scarce production index is normalised again to be in the range from 0 to 1. We multiply all of the scores by 100 to be in the range from 0 to 100. To obtain the final score, we sum up all factors with equal weights.

Z-scores
In the extended results section, to understand how each factor has performed over time, we calculate Z-scores by subtracting for each industry-indicator observation in a year the historical average of the series. We then divide this value by the historical standard deviation.

The Z-scores are aligned such that 0 is the historical average of the series. In the industry scorecards, we use Z-scores in 2023 to determine the trend:
- If it's above 1, the arrow is upward pointing,
- If it's between 0.5 and 1, it is right-upward pointing,
- If it's between 0.5 and –0.5, there is a dot,
- If it's between –0.5 and 1, it is left-downward sloping,
- If it's below –1, it is downward sloping.

For scarce production factors, an upward trend indicates more use of each factor.

Extended results

Table 8 Centrality (eigenvector centrality) calculations and ranking for all industries

Industry	Centrality score 1995-2020	Centrality rank 1995-2020
High/medium-high tech manufacturing (C3)	0.68	1
Construction (F)	0.44	2
Low tech manufacturing (C1)	0.29	3
Wholesale and retail trade (G)	0.25	4.5
Medium-low tech manufacturing (C2)	0.25	4.5
Other specialised business services (M)	0.17	6
Transportation and storage (H)	0.16	7
Information and communication (J)	0.12	8
Financial institutions (K)	0.10	9
Agriculture, forestry and fishing (A)	0.08	10
Renting and other business support (N)	0.07	11
Accommodation and food serving (I)	0.05	12
Energy supply (D)	0.03	13
Water supply and waste management (E)	0.02	14
Mining and quarrying (B)	0.01	15

Table 9 Agriculture, forestry and fishing (A) summary scorecard

Indicator	Category	Z-score in 2023	Trend symbol	Rank vs other industries (1 is the best)
Centrality	Centrality indicator	-0.84	↙	11
GDP share	Economic indicator	-0.72	↙	13
Labour productivity growth	Economic indicator	1.46	↑	2.5
R&D share	Economic indicator	0.14	·	8
Labour share	Scarcity indicator	-1.68	↓	4
Gross capital stock share	Scarcity indicator	-0.67	↙	10
Greenhouse gas emissions share	Scarcity indicator	1.96	↑	14
Acidification share	Scarcity indicator	1.46	↑	15
Water use share	Scarcity indicator	-0.87	↙	10
Physical space share	Scarcity indicator	0.47	·	15

Table 10 Mining and quarrying (B) summary scorecard

Indicator	Category	Z-score in 2023	Trend symbol	Rank vs other industries (1 is the best)
Centrality	Centrality indicator	-1.26	↓	15
GDP share	Economic indicator	-1.25	↓	14
Labour productivity growth	Economic indicator	-1.01	↓	15
R&D share	Economic indicator	1.53	↑	14
Labour share	Scarcity indicator	-1.26	↓	1
Gross capital stock share	Scarcity indicator	-1.76	↓	6
Greenhouse gas emissions share	Scarcity indicator	-1.81	↓	5
Acidification share	Scarcity indicator	-2.31	↓	3
Water use share	Scarcity indicator	0.81	↗	9
Physical space share	Scarcity indicator	-1.62	↓	1

Table 11 Low tech manufacturing (C1) summary scorecard

Indicator	Category	Z-score in 2023	Trend symbol	Rank vs other industries (1 is the best)
Centrality	Centrality indicator	-0.57	↙	4
GDP share	Economic indicator	-0.54	↙	9
Labour productivity growth	Economic indicator	3.29	↑	1
R&D share	Economic indicator	1.12	↑	6
Labour share	Scarcity indicator	-0.99	↙	8
Gross capital stock share	Scarcity indicator	-1.21	↓	9
Greenhouse gas emissions share	Scarcity indicator	0.10	·	9
Acidification share	Scarcity indicator	-1.16	↓	6.5
Water use share	Scarcity indicator	-0.98	↙	11
Physical space share	Scarcity indicator	-0.22	·	8

Table 12 Medium-low tech manufacturing (C2) summary scorecard

Indicator	Category	Z-score in 2023	Trend symbol	Rank vs other industries (1 is the best)
Centrality	Centrality indicator	-1.85	↓	6
GDP share	Economic indicator	-1.10	↓	10
Labour productivity growth	Economic indicator	-1.08	↓	14
R&D share	Economic indicator	0.24	·	7
Labour share	Scarcity indicator	-1.40	↓	5
Gross capital stock share	Scarcity indicator	-1.04	↓	5
Greenhouse gas emissions share	Scarcity indicator	0.31	·	11
Acidification share	Scarcity indicator	-0.89	↙	13
Water use share	Scarcity indicator	0.10	·	12
Physical space share	Scarcity indicator	-0.22	·	5

Table 13 High/medium-high tech manufacturing (C3) summary scorecard

Indicator	Category	Z-score in 2023	Trend symbol	Rank vs other industries (1 is the best)
Centrality	Centrality indicator	-0.10	·	1
GDP share	Economic indicator	0.56	↗	4
Labour productivity growth	Economic indicator	0.51	↗	8
R&D share	Economic indicator	2.86	↑	1
Labour share	Scarcity indicator	-0.14	·	7
Gross capital stock share	Scarcity indicator	-0.91	↙	14
Greenhouse gas emissions share	Scarcity indicator	-0.27	·	12
Acidification share	Scarcity indicator	-1.24	↓	9.5
Water use share	Scarcity indicator	-0.07	·	14
Physical space share	Scarcity indicator	1.27	↑	11

Table 14 Energy supply (D) summary scorecard

Indicator	Category	Z-score in 2023	Trend symbol	Rank vs other industries (1 is the best)
Centrality	Centrality indicator	-1.49	↓	13
GDP share	Economic indicator	3.20	↑	11
Labour productivity growth	Economic indicator	0.23	·	5
R&D share	Economic indicator	2.17	↑	12
Labour share	Scarcity indicator	0.49	·	2
Gross capital stock share	Scarcity indicator	1.23	↑	13
Greenhouse gas emissions share	Scarcity indicator	-3.12	↓	15
Acidification share	Scarcity indicator	-1.84	↓	9.5
Water use share	Scarcity indicator	-0.46	·	15
Physical space share	Scarcity indicator	0.34	·	3

Table 15 Water supply and waste management (E) summary scorecard

Indicator	Category	Z-score in 2023	Trend symbol	Rank vs other industries (1 is the best)
Centrality	Centrality indicator	0.80	↗	14
GDP share	Economic indicator	-2.26	↓	15
Labour productivity growth	Economic indicator	0.11	·	10.5
R&D share	Economic indicator	-0.54	↙	13
Labour share	Scarcity indicator	0.55	↗	3
Gross capital stock share	Scarcity indicator	-1.05	↓	2
Greenhouse gas emissions share	Scarcity indicator	1.67	↑	10
Acidification share	Scarcity indicator	1.62	↑	9.5
Water use share	Scarcity indicator	1.89	↑	13
Physical space share	Scarcity indicator	0.34	·	10

Table 16 Construction (F) summary scorecard

Indicator	Category	Z-score in 2023	Trend symbol	Rank vs other industries (1 is the best)
Centrality	Centrality indicator	0.39	·	2
GDP share	Economic indicator	-0.04	·	6
Labour productivity growth	Economic indicator	1.09	↑	6.5
R&D share	Economic indicator	-1.79	↓	11
Labour share	Scarcity indicator	-1.15	↓	11
Gross capital stock share	Scarcity indicator	0.96	↗	4
Greenhouse gas emissions share	Scarcity indicator	2.17	↑	8
Acidification share	Scarcity indicator	-2.07	↓	12
Water use share	Scarcity indicator	0.53	↗	4
Physical space share	Scarcity indicator	1.35	↑	13

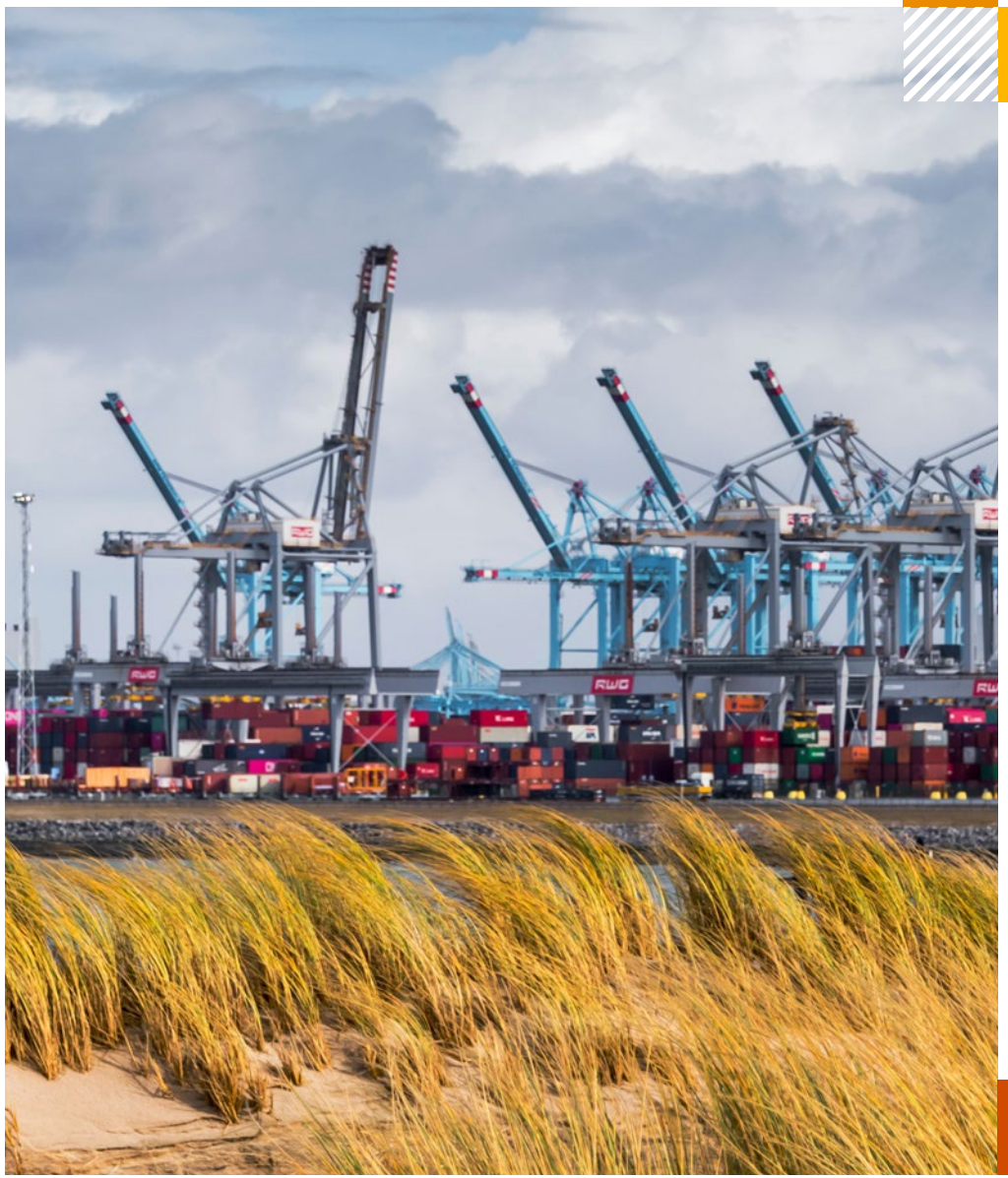


Table 17 Wholesale and retail trade (G) summary scorecard

Indicator	Category	Z-score in 2023	Trend symbol	Rank vs other industries (1 is the best)
Centrality	Centrality indicator	1.08	↑	3
GDP share	Economic indicator	-0.09	·	1
Labour productivity growth	Economic indicator	-0.01	·	9
R&D share	Economic indicator	-2.32	↓	4
Labour share	Scarcity indicator	-2.04	↓	15
Gross capital stock share	Scarcity indicator	-1.14	↓	12
Greenhouse gas emissions share	Scarcity indicator	0.00	·	7
Acidification share	Scarcity indicator	-1.42	↓	9.5
Water use share	Scarcity indicator	1.58	↑	7
Physical space share	Scarcity indicator	1.48	↑	12

Table 18 Transportation and storage (H) summary scorecard

Indicator	Category	Z-score in 2023	Trend symbol	Rank vs other industries (1 is the best)
Centrality	Centrality indicator	0.47	·	8
GDP share	Economic indicator	-1.07	↓	8
Labour productivity growth	Economic indicator	-1.08	↓	13
R&D share	Economic indicator	1.07	↑	10
Labour share	Scarcity indicator	-1.06	↓	12
Gross capital stock share	Scarcity indicator	-0.43	·	15
Greenhouse gas emissions share	Scarcity indicator	2.23	↑	13
Acidification share	Scarcity indicator	-0.36	·	14
Water use share	Scarcity indicator	1.35	↑	6
Physical space share	Scarcity indicator	1.55	↑	14

Table 19 Accommodation and food serving (I) summary scorecard

Indicator	Category	Z-score in 2023	Trend symbol	Rank vs other industries (1 is the best)
Centrality	Centrality indicator	-0.44	·	12
GDP share	Economic indicator	0.83	↗	12
Labour productivity growth	Economic indicator	1.17	↑	2.5
R&D share	Economic indicator	2.88	↑	15
Labour share	Scarcity indicator	2.01	↑	9
Gross capital stock share	Scarcity indicator	0.08	·	1
Greenhouse gas emissions share	Scarcity indicator	0.78	↗	4
Acidification share	Scarcity indicator	0.00	·	3
Water use share	Scarcity indicator	1.50	↑	8
Physical space share	Scarcity indicator	1.52	↑	2

Table 20 Information and communication (J) summary scorecard

Indicator	Category	Z-score in 2023	Trend symbol	Rank vs other industries (1 is the best)
Centrality	Centrality indicator	1.67	↑	7
GDP share	Economic indicator	0.50	·	7
Labour productivity growth	Economic indicator	0.07	·	10.5
R&D share	Economic indicator	-1.94	↓	3
Labour share	Scarcity indicator	1.80	↑	10
Gross capital stock share	Scarcity indicator	-0.15	·	8
Greenhouse gas emissions share	Scarcity indicator	-1.80	↓	1
Acidification share	Scarcity indicator	0.00	·	3
Water use share	Scarcity indicator	1.64	↑	1.5
Physical space share	Scarcity indicator	1.49	↑	4

Table 21 Financial institutions (K) summary scorecard

Indicator	Category	Z-score in 2023	Trend symbol	Rank vs other industries (1 is the best)
Centrality	Centrality indicator	-0.42	·	10
GDP share	Economic indicator	-2.43	↓	5
Labour productivity growth	Economic indicator	-0.87	↙	12
R&D share	Economic indicator	1.56	↑	5
Labour share	Scarcity indicator	-1.56	↓	6
Gross capital stock share	Scarcity indicator	-1.11	↓	7
Greenhouse gas emissions share	Scarcity indicator	-1.16	↓	2
Acidification share	Scarcity indicator	-0.27	·	3
Water use share	Scarcity indicator	-1.60	↓	3
Physical space share	Scarcity indicator	1.25	↑	6

Table 22 Other specialised business services (M) summary scorecard

Indicator	Category	Z-score in 2023	Trend symbol	Rank vs other industries (1 is the best)
Centrality	Centrality indicator	2.09	↑	5
GDP share	Economic indicator	1.66	↑	2
Labour productivity growth	Economic indicator	1.83	↑	6.5
R&D share	Economic indicator	-1.61	↓	2
Labour share	Scarcity indicator	2.01	↑	13
Gross capital stock share	Scarcity indicator	0.77	↗	3
Greenhouse gas emissions share	Scarcity indicator	1.50	↑	3
Acidification share	Scarcity indicator	-1.02	↓	3
Water use share	Scarcity indicator	1.76	↑	5
Physical space share	Scarcity indicator	1.49	↑	9

Table 23 Renting and other business support (N) summary scorecard

Indicator	Category	Z-score in 2023	Trend symbol	Rank vs other industries (1 is the best)
Centrality	Centrality indicator	2.04	↑	9
GDP share	Economic indicator	1.40	↑	3
Labour productivity growth	Economic indicator	1.97	↑	4
R&D share	Economic indicator	2.55	↑	9
Labour share	Scarcity indicator	0.69	↗	14
Gross capital stock share	Scarcity indicator	1.20	↑	11
Greenhouse gas emissions share	Scarcity indicator	1.99	↑	6
Acidification share	Scarcity indicator	-0.67	↙	6.5
Water use share	Scarcity indicator	1.48	↑	1.5
Physical space share	Scarcity indicator	1.53	↑	7

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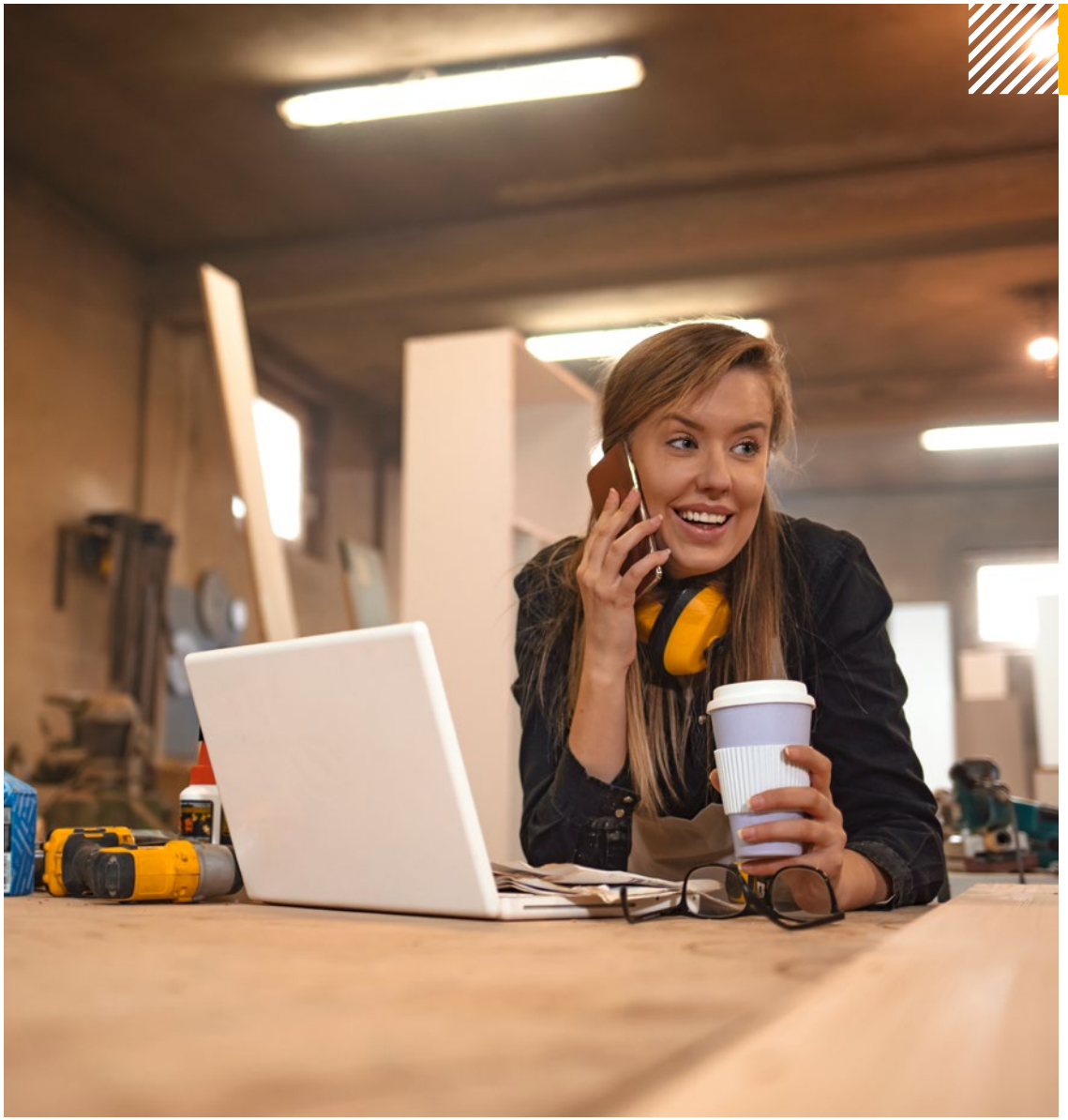

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