

Innovativeness of the Netherlands relative to EU countries

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Executive Summary

The report compares the scores of the Netherlands on indicators of innovativeness from the European Innovation Scoreboard with the EU average scores over the period 2009-2016. We analysed systematic over- and underperformance of the Netherlands and the trends of these indicators over the years.

Over the whole period the Netherlands has been strong in conditions for innovation, particularly in knowledge production and public support, and in research collaboration between public research institutes and the private sector. The country strongly outperforms the EU average on many indicators related to government policy and activities of public research institutes in the field of innovation. The Netherlands also performs well on some of the business innovation activities, such as venture capital expenditures, opportunity-driven entrepreneurship, SMEs with product or process innovations and patent applications.

Relative weaknesses of the Netherlands remain in other aspects of the conversion of knowledge into successful innovations in the business sector. The Netherlands performs weak in investments in innovation by the business sector, in training of personnel in ICT, in design applications and in revenues generated with new products and services. The investment in R&D and revenues generated from innovation increase over time, but the Dutch business sector does not keep up with the rest of the EU, which grows significantly stronger in these respects. An exception to these negative trends are the investments by the business sector in public research, which is higher than the EU average but which is decreasing over time, and the number of small and medium-sized enterprises (SMEs) which report to have introduced product and process innovations, which is higher than the EU average and increases over time.

Due to the strong and improved position of the Netherlands in conditions for innovation, the Netherlands has improved its 5th position to the 4th position in the ranking and strengthens its position in the group of innovation leaders in the EU. Nevertheless improvement on the weak aspects mentioned above remains required. Firms should particularly invest in innovation management, to more effectively convert knowledge into successful innovation.

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Summary of results

Scores relative to the EU average

The Netherlands systematically scores higher than the average of the EU on many indicators:

- Overall: Summary Innovation Index
- Framework conditions
 - New doctorate graduates
 - Population aged 25-34 with tertiary education
 - Lifelong learning
 - International scientific co-publications
 - Top 10% most cited scientific publications
 - Foreign doctorate students
 - Broadband penetration
 - Opportunity driven entrepreneurship
- Investments
 - R&D expenditure in the public sector
 - Venture capital expenditures
- Innovation activities
 - SMEs with product or process innovations
 - SMEs innovating in-house (only recently higher)
 - Innovative SMEs collaborating with others
 - Public-private co-publications
 - Private co-funding of public R&D expenditures
 - PCT patent applications
 - Trademark applications
- Impacts
 - Employment in knowledge-intensive activities
 - Employment in fast-growing enterprises of innovative sectors
 - Knowledge-intensive services exports

On the other hand, the Netherlands performs systematically lower compared to the EU average on:

- Investments
 - R&D expenditures in the business sector
 - Non-R&D innovation expenditures
 - Enterprises providing training to develop or upgrade ICT skills of their personnel
- Innovation activities
 - SMEs with marketing and organizational innovations
 - Design applications

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- Impacts
 - o Medium and high tech product exports
 - o Sales of new-to-the-market and new-to-the-firm product innovations

Trends

The Netherlands shows a positive trend on many of the indicators that are already strong (see Appendix), but only in a few cases this positive trend is significantly more positive than the trend for the EU as a whole. These positive trends relative to the EU are:

- Lifelong learning
- International scientific co-publications
- SMEs with product or process innovations

Since the Netherlands already scored higher than the EU on these indicators, these trends mean that the Netherlands enlarges its lead in these areas even more.

In addition, the Netherlands shows a positive trend on some of the weak indicators, but the positive trend is never statistically significantly different from the average of the EU. In other words, the Netherlands does not catch up with the EU in those indicators. Even more problematic, the Netherlands even stays behind the average of the EU in an indicator that is already weak:

- Design applications

Conclusion

The results above mean that the Netherlands outperforms the EU average on all framework conditions for innovation. Many of these conditions refer to government activities and policies in the field of innovation. So, we may conclude that the Netherlands performs strong in the government and public sector providing the conditions for innovation.

The Netherlands also performs well on a number of indicators related to business innovation activities, referring to the conversion of knowledge into successful innovations. Examples are venture capital expenditures, opportunity-driven entrepreneurship, SMEs with product or process innovations, SMEs innovation in-house and private co-funding of public R&D expenditures. On the other hand, many of the weaknesses mentioned above are also related to the business sector. The Netherlands performs weak in investments in innovation by the business sector, in training of personnel in ICT, in design applications and in revenues generated with new products and services. The investment in R&D and revenues generated from innovation increase over time, but the Dutch business sector does not diminish its lag compared to the EU, which grows significantly stronger in these respects.

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In design applications, the Netherlands even shows a negative trend, and the number decreases more than in the rest of the EU, so we get more behind in that indicator too. Only last year the Netherlands improved its performance on this indicator. Another negative trend concerns the investments by the business sector in public research, which has been higher than the EU average in the past period, but which is now decreasing over time.

Due to the strong position of the Netherlands in conditions for innovation, the Netherlands has kept its 5th position in the ranking and remains part of the group of innovation leaders in the EU. Nevertheless improvements on the weak aspects related to business innovation mentioned above are required. Firms should particularly invest in innovation management, to more effectively convert knowledge into successful innovation.

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Methodology

We used data from the European Innovation Scoreboard, comprising the Netherlands and the EU average for the period 2009-2016. Systematic outperformance and underperformance of the Netherlands compared to EU was concluded from a t-test between the (non-missing) data points over the studied period. In-text we report the t-statistic (t), degrees of freedom ($df.$) and level of significance (p) respectively.

Using Generalized Least Squares regression with a correction for autocorrelation on the years at the Netherlands and EU level, we statistically analysed the trendlines per indicator for the Netherlands and for the EU, and we compared the trends for the Netherlands and the EU by means of interacting the two trendlines. We used $\alpha < 0.05$ as criterion for significance, although we sometimes concluded weak significance for $\alpha < 0.01$. When applicable, in-text we report the coefficient of the trendline (b), its standard error ($s.e.$) and the level of significance of the trend (p) respectively. For each indicator we provide a graph with the original data points for the EU and the Netherlands over the time frame. Note that these pictures do not include the statistically calculated trendlines, which are assumed to be linear.

The Scoreboard introduced several new indicators and removed some old ones. We indicate which indicators were new or revised.

Reading guide: The years in the charts are the publication dates of the European Innovation Scoreboard reports. The underlying data are usually from the previous year and for some indicators from 2-3 years before the publication dates.

Abbreviations used

EIS – European Innovation Survey

EU – European Union

GDP – Gross Domestic Product

EUIPO – European Union Intellectual Property Office

WIPO – World Intellectual Property Office

PPS – Purchasing Power Standard

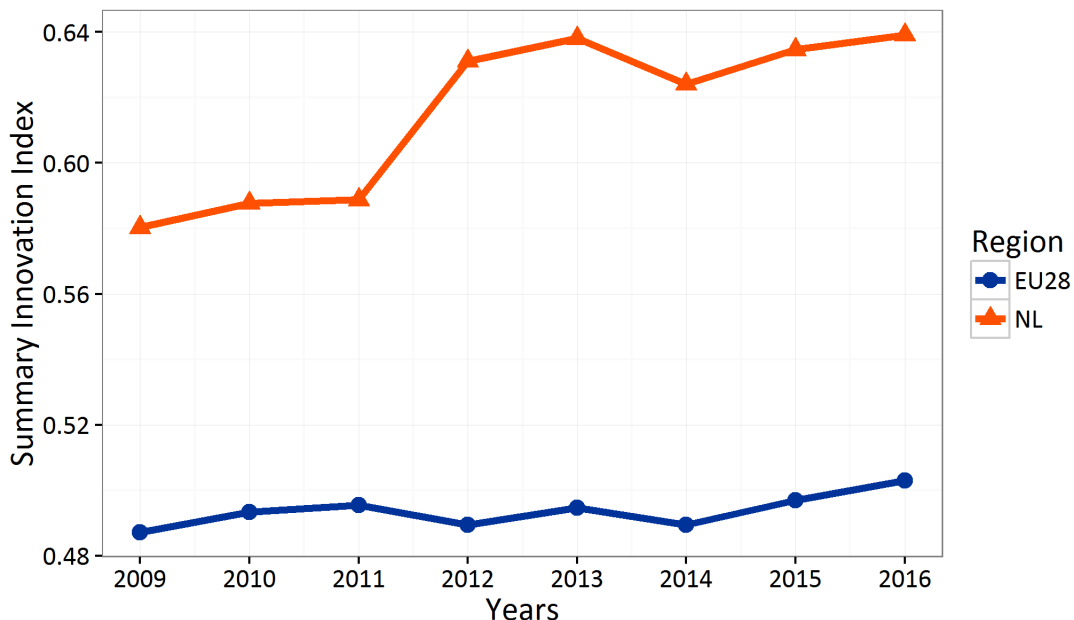
For this report, data were used from the European Innovation Scoreboard, European Commission, prepared by Merit, Maastricht, the Netherlands. We thank Hugo Hollanders from Merit for his kind co-operation.

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Summary Innovation Index

The Summary Innovation Index summarizes the range of different indicators of innovation and measures the innovation performance. The summary innovation index of the Netherlands was higher than the EU average over the whole period ($t = 13.35$, $df. = 7.56$, $p < 0.001$). In 2009 it was 19% higher than EU average. In 2013 had increased its lead to 29% of the EU average. Over the full period the Summary Innovation Index score of the Netherlands increased, with the exception of 2014, in which the index declined slightly by 2% as compared to the previous year. A decline of 1% in the EU average can also be observed in that year. In 2016 the average index score of the Netherlands was 27% higher than the EU average.

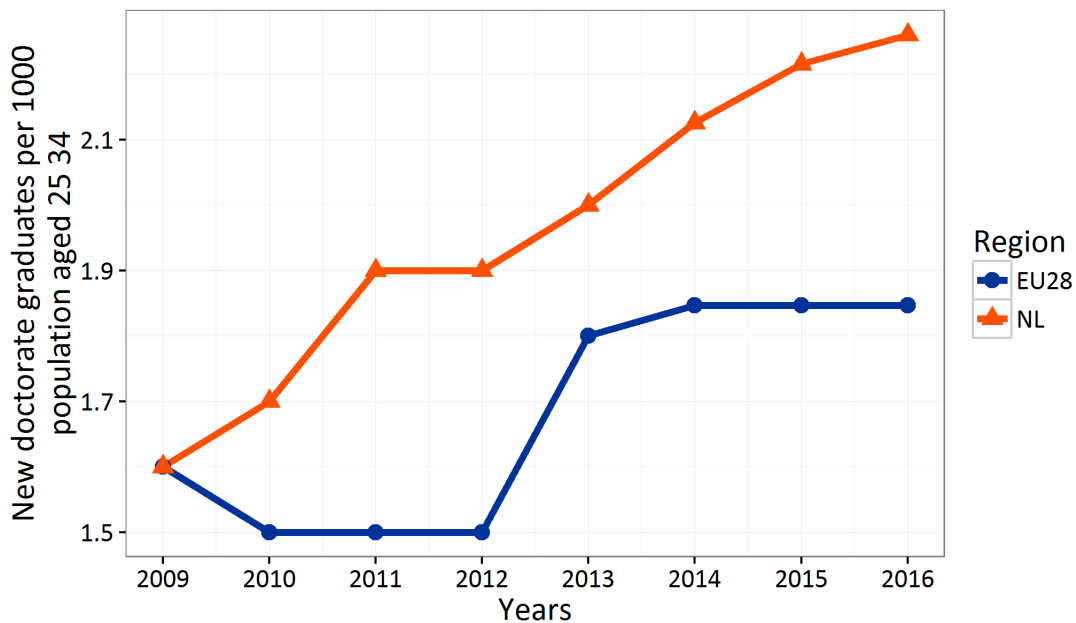
The observable trends in the figure below are positive for both the Netherlands and the EU. The score of the Netherlands increased 1.5% on average per year, while the score of the EU increased 0.5% on average per year. Only the trend of the Netherlands shows a significant increase over the full time period ($b = 0.009$, $s.e. = 0.002$, $p = 0.003$). The difference between the trend line of the Netherlands and the EU is significant ($b = 0.007$, $s.e. = 0.002$, $p < 0.05$).



New doctorate graduates

The indicator refers to new doctorate graduates per 1000 population aged 25-34. The score of the indicator for the Netherlands was higher than the EU average over the whole period ($t = 2.75$, $df. = 12.73$, $p = 0.02$).

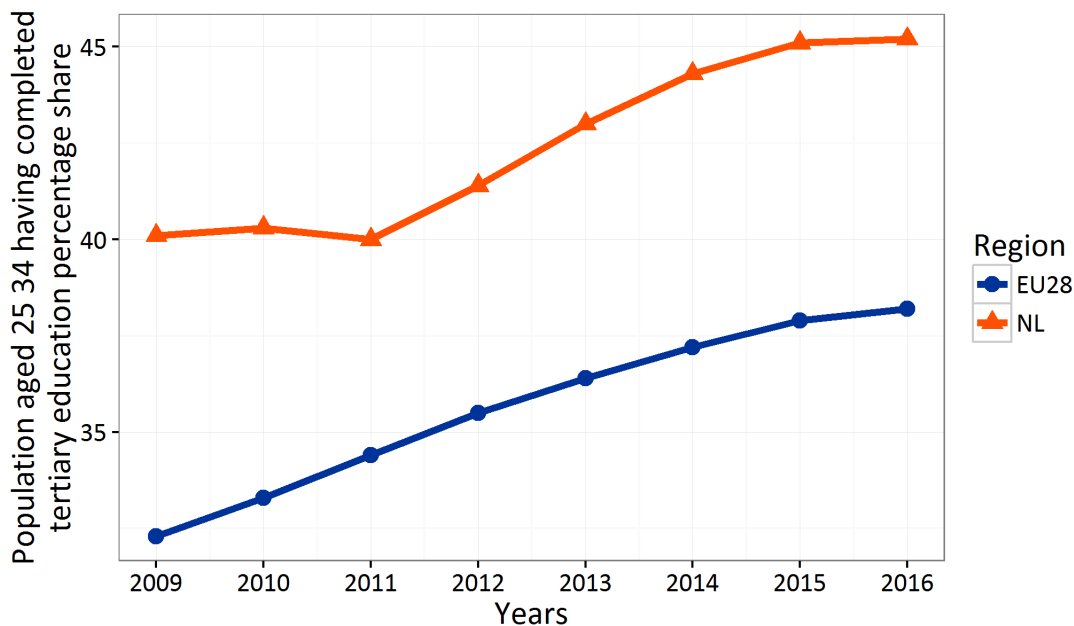
The general observable trends for both the Netherlands and the EU are positive over the full period. The score of the Netherlands increased 5.9% on average per year, while the score of the EU increased 2.2% on average per year. There is no significant increase or decrease of the score of the Netherlands relative to the EU, meaning that the positive trend of the Netherlands follows that of the EU over the given time period.



Population aged 25-34 with tertiary education (revised)

Population aged 25-34 with tertiary education refers to the percentage of the population aged 25-34 having completed tertiary education (revised¹). The percentage of population with tertiary education in the Netherlands is approximately 45% in 2016, which is 18% higher than the EU average. Over the whole period the percentage of population of the Netherlands with tertiary education was higher than the EU average ($t = 6.13, df. = 13.98, p < 0.001$).

Statistical analysis shows positive and significant trends for both the Netherlands ($b = 0.73, s.e. = 0.21, p < 0.01$) and the EU ($b = 0.84, s.e. = 0.21, p < 0.01$). The score of the Netherlands increased 1.8% on average per year, while the score of the EU increased 2.6% on average per year. On average there is no significant increase or decrease of the trend of the Netherlands relative to the EU over the time period.

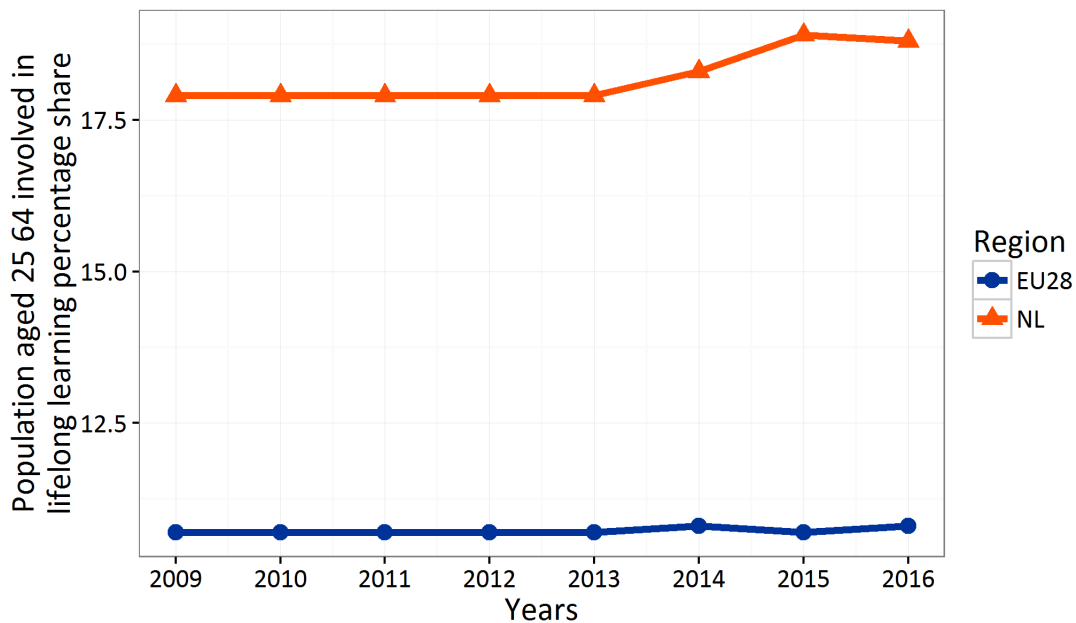


¹ The share of *Population having completed tertiary education* has been revised (compared to the previous version of the EIS) by increasing the age group from 30-34 to 25-34.

Lifelong learning (new indicator)

The indicator refers to the percentage of population aged 25-64 involved in lifelong learning (new indicator²). The score of the indicator for the Netherlands was higher than the EU average over the whole period ($t = 48.54, df. = 7.16, p < 0.001$). In 2013 the Netherlands had 17.9% of population involved in life long learning, whereas the EU average was 10.7%. In 2016 the average of the Netherlands had grown to 18.8%, whereas the EU average only to 10.8%.

Data for the period 2009-2012 for the Netherlands are missing³. We analyse the trend of the Netherland relative to the EU over the period 2013 to 2016. Over this period only the trend the Netherlands was positive and significant ($b = 0.32, s.e. = 0.09, p < 0.05$) and the increase of the trend of Netherlands relative to the trend of the EU was positive and weakly significant ($b = 0.29, s.e. = 0.13, p = 0.09$).



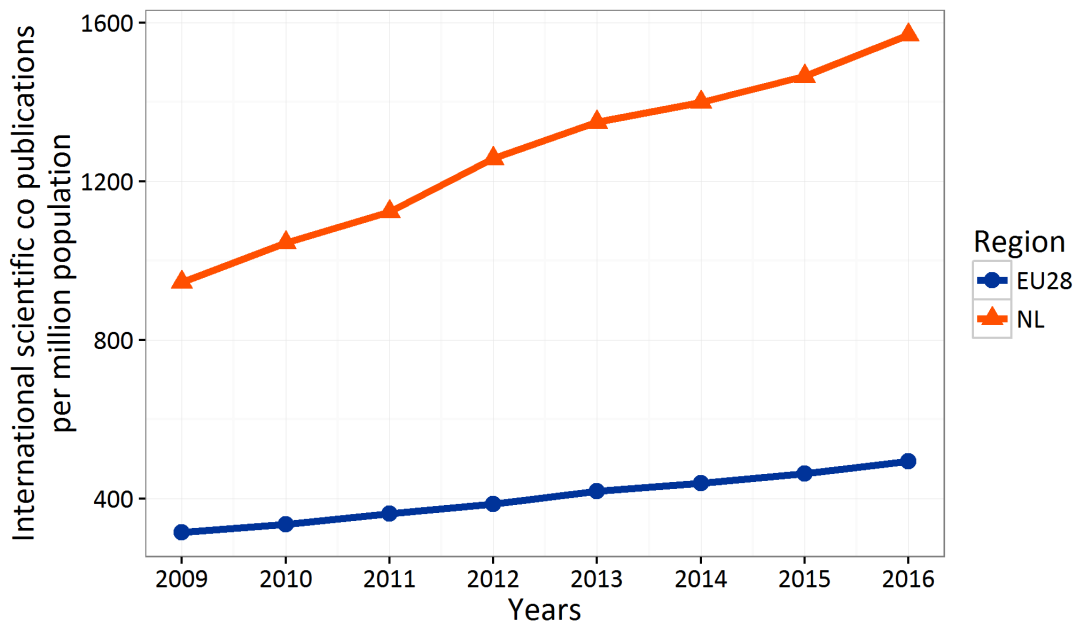
² New as compared to the previous version of the EIS. The indicator was also included in earlier versions of the EIS, but was removed from the 2010 report onwards.

³ The presented scores in the years 2009-2012 are equal to the score in the year 2013 and were used in the calculation of the Summary Innovation Index.

International scientific co-publications

The indicator refers to the international scientific co-publications per million population⁴. The indicator is a proxy for the quality of research. In 2016 the Netherlands had 1569 co-publications per million population, which is 66% higher than in 2009, presenting an average growth of 9.4% per year. The score of the indicator for the Netherlands was significantly higher than the EU average over the whole period ($t = 10.89$, $df. = 8.17$, $p < 0.001$). In 2016 the Netherlands had approximately 216% more international scientific co-publications per million inhabitants than the average EU country.

Statistical analysis indicates positive and significant trends for both the Netherlands ($b = 88.83$, $s.e. = 5.02$, $p < 0.001$) and the EU ($b = 25.51$, $s.e. = 5.02$, $p < 0.001$). The Netherlands showed significantly stronger growth in the number of international scientific co-publications than the EU ($b = 63.33$, $s.e. = 7.10$, $p < 0.001$).



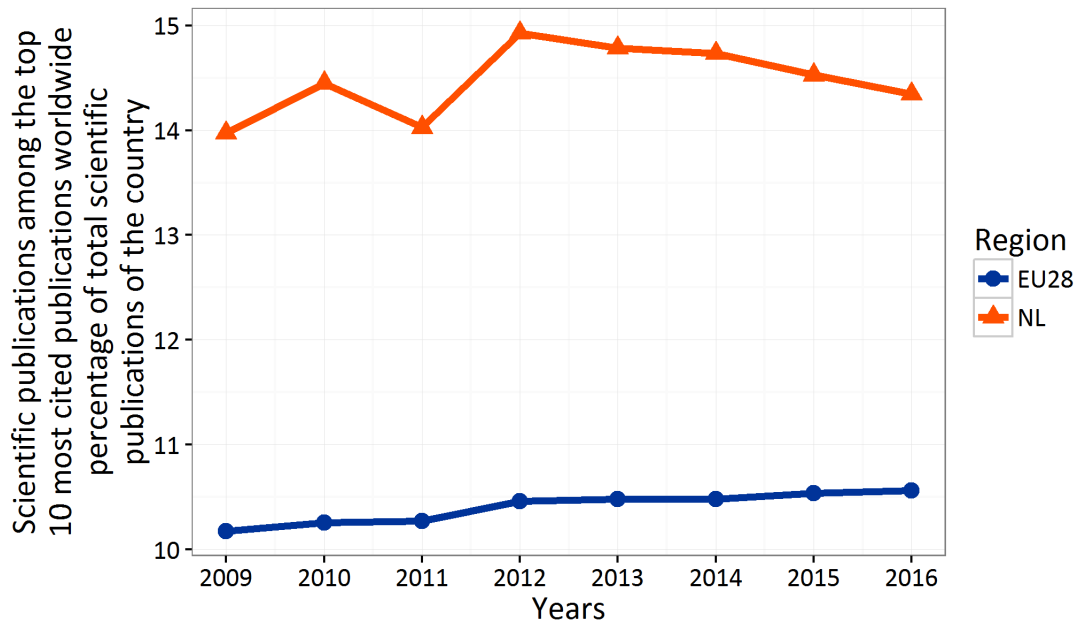
⁴ Number of scientific publications with at least one co-author based abroad (where abroad is non-EU for the EU28).

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Top 10% most cited publications

The indicator refers to the number of scientific publications among the top 10% most cited publications worldwide as percentage of total scientific publications of the country. The indicator is a measure for the efficiency of the research system, as highly cited publications are assumed to be of higher quality. The score of the indicator for the Netherlands was higher than the EU average over the whole period ($t = 30.62$, $df. = 9.42$, $p < 0.001$). Despite the fact that the Netherlands grew on the indicator with an average 0.38% per year, it has systematically declined since 2012. Over the full time period, the average growth of the EU countries was positive with 0.54% per year.

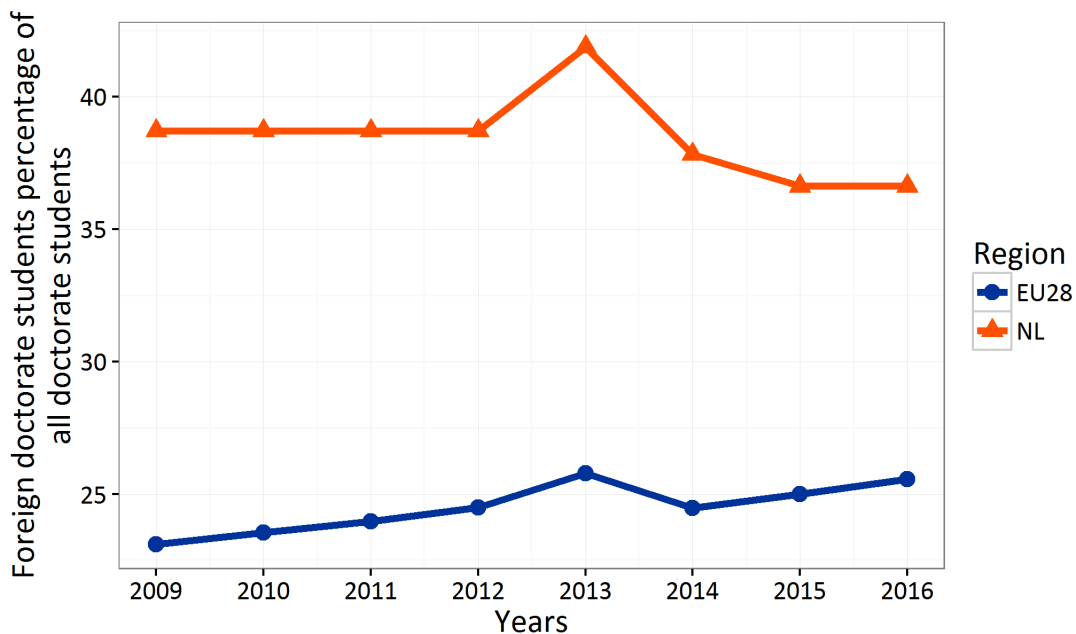
Statistical analysis shows no significant trend on the indicator for both the Netherlands and the EU over the full time period and no significant increase or decrease of the score of the Netherlands relative to the EU. Nevertheless, the trend of the Netherlands does show a significant decrease since 2012 ($b = -0.15$, $s.e. = 0.02$, $p < 0.001$) and this trend differed significantly from that of the EU ($b = -0.17$, $s.e. = 0.03$, $p = 0.001$).



Foreign doctorate students (revised)

The indicator refers to non-EU doctorate students as a percentage of all doctorate students (revised⁵). The indicator reflects the mobility of students as an effective way of diffusing knowledge. The Netherlands significantly outperformed the average EU country the whole period ($t = 20.85$, $df. = 11.09$, $p < 0.001$). The score of the Netherlands decreased 0.7% on average per year, while the score of the EU increases 1.5% on average per year.

For the Netherlands data between 2009-2011 are missing⁶. We analyse the trends over the period of 2012-2016. Over this period the trend for the Netherlands was negative, while the trend for the EU was positive. Statistical analysis indicates that neither trend line nor the difference between them is significant.



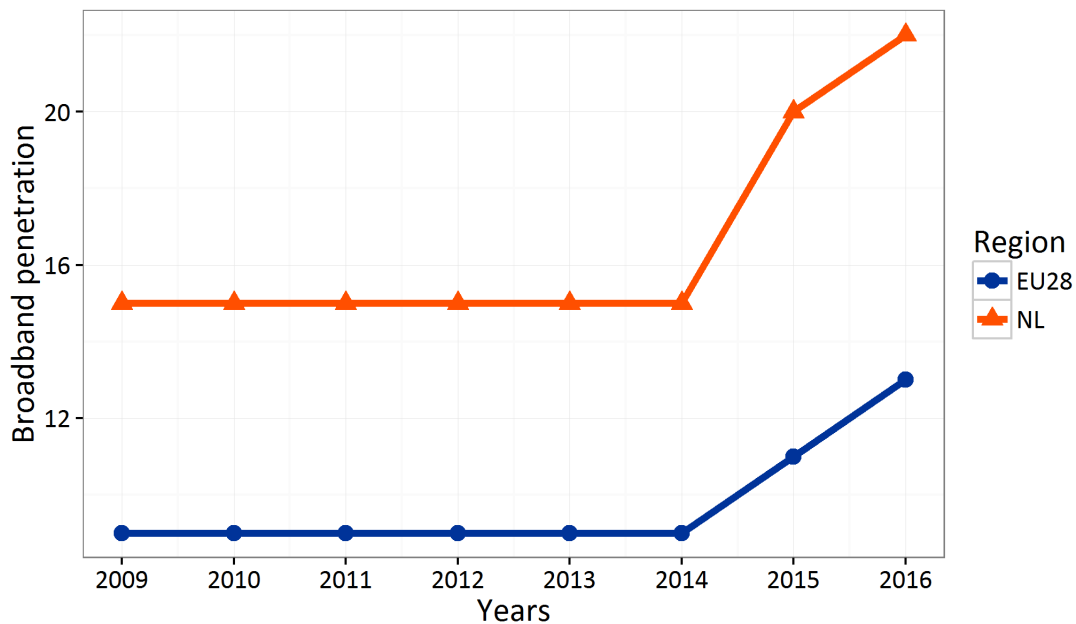
⁵ Indicator was revised (as compared to the previous version of the EIS) by not only capturing students with a citizenship of non-EU Member States, but including all students with a citizenship of any foreign country (thus also including other EU Member States).

⁶ The presented scores for the Netherlands in 2009-2011 years are equal to the score in the year 2012 and were used in the calculation of the Summary Innovation Index.

Broadband penetration (new indicator)

The indicator refers to the share of enterprises with a maximum contracted download speed of the fastest fixed internet connection of at least 100 Mbps (new indicator) and captures the increasing digitisation of European economies. Data are only available for the period 2014-2016. In those years the score of the indicator for the Netherlands was higher than the EU average ($t = 5.97$, $df. = 10.59$, $p < 0.001$).

Data are missing for 2009-2013⁷. The trends for both the Netherlands and the EU were positive in the years 2014-2016. Due to the lack of data statistical analysis of the trends cannot be conducted. Nevertheless, the score on the indicator seems to follow a general trend, as it increased with 47%, for the Netherlands between 2014 and 2016, which is similar to the 44% growth in the indicator for the average EU country.

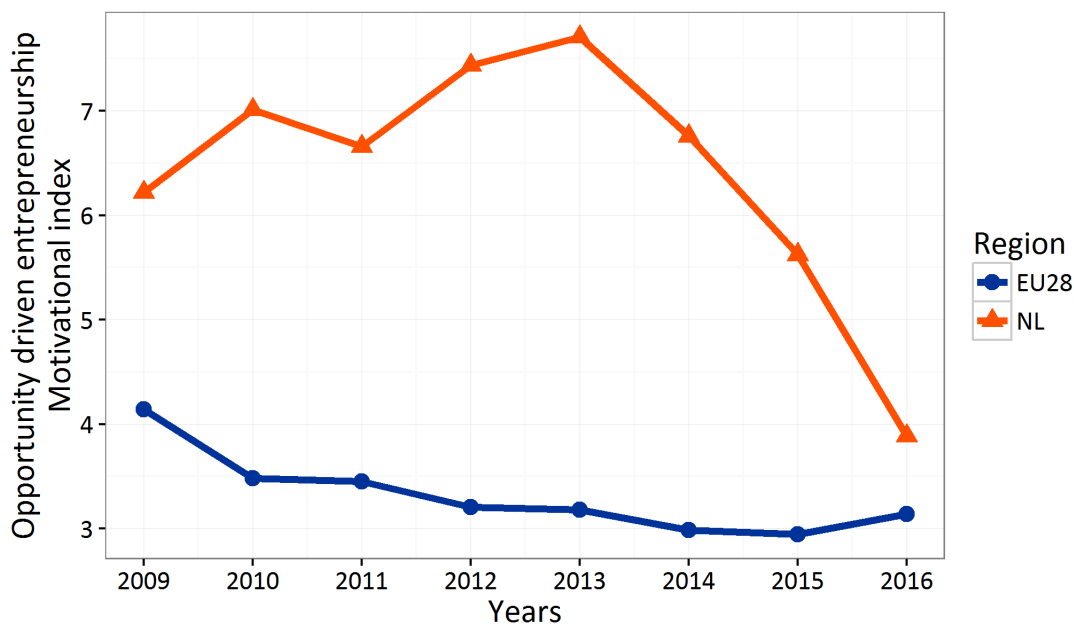


⁷ The presented scores in 2009-2013 years are equal to the score in the year 2014 and were used in the calculation of the Summary Innovation Index.

Opportunity-driven entrepreneurship (new indicator)

The indicator⁸ refers to the ratio between the share of persons involved in improvement-driven entrepreneurship and the share of persons involved in necessity-driven entrepreneurship (new indicator). Improvement-driven entrepreneurship refers to the generation of new business opportunities because of the attractiveness of those opportunities, and not because of unemployment risks of the entrepreneur. The score of the indicator for the Netherlands was higher than the EU average over the whole period ($t = 6.89$, $df. = 8.39$, $p < 0.001$). The score of the Netherlands decreased 5.4% on average per year, while the score of the EU decreased 3.46% on average per year. Where the Netherlands still scored 143% higher than the EU in 2013, this difference had declined to 24% in 2016.

Statistical analysis shows no significant trends for the Netherlands and the EU over the full time period, nor a significant increase or decrease of the score of the Netherlands relative to the EU. Statistical analysis of the trends of the period 2013-2016 shows a significant negative decline for the Netherlands ($b = -1.27$, $s.e. = 0.19$, $p < 0.01$). The Dutch score decreased significantly compared to the EU in that period ($b = -1.26$, $s.e. = 0.26$, $p < 0.01$).

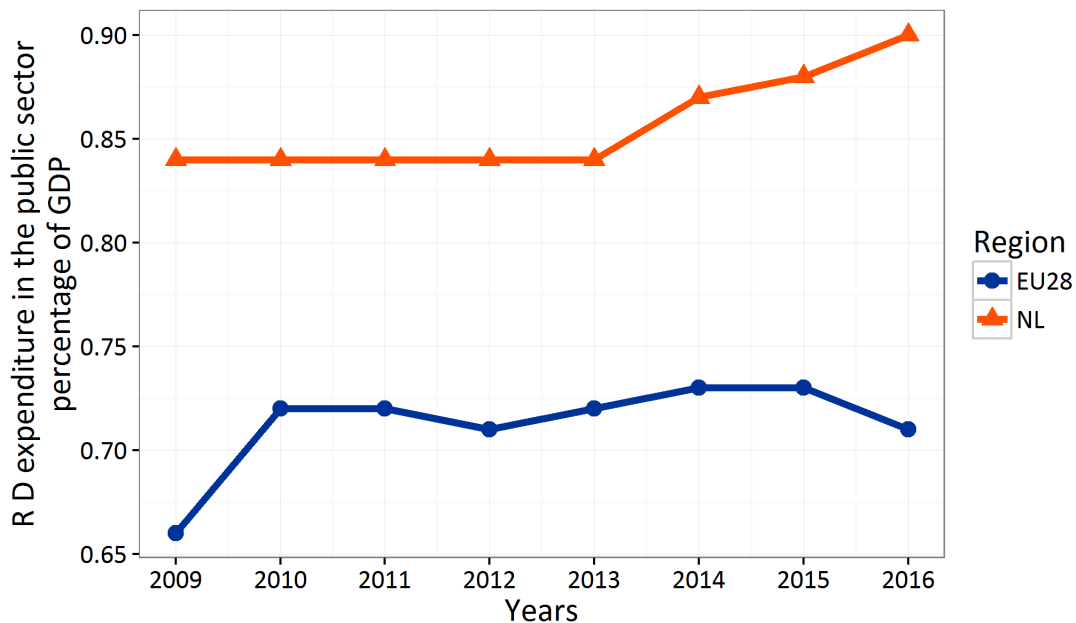


⁸ The original values for this indicator were replaced with their square root, to correct for skewness of the data (i.e. skewness above 1).

R&D expenditure in the public sector

The indicator refers to R&D expenditures in the public sector measured as a percentage of GDP. The indicator only includes direct investments in R&D, and does not include tax arrangements such as the WBSO and Innovation Box. The score of the indicator for the Netherlands was higher than the EU average over the whole period ($t = 12.39$, $df. = 13.95$, $p < 0.001$).

Data for the Netherlands are missing for the period 2009-2012⁹. Statistical analysis of the trend centers on the period 2013-2016 and shows a positive weakly significant trend for the Netherlands ($b = 0.02$, $s.e. = 0.01$, $p = 0.06$). There was weak evidence that the score of the Netherlands increased relative to the EU. Since 2013 the score of the Netherlands has increased with an average of 2.4% per year, while the score of the EU decreased with an average of 0.46% per year.



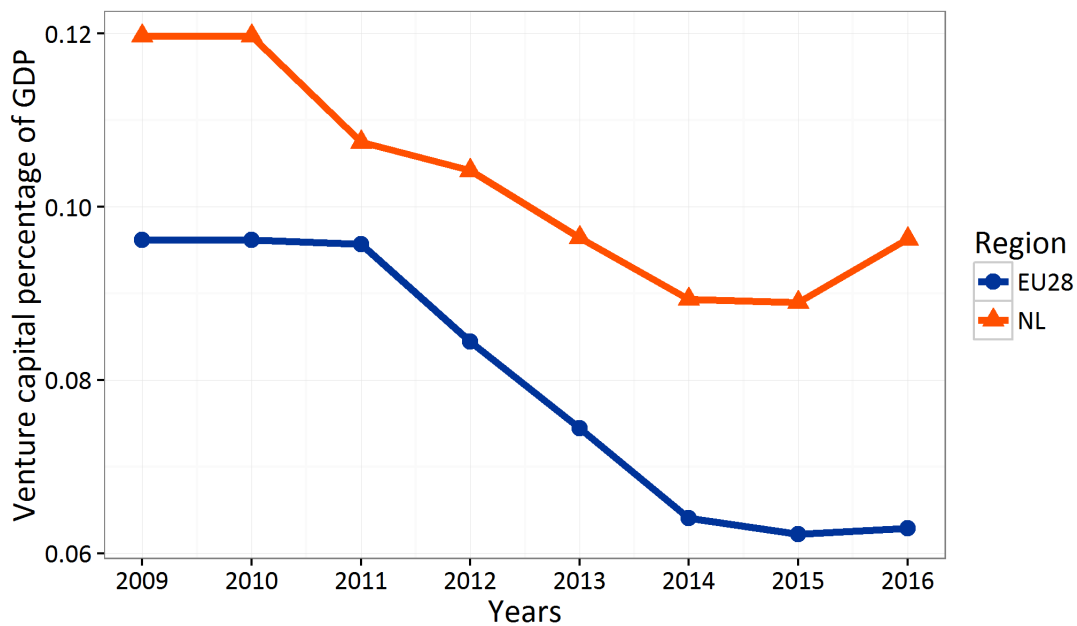
⁹ The presented scores in 2009-2012 years are equal to the score in the year 2013 and were used in the calculation of the Summary Innovation Index.

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Venture capital expenditures

The indicator refers to venture capital investments in early stage ventures as percentage of GDP. The amount of venture capital is a proxy for the relative dynamism of new business creation. The score of the indicator for the Netherlands was higher than the EU average over the whole period ($t = 3.33$, $df. = 13.29$, $p < 0.01$). The score of the Netherlands declined with an average of 3% per year, whereas the EU average declined with an average of 5% per year. Between 2009 and 2013, the Netherlands declined with 19.5% and the EU with 34.6%.

The Netherlands appears to follow the general negative trend of the EU over the time period. Although, notably 2016 could be a reversal of this trend for the Netherlands. Additionally, statistical analysis of the trends only shows a weakly significant negative trend for the EU ($b = -0.01$, $s.e. = 0.002$, $p = 0.06$). There is no significant increase or decrease of the score of the Netherlands relative to the EU.

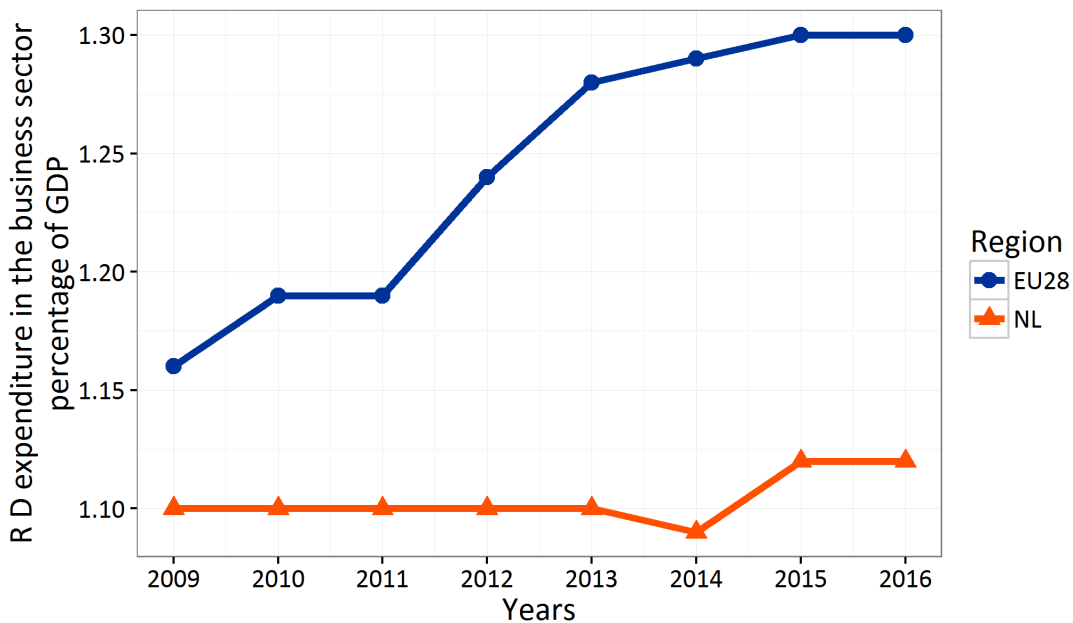


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R&D expenditure in the business sector

The indicator refers to spending on R&D by businesses and captures the formal creation of new knowledge within firms. The score of the indicator for the Netherlands was significantly lower than the EU average over the whole period ($t = -6.85$, $df. = 7.49$, $p < 0.001$).

Data for the Netherlands between 2009 and 2012 is missing¹⁰. We only analyse the trends in 2013-2016. In this period, the trends for both the Netherlands and the EU are positive but not significant. The score of the Netherlands increases 0.3% on average per year, while the score of the EU increases 1.7% on average per year. The score for the Netherlands did not increase or decrease significantly compared to the EU between 2013 and 2016.

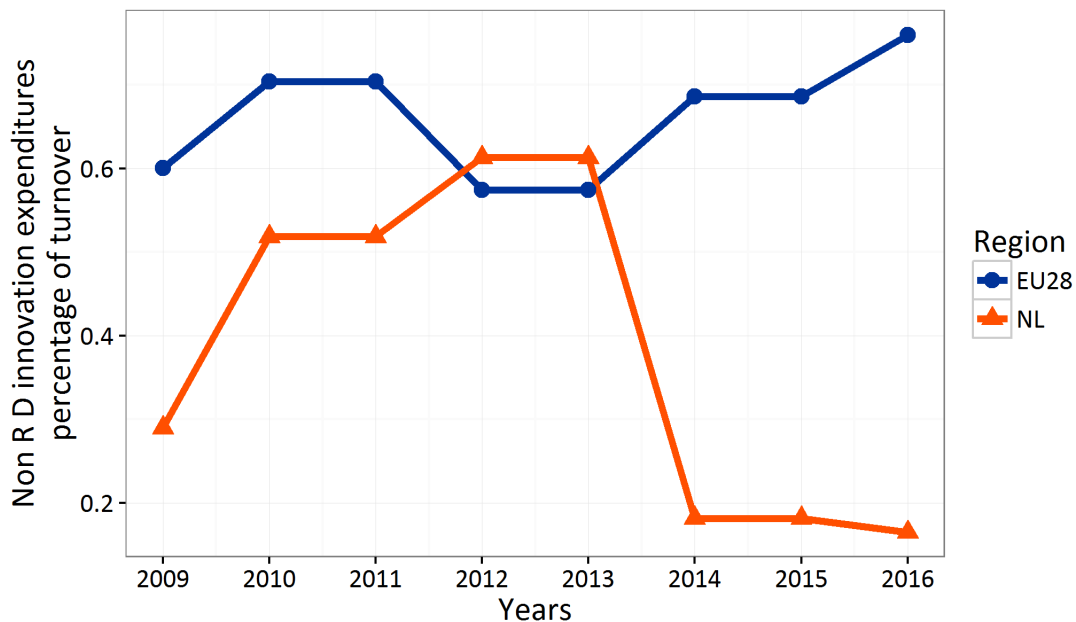


¹⁰ The presented scores in 2009-2012 years are equal to the score in the year 2013 and were used in the calculation of the Summary Innovation Index.

Non-R&D innovation expenditures

The indicator refers to non-R&D innovation expenditures, as a percentage of total turnover of companies. These expenditures can relate to the acquisition of new equipment, patents or licenses. The score of the indicator for the Netherlands on average was lower than the EU average over the period ($t = -3.69$, $df. = 8.64$, $p < 0.01$). In spite of upward fluctuations, the score of the Netherlands decreased on average 6% per year. Simultaneously, the score of the EU increased by 3.7% on average per year. In 2016 the score of the Netherlands on this indicator was 78% lower than that of the average EU country, while in 2013 the score was still 6.7% higher, representing a decline of more than 70%.

Because of the fluctuations of the indicator, statistical analysis shows no significant trends for both the Netherlands and the EU over the time period 2009-2016, and no significant increase or decrease of the score of the Netherlands relative to the EU.

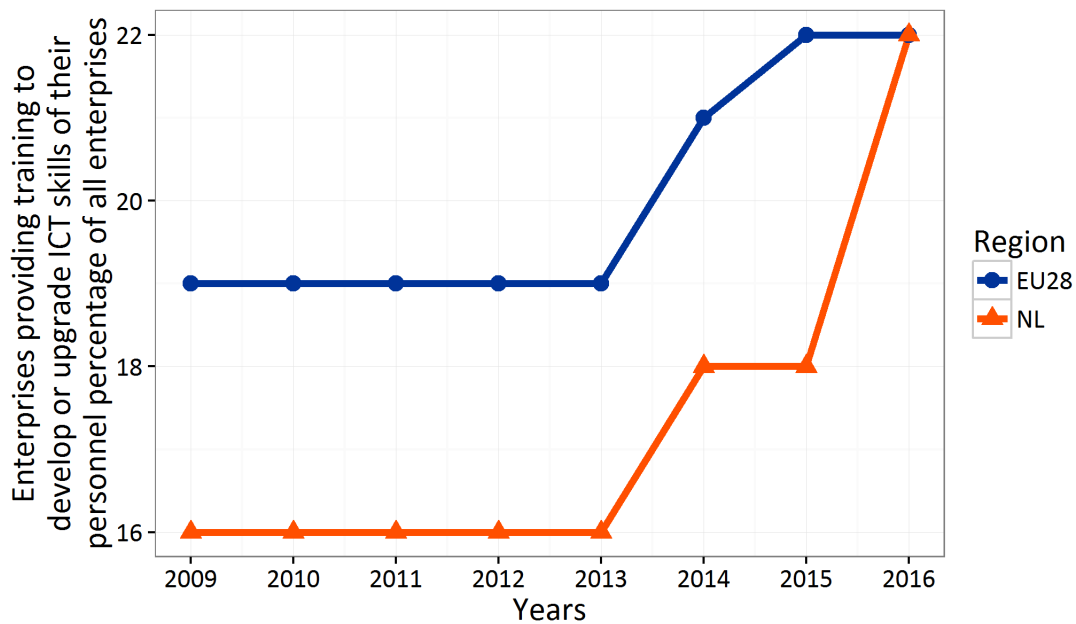


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Enterprises providing training to develop or upgrade ICT skills of their personnel (new indicator)

The indicator refers to the number of companies that provide ICT training to their personnel as a percentage of total number of enterprises (new indicator) and is a proxy for the overall ICT skills development of employees in a country. The score of the indicator for the Netherlands was not significantly lower than the EU average over the period 2013-2016 ($t = -1.73$, $df. = 4.72$, $p = 0.15$).

Data are not available for the period 2009-2012¹¹. Statistical analysis of trends over the period 2013-2016 shows a positive significant trend for the Netherlands ($b = 1.83$, $s.e. = 0.47$, $p = 0.02$). The trend of the Netherlands did not increase or decrease significantly compared to the EU. The score of the Netherlands increase on average 12.5% per year, while the score of the EU increased on average 5.3% per year.



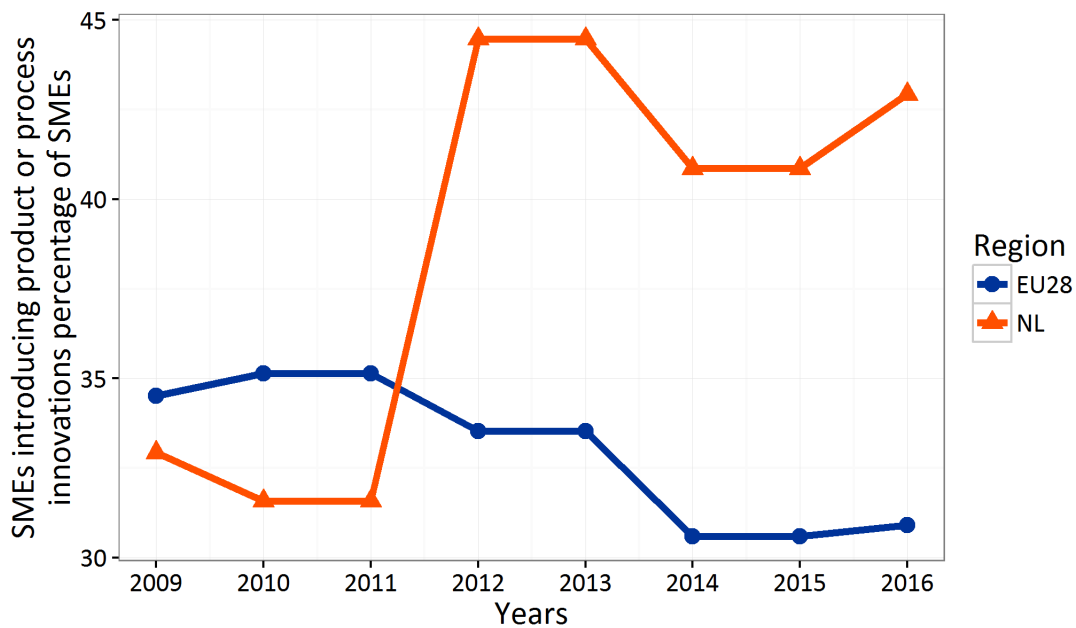
¹¹ The presented scores in 2009-2012 years are equal to the score in the year 2013 and were used in the calculation of the Summary Innovation Index.

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SMEs with product and process innovations

The indicator refers to the number of SMEs that have introduced new or significantly improved products or production processes, as a percentage of the total number of SMEs. Over the full timeframe, on average the Netherlands outperformed the EU on this indicator ($t = 2.67$, $df. = 8.69$, $p = 0.03$). While in 2011 the Netherlands scored 10% lower than the average EU country, in 2016 they scored 39% higher.

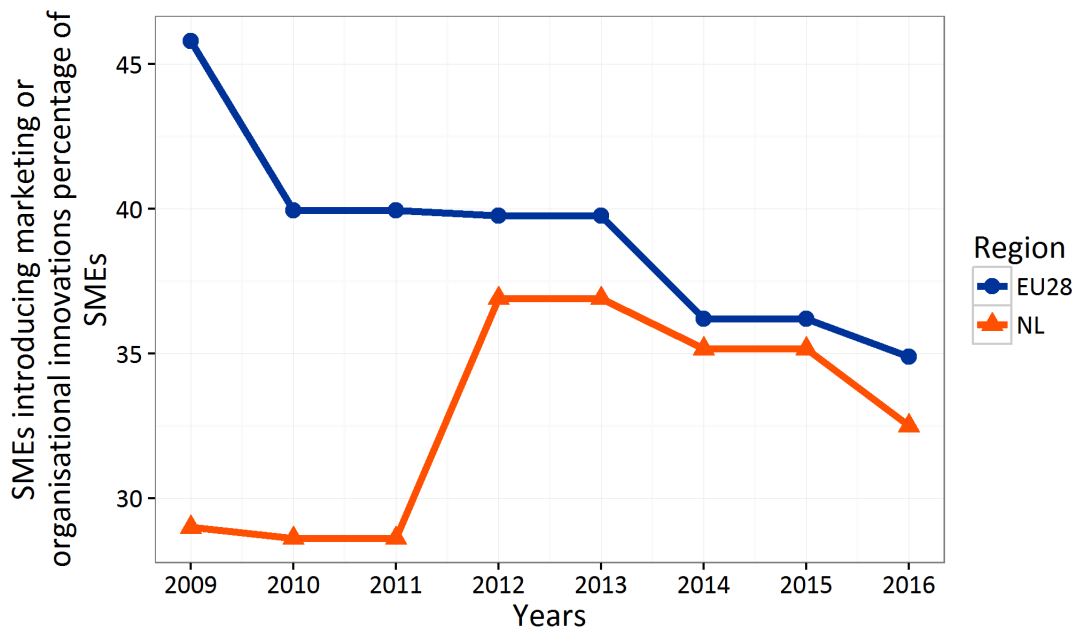
Statistical analysis shows a significant positive trend for the Netherlands ($b = 1.57$, $s.e. = 0.71$, $p < 0.05$). The score of the Netherlands increased 4.3% on average per year, while the score of the EU decreased 1.5% on average per year. The increase of the Netherlands differs significantly from the EU trend ($b = 2.2$, $s.e. = 1.01$, $p = 0.05$).



SMEs with marketing or organizational innovations

The indicator refers to the number of SMEs that introduce marketing or organisational innovations, as a percentage of the total number of SMEs. The score of the indicator for the Netherlands was significantly lower than the EU average between 2009 and 2016 ($t = -3.50$, $df. = 13.93$, $p < 0.01$). In this period the Netherlands increased their performance on this indicator with 12%, whereas the average EU country decreased its performance on the indicator with nearly 24%.

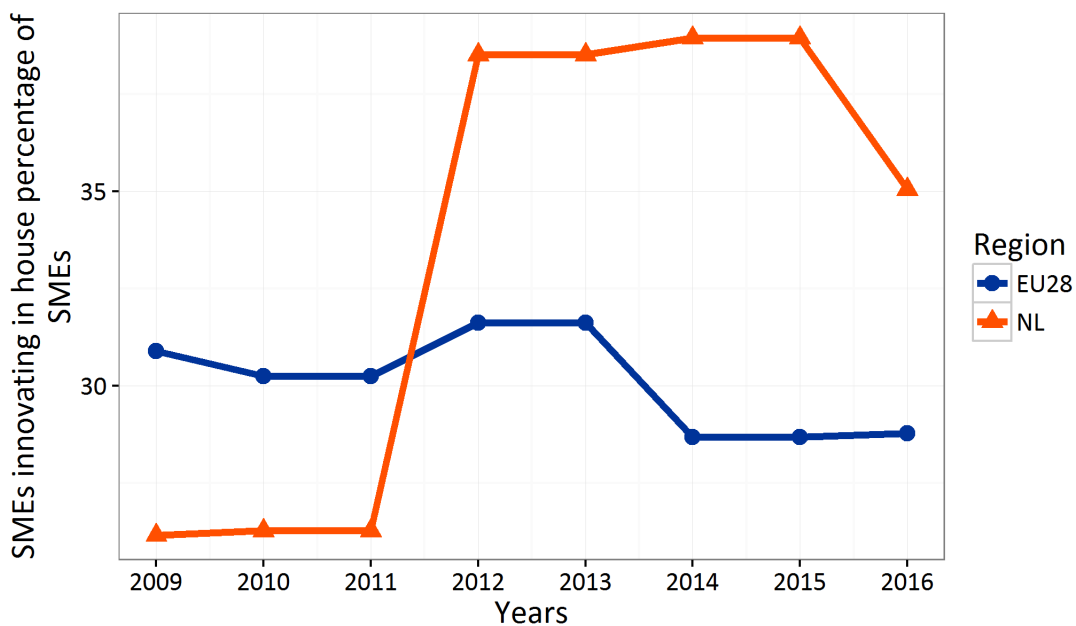
Statistical analysis indicates no significant trends. Additionally, there is no statistical evidence that the trend for the Netherlands is significantly different from that of the EU.



SMEs innovating in-house

The indicator refers to the degree that have introduced any new of significantly improved products or production processes have innovated in-house, as a percentage of SMEs. SMEs which introduce new products or processes together with other firms are also included. While the score of the indicator for the Netherlands is significantly higher than the EU average in recent years ($t = 7.07$, $df. = 5.64$, $p < 0.001$), but over the whole period the score of the Netherlands is not significantly higher than the score for the EU ($t = 1.56$, $df. = 7.57$, $p = 0.16$). On average the score of the Netherlands increased 4.9% per year, while the score of the EU decreased 1% per year

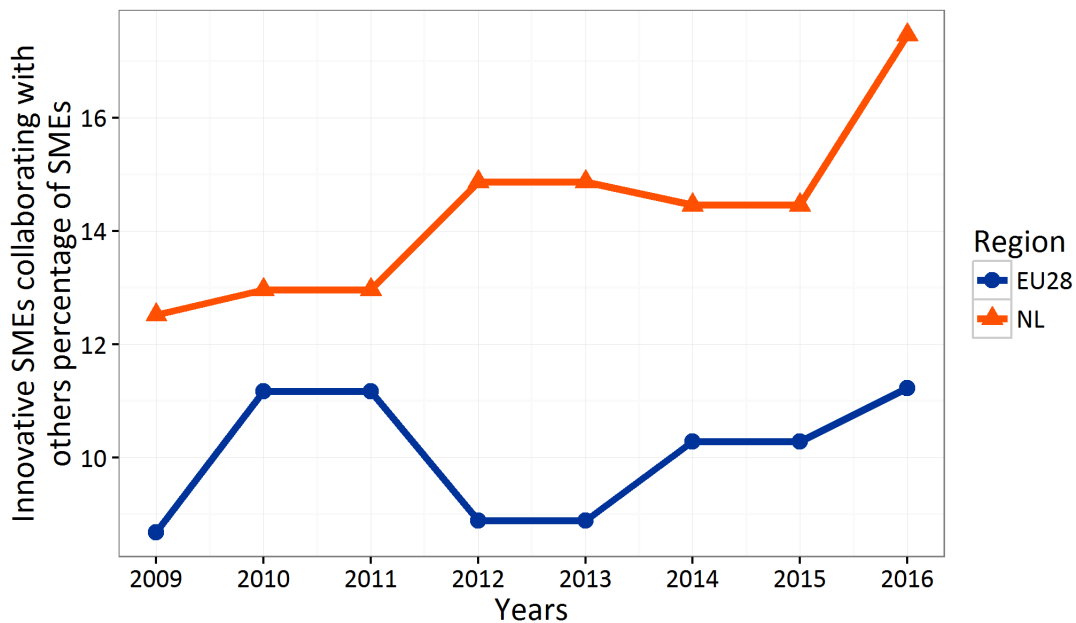
Statistical analysis shows no significant trends for Netherlands or the EU. The trend of the Netherlands is not significantly different from the trend of the EU.



Innovative SMEs collaborating with others

The indicator refers to the degree to which SMEs are co-operating with others in order to innovate, as a percentage of SMEs. In the Netherlands in 2016 17.5% of the SMEs collaborated with others to innovate; an increase of over 20% as compared to 2015. Over the whole period the score of the indicator for the Netherlands was higher than the EU average ($t = 6.24, df. = 12.54, p < 0.001$).

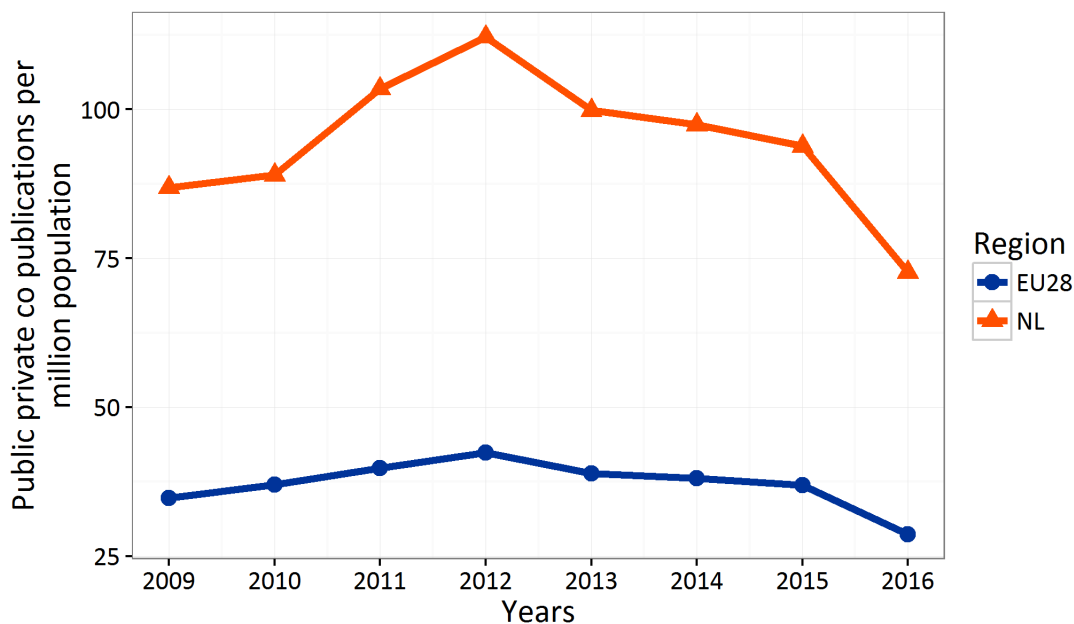
Statistical analysis indicates that the trend for the Netherlands was positive and significant ($b = 0.61, s.e. = 0.23, p = 0.02$). The score of the Netherlands increased on average 5.6% per year, while the score of the EU increased on average 4.2% per year. There is no significant increase or decrease of the score of the Netherlands relative to the EU. That means, statistically they seem to follow the same trend.



Public-private co-publications

The indicator¹² refers to the number of co-publications between academia and private industry per million of inhabitants. On this indicator the Netherlands outperformed the average EU country over the whole period ($t = 12.88$, $df. = 8.61$, $p < 0.001$). Interestingly, while the Dutch public-private co-publications have been declining since their peak in 2012, 2016 showed an even stronger decline on the indicator of more than 22%. On average the score of the Netherlands decreased 2.3% per year and the score of the EU decreased 2.5% per year.

Statistical analysis indicates no significant trends for both Netherlands or the EU. There is no significant increase or decrease of the score of the Netherlands relative to the EU. This result might be explained by the inflection point for the trend of the Netherlands in 2012. Sub-analysis shows that trend of the Netherlands is significantly negative since 2012 ($b = -9.46$, $s.e. = 2.12$, $p < 0.01$). Additionally, there is weak statistical evidence that the score of the Netherlands decreased more rapidly than that of the EU between 2012 and 2016 ($b = -6.318$, $s.e. = 3.13$, $p < 0.1$).



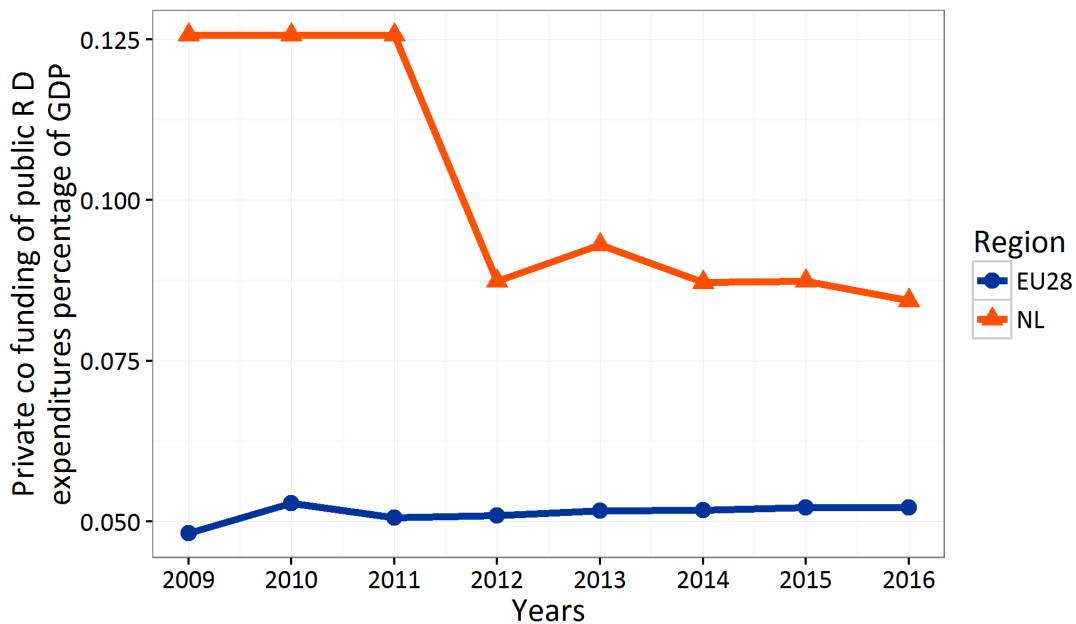
¹² The original values for this indicator were replaced with their square root, to correct for skewness of the data (i.e. skewness above 1).

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Private co-funding of public R&D expenditures (new indicator)

The indicator refers to the investments of business sector in public research as a percentage of GDP (new indicator). While the Netherlands systematically outperforms the average EU country ($t = 7.26$, $df. = 7.08$, $p < 0.001$), the score has observably declined since 2011.

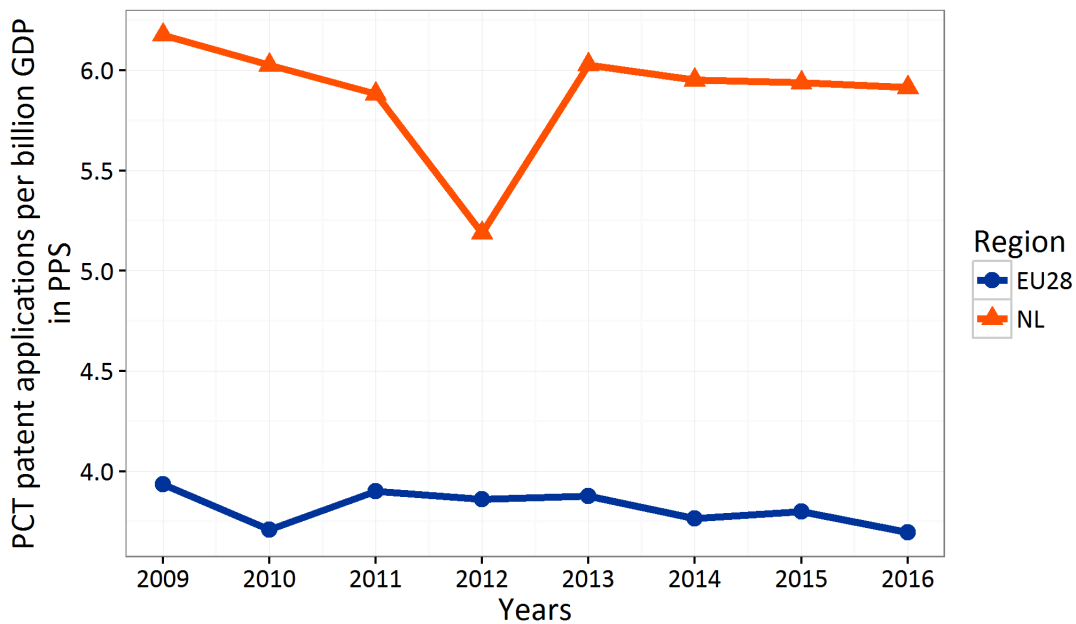
Statistical analysis shows that the trend for the Netherlands is significantly negative ($b = -0.01$, $s.e. = 0.001$, $p < 0.001$). Over the full time period, on average the score of the Netherlands decreased 4.7% per year, while the score of the EU increased 1.2% per year. The trend for the Netherlands on this indicator differed significantly from the EU trend ($b = -0.01$, $s.e. = 0.002$, $p < 0.01$).



PCT patent applications

The indicator¹³ refers to the number of patent applications filed under the PCT, per billion GDP in PPS. Filing under the PCT refers to international patent applications. In 2016 the Netherlands scored 60% higher than the average EU country on this indicator and significantly outperformed the EU average over the whole period ($t = 18.87, df. = 8.24, p < 0.001$). The score of the Netherlands decreased 0.6% on average per year, while the score of the EU decreased 0.9% on average per year.

Statistical analysis provides no evidence for any significant trends in either the Netherlands or the EU. There is no significant increase or decrease of the score of the Netherlands relative to the EU. That means, both lines seem to follow the same trend.

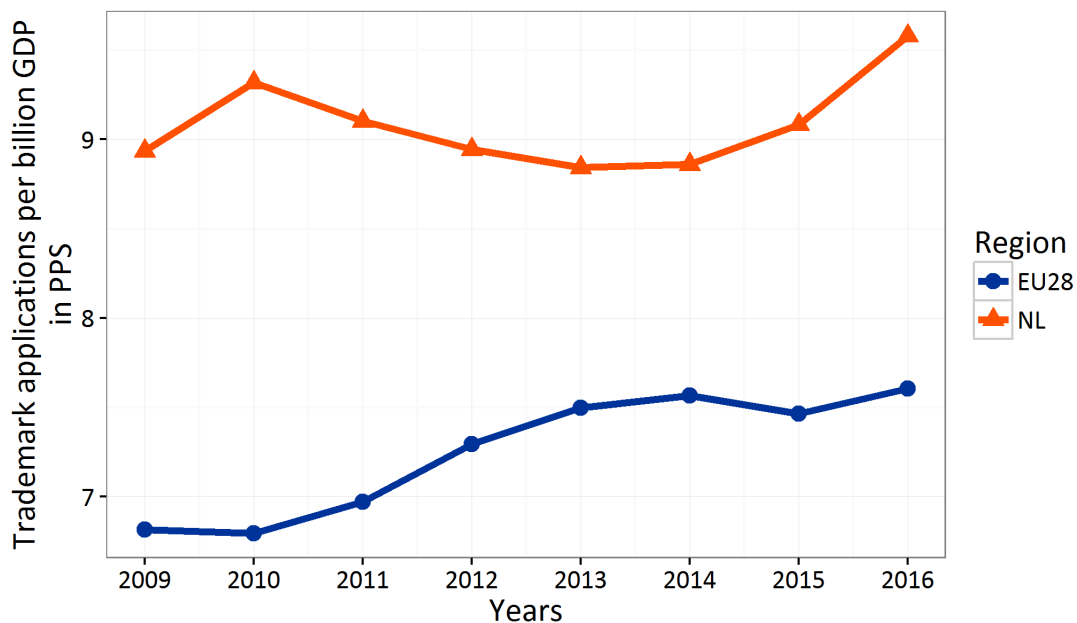


¹³ The original values for this indicator were replaced with their square root, to correct for skewness of the data (i.e. skewness above 1).

Trademark applications (revised)

The indicator¹⁴ refers to trademark applications per billion GDP (revised¹⁵). Trademarks refer to new names or logos of firms and are an indicator of innovation. The indicator includes both trademark applications at the European Union Intellectual Property Office (EUIPO) as well as at the World Intellectual Property Office (WIPO). Interestingly, the trend of the Netherlands on this indicator has shifted in recent years from negative to positive. On average the score of the indicator for the Netherlands was significantly higher than the EU average over the whole period ($t = 12.22$, $df. = 12.95$, $p < 0.001$) and increased by 1.0% on average per year as opposed to 1.6% on average per year for the EU.

Statistical analysis shows no significant trends for the Netherlands or EU. There is no significant increase or decrease of the score of the Netherlands relative to the EU.



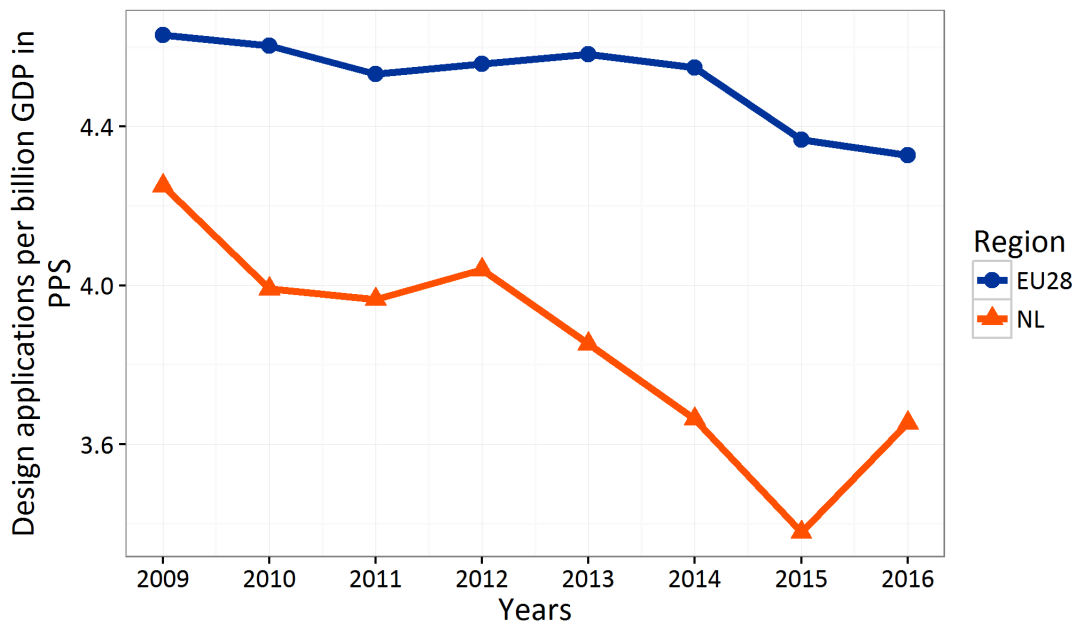
¹⁴ The original values for this indicator were replaced with their square root, to correct for skewness of the data (i.e. skewness above 1).

¹⁵ The indicator measuring Trademark applications has been revised and will aggregate data from the European Union Intellectual Property Office (EUIPO) on Community trademark applications with data from the World Intellectual Property Organization (WIPO) on trademark applications applied for under the Madrid Protocol.

Design applications

The indicator refers to the number of applications for registration of new designs, per billion GDP. It only includes design applications at the European Union Intellectual Property Office (EUIPO). The Netherlands significantly underperforms the EU on design applications over the whole period ($t = -6.41$, $df. = 9.23$, $p < 0.001$). Notably, in 2016 the Netherlands improved by 8% on this performance indicator, while the EU average still declined as before. Perhaps this is an indication that the historical negative trend of the Netherlands on this indicator is at a turnaround.

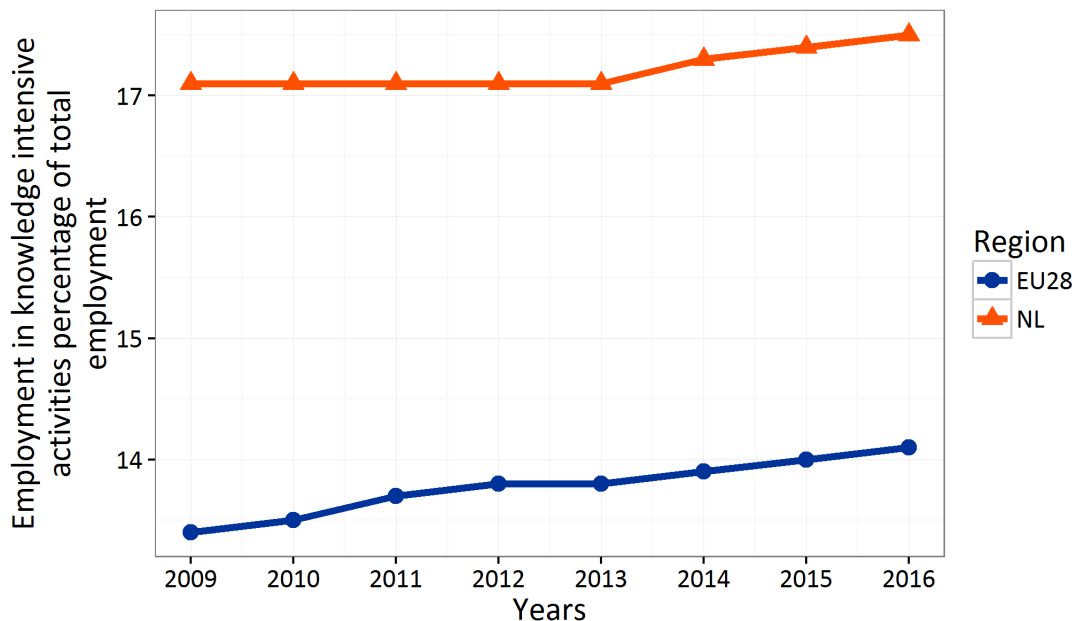
Statistical analysis shows negative and (weak) significant trends both the Netherlands ($b = -0.10$, $s.e. = 0.01$, $p < 0.001$) and the EU are negative ($b = -0.04$, $s.e. = 0.02$, $p = 0.07$). The score of the Netherlands decreased 2.0% per year on average, while the score of the EU decreased 1.0% per year on average. The trend for the Netherlands is (almost) significantly more negative than the trend for the EU ($b = -0.06$, $s.e. = 0.03$, $p = 0.06$).



Employment in knowledge-intensive activities

The indicator refers to the number of employed persons in knowledge-intensive activities in business industries, as a percentage of GDP. The indicator is defined as employment in business sectors in which at least 33% of employment has a higher education degree. The score of the indicator for the Netherlands was higher than the EU average over the whole period ($t = 33.68, df. = 12.45, p < 0.001$).

For the Netherlands data in the period 2009-2012 are missing¹⁶. Over the period 2013-2016 statistical analysis indicates a positive and significant trend both the Netherlands ($b = 0.13, s.e. = 0.02, p < 0.01$) and the EU ($b = 0.1, s.e. = 0.02, p < 0.05$). On average both the score of the Netherlands and EU increased by 0.32% per year. There is no significant increase or decrease of the score of the Netherlands relative to the EU. That means that both the Netherlands and the EU as a whole seem to follow a similar trend over 2013-2016.

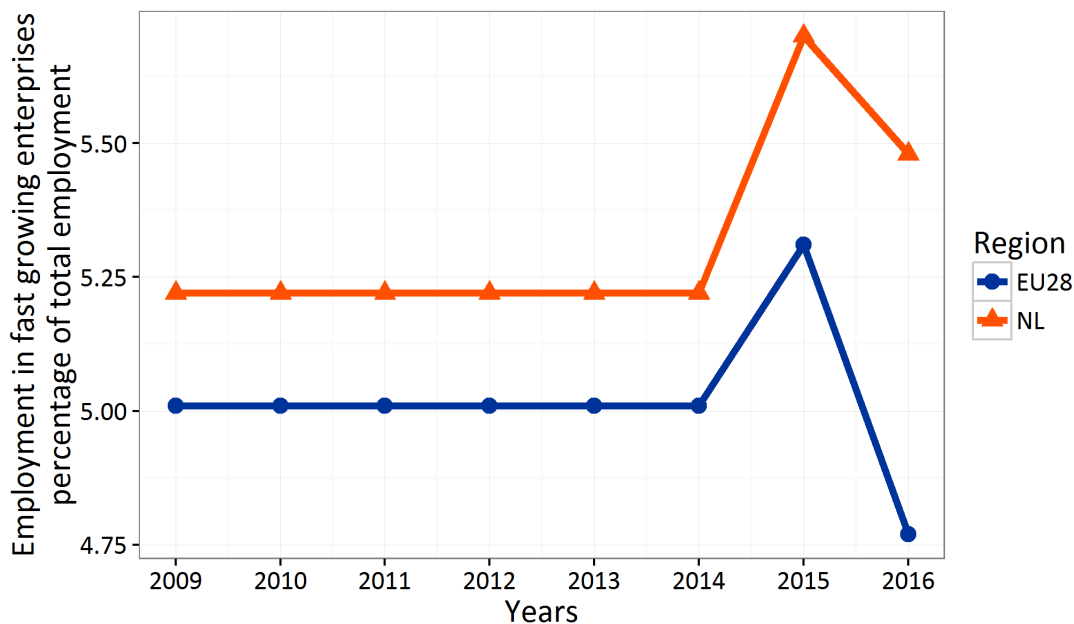


¹⁶ The presented scores in 2009-2012 years are equal to the score in the year 2013 and were used in the calculation of the Summary Innovation Index.

Employment in fast-growing enterprises of innovative sectors (new indicator)

The indicator refers to employment in fast-growing enterprises (new indicator). It measures the share of employment in high-growth enterprises in the top 50% most innovative sectors, as a percentage of total employment. The score of the indicator for the Netherlands was higher than the EU average over the whole period, but this difference was only weakly significant ($t = 2.37$, $df. = 5.99$, $p = 0.06$). While the score of the Netherlands decreased by almost 4% in 2016, the score of the EU dropped more rapidly with more than 10%.

The data for 2009-2013 is missing¹⁷. Because of limited data availability statistical analysis of the trend lines was not possible. By observation we determine that the Netherlands and the EU appear to follow a similar trend. Although, over the period 2014-2016 the Netherlands increased their score on the indicator by 5%, whereas the EU average score declined with 4.8%.



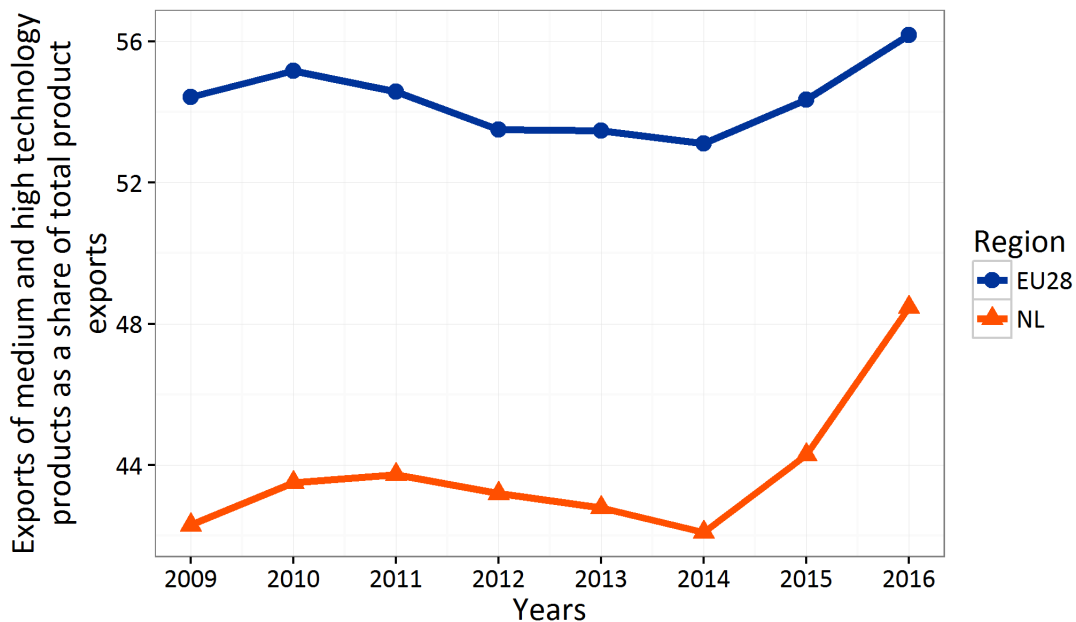
¹⁷ The presented scores in 2009-2013 years are equal to the score in the year 2014 and were used in the calculation of the Summary Innovation Index.

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Medium and high-tech product exports

The indicator refers to the exports of medium and high-technology products as a share of total product export. The Netherlands significantly underperforms the EU on this indicator ($t = -13.20$, $df. = 10.27$, $p < 0.001$). Although, it has rapidly increased its score since 2014 with more than 15%, decreasing the gap between the Netherlands and the EU to 14% (an improvement of 8% as compared to 2009).

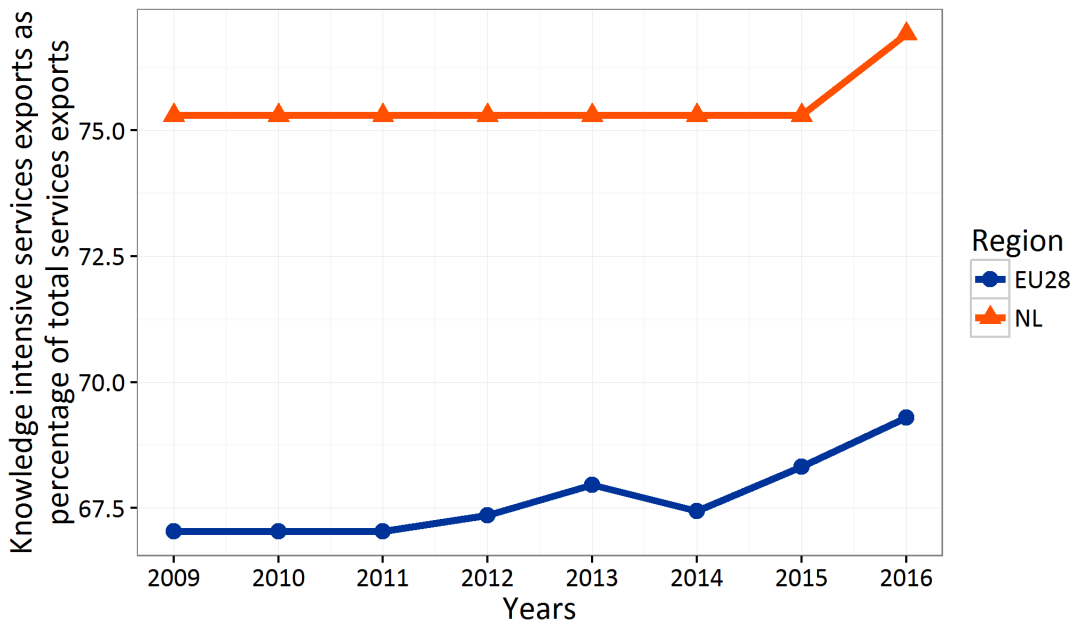
Statistical analysis indicates no significant trends for either the Netherlands or the EU. The score of the Netherlands increased 2.1% on average per year, while the score of the EU increases 0.5% on average per year. There is no significant increase or decrease of the score of the Netherlands relative to the EU. That is, they appear to follow similar trends.



Knowledge-intensive services exports (revised)

The indicator refers to knowledge-intensive services exports, as a percentage of total services exports (revised¹⁸). Due to the revision, there are only data available for recent years. In the past definition of the indicator the Netherlands scored below the EU, but now the Netherlands scores higher than the EU.

Because of the limited available data, statistical analysis of the difference between the Netherlands and the EU or the trend of the Netherlands is not possible. For the EU trend we don't observe a statistically significant increase over the years 2009-2016. Still, the average increase of the score of the EU is 3.4% per year, whereas the Netherlands increased their score by 2% from 2015 to 2016.



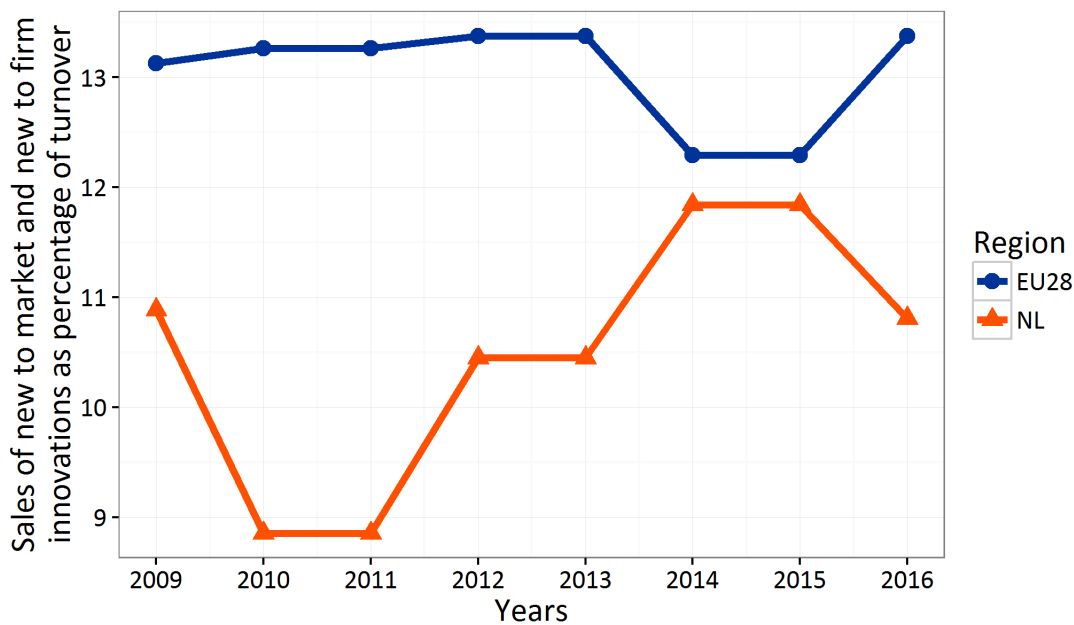
¹⁸ As compared to the previous EIS, the indicator now includes license and patent revenues from abroad (which was a separate indicator in the EIS 2016).

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Sales of new-to-the-market and new-to-the-firm product innovations

The indicator refers to sales of new-to-market and new-to-firm innovations as a percentage of turnover of companies. Both score of the Netherlands and that of the EU average appear to fluctuate over the time frame. Despite this, the Netherlands significantly underperformed the EU average between 2009 and 2016 ($t = -5.79, df. = 9.3, p < 0.001$). Notably, between 2011 and 2014 the Netherlands increased their score with 33%, but declined again with almost 9% from 2015 to 2016.

Statistical analysis indicates no significant trends in the scores of the Netherlands and the EU on this indicator. There are no significant increase or decrease of the score of the Netherlands relative to the EU.



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Appendix. Overview of indicators: EU measurement framework

RESULTS TABLE

FRAMEWORK CONDITIONS	Score	Trend	Trend relative to EU
<i>Human resources</i>			
New doctorate graduates	Higher	Positive	---
Population aged 25-34 with tertiary education	Higher	Positive	---
Lifelong learning	Higher	Positive	Positive
<i>Attractive research systems</i>			
International scientific co-publications	Higher	Positive	Positive
Top 10% most cited publications	Higher	Negative	Negative (recent)
Foreign doctorate students	Higher	---	---
<i>Innovation-friendly environment</i>			
Broadband penetration	Higher	---	---
Opportunity-driven entrepreneurship	Higher	Negative	Negative
INVESTMENTS			
<i>Finance and support</i>			
R&D expenditure in the public sector	Higher	Positive	---
Venture capital expenditures	Higher	Negative	---
<i>Firm investments</i>			
R&D expenditure in the business sector	Lower	---	---
Non-R&D innovation expenditures	---	---	---
Enterprises providing training to develop or upgrade ICT skills of their personnel	---	Positive	---
INNOVATION ACTIVITIES			
<i>Innovators</i>			
SMEs with product or process innovations	Higher	Positive	Positive
SMEs with marketing or organisational innovations	Lower	---	---
SMEs innovating in-house	Higher	---	---
<i>Linkages</i>			
Innovative SMEs collaborating with others	Higher	Positive	--- (recent)
Public-private co-publications	Higher	Negative	Negative (recent)
Private co-funding of public R&D expenditures	Higher	Negative	Negative
<i>Intellectual assets</i>			
PCT patent applications	Higher	---	---
Trademark applications	Higher	---	---

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RESULTS TABLE (continued)

	Score	Trend	Trend relative to EU
Design applications	Lower	Negative	Negative
IMPACTS			
<i>Employment impacts</i>			
Employment in knowledge-intensive activities	Higher	Positive	
Employment fast-growing enterprises of innovative sectors	Higher	---	---
<i>Sales impacts</i>			
Medium and high tech product exports	Lower	---	---
Knowledge-intensive services exports - REVISED	---	---	---
Sales of new-to-market and new-to-firm product innovations	Lower	---	---

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Contact details

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