CPB Netherlands Bureau for Economic Policy Analysis

The importance of Dutch service activities in global value chains of manufactured goods

76% of the income earned by Dutch workers from global production and trade of goods, such as cars, comes from service activities.
Within the manufacturing industry, two-thirds of the labour income comes from these activities.
Compared to other countries, the Netherlands is specialized in professional services, such as marketing and accounting, and much less in production activities.

Our study on the role of the Dutch economy in global value chains for manufactured goods from 2000 to 2018 shows a significant shift towards service activities.

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Summary

"It ain't what you make, it is the way that you make it" [1]

This research examines the extent to which different types of activities (or jobs) in the Netherlands contribute to the global production of goods. Manufactured goods undergo many transformation steps before reaching the consumer. In addition to intermediate inputs, each step also requires different types of activities performed by workers. For example, creating a car involves activities such as production and assembly, as well as research, engineering, and marketing. Companies and workers around the world constantly compete to deliver each of these intermediate products and activities at the lowest price. We categorize all jobs worldwide into six activities: *administrative services*, *professional services*, *engineering*, *management*, *production*, *and other activities*. Using the tools of international trade, we calculate how much each of these six activities in each country contributes to global goods production. So, when a car is sold somewhere in the world, we can calculate how much income these six activities earned from it in the Netherlands.

We observe a significant shift from production activities to service activities within the Netherlands. Although this pattern is also observed in many other advanced economies, it is more pronounced in the Netherlands. From 2000 to 2018, the share of production activities, such as assembly, decreased by approximately 7 percentage points, while professional services, including consulting and marketing, increased by about the same extent. At the same time, the share of production activities in the total income of the manufacturing industry decreased, indicating a reallocation of production activities in the manufacturing industry to professional service activities in other sectors. In 2018, non-production activities (mainly services) contributed 66% to the value generated within the manufacturing industry, overshadowing the 34% generated by production activities. These findings emphasize the 'servicification' of the Dutch economy.

Understanding the composition of activities within global production processes is crucial for various policy goals and discussions. Activities differ in the role they play within production processes, as well as the associated earning potential. At the same time, different activities require different types of public input (such as a labour force with a certain level of education, legal regulations and institutions, infrastructure, or access to energy). Policy measures can therefore have significant implications for the types of activities that can be performed in a particular country. Policies on topics such as international trade, migration, education, research and development, and infrastructure investment partly determine how different activities will be carried out in the Netherlands in the future. There are currently lively debates and objectives regarding reshoring and friendshoring, as well as open strategic autonomy. This is accompanied by discussions about the role of the national manufacturing industry. Given the interconnection of sectors and the increasing importance of service activities, it seems not very meaningful to make the share of the manufacturing industry in GDP a target indicator of industrial policy.

[1] Paraphrasing a song by Fun Boy Three & Bananarama in 1982.

1 Introduction[2]

The question of "How does the Netherlands earn its income?" is often answered by looking at the output of industries or their export values (see e.g. van Bree, 2022)**.** Such responses typically highlight the 'what' — e.g. the export of flowers — rather than the 'how' — e.g. managing a complex cross-border logistical process. This study shifts focus to the underlying activities in production and trade (i.e. global value chains) across industries. We ask, "How much does the Netherlands earn from activities like management, rather than just from products like flower exports?" By emphasizing activities over products, we gain deeper insight into global value chains and international production networks. This approach not only reveals the Netherlands' role in these networks but also informs discussions on industrial policy, the importance of manufacturing, and strategies around reshoring and friendshoring.

We can improve our understanding of global value chains by adding the activity dimension to the traditional analysis.[3] The production of manufactured goods happens within a globally competitive process. Every stage of production requires several inputs, such as intermediate goods, and activities performed by workers. For example, selling a car to a consumer might first require a researcher to experiment with the physical properties of different materials, a production worker to assemble a car frame and other intermediate goods (such as a set of pedals and a bell), and a sales person to market the finished car. Within global value chains, there is competition among firms, and workers, to be the supplier of each of these inputs.

In this study, we examine how countries contribute to the global production of manufactured goods through various activities. For each country, we calculate their GVC income as the value they add to the global production of manufactured goods. We split up this GVC income into capital income, and six distinct types of labour income, reflecting different activities performed in the economy (*activity GVC incomes*).[4] These activities are *administrative services*, *professional services*, *engineering*, *management*, *production*, and *other activities*. Together they cover all work-related activities. For example, the engineering activity GVC income earned in the Netherlands captures all the money earned by engineers in the Netherlands who participate in global value chains for manufactured goods.

Building on the work of Timmer et al. (2019), we calculate measures of activity specialization, a concept that goes beyond traditional measures in international trade.[5] Unlike the 'revealed comparative advantage' concept, which primarily focuses on goods exports, activity specialization refers to the extent to which entities—e.g. firms, industries, or countries—may specialize in specific *activities* for which they have a competitive advantage in the global production process. For instance, one country might specialize in the engineering aspects of electronics (design), due to its highly-educated engineering workforce, while another country may specialize in production activities (like assembly), due to its abundance in less-educated workers. A country has a high *activity specialization*, if it earns a larger share of its total activity GVC income from a particular activity compared to other countries.

Manufacturing has been central to several recent policy debates and closely intertwined with international trade in goods. The Ministry of Economic Affairs & Climate has stated the goal of "continued

[2] We thank Gaaitzen de Vries of Rijksuniversiteit Groningen (RUG) for sharing the data on activity shares with us, and Sakura de Vries for her excellent initial work on these data for our study.
[3] Our approach evolves from initially analysing trade flows, to focusing on value-added per country-industry, and finally to dissecting industrial value-added by specific activities.
[4] In the remainder of the study we focus on the activity incomes, i.e. different parts of labour income. For a brief overview of capital income see figure 8 and figure 9 in appendix 3.
[5] Our term "activities" is equivalent to the term "functions" used by (Timmer et al., 2019).

Dutch global technological leadership" in the coming decades, and it sees a key role within this process for manufacturing. To achieve this goals, the Netherlands ought to maintain a significant manufacturing industry, 10-15% of GDP according to (Ministerie EZK, 2022). Manufacturing is important not only as a source of employment, but also as a source of innovation, and a growth engine for the entire economy (Rodrik, 2022). Geopolitical considerations are another area in which manufacturing is central. Open strategic autonomy, meaning that the Netherlands is an open economy which should nonetheless not be too dependent on other countries for critical resources, has become an important aim in recent years (Ministerie van BZ, 2022).[6]

The report is structured as follows. Section 2 of the report describes the method we used in a non-technical way and explains the data we used. Section 3 presents and discusses the main results. The appendix provides a more technical description of the methodology and some additional results.

[6] For the government, the open strategic autonomy (OSA) of the European Union represents its ability to, as a global player and in cooperation with international partners, safeguard its public interests and be resilient in an interconnected world, based on its own insights and choices. OSA is defined at the European level and is about dependency as well as a strong internal market and increased geopolitical capacity of the EU.

2 Method & Data

2.1 Methodology and definitions

Global value chain (GVC) income is the total value added at each step of the value chain to meet the global final demand for manufactured goods. Manufactured goods include things like food products, textiles, chemical products, metal and electrical equipment.[7] The GVC income sums up all contributions of labour and capital to both domestic and foreign final demand.

We use Input-Output matrices to dissect the value of the final demand for manufactured goods. This method allows us to identify and quantify each component of value added throughout the value chain. It takes into account not just direct production costs, but also indirect incomes from services like research and development or logistics that one industry provides to another. For a more thorough understanding, we can further break down GVC income by specific countries, industries, or types of activities involved.

We calculate GVC incomes per country-industry by utilizing the OECD Inter-Country Input-Output (ICIO) tables, following the methodology proposed by (Timmer et al., 2013; Los et al., 2014). GVC income is defined as

$$\mathbf{v}^c = \hat{\mathbf{p}} * \mathbf{L} * \mathbf{f}^c \, .$$

The GVC expression is best read from right to left. We start by considering the global final demand for manufactured goods ($\mathbf{f}^c$). $\mathbf{f}^c$ contains the amount of final use of these goods in the world, i.e. consumption by households, government spending, and investments by firms, for instance in new machines for a factory. Next, we determine the necessary gross production levels to meet this final demand via the so-called Leontief inverse, denoted as $\mathbf{L}$. Finally, we calculate the associated income by multiplying these production levels by the value-added per gross output ratio at the country-industry level (diagonal matrix $\hat{\mathbf{p}}$). $\mathbf{v}^c$ is then a vector containing, for each country-industry in the data, the value added contributed to the global final demand for manufactured goods.

The Leontief inverse is a crucial tool for understanding and mapping out value chains, both within and across countries. It helps us answer complex questions about the production process. For example, if we ask, "What inputs are needed to produce an automobile?" the initial response would include all the goods and services directly used in assembling a car, like tires, screws, an engine, seats, as well as logistical and accounting services. However, this leads to further questions since these components themselves require production. For instance, we might ask, "What inputs are needed to produce the tires, engines, and other parts of a car?" The answer would involve materials like rubber for tires, machinery for engines, more screws, and so on. This line of questioning can extend through many layers of production.

The Leontief inverse tracks this entire process, providing a comprehensive overview of the total (or 'gross') input requirements from different industries needed for any given production process. This includes both domestic and international industries, although it focuses on industry requirements and not

[7] In the Dutch Standard Industrial Classification (SBI) it relates to all industries falling in category C. See appendix 2 for a list of all manufacturing, and non-manufacturing industries of the economy.

specific activities. Essentially, it allows us to see the full scope of inputs and industries involved in producing any product, whether it's within a single country or globally.

In the following step, we break down global value chain income into activity GVC incomes per country-industry. This allows us to identify which specific activities are adding value within GVCs. Switching to cell notation instead of matrix notation, we define activity GVC incomes v^a_{isk} (with superscript *a* for "activity"), i.e. the income earned by activity k in industry s in country i as:

$$v^a_{isk} = \alpha_{isk} l_{is} v^c_{is}$$

Again reading the expression from right to left, we start with GVC incomes (v^c_{is}) of industry s in country i. We then compute activity GVC income as labour income from GVC participation by multiplying GVC incomes with the respective labour share of that country-industry (l_{is}). By further multiplying this total labour income per country-industry with the share of activity k within labour income in a given country-industry (α_{isk}), we finally calculate the GVC income earned with different activities, or *activity GVC incomes* (v^a_{isk}). In some applications, we further take the sum of v_{isk} across industries, in order to calculate the total income earned by activity k in country i: $v^a_{ik} = \sum_s v^a_{isk}$.

In this study, we use the specialisation indicator introduced by Timmer et al (2019).[8] This indicator applies the concept of revealed comparative advantage (RCA) to activity GVC incomes (rather than to trade flows, as is often done in the literature). RCA is a measure of the relative ability of a country to produce a good vis-à-vis its trading partners (French, 2017). The specialisation indicator goes beyond tracking the value that activities add in global value chains but delves into understanding how these patterns compare to those of other countries.

We analyse specialization patterns by examining which country has a relatively high share within its total activity GVC income from a particular activity. Specifically, for activity *k* in country *i*, we calculate the specialization in activities index (S_{ik}):

$$S_{ik} = \frac{v^a_{ik} / \sum_k v^a_{ik}}{\sum_i v^a_{ik} / \sum_i \sum_k v^a_{ik}}$$

This involves calculating, for each country *i*, the ratio between the income generated by activity *k* (v^a_{ik}) and the total labour income from GVC participation ($\sum_k v^a_{ik}$). We then compare this ratio to the (weighted-)average ratio across all countries ($\sum_i v^a_{ik} / \sum_i \sum_k v^a_{ik}$). A specialization value of larger than 1 implies that a country is specialized in this activity, relative to other countries. For instance, if China earns 40% of its income from production activity while the global average is 20%, China will have a specialization value of 2, and we can conclude that it specializes in production activities.

2.2 Data

Our analysis relies on data from two primary sources: the OECD Inter-Country Input-Output (ICIO) table, which contains detailed data on international trade and supply chains, and data on labour incomes earned with different activities in those country-industries, shared with us by the University of Groningen.

[8] In their study, Timmer et al use the term functional specialization. Because we use the term activities, we prefer specialization in activities, or simply specialization.

The final sample covers a wide range of European economies, along with several large non-European economies. Combining input-output data with activities data yields a dataset covering 44 industries and 39 countries spanning 2000-2018. For each country-industry, it features detailed annual information on the number of workers and amount of labour income for 13 occupations, which we aggregate into the 6 broad activity groups outlined above. This final dataset contains 31,326 country-industry-year observations, each with data on 6 activities, in the final dataset.[9] Appendix 2 shows lists of the different activities, industries, and countries contained in the final dataset.

2.2.1 World input-output table

The primary data source for understanding the structure and size of global value chains is the world input-output table, also known as the Multi-Regional Input-Output (MRIO) table. This table details the value of all intermediate deliveries between various countries and industries. That means it shows how much one country-industry pair sends to another country-industry pair. It also captures the gross production, final demand (like consumption and investment), and value added for each country-industry combination. Importantly, the table breaks down final demand by the destination country. For example, it might show the value for delivery of agricultural products from the Netherlands for final use in China, counting as an export for the Netherlands and an import for China. Another example could be machinery from Germany delivered to the U.S. automotive industry, highlighting international trade's role in the MRIO.

The data in an MRIO adhere to two key accounting principles. Firstly, a country-industry's gross production value equals the sum of all intermediate deliveries to and from all country-industry pairs, including its own, plus deliveries to all countries for final use. Secondly, the value added of a country-industry always equals its gross production value minus the value of all its intermediate supplies. This means the combined value produced by all industries of a country adds up to that country's GDP.

We use the OECD Global Input-Output table for our MRIO. This table covers the 38 OECD member states, 28 additional countries, and a Rest-of-the-World category, offering a comprehensive view of global production and trade. It includes data on 45 industries, and we use data for years 2000 to 2018.[10]

2.2.2 Activity data

We use six different categories of activities: management, engineering, professional services, administrative services, production, and other activities. Each activity captures groups of workers and consists of one of more detailed occupations. In total we have information on 13 separate ISCO-08 occupations, kindly provided by from Kruse et al. (2023). See appendix 2 for more information on the specific underlying occupations, and appendix 1.2 for details on how we handled the raw activity data.

The activities contain different tasks that require different skills.[11] Production activities represent activities that involve manual labour or the operation of machinery. Relevant occupations include truck drivers, machine operators, farmers, but also artisanal workers. Managers include directors, upper management and CEO. Legislators and lobbyists are also included in this group. Engineering include designers like (software) engineers and skilled technicians. Professional services include high-skilled occupations in marketing, law, research, etc. Administrative services include personal services, cleaning services, but also storefront sales.

[9] The keen reader will have noticed 44*39*19 would instead make for 32,604 observations. the total is somewhat lower due to some smaller countries lacking significant activity in certain industries, which are then aggregated into broader industries.
[10] While data on the OECD's MRIO is available for years 1995 – 2018, we show most results for the period 2000 – 2018, due to better data quality in that time period.
[11] See Reijnders and de Vries (2018) for more information regarding the grouping of the occupations.

Finally, the other category contains occupations that are less relevant for the concept of activity GVC incomes, and includes healthcare and education professionals, and the armed forces.

The data feature labour income and employment for each activity, as well as capital income for 45 industries in 38 countries, spanning 2000 to 2018. The data feature mostly European countries, but also include the USA, China, Japan, several other Asian and South American countries. Combining these data with capital shares from the OECD MRIO, we can fully allocate the value added of each industry in each country to specific labour activities, or capital income.

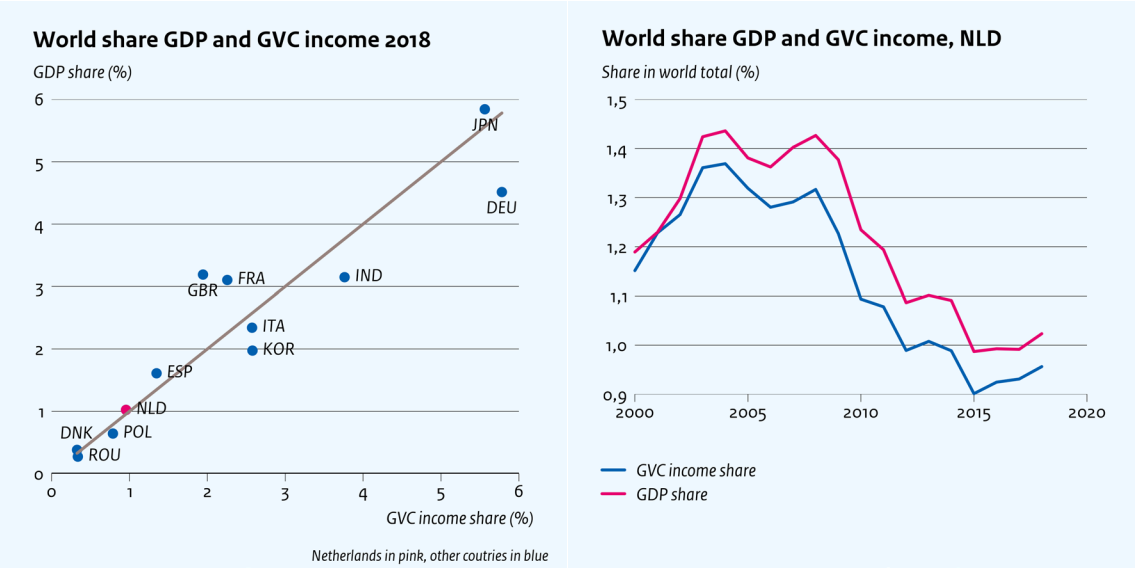
3 Results

3.1 The contribution of different activities to GVC income from goods

Figure 1 (left) compares how involved different countries are in Global Value Chains (GVCs) by looking at two aspects. First (y-axis) the size of their economy (their share in global GDP) and second (x-axis), their participation in GVCs (their share in global GVC income). The Netherlands has similar shares in both global GDP and GVC income, indicating that the Dutch contributions to the global economy and global value chain income are roughly equivalent. However, this pattern is not consistent across all countries. The UK and France, for example, have a smaller role in GVC income than their GDPs would suggest, while Germany's role in GVC income is much larger than its GDP would indicate.

Figure 1 (right) shows that the Netherlands has maintained a stable balance between its share in global GDP and GVC income. Since the early 2000s, the Dutch share of global GDP has been slightly higher than its GVC income share, but this difference hasn't changed significantly. During this period, the Dutch economy has gradually shifted from manufacturing to services, which may be becoming more significant for GVC income. The remaining part of this section will explore the development of Dutch GVC income and the activities contributing to it.

Figure 1: The Dutch share of global GVC income from goods is comparable to its share in global GDP



Note: The left panel shows the correlation between each countries share of global GDP and its share in global GVC income. The diagonal line indicates equivalence between the two. The right panel shows the development of the two shares for the Netherlands specifically.

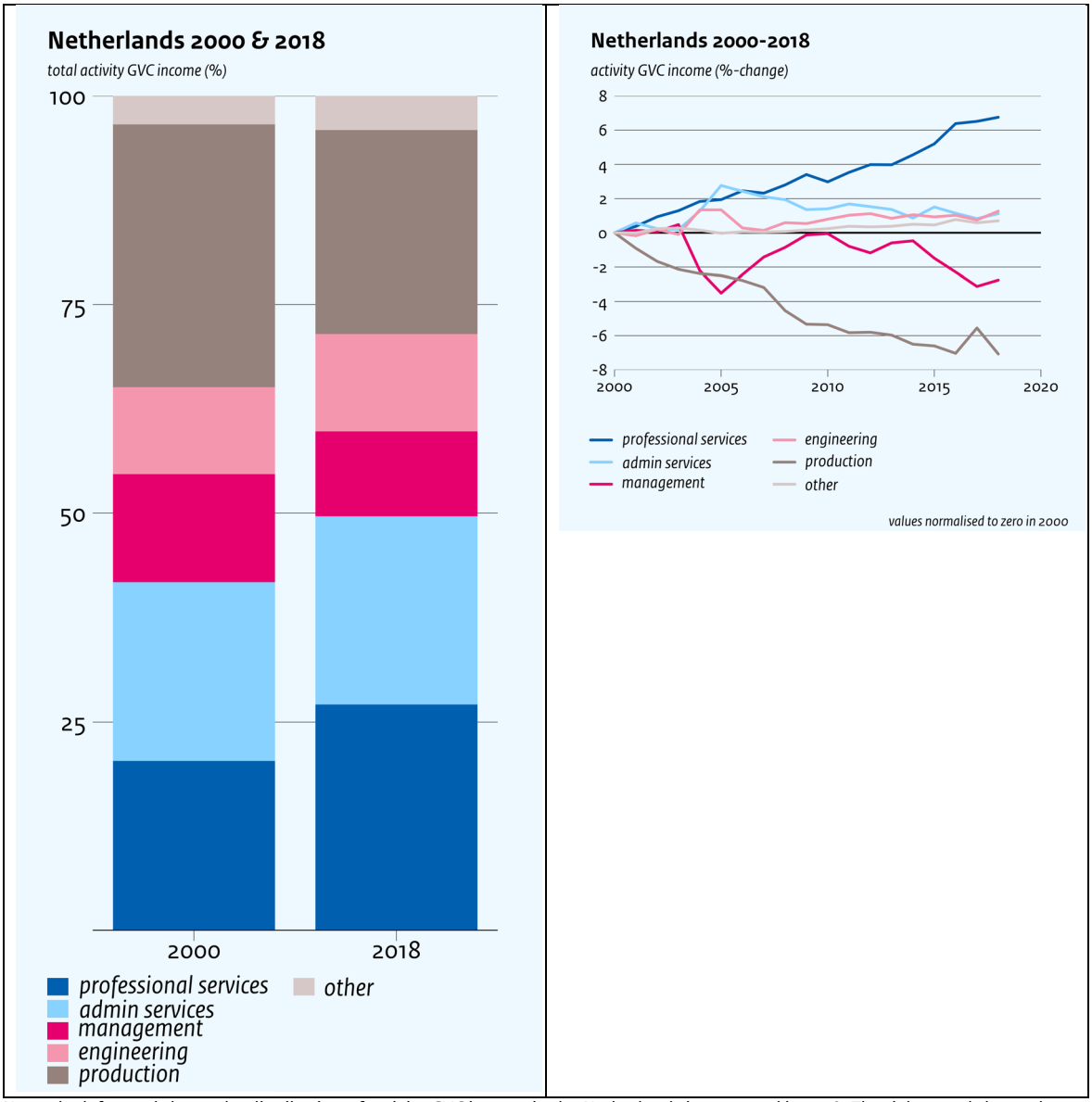
Figure 2 (left) shows that income from production activities as a share of total activity GVC income[12] has declined strongly since 2000, this is balanced by an increase in the share of professional services. The latter includes activities related to, marketing, and legal services, among others. Professional services have

[12] This equals GVC income excluding capital income, or equivalently, the sum of all activity GVC income for the country. For the total of all activity income, not just from GVC, see appendix Figure 7.

become the top contributor, accounting for 27% of total activity GVC income in 2018. In 2000, production activities still generated the most income with a share over 31%, however by 2018 this share decreased with 7%-points. Administrative services, management activities and engineering have remained more or less constant (figure 2 right).

To understand figure 2, it is helpful to note that it details the contribution of the six different activities to the labour income generated within the global value chains for manufactured goods. Essentially, the figure breaks down the earnings from various stages involved in producing a good. Take, for example, a car made in the Netherlands and purchased by someone in Germany. The figure doesn't just show the income from production activities (like assembling the bike parts), but also includes earnings from other activities such as professional services (like design, marketing, and legal services). This concept also applies to a German car bought in France, which might include activities conducted in the Netherlands. In the same way it applies to a Dutch car both made and sold within the Netherlands.

Figure 2: The contribution of production activities to global value chain income from goods has decreased



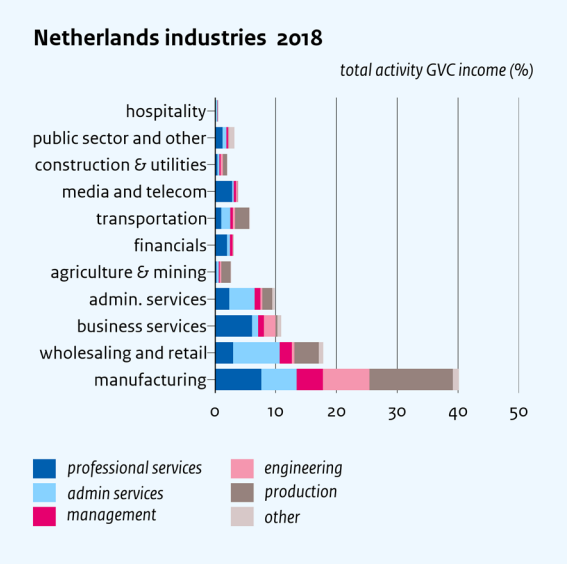
Note: the left panel shows the distribution of activity GVC income in the Netherlands in 2000 and in 2018. The right panel shows the development of activity GVC income for each activity over the same period.

Figure 3 provides a detailed view of the activity GVC income for each industry in the Netherlands contributed by the various activities within global value chains for manufactured goods. To illustrate, consider again our car manufactured in the Netherlands and purchased by someone in Germany. The majority of the work, including the actual assembly and engineering design, is carried out in the Dutch manufacturing industry. This means that a significant portion of the value added—like assembling parts and designing the car—happens within this industry. However, it is key to realise that while a large share of the activity GVC income in manufacturing is indeed production activities, like assembly of the car, this only constitutes about one third of the total activity GVC income in the manufacturing industry. Of the remainder, another third consists of services and engineering is around 20%.[13]

Figure 3 provides two key insights with implications for industrial policy: first, within the manufacturing industry, the figure shows that production activities contributes only 34% of activity GVC income. Non-production activities make up the majority of activity GVC income (66%) in manufacturing (as depicted in the bottom bar of figure 3). When taking the example of a manufacturing firm of cars, more of the income is earned by people who do the design, marketing, organising logistics or providing legal advice than by people who assemble the car.

Secondly, the figure highlights that the top-10 industries outside manufacturing contribute 60% to the activity GVC income from goods. Within these industries, again non-production activities emerge as the most significant contributors, with professional and administrative services accounting for over 60% of the activity GVC income in nearly every industry except agriculture, construction, transportation, and manufacturing itself. This underscores the importance of taking into account the contribution of activities, which can show significant differences and developments over time, further supporting the argument for activity-based targets in industrial policy.

Figure 3: professional services play a significant role in contributing to activity GVC income across various industries



Note: the figure shows income from global manufacturing value chains per activity category for the Netherlands in different industries

Given the interconnectedness of industries and the increasing importance of service activities, it seems not very meaningful to make the share of manufacturing industry in GDP a target indicator of industrial policy. When assessing the importance of the manufacturing industry, it is good to consider both its core

[13] We do not distinguish between professional services that are more prevalent in manufacturing and those in business services.

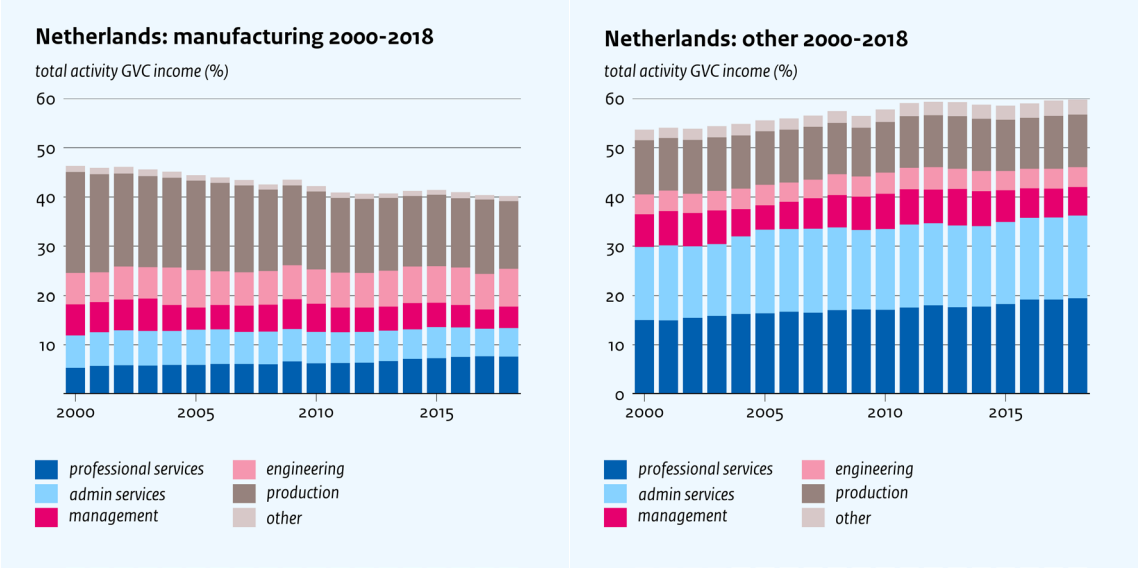
production activities and the related service activities that support it, both in the manufacturing industry and in other industries. This broader perspective provides a more accurate representation of the manufacturing industry's economic significance and underscores the need for a comprehensive approach to industrial policy. This resonates with the analysis made by Rodrik (2022) for the need to expand industrial policy beyond manufacturing, to include smaller and more diverse service firms.

We find that foreign final demand is more important for GVC income in the Netherlands than domestic final demand. Specifically, we observe that a larger share of activities within the Netherlands are performed to satisfy foreign consumption and investment rather than domestic final demand. For example, activity GVC income within manufacturing for foreign demand is over twice the size of that for domestic finale demand. This picture of higher activity GVC income from foreign final demand over domestic is also observed in other industries in the Netherlands.

Figure 4 reveals a notable reduction in the manufacturing industry's share of activity GVC income, primarily due to a decline in production activities, such as the assembly of parts in our car example. This trend may have been influenced by outsourcing to lower-cost countries or increased automation. Conversely, there's a rising contribution from non-manufacturing industries to GVCs for manufactured goods, driven by professional service activities. This expansion is evident across diverse industries, including wholesale & retail and media & telecom, indicating a shift in the industries' dynamics and sources of income. Additionally, within manufacturing itself, the share of professional service activities in total activity GVC income has grown, even though the share of manufacturing as a whole has declined. This suggests that the rising prominence of service activities reflects more than just a shift towards services industries; it indicates a broader increase in service activities throughout the entire economy.

The decline in activity GVC income from manufacturing, and especially from production activities coincides with the widespread trend of employment deindustrialization, linked to the adoption of labour-saving technologies in successful manufacturing industries. Rodrik (2022) argues that this trend challenges the traditional notion that focusing industrial policy solely on manufacturing will increase the supply of "good jobs" in that industry. However, for the Netherlands, there seems to have been a shift towards good jobs already, namely professional services.

Figure 4: contribution of production activities is decreasing in manufacturing (left); contribution of professional services in other industries (right) is increasing in GVC income from goods



Note: the figure shows global value chain income per activity category for the Netherlands in the manufacturing industry (left) and the rest of the economy (right)

3.2 Specialisation in activities

Figure 5 shows that the Netherlands is specialised in professional services. Previous sections highlighted the growing importance of Dutch professional services in GVC income, both within manufacturing, and in other industries. This raises the question of how the Netherlands compares to other advanced economies? In many advanced economies, the service industry has become more dominant. As shown in figure 5, the Netherlands is particularly distinct in this trend, showcasing a more pronounced shift towards service activities compared to its peers.

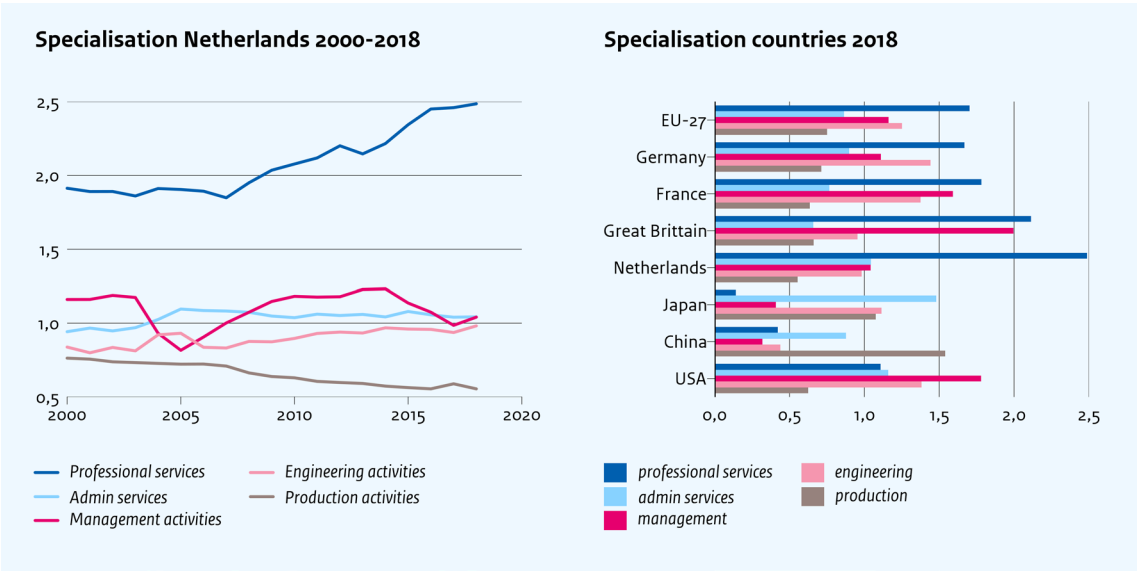
The figures show specialization in activities, an index for different activity categories across countries. A score higher than 1 indicates a country's specialization in a particular activity relative to other countries. In this context, figure 5 (left) shows the Netherlands scores remarkably high for professional service activities, which has increased markedly since 2005 and culminated in a score of about 2.5 in 2018. This suggests a significant and increasing specialization. In contrast, the Dutch score for production activities is just 0.5 and has been declining for years. Scores for other activities are more stable and around 1.0.

The Dutch specialisation in professional services reflects broader patterns of specialisation in the world, following the fragmentation of production processes. For example, low-income countries often concentrate on labour-intensive production activities. Yet, there's a phenomenon known as economic upgrading, where economic players – including countries, companies, and workers – transition from lower-value to relatively higher-value activities within global production networks. China, for instance, remains primarily focused on production activities, much like Japan, though to a lesser extent. However, China's role has evolved from merely assembling imported components to creating and marketing its own branded products, both domestically and internationally. This shift highlights a significant economic upgrade in the global value chain production (Gereffi, 2019).

While other advanced economies also show a specialization in professional services, none exhibits as distinct a profile as the Netherlands. For example, figure 5 (right) indicates that Germany also shows a

specialization in engineering, whereas France, the UK, and the USA score highly in management activities, possibly reflecting the presence of corporate headquarters in these countries. On the other hand, China remains heavily specialized in production activities, with lower specialization scores in other areas. This comparison underscores the Netherlands' distinct role in the global economy; the Netherlands is unmatched by other advanced countries in its specialisation in professional services. Moreover, this specialisation has become even more pronounced over the past decade.

Figure 5: The Netherlands is increasingly specialized in professional services over time (left) and compared to other countries (right)

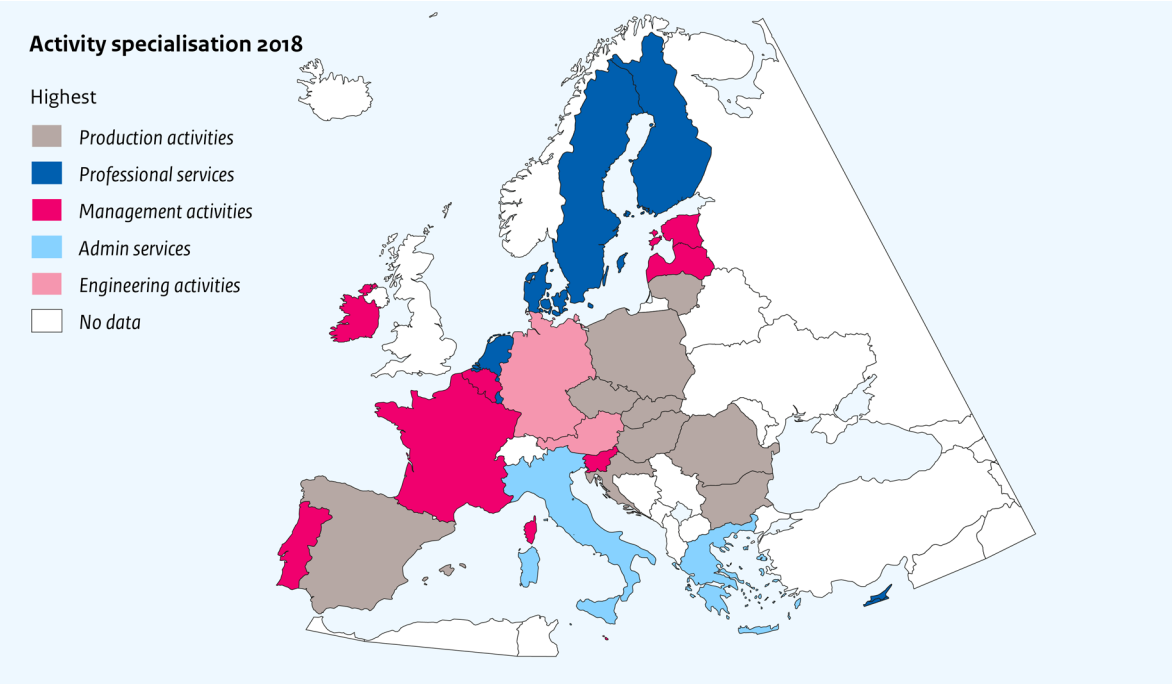


Note: The figure shows specialisation in activities per activity category, see section 2.1 for calculations. A value larger than 1 means a an activity is performed more intensively than for an average country. If this is the case, we say that a country is specialised in that particular activity. Higher values indicate higher degrees of specialisation. Conversely, a value lower than 1 means that an activity is performed with less intensity than average.

Figure 6 shows an index of specialization in activities calculated exclusively for the EU. We find that, compared to the EU average, the Netherlands stands out as the most specialised in professional services. While the Nordic countries also exhibit a notable specialization in professional services, none match the level of the Netherlands. In contrast, several Eastern European countries show a specialization in production activities, while France and Germany are distinctively specialized in management and engineering, respectively. These results show that while the EU as a whole tends towards specialization in professional services relative to the rest of the world, there is still considerable variation in specialization among EU countries themselves.

In a global comparison, Europe's activity specialization is distinctly oriented towards service activities. This trend, while highlighting Europe's strengths in the service sector, simultaneously has raised potential concerns e.g. by the European Commission, about the diminishing presence of production activities within the European Union. In response, there is a growing focus on strategies such as reshoring and nearshoring. These strategies aim reorganise European value chains by bringing back production closer to home, thereby to better manage its economic dependencies in an increasingly interconnected global market (see for instance Interreg Europe, link).

Figure 6: Activity Specialization within the EU



Note: Whereas figure 5 compares each country with the average for all countries across the world, the index shown here is calculated only for EU countries, and compares each country with the average of all EU countries

4 References

van Bree, T., 2022, De waarde van de Nederlandse industrie, Whitepaper, TNO.

French, S., 2017, Revealed comparative advantage: What is it good for?, *Journal of International Economics*, vol. 106: 83-103.

Gereffi, G., 2019, Economic upgrading in global value chains, *Handbook on global value chains*, : 240-254.

Kruse, H., M.P. Timmer, G.J. De Vries and X. Ye, 2023, Export Diversification from an Activity Perspective: An Exploration Using Occupation Data, Policy Research Working Papers, World Bank. https://doi.org/10.1596/1813-9450-10463.

Los, B., M. Timmer and G. de Vries, 2014, De concurrentiepositie van Nederland in mondiale waardeketens, *ESB*, vol. 99(4689 & 4690): 432-436.

Ministerie EZK, 2022, Kamerbrief strategisch en groen industriebeleid.

Ministerie van BZ, 2022, Kamerbrief over open strategische autonomie.

Reijnders, L.S. and G.J. de Vries, 2018, Technology, offshoring and the rise of non-routine jobs, *Journal of Development Economics*, vol. 135: 412-432.

Rodrik, D., 2022, An Industrial Policy for Good Jobs, Policy ProposalThe Hamilton Project, Brookings Institute.

Timmer, M.P., B. Los, R. Stehrer and G.J. de Vries, 2013, Fragmentation, incomes and jobs: an analysis of European competitiveness, *Economic Policy*, vol. 28(76): 613-661. https://doi.org/10.1111/1468-0327.12018.

Timmer, M.P., S. Miroudot and G.J. de Vries, 2019, Functional specialisation in trade, *Journal of Economic Geography*, vol. 19(1): 1-30.

Appendix 1 Technical description of the methodology

A1.1 GVC Incomes, Activity GVC Incomes, & Activity Specialization

To calculate GVC incomes, we follow the methodology explained in Timmer et al., (2013). We start with some basic assumptions. There are *S* industries and *N* countries. We use annual data in our analysis, but for simplicity, we won't include time references here. Each country-industry combination produces one product. So, there are a total of $S \times N$ different products. We use the term "country-industry" to describe a specific industry in a specific country, such as the transport industry in the Netherlands or the car industry in Germany.

In each country-industry, products are made using local production resources (labour, machinery, etc.) and intermediate materials, which can either be locally sourced or bought from foreign suppliers. These products can be used in two ways:

- To meet the final demand (either domestically or abroad).
- As intermediate inputs in producing other goods or services (domestically or abroad).

Final demand includes all goods consumed by households and governments products (either, as well as investment.

To keep track of how products move within and between countries, we need to measure from which country-industry a product is obtained (the source) and where it is going to (the destination). For a specific product, we denote: *i* as the source country; *j* as the destination country; *s* as the source industry; *t* as the destination industry. We consider changes in inventories as part of investment demand and thereby impose product market clearing: there are no unsold products left.

The product market clearing conditions are given by:

$$y_i^s = \sum_j f_{ij}^s + \sum_j \sum_t m_{ij}^{st} \tag{1}$$

where y_i^s is the value of gross output in industry *s* of country *i*; f_{ij}^s is the value of products shipped from this industry for final use in country *j*, and m_{ij}^{st} is the value of products shipped from this industry for intermediate use by industry *t* in country *j*. The use of these products can be at home ($i = j$) as well as abroad ($i \neq j$).

By employing matrix algebra, we can condense the market clearing conditions for all country-industry (*SN*) products into a concise global input-output system. First, we need to define some terms. **Y** represents a production vector with dimensions ($SN \times 1$). This vector stacks the levels of output for each country-industry. **F** is also a vector with dimensions ($SN \times 1$), created by stacking the global final demand for output from each country-industry, denoted as f_i^s. The total global final demand is the sum of demands from all countries, calculated as $f_i^s = \sum_j f_{ij}^s$.

Additionally, we define a global matrix called A with dimensions ($SN \times SN$). The elements of this matrix, a_{ij}^{st}, indicate the output of industry *s* in country *i*, which is used as an intermediate input by industry *t* in country *j*, expressed as a share of the output in the latter industry, i.e. $a_{ij}^{st} = m_{ij}^{st}/y_j^t$. Essentially, the matrix **A** reveals how products from each country-industry are manufactured using a mix of various intermediate products, both domestic and foreign.

We can express the combined market clearing conditions for the stacked SN goods from equation (1) in a more concise manner as $\mathbf{y} = \mathbf{A}\mathbf{y} + \mathbf{f}$. If we rearrange this equation, we get the following fundamental input-output identity:

$$\mathbf{y} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{f} \tag{2}$$

In this equation, **I** represents an identity matrix with dimensions $SN \times SN$, consisting of ones on the diagonal and zeros elsewhere. The term $(\mathbf{I} - \mathbf{A})^{-1}$ is the Leontief inverse (denoted as **L** in the main text). The element in row *m* and column *n* of this matrix provides the total production value of industry *m* required to produce one unit of final output of product *n*.

We want to decompose the value of final demand for a specific product into the value-added contributions of the different country-industries along the value chain. We define value added in the standard manner, which is the gross output value (at basic prices) minus the cost of intermediate goods and services (at purchasers' prices). p_i^s denotes the value added per unit of gross output produced in industry *s* in country *i*. These direct value added coefficients are collected in a stacked *SN*-vector called **p**.

To incorporate the indirect contributions, we calculate the *SN*-vector of value-added levels, denoted as v. Value added by country-industry is obtained by pre-multiplying the gross outputs required for the production of final demand by **p:**

$$\mathbf{v} = \hat{\mathbf{p}}\,(\mathbf{I} - \mathbf{A})^{-1}\mathbf{f} \tag{3}$$

Here, the hat symbol represents a diagonal matrix with the elements of **p** along the diagonal.

With this we can calculate the value-added levels that can be attributed to a specific set of final demand levels. We do this by post-multiplying $\hat{\mathbf{p}}\,(\mathbf{I} - \mathbf{A})^{-1}$ with any vector of final demand levels. This enables us to determine how much value added is associated with particular final demand levels. These levels of value added will be influenced by two key factors:

1. The structure of the global production process, as outlined in the global intermediate inputs coefficients matrix **A**.
2. The vector of value-added coefficients within each country-industry, represented by **p**.

It's important to note that alterations in both p and A can occur due to certain economic developments. For instance, when outsourcing takes place, the activities that originally generated value added within an industry may now be integrated into intermediate inputs obtained from other country-industries. Additionally, changes can take place in matrix **A** when, for example, an industry decides to change its sources for intermediates, shifting from one country to another. These shifts in both **p** and **A** have a direct impact on how value added is distributed and attributed in the production process.

A1.2 Time Series Smoothing for Activity Data

We use a simple data smoothing algorithm to account for large discontinuities in a few observations of the activity data. The raw data on activity incomes contains information on labour income shares for 13 occupations for each industry, country, and year in the data. In most year-on-year observations (e.g. the share of labour income of farmers in the French agricultural industry in years 2005 and 2006), changes are in the range of a few percentage points. In some cases, however, the raw time series data contain large discontinuities. We attribute such large discontinuities to changes in measurement, rather than changes in the underlying data-generating process.

We remove large discontinuities from the activities data by keeping observations constant year-on-year in these specific cases. We define large discontinuities as cases where, for a given time series (meaning a given combination of activity, industry, and country over time), the change from year $t+1$ to year t is simultaneously larger than three standard deviations (calculated for that specific time series using the raw data), and larger than 5 percentage points in absolute terms. Note that we implement this procedure "backwards"; for each individual time series, we take the value observed at the end of the sample period (i.e. in 2018) as given, and apply the above procedure to each consecutive year backwards in time. The exact thresholds of this procedure are somewhat arbitrary; we have experimented with other thresholds close to these values, and the results did not change substantially.

Appendix 2: List of activities & industries

The original data for the different activities from (Kruse et al., 2023) are categorised into 13 occupations. We aggregate these 13 occupations into 5 activity groups. Table 1 contains the exact aggregation.

Table 1: List of Activities and Occupations

Occupation	Activity	ISCO codes
Legislators	Managers	11
Managers	Managers	12, 13
Engineers & Technicians	Engineers	21, 31
Other Professionals	Professional services	24, 34
Administrative Staff	Administrative services	41, 42
Personal Service Providers	Administrative services	51, 910, 912-916
Salespeople	Administrative services	52, 911
Craftsmen and Machine Operators	Production	71-74, 81, 82, 93
Farmers	Production	60, 61, 92
Vehicle Drivers	Production	83
Medical Professionals	Other activities	22, 32
Educators	Other activities	23, 33
Others, Armed Forces	Other activities	01-03, 90

Table 2: List of Countries

Countries			
Austria	Germany	Hungary	Norway
Belgium	Denmark	Ireland	Poland
Bulgaria	Spain	Iceland	Portugal
Switzerland	Estonia	Italy	Romania
Chile	Malta	Japan	Slovak Republic
China	Finland	South Korea	Slovenia
Colombia	France	Lithuania	Sweden
Costa Rica	United Kingdom	Luxembourg	Turkey
Cyprus	Greece	Latvia	United States
Czech Republic	Croatia	Netherlands	

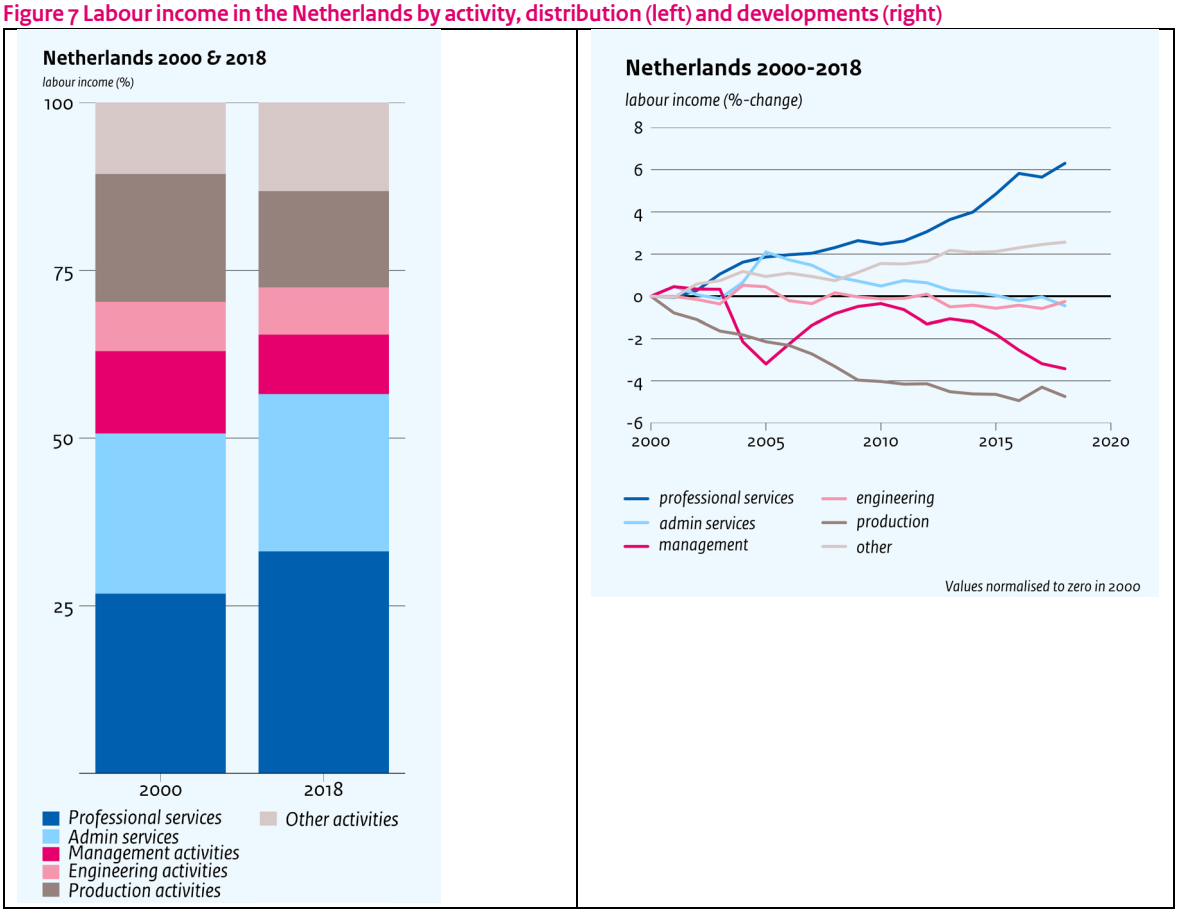
Table 3: List of industries

Manufacturing industries		Other industries	
Food products	(10T12)	Agriculture & Forestry	(01T02)
Textiles	(13T15)	Fishing	(03)
Wood products	(16)	Mining, energy	(05T06)
Paper & printing	(17T18)	Mining, non-energy	(07T08)
Petroleum products	(19)	Mining, services	(09)
Chemical products	(20)	Energy	(35)
Pharmaceuticals	(21)	Water & waste	(36T39)
Rubber & plastic products	(22)	Construction	(41T43)
Other mineral products	(23)	Wholesale & retail trade	(45T47)
Basic metals	(24)	Land transport	(49)
Metal products	(25)	Water transport	(50)
Computers & electronics	(26)	Air transport	(51)
Electrical equipment	(27)	Warehousing	(52)
Machinery	(28)	Postal services	(53)
Motor vehicles	(29)	Accommodation & food	(55T56)
Other transport equip.	(30)	Publishing, mail & video	(58T60)
Furniture & other	(31T33)	Telecom	(61)
		IT-services	(62T63)
		Financial services	(64T66)
		Real estate services	(68)
		Business services	(69T75)
		Administrative services	(77T82)
		Public administration	(84)
		Education	(85)
		Healthcare	(86T88)
		Arts & entertainment	(90T93)
		Other services	(94T96)

Appendix 3: Additional results

Figure 7 shows the developments of activity income in the entire economy, rather than just the activity GVC income as shown in figure 2. Both figures highlight similar trends: the growing significance of service activities, the declining role of production, and the increasing importance of professional services. However, when considering the entire economy, 'other activities', such as teachers and armed forces, account for a larger share of total income. Additionally, services become even more with professional and administrative services representing well over 50% of all activity income. Notably, management activities seem to have experienced a strong decline since 2010 .

Figure 7 Labour income in the Netherlands by activity, distribution (left) and developments (right)

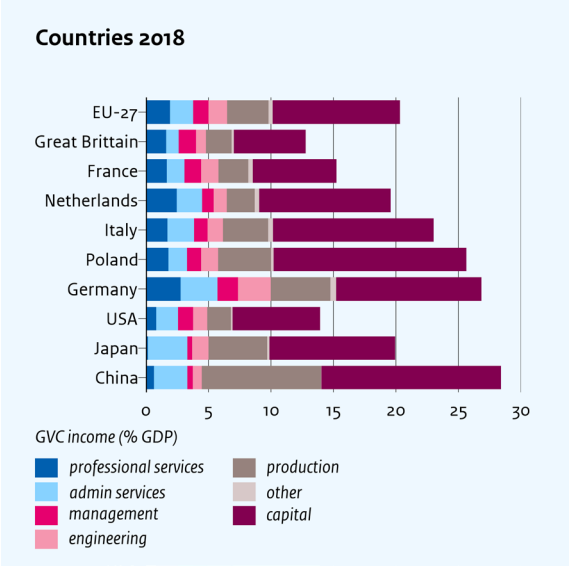


The total income derived from GVCs for manufactured goods in the Netherlands is around 20% of GDP, which is relatively average compared to peer countries (figure 8, in appendix 3). In some EU countries it is somewhat higher, e.g. in Germany (almost 27%), Poland (almost 26%) and Italy (23%), while in other countries it is much lower, e.g. in France (15%) and the UK (almost 13%). The GVC income is highest in China.

The contribution of capital to GVC income varies quite strongly between countries. This contribution flows from different types of productive assets. Buildings and machinery are important capital assets, but also computers, and even more intangible assets like software and brand-names. Capital income ranges from 60% (in Poland) to 43% (in Germany) of GVC income. The contribution of capital in the Netherlands has increased

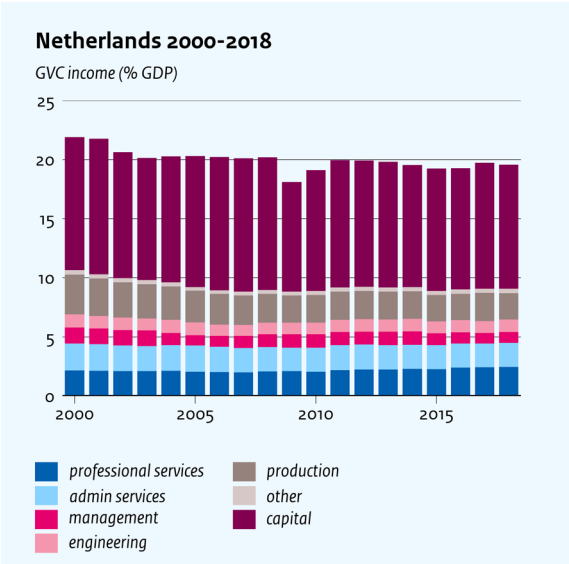
from 51% in 2000 to 54% in 2018 (figure 9), while the GVC income as share of GDP has decreased, from 22% in 2000 to 19,6% in 2018.

Figure 8: The Netherlands has a middle position in GVC income as share of GDP



Note: The figure shows the GVC income as a share of GDP and compares the Netherlands with other countries. It also includes the GVC income that the capital employed in GVCs for manufactured goods has generated

Figure 9 : capital earns as much GVC income as labour



Note: The figure shows the GVC income as a share of GDP for the Netherlands between 2000 and 2018.