

On the academic postdoctoral track in Flanders (Belgium) after obtaining a doctorate

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FIGURES ON THE ACADEMIC POSTDOCTORAL TRACK IN FLANDERS

It has been known for some time that only a minority of doctorate holders become a professor in the (long) term. Starting from the database Human Resources in Research Flanders (HRRF, see also the HRRF basic indicators and the interactive visualization on the ecom website for more details (1), (2)), we observe that in the cohort of doctorate holders from 2006-2007 to 2008-2009, for instance, only 13.8% were working as professors after eight years. This share varies strongly depending on the science cluster (4.7% in exact sciences versus 23.5% in social sciences). We also observe that the share becoming a professor is highest among Belgian male doctorate holders and particularly low among non-Belgians who obtained the doctorate in Flanders. Thus, we already have relevant, albeit fragmented, information on the academic postdoctoral career in Flanders. However, the full academic career path of doctorate holders in Flanders, i.e. from the time they obtain their doctorate until they leave the university or until they become a professor, is missing. This is covered by the present ecom brief.

PURPOSE OF THIS BRIEF

In this ecom brief we offer a complete overview of the academic pathway doctorate holders follow in **Flanders** after obtaining a doctorate at a Flemish university. First of all, we look at two cohorts of doctorate holders to see how large the share is that became a postdoctoral researcher at a Flemish university. Next we zoom in on that specific group of postdoctoral researchers and we answer the following questions:

- What is the share that left the Flemish university as a postdoctoral researcher and how much time did this group work as a postdoctoral researcher before quitting the academic research activities in Flanders?

- What is the share that became a professor, how much time did this group work as a postdoctoral researcher before becoming a professor and how much time elapsed between obtaining the doctorate and becoming a professor?

Next, we look at the share that became a professor without an intermediate postdoctoral research activity in Flanders and at how much time passed between obtaining the doctorate and becoming a professor.

Finally, we look at the total share of doctorate holders who became a professor and at how much time there was between obtaining the doctorate and becoming a professor.

We look at these results by science cluster in which the doctorate was obtained, gender and nationality.

MARKING OUT DATA SOURCE AND DEFINITIONS

The HRRF database contains the appointments of all researchers associated with one of the five Flemish universities since 1990. In addition, it also includes all doctoral enrolments and defences. The database contains information such as gender, nationality, age, in which science cluster the research is carried out and the type of funding. The latest update on which this brief is based, contains the data of the academic year 2016-2017

(https://www.ecoom.be/en/research/research_careers/methods/HRRF).

The **science clusters** used in this brief are those determined by the science field of the doctoral degree.

Gender in the HRRF is gender as known on the identity card.

By **postdoctoral research** we mean the positions for which a doctoral degree is required and 1) where one is funded by the universities (doctoral assistants and project funding), the Research Foundation – Flanders (FWO) or the Flanders Innovation & Entrepreneurship (VLAIO, formerly IWT), or 2) where one is employed by a strategic research centre (VIB, IMEC (formerly iMinds and IBBT) and VITO) with a clear link to one of the Flemish universities.

In the determination of the promotion to **professor**, we also include the professors from the '*integration framework*' (integration in the university of most academic programmes that were offered by the university colleges until 30/9/2013).

In this brief we look at the **situation in Flanders**. When mentioning **doctorate holders**, we refer to researchers who obtained their doctorate in Flanders. Also when we talk about becoming a postdoctoral researcher and becoming a professor, this always concerns the situation in Flanders.

We look at the results for **two cohorts** of doctorate holders: the doctorate holders from the academic years 1990-1991 to 2004-2005 on the one hand (**cohort 1**, N=10,044) and from the academic years 2005-2006 to 2015-2016 on the other hand (**cohort 2**, N=16,322). The characteristics of both cohorts are shown in [Table 1](#). Because we only have a relatively short follow-up period for **cohort 2**, **some results will change significantly in future updates** (e.g. the share becoming a professor and the duration of the postdoctoral research activity before becoming a professor or before leaving the university). For this reason, cohort 1 and 2 cannot be compared for these aspects.

The duration of the postdoctoral research activity before one becomes a professor in Flanders is determined by the moment of the first postdoctoral research activity and the moment one became a professor. Researchers whose last appointment as paid postdoctoral researcher ended before 2/7/2017 and who in the remaining three months for which we have data (the HRRF database contains data until 30/9/2017) did not have an appointment as a professor, are considered as researchers who left the university in Flanders as a postdoctoral researcher. The persons who were 60 years or older at the end of their last appointment and thus potentially (early) retired, were removed from this specific analysis. It concerns an absolute minority: 24 persons from cohort 1 and 4 persons from cohort 2.

Table 1: Characteristics of cohort 1 and 2 doctorate holders

	Cohort 1 (N=10,044)	Cohort 2 (N=16,322)
% Women	32.1%	43.3%
% Non-Belgians	23.2%	31.4%
Science cluster		
(Bio)Medical sciences (BMS)	18.1%	24.2%
Humanities (H)	13.3%	12.9%
Social sciences (SS)	8.7%	13.8%
Applied sciences (AS)	28.1%	29.5%
Exact sciences (ES)	31.8%	18.9%
Inter-/Multidisc.+Arts	0.0%	0.6%

RESULTS

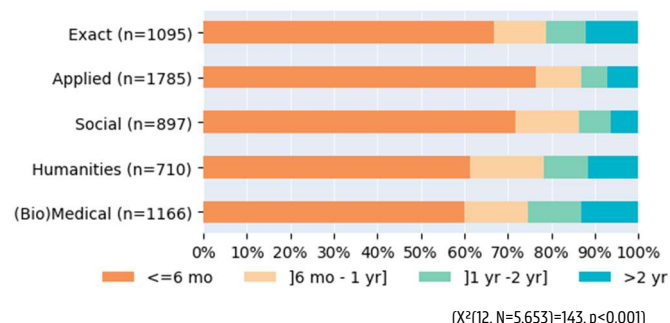
WHEN DO PEOPLE START WORKING AS A POSTDOCTORAL RESEARCHER?

Before we look at the share of researchers who became a postdoctoral researcher after obtaining a doctorate in Flanders, it is useful to find out when this postdoctoral research started in relation to the moment of obtaining the doctorate. We examine this for the doctorate holders who became a postdoctoral researcher during the period 2006-2007 to 2016-2017 (N=5,653). The majority started the postdoctoral research

activities within six months after defending their doctorate (69%). One in ten started the postdoctoral research activities more than two years after the doctoral defence; for another small share (<2%) this happened more than eight years after obtaining the doctoral degree. There are small but significant differences between the science clusters ([Figure 1](#)). In the applied sciences, the share of doctorate holders that started postdoctoral research activities within six months is the highest (77%). This is followed by the social sciences with 72%. In the (bio)medical sciences, we find the largest share that only started postdoctoral research activities more than one year after obtaining the doctorate (26%).

These results imply that the figures related to the share becoming a postdoctoral researcher in cohort 2, will still be subject to minor changes with new updates of the HRRF database.

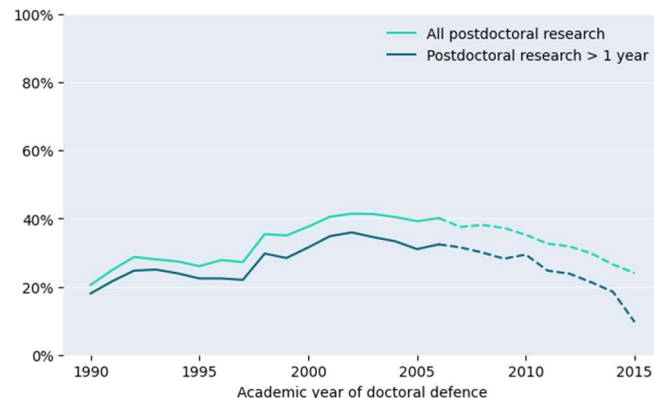
Figure 1: Moment at which one started postdoctoral research activities in Flanders after obtaining the doctorate in Flanders, results by science cluster - Period 2006-2007 until 2016-2017



HOW LARGE IS THE SHARE THAT BECAME A POSTDOCTORAL RESEARCHER?

Next, we look at the evolution of the share of doctorate holders who became a postdoctoral researcher at a Flemish university after obtaining the doctorate ([Figure 2](#)). We show a full line up to the doctorate holders from 2006-2007. As the results for more recent doctorate holders will still be subject to small or bigger changes, a dotted line is used for doctorate holders from 2007-2008 onwards.

Figure 2: Share of doctorate holders becoming a postdoctoral researcher - Evolution from 1990-1991 to 2015-2016



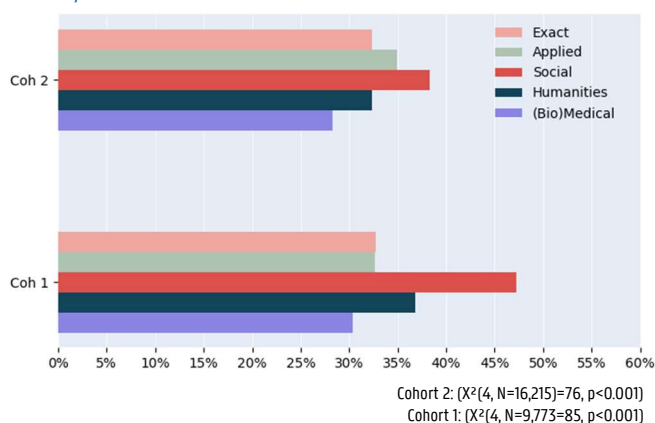
For the more recent doctorate holders (from 2007-2008), the results are subject to greater change, which is why they are shown by a dashed line.

The share that started postdoctoral research activities, regardless of the duration of it ('turquoise line'), increased strongly as from the doctorate

holders of 1998-1999, and then showed a gradual increase until the 2002-2003 doctorate holders. Although the figures for the more recent doctorate holders will still change, it seems that a maximum of 41% has already been reached among the doctorate holders from 2002-2003 to 2004-2005. As a significant share of researchers started postdoctoral research activities in Flanders of at most one year, we also include the result for postdoctoral research activities of more than one year only (dark blue line). The same pattern is observed. The maximum share that started postdoctoral research activities of more than one year is 36%. From here onwards, we discuss the results for the two cohorts of doctorate holders as described in 'Marking out data source and definitions' (see also Table 1). In cohort 1, 34% of the doctorate holders became a postdoctoral researcher in Flanders (N=3,373) and in cohort 2 for now, this was 33% (N=5,360).

Figure 3 shows the share of doctorate holders who became a postdoctoral researcher by science cluster. In both cohorts, the difference between the science clusters is significant, but in cohort 1 the differences were larger.

Figure 3: Share of doctorate holders who became a postdoctoral researcher, results by science cluster - Doctorate holders cohort 1 and 2



In the period '90-'04, 47% of the social and 37% of the humanities doctorate holders started postdoctoral research activities. In the other science clusters, this was 33% (applied and exact) and 30% ((bio)medical). In cohort 2, the share that started postdoctoral research activities is still the highest in the social sciences with 38%. This is immediately followed by the applied sciences with 35%. We have previously observed that researchers in the applied sciences start the postdoctoral research activities earlier and in the (bio)medical sciences later (Figure 1). If these findings from the past still hold, these figures for (bio)medical sciences (for now, 28% became a postdoctoral researcher in cohort 2) may therefore change somewhat in future updates.

Table 2 shows the share of doctorate holders who became a postdoctoral researcher by science cluster and gender.

First of all, it is striking that in cohort 1 in the (bio)medical, humanities and applied sciences, women significantly more than men started postdoctoral research activities. There was no difference between men and women in the social sciences; in the exact sciences, on the other hand, the share of men was significantly higher. In cohort 2, only among the humanities did we find a significantly larger share of women than

of men becoming postdoctoral researcher. In the applied sciences, we found the opposite.

Table 2: Share of doctorate holders who became a postdoctoral researcher, results by science cluster and gender - Doctorate holders cohort 1 and 2

	Cohort 1			Cohort 2		
	Men	Women	p	Men	Women	p
BMS	28.0%	33.7%	**	27.5%	28.9%	ns
H	33.4%	44.5%	***	30.5%	35.1%	*
SS	46.6%	48.3%	ns	38.0%	38.6%	ns
AS	31.2%	37.0%	**	37.4%	29.3%	***
ES	34.4%	29.5%	**	33.4%	30.7%	ns
Total ⁽¹⁾	32.8%	35.4%	*	33.8%	31.6%	**

Results X²: ns: non-significant; * p<0.05; ** p<0.01; *** p<0.001

(1) This total also includes those who do not have a science cluster or fall within the small group of multidisciplinary research or the arts.

Table 3 shows the share of doctorate holders who became a postdoctoral researcher by science cluster and nationality. In all science clusters and in both cohorts, the share of non-Belgian doctorate holders who started postdoctoral research activities is significantly lower than the share of Belgian doctorate holders.

Table 3: Share of doctorate holders who became a postdoctoral researcher, results by science cluster and nationality - Doctorate holders cohort 1 and 2

	Cohort 1			Cohort 2		
	Belgian	Non-Belgian	p	Belgian	Non-Belgian	p
BMS	34.5%	13.9%	***	32.3%	15.7%	***
H	48.4%	8.1%	***	43.0%	12.1%	***
SS	54.1%	14.0%	***	45.5%	17.3%	***
AS	41.7%	8.3%	***	44.1%	19.4%	***
ES	39.4%	10.7%	***	38.7%	20.5%	***
Total ⁽¹⁾	41.1%	9.9%	***	39.8%	17.6%	***

Results X²: ns: non-significant; * p<0.05; ** p<0.01; *** p<0.001

(1) This total also includes those who do not have a science cluster or fall within the small group of multidisciplinary research or the arts.

DOCTORATE HOLDERS WHO LEFT THE FLEMISH UNIVERSITY AS A POSTDOCTORAL RESEARCHER

Here we look at the doctorate holders who did not promote to professor after the postdoctoral research activities and who were no longer working in an academic position at a Flemish university on 1/7/2017. In cohort 1 this concerns 1,776 researchers (18% of the doctorate holders) and in cohort 2 2,803 researchers (17% of the doctorate holders). How much time did they work as a postdoctoral researcher before leaving the university? In cohort 1, we find that 50% had been working as a postdoctoral researcher for at least 2.8 years (median or P50); one in four had been working for less than 1.1 years as a postdoctoral researcher (P25) and one in four at least 5.3 years (P75). The median is lowest in applied sciences with 2.4 years and highest in humanities and social sciences with 3.0 years (Table 4).

In cohort 2, we find that 50% had been working as a postdoctoral researcher for at least 1.7 years (P50); one in four had been working as a postdoctoral researcher for less than 0.8 years (P25) and one in four at least 3.2 years (P75). The median is lowest in applied sciences with 1.5 years and highest in humanities with 2.0 years (Table 4).

In Appendix 1 and Appendix 2, gender and nationality dimensions are added respectively for the sake of completeness. In both cohorts, we

observe a significant difference between men and women in the applied sciences with respect to the length of time one had been working as a postdoctoral researcher before discontinuing it; the time spent in a postdoctoral position was longer among women than among men. Compared to Belgian doctorate holders, non-Belgian doctorate holders in both cohort 1 and cohort 2 generally have a significantly shorter period of time that they have been working as a postdoctoral researcher before leaving the Flemish university.

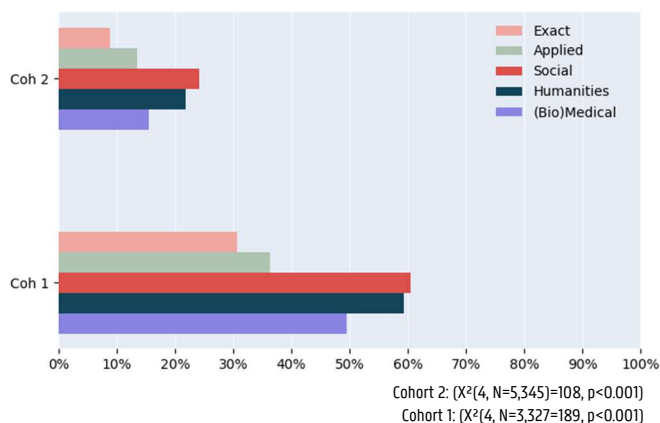
Table 4: Duration (percentiles in years) of postdoctoral research activities of doctorate holders no longer working in an academic position in Flanders on 1/7/2017, results by science cluster - Doctorate holders cohort 1 and 2

	n	P25	P50	P75	Mean Rank
Cohort 1 Kruskal-Wallis: H(4)=17, p=0.002					
BMS	255	1.3	2.7	6.0	925
H	184	1.9	3.0	6.00	980
SS	149	1.2	3.0	5.1	902
AS	521	1.0	2.3	4.8	820
ES	656	1.2	2.9	5.4	885
Cohort 2 Kruskal-Wallis: H(4)=21, p<0.001					
BMS	550	0.9	1.9	3.5	1482
H	324	0.9	2.0	4.0	1527
SS	401	0.7	1.6	3.0	1348
AS	940	0.7	1.5	3.0	1340
ES	582	0.7	1.7	3.0	1380

DOCTORATE HOLDERS WHO BECAME A PROFESSOR AFTER HAVING WORKED AS A POSTDOCTORAL RESEARCHER AT A FLEMISH UNIVERSITY

Of all doctorate holders who worked as a postdoctoral researcher, we see that 43% (N=1,463) and 16% (N=846) became a professor (cohort 1 and 2 respectively). There are significant differences between the science clusters. In both cohorts, the promotion is highest in the social sciences and humanities and lowest in the applied and exact sciences (Figure 4).

Figure 4: Share of doctorate holders who became a professor after the postdoctoral research activities, results by science cluster - Doctorate holders cohort 1 and 2



When we add the dimension gender, we find that in cohort 1 in all science clusters men significantly more than women became a professor (Table 5). In cohort 2, the differences between men and women are smaller for now; only in the (bio)medical, humanities and

social sciences did men significantly more than women promote to professor.

Table 5: Share of doctorate holders who became a professor after the postdoctoral research activities, results by science cluster and gender - Doctorate holders cohort 1 and 2

	Cohort 1			Cohort 2		
	Men	Women	p	Men	Women	p
BMS	57.7%	40.2%	***	20.5%	12.2%	***
H	64.2%	50.8%	**	24.6%	18.3%	*
SS	64.7%	52.5%	*	29.4%	19.6%	***
AS	41.4%	23.0%	***	14.1%	11.6%	ns
ES	33.8%	23.5%	**	9.9%	6.9%	ns
Total ⁽¹⁾	47.5%	35.2%	***	17.3%	13.6%	***

Results X^2 : ns: non-significant; * $p<0.05$; ** $p<0.01$; *** $p<0.001$

(1) This total also includes those who do not have a science cluster or fall within the small group of multidisciplinary research or the arts.

When we add the dimension nationality next to science cluster, we see that the share of doctorate holders who became a professor after the postdoctoral research activities is significantly higher among Belgians than among non-Belgians (Table 6).

Table 6: Share of doctorate holders who became a professor after the postdoctoral research activities, results by science cluster and nationality - Doctorate holders cohort 1 and 2

	Cohort 1			Cohort 2		
	Belgian	Non-Belgian	p	Belgian	Non-Belgian	p
BMS	51.8%	25.0%	***	17.0%	6.0%	***
H	61.0%	33.3%	**	23.7%	8.0%	***
SS	61.5%	40.0%	ns	26.4%	7.1%	***
AS	37.8%	15.0%	***	16.0%	3.7%	***
ES	32.3%	11.3%	***	10.5%	2.7%	***
Total ⁽¹⁾	45.1%	20.5%	***	18.0%	4.6%	***

Results X^2 : ns: non-significant; * $p<0.05$; ** $p<0.01$; *** $p<0.001$

(1) This total also includes those who do not have a science cluster or fall within the small group of multidisciplinary research or the arts.

Table 7: Duration (percentiles in years) of the postdoctoral research activities before promoting to professor, results by science cluster - Doctorate holders cohort 1 and 2

	n	P25	P50	P75	Mean Rank
Cohort 1 Kruskal-Wallis: H(4)=74, p<0.001					
BMS	266	2.2	3.7	6.1	641
H	284	2.0	4.2	7.0	666
SS	241	2.0	3.1	6.0	599
AS	325	3.0	5.0	8.0	762
ES	312	3.9	6.0	9.0	860
Cohort 2 Kruskal-Wallis: H(4)=45, p<0.001					
BMS	174	2.0	3.0	5.0	418
H	149	1.7	3.0	4.8	376
SS	208	1.6	2.5	4.6	359
AS	226	2.9	4.0	5.6	499
ES	88	2.1	4.0	5.7	468

We then examine the length of time one had been working as a postdoctoral researcher before promoting to professor. In cohort 1, we find that 50% had been working as a postdoctoral researcher for at least 4.5 years before promoting to professor (P50). One in four had been working as a postdoctoral researcher for less than 2.4 years (P25) and one in four for at least 7.3 years before promoting to professor (P75).

We notice significant differences between the science clusters. In the social sciences, we find the shortest duration and in the exact sciences the longest (Table 7).

In cohort 2, we find that 50% had been working as a postdoctoral researcher for at least 3.2 years before promoting to professor (P50). One in four had been working as a postdoctoral researcher for less than 2.0 years (P25) and one in four for at least 5.0 years (P75) before promoting to professor. We notice significant differences between the science clusters. Again, we find the shortest duration in the social sciences. The longest duration is observed in the applied sciences (Table 7).

As shown earlier (Figure 1), one does not always start postdoctoral research immediately after obtaining a doctorate. Therefore, the time between obtaining the doctorate and becoming a professor is usually longer than the time during which one was working as a postdoctoral researcher. In cohort 1, the time between obtaining a doctorate and promoting to professor was at least 5.6 years for 50% of the doctorate holders (P50). For one in four it was less than 3.3 years (P25) and for one in four at least 8.6 years (P75). In cohort 2, the time between obtaining a doctorate and promoting to professor was at least 4.0 years for 50% of the doctorate holders (P50). For one in four it was less than 2.4 years (P25) and for one in four at least 5.6 years (P75). The same differences by the science clusters persist (Table 8).

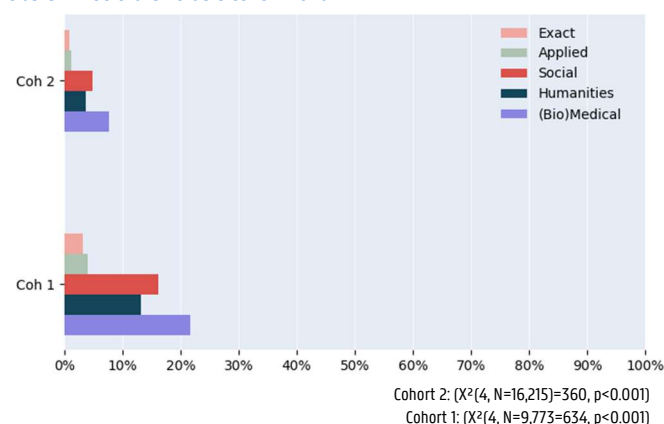
Table 8: Duration (percentiles in years) between obtaining the doctorate and the promotion to professor among doctorate holders with intermediate postdoctoral research activities in Flanders, results by science cluster - Doctorate holders cohort 1 and 2

	n	P25	P50	P75	Mean Rank
Cohort 1 Kruskal-Wallis: H(4)=101, p<0.001					
BMS	266	3.3	5.3	7.7	674
H	284	2.5	5.4	7.9	652
SS	241	2.4	4.0	6.8	566
AS	325	3.6	5.8	8.6	739
ES	312	4.7	7.6	10.3	895
Cohort 2 Kruskal-Wallis: H(4)=43, p<0.001					
BMS	174	2.9	4.3	5.7	459
H	149	2.1	3.8	5.5	391
SS	208	2.0	3.2	4.8	343
AS	226	3.3	4.4	6.1	483
ES	88	2.7	4.3	5.9	442

DOCTORATE HOLDERS WHO BECAME A PROFESSOR WITHOUT INTERMEDIATE POSTDOCTORAL RESEARCH ACTIVITIES AT A FLEMISH UNIVERSITY

Part of the holders of a doctorate obtained in Flanders promoted to professor without an intermediate postdoctoral research activity at a Flemish university. We refer to this as 'direct promotion'. This does not necessarily mean that they became a professor immediately after obtaining the doctorate, as will also become apparent from the analysis of the time between obtaining the doctorate and becoming a professor (see Table 11). In cohort 1 it concerns 998 people (10% of the doctorate holders) and in cohort 2 579 people (4% of the doctorate holders). The share is highest in the (bio)medical sciences (22% in cohort 1 and 8% in cohort 2) and lowest in the applied and exact sciences (respectively 4% and 3% in cohort 1 and 1% in cohort 2) (Figure 5).

Figure 5: Share of doctorate holders who became a professor without intermediate postdoctoral research activities in Flanders, results by science cluster - Doctorate holders cohort 1 and 2



When we add the gender dimension next to the science cluster, we find that in the (bio)medical sciences in both cohorts this 'direct promotion' is significantly higher among men than among women (Table 9). In humanities, on the other hand, we find in cohort 1 a significantly smaller 'direct promotion' among men than among women.

Table 9: Share of doctorate holders who became a professor without intermediate postdoctoral research activities in Flanders, results by science cluster and gender - Doctorate holders cohort 1 and 2

	Cohort 1			Cohort 2		
	Men	Women	p	Men	Women	p
BMS	26.2%	15.6%	***	11.6%	5.0%	***
H	11.4%	17.3%	**	3.9%	3.5%	ns
SS	17.7%	13.4%	ns	5.7%	4.2%	ns
AS	4.3%	3.0%	ns	1.2%	1.3%	ns
ES	3.1%	3.0%	ns	0.8%	0.8%	ns
Total ⁽¹⁾	10.2%	9.3%	ns	3.8%	3.2%	*

Results X²: ns: non-significant; * p<0.05; ** p<0.01; *** p<0.001
(1) This total also includes those who do not have a science cluster or fall within the small group of multidisciplinary research or the arts.

When we add the dimension nationality next to the science cluster, we find that for non-Belgians the 'direct promotion' is particularly small. This leads to significant differences in both cohorts and this is the case for all science clusters (Table 10).

Table 10: Share of doctorate holders who became a professor without intermediate postdoctoral research activities in Flanders, results by science cluster and nationality - Doctorate holders cohort 1 and 2

	Cohort 1			Cohort 2		
	Belgian	Non-Belgian	p	Belgian	Non-Belgian	p
BMS	26.3%	2.9%	***	9.5%	2.0%	***
H	17.9%	1.6%	***	5.5%	0.4%	***
SS	19.4%	0.7%	***	6.4%	0.7%	***
AS	5.3%	0.3%	***	1.8%	0.2%	***
ES	3.9%	0.6%	***	1.1%	0.1%	**
Total ⁽¹⁾	12.7%	1.1%	***	4.9%	0.6%	***

Results X²: ns: non-significant; * p<0.05; ** p<0.01; *** p<0.001
(1) This total also includes those who do not have a science cluster or fall within the small group of multidisciplinary research or the arts.

We will now look at the time between obtaining a doctorate and becoming a professor for these 'direct promotion' researchers. In cohort 1, we found that for 50% the time between obtaining the

doctorate and promoting to professor was at least 2.9 years; for one in four it was less than 0.8 years (P25) and for one in four it was at least 8.2 years (P75). In cohort 2, the time between obtaining a doctorate and promoting to professor was at least 2.6 years for 50%; for one in four it was less than 1.1 years (P25) and for one in four it was at least 4.6 years (P75).

There are significant differences by science cluster in both cohorts. In the (bio)medical, social sciences and humanities, one promotes sooner to professor than in the exact and applied sciences (Table 11).

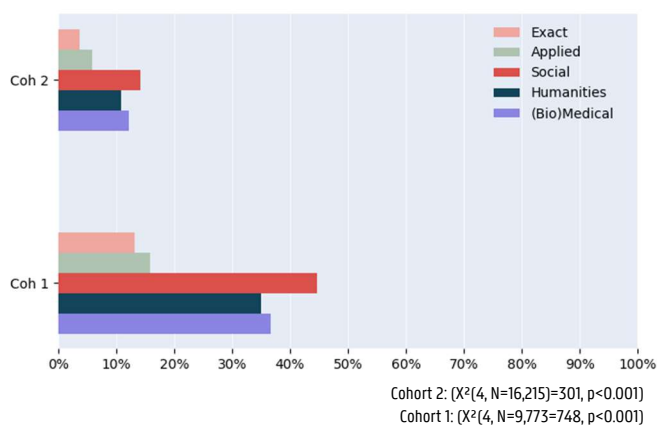
Table 11: Duration (percentiles in years) between obtaining the doctorate and becoming a professor among doctorate holders who became a professor without intermediate postdoctoral research activities in Flanders, results by science cluster - Doctorate holders cohort 1 and 2

	n	P25	P50	P75	Mean Rank
Cohort 1 Kruskal-Wallis: H(4)=89, p<0.001					
BMS	384	0.8	2.4	5.4	394
H	172	0.8	2.8	8.2	434
SS	137	0.7	2.0	7.8	405
AS	109	2.5	8.1	12.3	583
ES	96	3.3	8.4	14.5	611
Cohort 2 Kruskal-Wallis: H(4)=23, p<0.001					
BMS	305	1.1	2.4	3.9	271
H	79	1.3	2.6	4.3	294
SS	111	0.8	2.5	5.0	276
AS	58	1.9	5.0	7.1	374
ES	24	2.4	4.2	5.5	355

TOTAL SHARE OF DOCTORATE HOLDERS THAT BECAME A PROFESSOR AT A FLEMISH UNIVERSITY

In the results from this ecom brief, we gave results on becoming a professor with and without intermediate postdoctoral research activities in Flanders. As a closure of this results section, we provide the total share that promoted to professor. In cohort 1 this concerns 2,461 doctorate holders (25%) and in cohort 2 1,425 doctorate holders (9%). In both cohorts, the share is highest in the social sciences, followed by (bio)medical sciences and humanities (Figure 6).

Figure 6: Share of doctorate holders that became a professor, results by science cluster - Doctorate holders cohort 1 and 2



When we add the dimension gender next to science cluster, we notice in cohort 1 a significantly higher share of men who eventually became a professor than of women, with the exception of humanities, where the share of women is significantly higher (Table 12). In cohort 2 **for now**,

there is no significant difference between men and women in humanities and applied sciences; in the other clusters, the share of men that promoted to professor **for now**, is significantly higher than that of women.

Table 12: Share of doctorate holders that became a professor, results by science cluster and gender - Doctorate holders cohort 1 and 2

	Cohort 1			Cohort 2		
	Men	Women	p	Men	Women	p
BMS	42.3%	29.2%	***	17.2%	8.5%	***
H	32.8%	39.9%	*	11.4%	9.9%	ns
SS	47.8%	38.7%	*	16.9%	11.8%	***
AS	17.2%	11.5%	***	6.4%	4.7%	*
ES	14.8%	9.9%	***	4.1%	2.9%	ns
Total ⁽¹⁾	25.8%	21.8%	***	9.7%	7.5%	***

Results χ^2 : ns: non-significant; * p<0.05; ** p<0.01; *** p<0.001

(1) This total also includes those who do not have a science cluster or fall within the small group of multidisciplinary research or the arts.

In Table 13 we add the dimension nationality next to science cluster. The results are fully in line with the other results that we reported so far in this ecom brief: the share of non-Belgian doctorate holders that promoted to professor is particularly small and significantly different from the share of Belgians.

Table 13: Share of doctorate holders that became a professor, results by science cluster and nationality - Doctorate holders cohort 1 and 2

	Cohort 1			Cohort 2		
	Belgian	Non-Belgian	p	Belgian	Non-Belgian	p
BMS	44.2%	6.4%	***	15.0%	2.9%	***
H	47.4%	4.3%	***	15.7%	1.4%	***
SS	52.6%	6.3%	***	18.4%	1.9%	***
AS	21.1%	1.5%	***	8.9%	0.9%	***
ES	16.6%	1.8%	***	5.2%	0.7%	***
Total ⁽¹⁾	31.3%	3.1%	***	12.1%	1.4%	***

Results χ^2 : ns: non-significant; * p<0.05; ** p<0.01; *** p<0.001

(1) This total also includes those who do not have a science cluster or fall within the small group of multidisciplinary research or the arts.

Finally, we look at the time between obtaining a doctorate and becoming a professor for the entire group of doctorate holders that promoted to professor in Flanders. In cohort 1, we find that for 50% the time between obtaining the doctorate and becoming a professor was at least 4.7 years; for one in four it was less than 2.3 years (P25) and for one in four it was at least 8.4 years (P75). In cohort 2, the time between obtaining a doctorate and becoming a professor was at least 3.5 years for 50%; for one in four it was less than 2.0 years (P25) and for one in four it was at least 5.3 years (P75).

There are significant differences by science cluster in both cohorts. In (bio)medical, social sciences and humanities, one promotes sooner to professor than in the exact and applied sciences (Table 14).

Table 14: Duration (percentiles in years) between obtaining the doctorate and becoming a professor among all doctorate holders who became a professor in Flanders, results by science cluster - Doctorate holders cohort 1 and 2

	n	P25	P50	P75	Mean Rank
Cohort 1 Kruskal-Wallis: H(4)=223, p<0.001					
BMS	650	1.5	3.7	6.7	973
H	456	1.8	4.6	8.0	1095
SS	378	1.6	3.4	7.3	995
AS	434	3.5	5.9	9.3	1335
ES	408	4.6	7.7	10.8	1518
Cohort 2 Kruskal-Wallis: H(4)=79, p<0.001					
BMS	479	1.4	3.3	4.7	646
H	228	1.9	3.3	5.3	692
SS	319	1.6	2.7	4.8	637
AS	284	3.1	4.4	6.4	881
ES	112	2.5	4.3	5.7	814

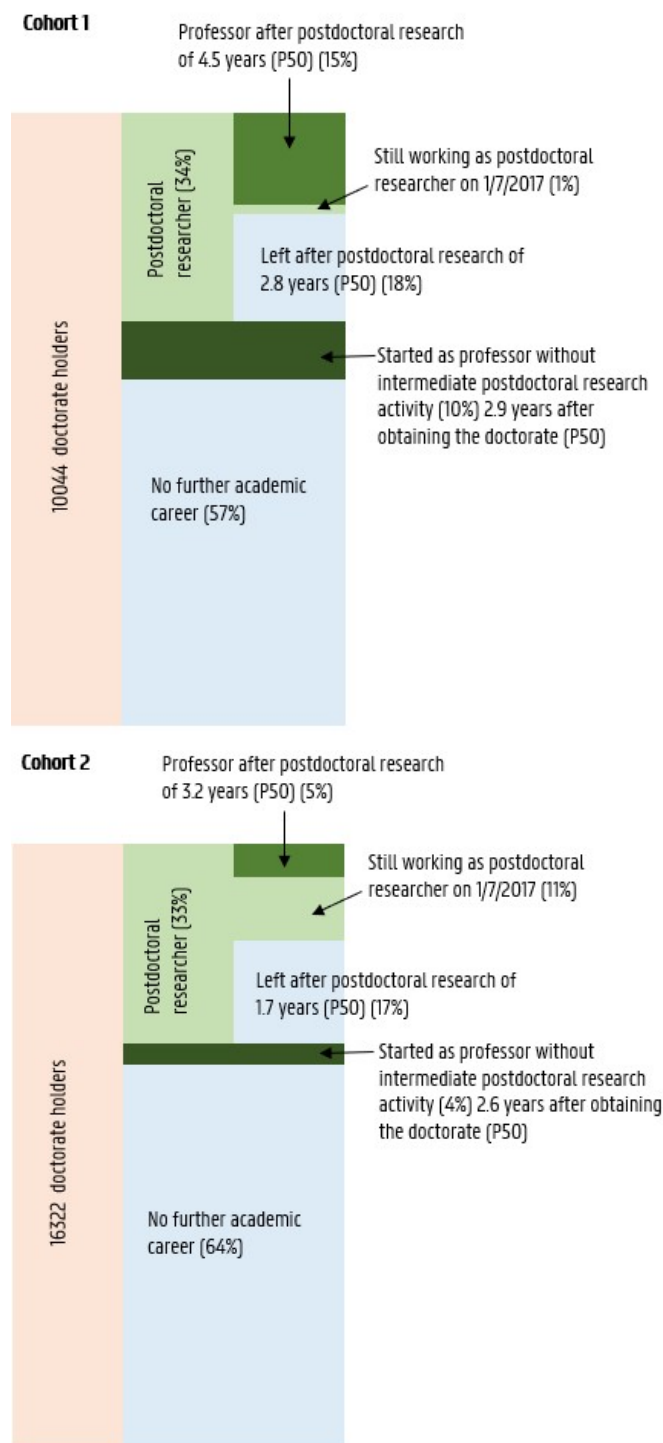
In [Appendix 3](#), the gender dimension is added for the sake completeness. In cohort 1, we generally see a significantly longer time between obtaining the doctorate and becoming a professor for women compared to men; the median is 5.3 years versus 4.5 years respectively. However, depending on the science cluster, the difference between women and men is only significantly different in the (bio)medical sciences and humanities. In cohort 2 **for now**, there are no significant differences between women and men in the time between obtaining the doctorate and becoming a professor.

No separate results are shown by science cluster and nationality because the number of non-Belgian professors in both cohorts is lower than 80. We do note, however, that overall there is no significant difference in duration between Belgians and non-Belgians.

SCHEMATIC SUMMARY

We conclude this results section with a schematic summary of the postdoctoral track in Flanders after obtaining the doctorate ([Figure 7](#)). Cohort 2 is obviously still subject to the largest changes; future updates of the HRRF database will increase the share promoting to professor. In addition, the duration of the postdoctoral research activity until promoting to professor, or until quitting the Flemish academic career, will also increase.

Figure 7: Schematic summary of the academic postdoctoral track after obtaining the doctorate in Flanders – Cohort 1 and cohort 2



Results for cohort 2 are still subject to significant changes with future updates of the HRRF database.

SUMMARY AND DISCUSSION

In this brief, we zoomed in on the academic career in Flanders after obtaining a doctorate. For this we looked at two cohorts of doctorate holders: those who obtained the doctorate during the period 1990-1991 to 2004-2005 (cohort 1, N=10,044) and those who obtained the doctorate during the period 2005-2006 to 2015-2016 (cohort 2, N=16,322). Although minor changes are still possible in cohort 1, it already provides a fairly complete picture of the academic trajectory in Flanders of these researchers. **For cohort 2, on the other hand, given the relatively short follow-up period, there will still be important changes with regard to the promotion to professor and the duration of the intermediate postdoctoral research activity.** Although it is expected that the promotion to professor in cohort 2 will remain lower than in cohort 1, it is already noticeable that the share of doctorate holders who started a postdoctoral research activity is similar in both cohorts (one in three). The same goes for the share that left the university after starting as a postdoctoral researcher (one out of two of the people who started postdoctoral research activities or 17% (cohort 2) to 18% (cohort 1) of the doctorate holders). However, in cohort 2 it is possible that part of these 'leavers' will return to a university in Flanders to continue the postdoctoral research and/or to promote to professor.

Of the doctorate holders who started postdoctoral research activities, we looked at the share that promoted to professor. In cohort 1 this was 43% after 4.5 years (P50 or median) of working as a postdoctoral researcher. In cohort 2 this was 16% after 3.2 years (P50) of working as a postdoctoral researcher (**results for now**). This was respectively 5.6 and 4.0 years (P50) after obtaining the doctorate.

Because not all doctorate holders who became a professor had an intermediate postdoctoral research activity in Flanders, we also looked at the researchers with '*direct promotion*': this concerns 10% of the doctorate holders from cohort 1 and, **for now**, 4% of the doctorate holders from cohort 2. Not surprisingly, these are mainly situated in the (bio)medical sciences, which reflects the clinicians who take up a position as a part-time professor, either immediately after the doctorate or not. Although these researchers with *direct promotion* did not become a professor immediately after the doctorate, they promoted to professor sooner after obtaining the doctorate in comparison to the group that had an intermediate postdoctoral research activity in Flanders (P50 of 2.9 years in cohort 1 and **for now** 2.6 years in cohort 2). The HRRF database does not contain any information on the activity in this intermediate phase: it is possible that one was working as a researcher outside Flanders or that one was working, as a researcher or not, at the non-academic labour market in Flanders.

In total, 25% of doctorate holders from cohort 1 became a professor and **for now**, 9% from cohort 2. This occurred respectively 4.7 and 3.5 years (P50) after obtaining the PhD.

In this ecom brief, we looked at the differences between the five science clusters. Already at the transition from doctorate to postdoctoral research, there are significant differences between the science clusters, but the differences become more pronounced at the stage where one becomes a professor: the share is always lowest in the

exact and applied sciences and highest in the humanities, social and (bio)medical sciences. We also note in the exact and applied sciences that, compared to researchers from the other science clusters, it took longer to promote to professor.

Next to science cluster, we added the dimension gender. To start with, we note that the share of female doctorate holders who started postdoctoral research activities was either equal or significantly higher than that of male doctorate holders. Exceptions are the exact sciences in cohort 1 and the applied sciences in cohort 2, where the share among males was significantly larger. This seems to be in contradiction with the results from ecom brief 16, where we found that the share of women among new postdoctoral researchers is always lower than or equal to the share of women among new doctorate holders (3). Obviously, when looking at the results from ecom brief 16, we have to take into account the important influx of non-Belgian researchers at postdoctoral level, with a rather low share of women (4).

If we move on to the next step, namely that of becoming a professor, we see a significantly smaller share among women than among men. However, there is one exception in cohort 1 in the humanities: there, the share of women who promoted to professor is significantly larger than the share of men. It took, however, significantly longer for women than for men to promote to a professorial position. In cohort 2 **for now**, there are no differences between men and women.

For the sake of completeness, we also examined the difference between Belgians and non-Belgians in this ecom brief. The results confirm the results from ecom brief 35 (4). Non-Belgian researchers who obtained their doctorate in Flanders only to a limited extent became a postdoctoral researcher in Flanders; in cohort 1 this was 10%, in cohort 2 it was already higher with 18%. Moreover, we find that, in general, their time as a postdoctoral researcher in Flanders is significantly shorter compared to that of Belgian doctorate holders. Finally, the share of non-Belgian doctorate holders that promoted to professor is very small ($\leq 3\%$).

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APPENDICES

Appendix 1: Duration (percentiles in years) of postdoctoral research activities of doctorate holders no longer working in an academic position in Flanders on 1/7/2017, results by science cluster and gender - Doctorate holders cohort 1 and 2

		P25	P50	P75	Mean Rank	Mann-Whitney U
Cohort 1						
BMS	Men (N=111)	1.2	3.0	6.5	129	U=7889, p=0.9
	Women (N=144)	1.5	2.6	5.7	127	
H	Men (N=103)	2.0	3.0	6.0	95	U=3869, p=0.4
	Women (N=81)	1.5	3.0	6.0	89	
SS	Men (N=88)	1.0	3.0	5.2	72	U=2445, p=0.4
	Women (N=61)	1.5	3.0	5.0	79	
AS	Men (N=349)	0.9	2.1	4.3	246	U=24654, p=0.001
	Women (N=172)	1.6	2.9	5.9	292	
ES	Men (N=439)	1.2	2.9	5.9	332	U=46016, p=0.5
	Women (N=217)	1.1	2.8	4.7	321	
Total ⁽¹⁾	Men (N=1,094)	1.0	2.7	5.41	873	U=355597, p=0.10
	Women (N=682)	1.4	2.9	5.2	914	
Cohort 2						
BMS	Men (N=190)	0.8	1.8	3.4	271	U=33282, p=0.6
	Women (N=360)	1.0	1.9	3.5	278	
H	Men (N=166)	0.9	2.4	4.0	166	U=12528, p=0.5
	Women (N=158)	1.0	1.9	3.9	159	
SS	Men (N=176)	0.6	1.5	3.0	195	U=18825, p=0.4
	Women (N=225)	0.7	1.7	3.0	205	
AS	Men (N=689)	0.7	1.4	3.0	457	U=76964, p=0.01
	Women (N=251)	0.7	1.7	3.9	508	
ES	Men (N=363)	0.7	1.6	3.0	288	U=38307, p=0.5
	Women (N=219)	0.7	1.7	3.3	298	
Total ⁽¹⁾	Men (N=1,589)	0.7	1.6	3.0	1363	U=901786, p=0.003
	Women (N=1,214)	0.8	1.8	3.6	1454	

(1) This total also includes those who do not have a science cluster or fall within the small group of multidisciplinary research or the arts.

Appendix 2: Duration (percentiles in years) of postdoctoral research activities of doctorate holders no longer working in an academic position in Flanders on 1/7/2017, results by science cluster and nationality - Doctorate holders cohort 1 and 2

		P25	P50	P75	Mean Rank	Mann-Whitney U
Cohort 1						
BMS	Belgian (N=221)	1.5	3.0	6.3	134	U=2543, p=0.002
	Non-Belgian (N=34)	0.8	1.3	4.6	92	
H	Belgian (N=165)	2.0	3.0	6.7	98	U=708, p<0.001
	Non-Belgian (N=19)	0.7	1.1	2.5	47	
SS	Belgian (N=138)	1.4	3.0	5.1	76	U=576, p=0.2
	Non-Belgian (N=11)	0.3	2.0	5.0	58	
AS	Belgian (N=472)	1.0	2.4	4.9	263	U=10602, p=0.3
	Non-Belgian (N=49)	1.0	2.2	3.4	241	
ES	Belgian (N=592)	1.2	3.0	5.5	333	U=14113, p=0.009
	Non-Belgian (N=60)	0.7	1.9	4.4	2661	
Total ⁽¹⁾	Belgian (N=1,599)	1.2	3.0	5.6	906	U=106603, p<0.001
	Non-Belgian (N=173)	0.8	1.9	3.9	703	
Cohort 2						
BMS	Belgian (N=467)	0.95	2.00	3.62	2813	U=16612, p=0.04
	Non-Belgian (N=83)	0.66	1.59	3.00	242	
H	Belgian (N=274)	1.00	2.29	4.00	166	U=6012, p=0.2
	Non-Belgian (N=50)	0.74	1.66	3.00	146	
SS	Belgian (N=343)	0.75	1.67	3.00	205	U=8488, p=0.07
	Non-Belgian (N=58)	0.41	1.31	3.00	176	
AS	Belgian (N=713)	0.83	1.59	3.41	492	U=65689, p<0.001
	Non-Belgian (N=227)	0.50	1.07	2.25	403	
ES	Belgian (N=437)	0.83	1.95	3.41	307	U=25058, p<0.001
	Non-Belgian (N=145)	0.50	1.00	2.45	246	
Total ⁽¹⁾	Belgian (N=2,239)	0.8	1.8	3.5	1454	U=515602, p<0.001
	Non-Belgian (N=564)	0.5	1.2	2.61	1197	

(1) This total also includes those who do not have a science cluster or fall within the small group of multidisciplinary research or the arts.

Appendix 3: Duration (percentiles in years) between obtaining the doctorate and becoming a professor among all doctorate holders who started as professor in Flanders, results by science cluster and gender - Doctorate holders cohort 1 and 2

		P25	P50	P75	Mean Rank	Mann-Whitney U
Cohort 1						
BMS	Men (N=430)	1.3	3.3	6.3	306	U=39011, p<0.001
	Women (N=220)	2.3	4.6	7.8	363	
H	Men (N=297)	1.6	4.0	7.5	218	U=20536, p<0.05
	Women (N=159)	2.2	5.6	9.0	248	
SS	Men (N=265)	1.5	3.4	7.1	188	U=14534, p=0.7
	Women (N=113)	1.6	3.6	7.4	193	
AS	Men (N=357)	3.4	5.8	9.3	213	U=12035, p=0.09
	Women (N=77)	4.2	6.9	9.3	240	
ES	Men (N=305)	4.6	7.5	10.6	200	U=14242, p=0.2
	Women (N=103)	4.8	8.6	12.4	219	
Total ⁽¹⁾	Men (N=1,760)	2.1	4.5	8.4	1207	U=574274, p<0.01
	Women (N=701)	2.4	5.3	8.7	1292	
Cohort 2						
BMS	Men (N=281)	1.4	3.0	4.7	232	U=25635, p=0.1
	Women (N=198)	1.5	3.4	4.8	251	
H	Men (N=140)	2.1	3.5	5.3	119	U=5561, p=0.2
	Women (N=88)	1.4	3.2	5.2	108	
SS	Men (N=180)	1.8	2.7	4.8	161	U=12249, p=0.7
	Women (N=139)	1.4	2.9	4.9	158	
AS	Men (N=215)	3.0	4.4	6.4	141	U=7103, p=0.6
	Women (N=69)	3.2	4.7	6.7	147	
ES	Men (N=78)	2.6	4.3	5.8	57	U=1287, p=0.8
	Women (N=34)	2.4	4.3	5.7	55	
Total ⁽¹⁾	Men (N=896)	2.1	3.5	5.3	722	U=228961, p=0.3
	Women (N=529)	1.7	3.5	5.2	698	

(1) This total also includes those who do not have a science cluster or fall within the small group of multidisciplinary research or the arts.

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