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Regional innovation

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In this publication the Rathenau Instituut examines to what extent and in what manner research and innovation are becoming more regional and urban in the Netherlands, with its network of small and medium-sized cities.

Analysing the available data at urban and regional levels gives us a better understanding of regional hotspots of innovation. Such hotspots often have close ties with other cities and regions. That means that innovation in the Netherlands is much more broadly dispersed across regions than a focus on cities would suggest.

1 Introduction

The region is hot. While previous Dutch governments had already focused on devolving tasks to local and regional authorities, the third Rutte government has made a point of stressing the role of the region by promoting 'Region Deals' and joint investment by national and regional government.

Regions also play an increasingly prominent role in research and innovation policy. For example, the Province of Limburg is funding a research institute in Geleen, and the Brainport public-private partnership in the Province of Noord-Brabant is the driver behind a regional innovation ecosystem.

Cities and metropolitan areas worldwide are increasingly positioning themselves as innovation drivers. They claim that their liveliness and diversity attract growing concentrations of creativity, entrepreneurship and innovation (Florida, Adler, & Mellander, 2017).

Much of the interest in urban innovation capacity is based on research conducted in the United States and the United Kingdom (Glaeser, 2011; Katz & Bradley, 2013). However, Dutch and European policymakers are also taking a growing interest in the city as a platform for or driver of innovation, as the Dutch and EU Urban Agendas demonstrate. The Organisation for Economic Cooperation and Development (OECD) also identifies a growing importance of cities, calling the 21st century 'The Metropolitan Century' (OECD, 2015a).

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The Rathenau Instituut supports the formation of public and political opinion on socially relevant aspects of science and technology. It conducts research on this subject and organises debates on science and new technology.

2 Regional innovation

The question, however, is to what extent these claims and expectations also hold true for the Netherlands, which has a dense network of small and medium-sized cities situated within relatively short distances of one another. Is innovation also being concentrated in large cities here? And does innovation capacity differ from one Dutch city and region to the next? These are important questions, in view of policymakers' growing interest in the region and the shifting responsibilities of national, regional and local government, and given the question of whether regional differences in innovation capacity require region-specific policy.

The data that we have available mainly cover the regional distribution of innovation, with data on urban areas being limited. This leads us to the following findings:

1. Innovation is broadly distributed over the Netherlands. We find a concentration of innovation activity in thirty municipalities. Moreover, about half of all innovative enterprises are located outside these hotspots.
2. Dutch regions all perform well in EU benchmarks, with several ranked at the top. The score for the best-performing region, Utrecht,¹ is a third higher than the EU average, while the score for the worst-performing region, Friesland, is only 5% lower than the EU average.
3. When we zoom in on the nine Dutch top sectors, we see regional hotspots of innovation within the sectors. These are not isolated islands, however; they have strong ties with other Dutch regions that extend beyond their provincial borders:
 - Research and innovation in High Tech Systems & Materials is concentrated in the rectangle formed by the cities of Amsterdam, Enschede, Eindhoven and Delft.
 - The smaller triangle formed by Leiden, Utrecht and Amsterdam is important for Life Sciences & Health.
 - Wageningen is a centre of expertise for another top sector, Horticulture & Starting Materials, with links to Enkhuizen and the Westland region.
 - Much of the Agro & Food sector is concentrated around Wageningen as well, but it is also fairly broadly dispersed across the entire country.
4. We also note striking differences between regions:
 - The ratio between public and private investment in research and development (R&D).² Private investment far outstrips public investment in R&D in the provinces of Noord-Brabant and Limburg, whereas the opposite is true in the province of Groningen. The province with the largest R&D investment is Zuid-Holland.
 - Both startups and scale-ups tend to cluster in Amsterdam and environs, Rotterdam and Utrecht. These enterprises clearly prefer being located in a strong urban area. We see innovative enterprises all across the Netherlands, but the majority are situated in only thirty municipalities.
 - Cities, especially those with universities, have large working populations that have completed tertiary education, an important prerequisite for innovation and a location incentive for enterprises. Nevertheless, tertiary school graduates can be found all across the Netherlands.

2 Dutch regions in Europe

The European Union plays an increasingly important role in stimulating research and innovation.³ In recent years, the EU's regional policy has come to focus more and more on the role of regional and local authorities in boosting the Union's innovation capacity.

¹ Utrecht's strong position can be explained by the large percentage of people who have completed tertiary education, the large number of scientific and public-private co-publications, and the considerable amount in public funding that it spends on R&D.

² R&D is usually defined as creative work undertaken on a systematic basis in order to increase the stock of knowledge and the use of this knowledge to devise new applications (OECD 2015b).

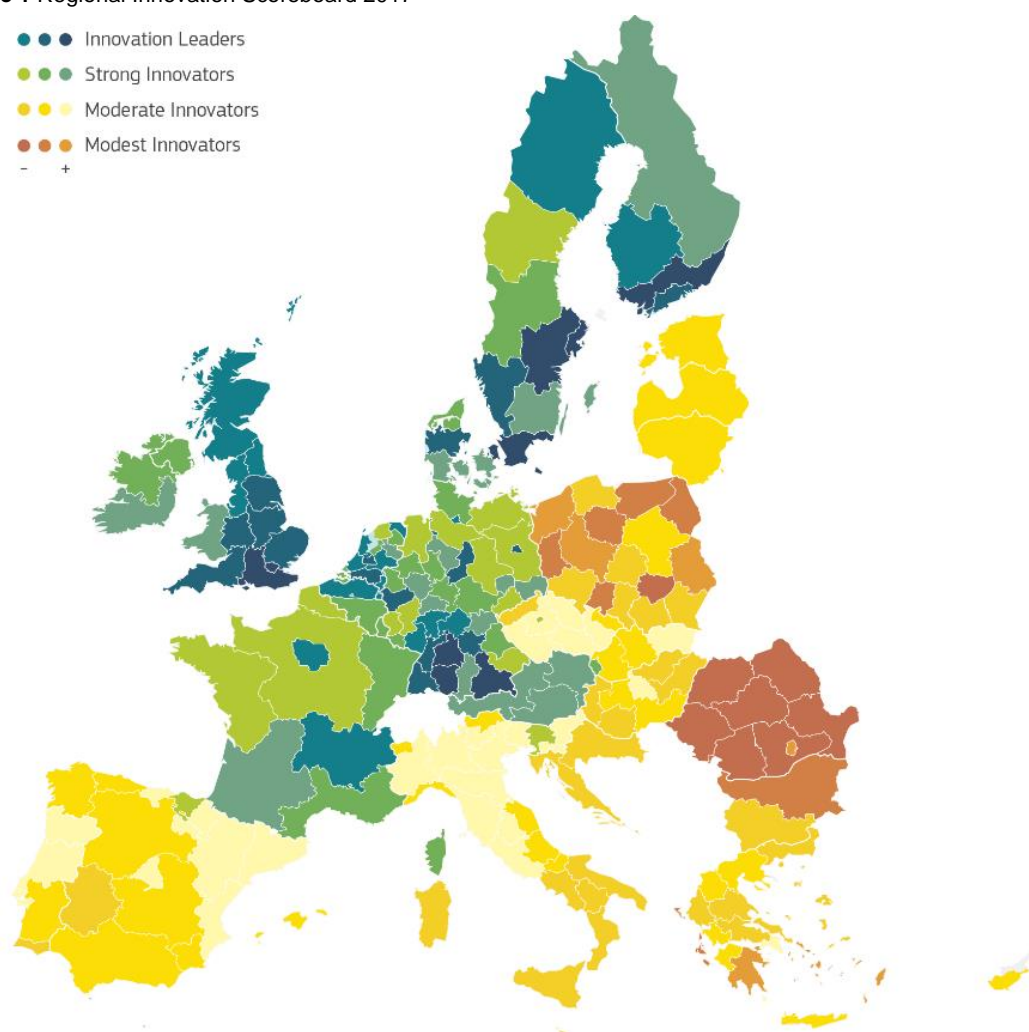
³ See also 'De Nederlandse wetenschap in de European Research Area' by the Rathenau Instituut (2016); <https://www.rathenau.nl/nl/nieuws/nederlandse-wetenschap-steeds-meer-europees>.

In order to qualify for funding from the European Regional Development Fund (ERDF), regions must develop research and innovation strategies for 'smart specialisation'. That means that Dutch regions must compete with other EU regions on research and innovation.

The question we answer in this section is: to what extent do the EU regions differ in terms of innovation performance and how are Dutch regions positioned in that regard? The Regional Innovation Scoreboard (RIS) offers useful indicators that can help us answer this question. It divides the EU's regions into four groups: Innovation Leaders, Strong Innovators, Moderate Innovators, and Modest Innovators.⁴

Figure 1 shows that there are considerable differences in regional innovation within the EU. Most of the Moderate and Modest Innovators are located in southern and eastern Europe. Innovation Leaders and Strong Innovators are located exclusively in western and central Europe.

Figure 1 Regional Innovation Scoreboard 2017



Source: European Commission, 2017

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⁴ The scoreboard is based on 18 indicators grouped into four main types (Framework Conditions, Investments, Innovation Activities, and Impacts). Scores on each indicator are benchmarked against the EU average, making it possible to assess whether a region is an Innovation Leader, a Strong Innovator, a Moderate Innovator, or a Modest Innovator. For a detailed description of the methodology and the full report, see http://ec.europa.eu/growth/industry/innovation/facts-figures/regional_nl.

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Dutch regions (i.e. the provinces) are relatively successful within the context of the EU. The worst-performing Dutch region, the province of Friesland, still has a regional innovation index score of 95% of the EU average and qualifies as a Strong Innovator (it should be noted, however, that even the weakest countries are classified as 'Modest' Innovators). Seven Dutch regions are among the top-scoring European regions and are Innovation Leaders, with scores ranging from 24% to 36.6% above the EU average. Utrecht has the highest score, followed by Noord-Brabant. While the classification into performance groups may suggest otherwise, the differences between the Dutch provinces are nevertheless considerable. Utrecht's score, for example, is 40 percentage points higher than Friesland's.

Table 1 How the Dutch provinces score on the Regional Innovation Scoreboard

	Regional Innovation Index		Performance group
	Score compared to other Dutch provinces	Score compared to other EU regions	
Utrecht	107.5	136.6	Innovation Leader
Noord-Brabant	102.5	130.3	Innovation Leader
Noord-Holland	100.4	127.5	Innovation Leader
Zuid-Holland	100.2	127.3	Innovation Leader –
Gelderland	99.2	126.1	Innovation Leader –
Groningen	98.4	125	Innovation Leader –
Limburg	97.6	124	Innovation Leader –
Overijssel	92.9	118	Strong Innovator +
Flevoland	86.2	109.6	Strong Innovator
Drenthe	83.5	106.2	Strong Innovator
Zeeland	81.5	103.6	Strong Innovator
Friesland	74.8	95	Strong Innovator

Source: European Commission. 2017

3 Differences between Dutch regions in innovation capacity

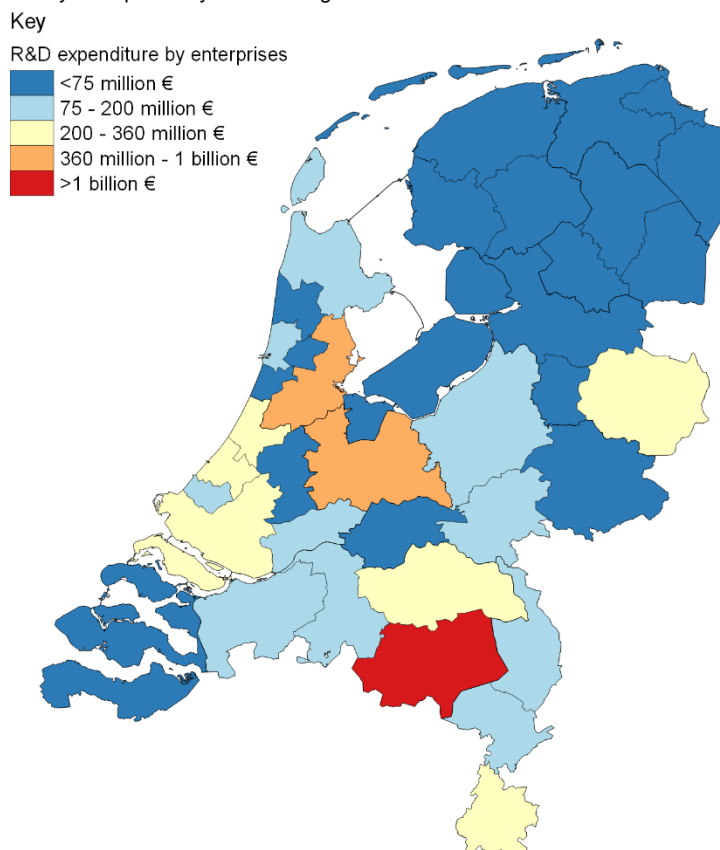
In the previous section, we considered the performance of Dutch regions within the EU and looked briefly at differences in innovation capacity. In this section, we address those differences at greater length. We start by considering the regional distribution of R&D expenditure in the private and public sectors. We then analyse the regional distribution of innovative enterprises, startups and scale-ups. Finally, we look at the presence of tertiary school graduates, as this is an important prerequisite for innovation.

3.1 R&D expenditure

R&D expenditure is an important indicator of technological innovation and innovation activity. The amount and intensity of R&D expenditure are often used as indicators of a national or regional capacity for innovation. One of the Dutch government's official policy objectives, for example, is to increase total R&D expenditure to 2.5% of the country's GDP by 2020, with 1.5% to be generated by the private sector.

Figure 2 shows that private R&D expenditure varies considerably between COROP regions, the forty Dutch regions used for regional research purposes since the 1970s. R&D expenditure by private enterprises tends to be concentrated around Amsterdam and Eindhoven, followed by Utrecht. Rotterdam, Enschede, Maastricht and Den Bosch-Oss trail by some distance. A further notable point is that private spending on R&D is limited in the three northernmost provinces of Groningen, Friesland and Drenthe.⁵

⁵ If we relate private R&D expenditure to regional domestic product, then the most R&D-intensive provinces are Noord-Brabant (2.29%), Limburg (1.32%) and Overijssel (1.15%). The provinces of Noord-Holland (0.82%) and Utrecht (0.59%) are considerably less R&D-intensive (European Commission, 2017).

Figure 2 R&D expenditure by enterprises by COROP region in 2015

Source: Statistics Netherlands. Adapted by the Rathenau Instituut.

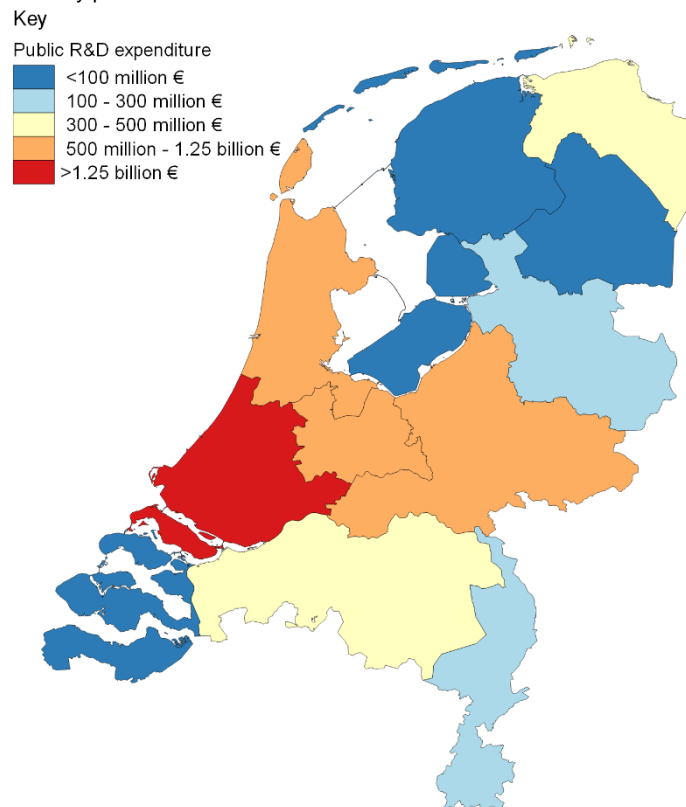
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Figure 3 shows how public R&D expenditure is distributed between the provinces.⁶ This refers to spending on R&D by research universities, university hospitals (UMCs), universities of applied sciences and public knowledge organisations such as the Netherlands Organisation for Applied Scientific Research (TNO). Most of this expenditure is concentrated in the province of Zuid-Holland, followed more distantly by Noord-Holland, Utrecht and Gelderland. Public spending on R&D is lowest in the four provinces that do not have a university.

In Figure 4, we combine public and private R&D expenditure. Zuid-Holland houses the largest amount of R&D expenditure, followed by Noord-Brabant and Noord-Holland. Gelderland and Utrecht follow at some remove. There are notable differences in the ratio between public and private expenditure. The pattern displayed by the province of Noord-Brabant is atypical, with 5.7 times as much private as public expenditure. Private-sector spending on R&D also surpasses public spending by a considerable margin in Limburg and Overijssel. The opposite is true in the provinces of Utrecht and Groningen: there, public spending on R&D outstrips private spending.

⁶ Unfortunately, there are no reliable figures on public R&D expenditure at COROP level.

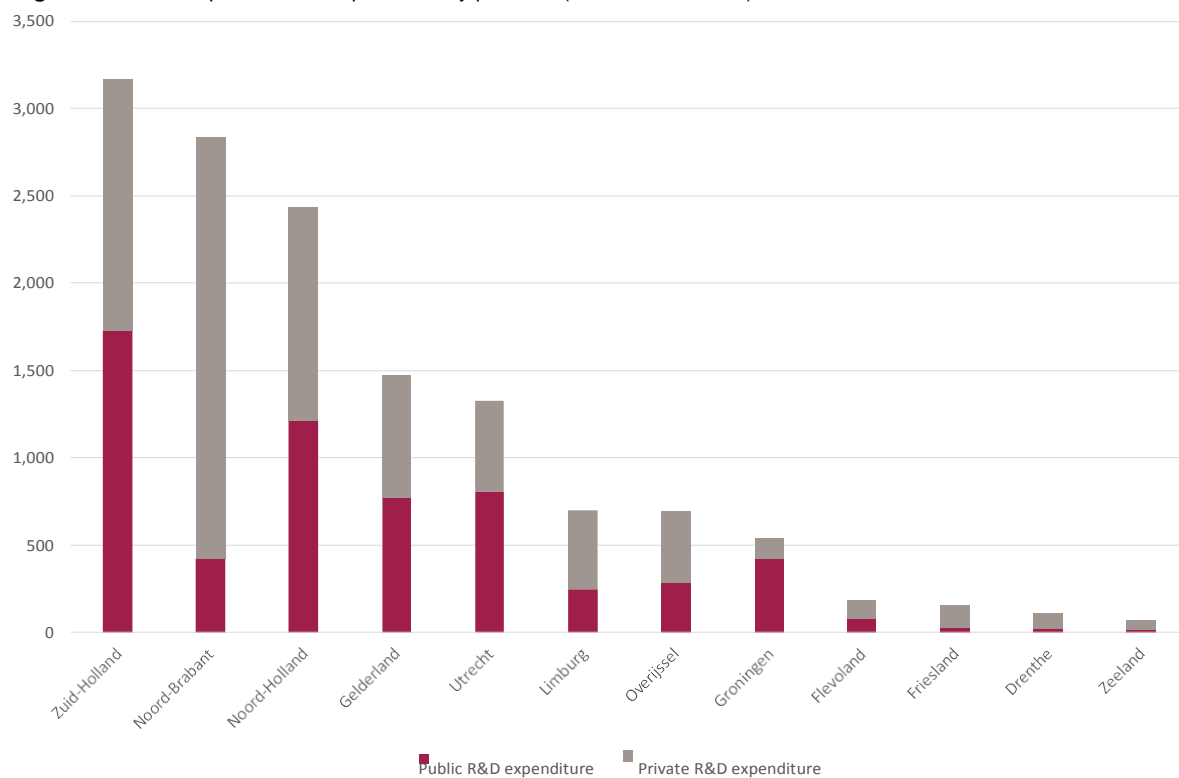
Figure 3 Public R&D expenditure by province in 2015



Source: Statistics Netherlands. Adapted by the Rathenau Instituut.

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Figure 4 Public and private R&D expenditure by province (in millions of euros) in 2015



Source: Statistics Netherlands. Adapted by the Rathenau Instituut.

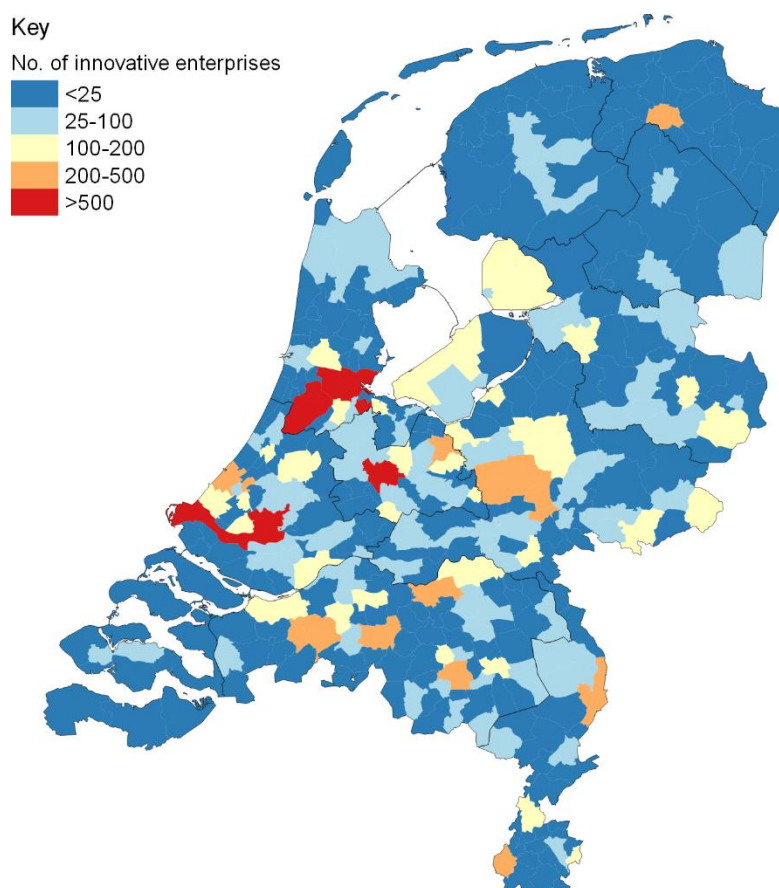
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3.2 Innovative enterprises

The *Community Innovation Survey* (CIS) that Statistics Netherlands organises every other year contains detailed information about the innovation efforts of enterprises. The CIS surveys innovation in the broad sense of the word. In addition to product and process innovation, it also includes organisational and marketing innovation. In other words, enterprises regarded as innovative in the CIS are not necessarily R&D-intensive.

The distribution of innovative enterprises shown in Figure 5 is roughly comparable to the distribution of private R&D expenditure in Figure 2. The innovative enterprises indicator is more nuanced, however, in part because the CIS data are available at municipal instead of COROP level (for example for R&D expenditure), but also because the indicator looks at innovation in the broad sense and not only at R&D. That is why, for example, the city of Groningen shows up as a relatively strong region for innovation in Figure 5, whereas it did not feature at all in Figure 2.

Figure 5 Number of innovative enterprises by municipality in 2014



Source: Statistics Netherlands. Adapted by the Rathenau Instituut.

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Figure 2 mainly revealed the differences between COROP regions; Figure 5 shows us that innovative enterprises also tend to concentrate within these regions. Half of all innovative enterprises are located in one of the thirty municipalities⁷ with the most innovative enterprises. Amsterdam, Rotterdam, Haarlemmermeer (Hoofddorp and Schiphol) and Utrecht stand head and shoulders above the rest when it comes to number of innovative enterprises within their boundaries; in total, they account for more than 15% of all innovative enterprises in the Netherlands. Next is a group of 16 municipalities with 200 to 500 innovative enterprises, followed by a group of more than forty municipalities with 100 to 200 innovative enterprises.

⁷ 19% of the municipalities with adequate data

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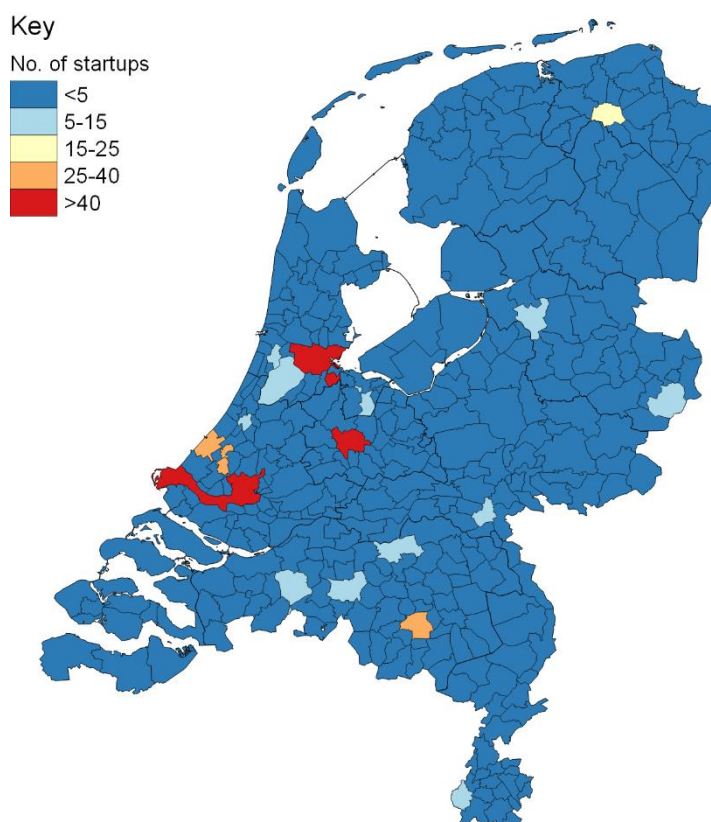
Innovative enterprises are clearly less prevalent in the three northernmost provinces (with the exception of the city of Groningen), Zeeland, and large areas of Overijssel and Limburg. The majority of municipalities have fewer than 100 innovative enterprises within their borders, but together these enterprises account for approximately half of the total number of innovative enterprises in the Netherlands.

Innovative enterprises are therefore concentrated in the larger cities, followed by a large group of municipalities. However, there are also many innovative enterprises located outside these municipalities and dispersed throughout the Netherlands.

3.3 Startups

Startups are young enterprises that have launched themselves in the market with an innovative product or service. Their locations can serve as an indicator for the regional distribution of innovation. We look specifically at startups with growth and upscaling aspirations, young enterprises that have based their product or service on a technological innovation and are attempting to acquire venture capital through various investment channels. We use the website dutchstartupdatabase.com, which provides access to a large number of Dutch startups. The public-private partnership StartUp Delta makes use of this database, for example. Although it is one of the more reliable databases, we remain cautious in our interpretation of the data. The database itself is not exhaustive; some of the startups listed there no longer exist, and new ones will have emerged since it was compiled. The database lists almost 1000 startups with known locations. The vast majority of these (75%) are located in large cities (mainly city centres). Most can be found in Amsterdam, followed by Utrecht and Rotterdam. Amsterdam dominates as a favoured startup location. Startups thus tend to be more highly concentrated than other enterprises. This indicator provides information about the regional distribution of innovation above and beyond the data on private R&D expenditure and number of innovative enterprises.

Figure 6 Number of startups in Dutch cities, mid-2017

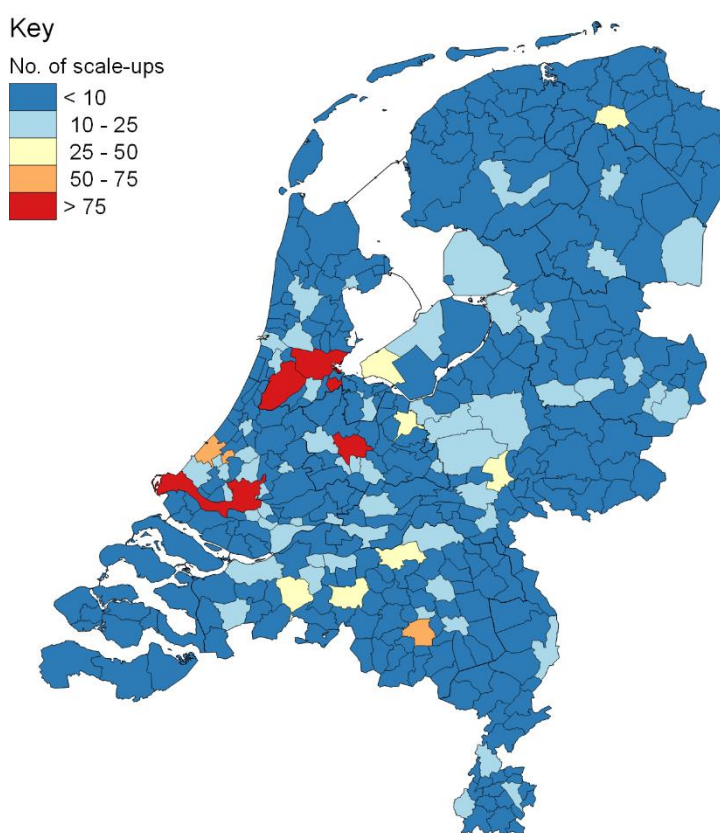


3.4 Scale-ups

In addition to startups, scale-ups are another indicator for innovation. Scale-ups are defined as enterprises that have experienced a 20% or more increase in revenue and/or number of employees over a three-year period. They must have a minimum of ten employees or a minimum of 5 million euros in revenue at the start of that period. To determine where these fast-growing enterprises are located, we use the Scale-Up Dashboard developed by the Erasmus Centre for Entrepreneurship.

As in the case of startups, we see that scale-ups are concentrated mainly in more urban areas. Amsterdam, Rotterdam and Utrecht once again head the list, but there are also many scale-ups in Eindhoven and The Hague. The most notable municipality on our map is Haarlemmermeer, which ties with Utrecht in having the third largest number of scale-ups after Amsterdam and Rotterdam. These scale-ups are concentrated around Schiphol Airport, an area that Statistics Netherlands categorises as a highly urbanised area based on the density of individual addresses (in this case particularly business addresses).

Figure 7 Number of scale-ups in the Netherlands in 2016



Source: Prof J. Jansen. Scale-Up Dashboard 2016. Erasmus Centre for Entrepreneurship. Adapted by the Rathenau Instituut.

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3.5 Percentage of tertiary school graduates in the labour force

A skilled workforce is an important prerequisite for research and innovation. It is crucial to technological innovation and to the ability to organise innovation.⁸ The importance of a good education applies across all educational levels and study programmes. The indicator that we use to identify approximately where 'human capital' is located is *Percentage of labour force (15-74 years) with completed tertiary education (higher professional/academic)*. One reason for using this indicator is that much is expected of tertiary school graduates when it comes to research and innovation. They play an important role in generating new ideas, in turning ideas into innovations, and in introducing innovations developed elsewhere within their own organisations.

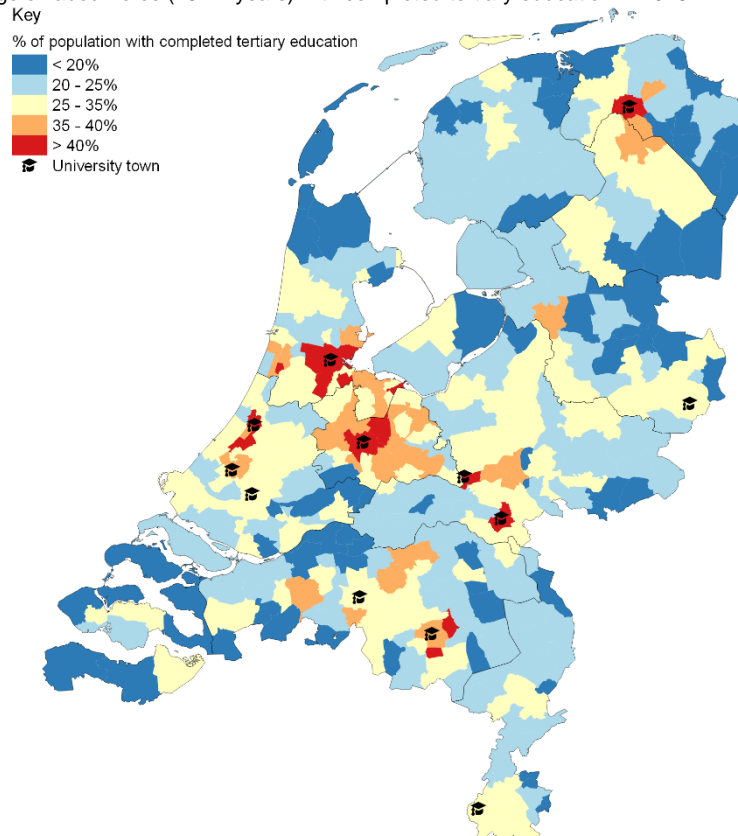
⁸ Research conducted by Erasmus University shows that technological advances account for only a quarter of innovation, whereas the capacity to organise innovation accounts for three quarters (Erasmus Concurrentie en Innovatiemonitor, 2017).

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The indicator offers an overall picture of where tertiary school graduates live and work. Because it basically assigns all tertiary school graduates to the same category, we cannot distinguish between the various study programmes or the type of work that these graduates do. In reality, each region has its own, specific human capital needs. A region that has many high-tech enterprises, for example around Eindhoven, will need employees with a technical background (although not exclusively), whereas a service economy such as Utrecht will require a more diverse mix of educational backgrounds.

The available dataset allows us to analyse the percentage of tertiary school graduates at municipal level. The map below shows where these people live. We see that they tend to congregate in metropolitan areas, such as Amsterdam, Rotterdam and Utrecht. We also see that cities such as Leiden, Eindhoven, Groningen and Nijmegen have many tertiary school graduates in their populations thanks to the presence of universities there, with graduates tending to remain after receiving their degrees. Human capital is therefore concentrated mainly in larger cities, but also in the surrounding municipalities.

Figure 8 Percentage of labour force (15-74 years) with completed tertiary education in 2016



Source: Statistics Netherlands. Adapted by the Rathenau Instituut.

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4 Sector differences

In this section, we look at how the regional distribution of research and innovation differs from one economic sector to the next. To what extent do sectors, and more particularly the Dutch top sectors, differ in terms of the regional distribution of innovation? We analyse the four largest sectors, measured by the share that they receive of the total sum in allowances awarded to public-private partnerships (under the PPP Allowance Scheme). They are:

- High Tech Systems & Materials (HTSM);
- Life Sciences & Health (LSH);
- Horticulture & Starting Materials (HPM), and
- Agro & Food.

We use these four top sectors to show how the regional distribution of research and innovation differs from one sector to the next, with each sector displaying a different pattern.⁹ Figure 9 shows the PPP allowance received, the number of innovation projects undertaken by small and medium enterprises active in the sector – these are the ‘Top Sector SME Innovation’ (MIT) projects – and the partnerships formed within the Top Consortia for Knowledge and Innovation (TKIs) for these four top sectors.

Maps 9.1a to 9.4a show the PPP allowance for each of the four top sectors. The allowance is an important instrument for the national government to promote innovation in these and other top sectors. It stimulates public-private partnerships within the TKI programmes by paying a bonus on top of the private contribution that enterprises make to PPP projects. The TKIs pass on the allowance to the participating public knowledge organisations, where it is spent.

Maps 9.1b to 9.4b show the distribution of MIT projects. MIT is a funding scheme that supports SME innovation projects in the top sectors. It serves as a second indicator for the regional concentration of research and innovation by sector.

Maps 9.1c to 9.4c show the partnerships between enterprises and/or knowledge institutions within the TKIs. Whereas the two previous indicators provided information about the location of knowledge institutions and SMEs active in the top sectors, these maps show which regions tend to work together within a sector.

⁹ Maps for the other top sectors are available at <https://www.rathenau.nl/nl/page/bijlagen-bij-feiten-cijfers-regionale-innovatie>

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Figure 9 PPP allowance received (2012-2016), number of MIT projects (2013-2016), and number of TKI partnerships (2012-2016) in the top sectors High Tech Systems & Materials (HTSM) and Life Sciences & Health (LSH).

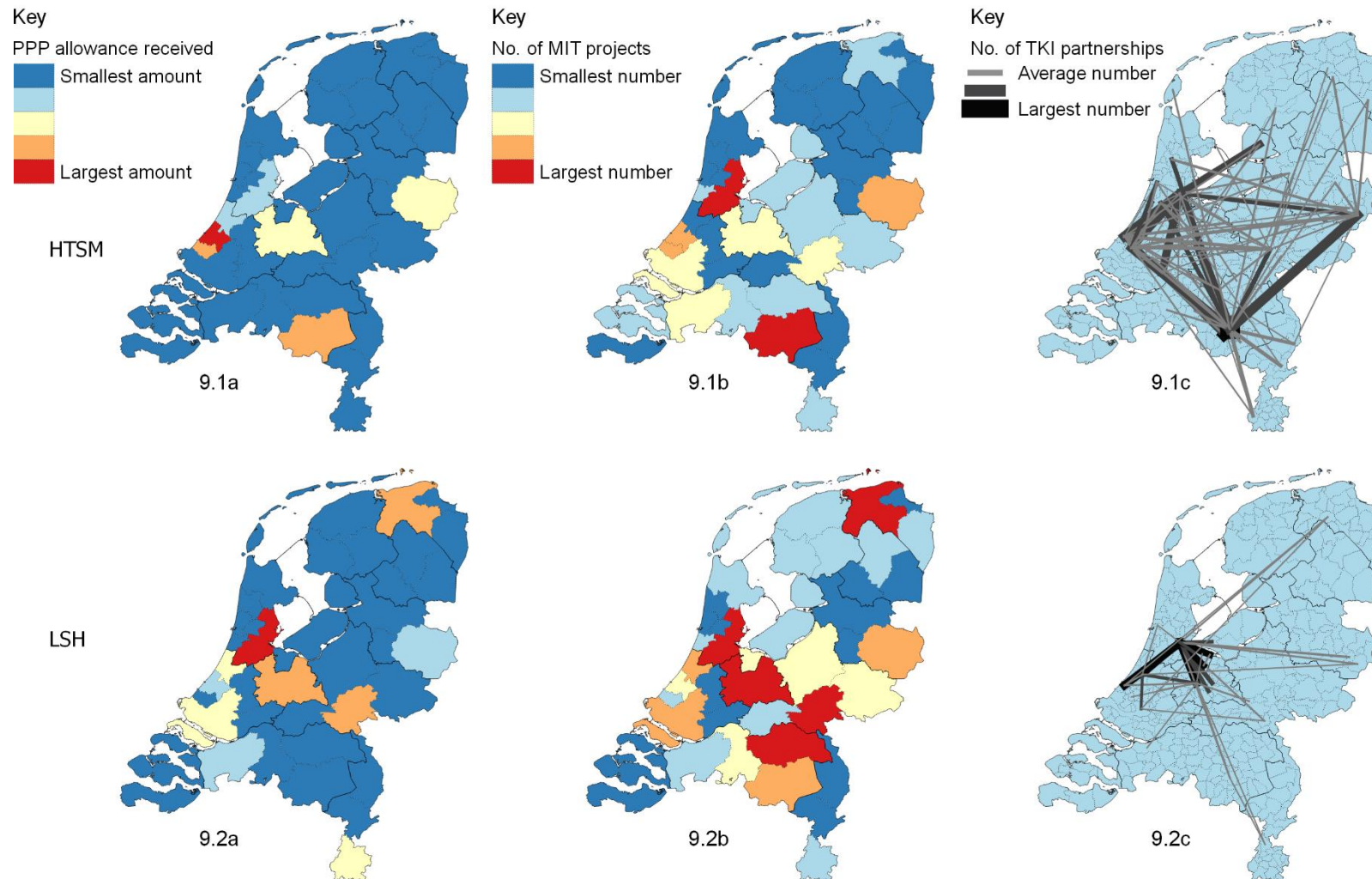
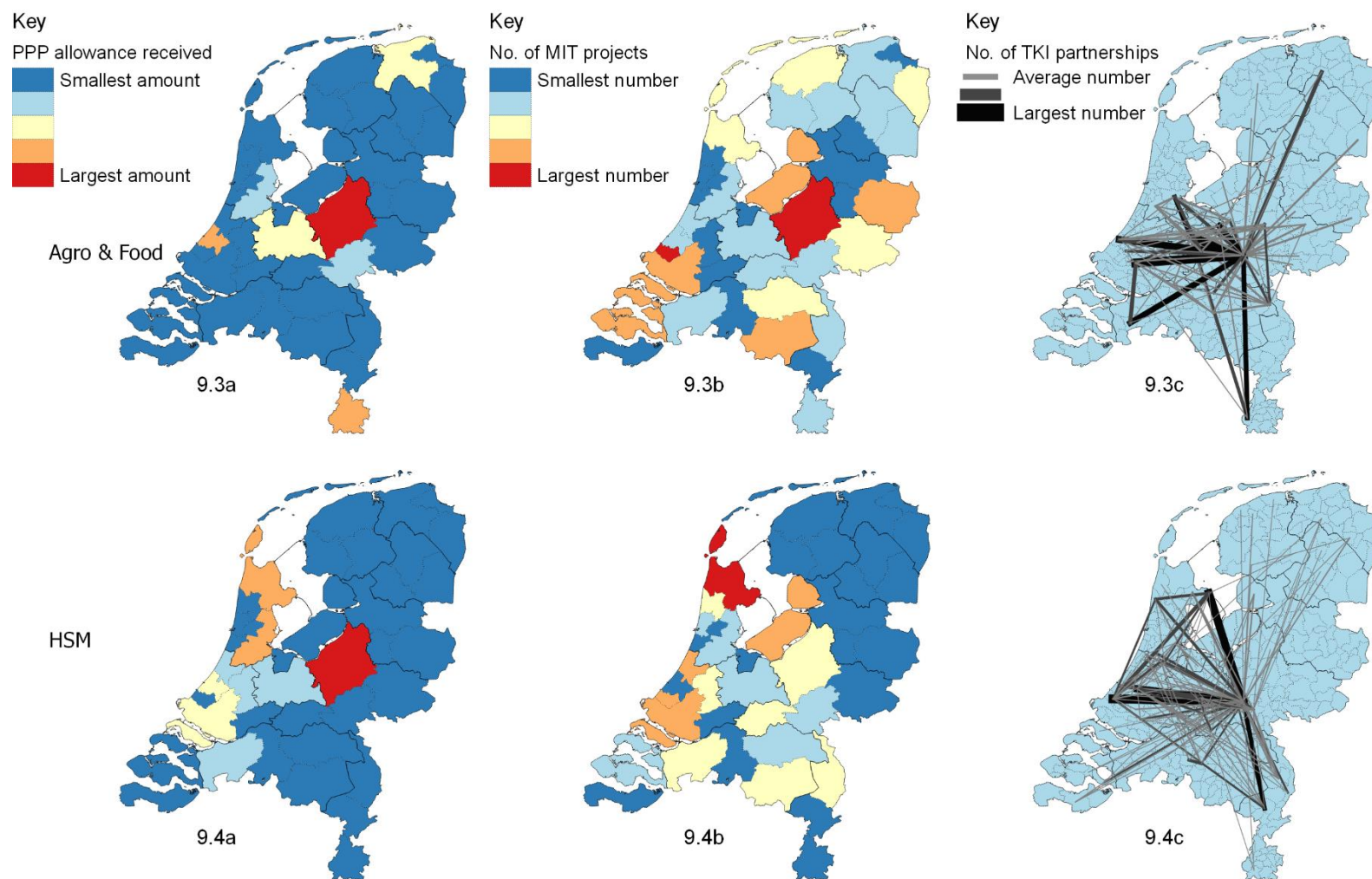


Figure 9 (continued) PPP allowance received (2012-2016), number of MIT projects (2013-2016), and number of TKI partnerships (2012-2016) in the top sectors Agro & Food and Horticulture & Propagation Materials (HSM).



High Tech Systems & Materials

The role of the three universities of technology, in Delft, Eindhoven and Twente, is very clear in all three indicators. The fact that TNO's head office is located in The Hague explains why so many PPP allowances are paid out to projects there. TNO's own PPP projects are likely to be carried out by TNO's offices in Delft and Eindhoven. The most important partnership hubs are concentrated around the universities of technology, TNO, and in Amsterdam, which – although it receives a small share of the total amount paid out in PPP allowances – has many innovative SMEs in the HTSM sector. There are also hubs in Dordrecht and the Noordoostpolder region.¹⁰ On the whole, the HTSM sector is situated largely within the diamond formed by Amsterdam, The Hague/Delft, Eindhoven and the Twente region.

Life Sciences & Health

Amsterdam plays a key role in the Life Sciences & Health sector, followed by Utrecht, Nijmegen and Groningen. In addition, there are a large number of MIT projects around 's-Hertogenbosch, Leiden, Rotterdam, Eindhoven and Enschede. Regions with a university medical centre or other large hospital and with a university of technology are most prominent. We can explain the lack of PPP allowances awarded in the 's-Hertogenbosch region by the absence of specialist institutions there, although there are innovative Life Sciences & Health SMEs active in Pivot Park Oss. The same pattern can be found in the Eindhoven region, albeit to a lesser extent; Eindhoven University of Technology does not specialise in LSH.

Agro & Food and Horticulture & Starting Materials

Wageningen UR is by far the most important centre of expertise for the top sectors Agro & Food and Horticulture & Starting Materials. The Veluwe and Westland regions are the most important locations for SMEs in Agro & Food, but the Flevoland, Twente, southeast Noord-Brabant, Rijnmond and Zeeland regions all have a relatively large number of MIT projects. Innovative SMEs in the HSM sector are located mainly in the northern part of the Province of Noord-Holland and in the Westland region, both of which host many seed companies. Rotterdam, the bulb-growing area ('Bollenstreek') and the Province of Flevoland are also clearly important. While HSM is mainly concentrated in Wageningen and the northern part of Noord-Holland, the Agro & Food sector is more dispersed, with hubs in Rotterdam, The Hague, Utrecht, Roosendaal, Maastricht and Groningen.

The general impression is that the PPP allowance is awarded mainly in regions with knowledge institutions that specialise in the relevant area of innovation, and that MIT funding shows the same pattern of concentration to some extent, but is also dispersed to other regions. In other words, the public knowledge institutions are not always located in the same regions as the enterprises with which they have partnered. The TKI partnerships clearly show that alliances are forged across what are, for the Netherlands, long distances.

5 Final remarks

This publication shows the extent to which innovation is distributed regionally across the Netherlands. It should be noted that solid data sources allowing us to monitor local/regional innovation policy are still lacking, even though there is a growing volume of policy in that area. For example, we cannot perform detailed analyses based on data sources such as the Community Innovation Survey (CIS). That makes it difficult for regional and local governments to pursue a policy backed up by reliable figures. At a time when policymaking is being devolved to local government, it would be sensible to improve data collection at regional level so that regional innovation policy can be grounded in reliable information.

Using available data, we have shown that innovation is broadly dispersed across the Netherlands, with about half of all innovative enterprises located in thirty hotspots and the other half located in all the other municipalities taken as a group. In other words, research and innovation are not necessarily big-city phenomena in the Netherlands. Compared with their counterparts in the EU, all the Dutch regions are performing well, and some extremely well. If we consider various economic sectors independently, we see that innovation does tend to be more clustered, but that there are also stronger ties across municipal and provincial boundaries. The Netherlands' success in innovation is therefore the product of many different municipalities and regions working together.

¹⁰ The Netherlands Aerospace Centre (NLR) has a branch here.

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About this publication

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