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Researcher Mobility in Swedish Higher Education Institutions

A study conducted for STINT by Elsevier's Analytical Services, September 2016

STINT
The Swedish Foundation for International Cooperation in Research and Higher Education

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Executive summary
Researcher Mobility in Swedish Higher Education Institutions

In total, 28 Swedish Higher Education Institutions (HEIs) are examined in this report, whose numbers of active researchers range from a few hundred to several thousands. The ten largest of these HEIs are referred to as the Big 10.

Overall, the Swedish HEIs show a high degree of mobility among their researchers[1]: throughout the period of 1996-2015, on average 74.4% of the researchers identified as having current or past affiliations with Swedish HEIs have published with at least two institutions. In this same period, on average 50.4% of the researchers have published at least once with a non-Swedish affiliation.

On average, a quarter (25.6%) of the researchers at the 28 HEIs has only published at the institution they are currently affiliated with. Such researchers tend to be early career researchers, having much shorter publication histories than the average researcher at their institution. They are also the least productive (in terms of publications) and the least cited (in terms of field-weighted citation impact - FWCI) when compared to researchers who show any kind of mobility. At the majority of the HEIs (23 out of 28) sedentary researchers nevertheless achieve a citation impact that is above the world average.

The majority of the HEIs have a smaller percentage of inflow than outflow, resulting in an average net outflow of 5.0%.[2] Among the 28 HEIs, the Big 10 show the highest percentages of net outflow. When comparing the nationally mobile researchers to the internationally mobile ones, the percentages of both outflow and inflow are nearly the same. However, there are a few differences between them in terms of FWCI. The nationally mobile outflow researchers achieve a higher FWCI than the internationally mobile ones, whereas the internationally mobile inflow researchers have a higher FWCI than the nationally mobile ones.

Researchers with transitory mobility – meaning stays of less than two years at their current affiliation or elsewhere before moving again – make up the largest percentage of the HEIs' total researchers in all cases. For the majority of HEIs, such researchers are also the most productive and most impactful type of researchers, with an average FWCI close to twice the world average. Comparing national mobility to international mobility, we see that transitory researchers are considerably more numerous among those with international mobility (37.0% on average for the 28 HEIs) than among those with national mobility (26.3%). The Big 10 rank among the lower percentages of transitory mobility on a national level, but among the higher percentages on an international level.

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[1] Please refer to Chapter 1.1 and 1.2 for the definitions of researchers and mobility categories, or see Appendix B for details of the methodology.

[2] Although 'net outflow' indicates that the number of people coming to a HEI is smaller than the number of people leaving, this should not be interpreted as a decrease in size of the HEI. The analyses in this report are based solely on the authors of publications, and do not include non-publishing research staff or (PhD) students.

Key Findings

HIGH INTERNATIONAL MOBILITY

50.4% of the 28 HEIs' researchers have been abroad

MOBILE RESEARCHERS MORE IMPACTFUL

Higher FWCI for researchers who move between institutions

HIGHLY IMPACTFUL TRANSITORY MOBILITY

Researchers with short-term mobility cited almost twice as often as the world average

Preface

Researcher mobility has become a key area of interest for the potential enhancement of a country's research performance. While such migration has traditionally been discussed in terms of losers ('Brain Drain') and winners ('Brain Gain'), current research suggests that researcher mobility results in win-win situations both in the short-term and the long-term.

On the one hand, an inflow of researchers enables the flow of ideas and knowledge to a country, despite some of them staying only for short or infrequent periods. On the other hand, although a country or institution may 'lose' some of its research talent to elsewhere, many researchers come back with stronger skills. Even permanent migration out of a country is not necessarily a bad thing, as those abroad often maintain strong ties to their previous place of study or employment. Through such connections, researchers have the ability to strengthen collaboration ties between countries and institutions and to improve the quality of their research.

The availability of comprehensive publication databases containing articles with complete author affiliation data, such as Scopus, has enabled the development of a systematic approach to researcher mobility analysis through the use of authors' addresses listed in their published articles as a proxy for their location.

With this report, Elsevier's Analytical Services aims to provide insights into various aspects of the researcher mobility in Sweden's higher education institutions.

Special thanks to Hans Pohl, Programme Director at STINT, for his collaboration and valuable reviews of draft versions of the report.

"(…) in order for knowledge-based societies to develop both in societal and economic terms they need to make most of the potential that researchers and research results offer in different disciplines. For this potential to materialize on equal terms, the global research community needs brain circulation (…)."

NordForsk Policy Paper 3 -2014 Crossing Borders – Obstacles and incentives to researcher mobility

STEVEN SCHEEROOREN

Contents

Introduction

This report has been commissioned by the Swedish Foundation for International Cooperation in Research and Higher Education (STINT), to examine the extent to which researchers at 28 Swedish higher education institutions (HEIs) have international research experience. The report studies the mobility of researchers, answering questions such as whether an institution is attractive to researchers and how various mobility classes contribute to each institution's research output and impact.

In order to measure researcher mobility, Elsevier's Analytical Services make use of the affiliations registered in author profile data in Scopus. Taking into account the publication data of 1996 to 2015, we look at the different affiliations an author has published with during this period to calculate the number of 'moves' a researcher makes. For our analyses, we divide researcher mobility into four categories: Sedentary, Inflow, Outflow, and Transitory. These will be further explained in Chapter 1.

For each of the 28 HEIs in this report, three mobility charts were created: an analysis of the total researcher mobility, the mobility involving only moves within Sweden, and the mobility of those moving outside of Sweden. In order to provide further insights in the data, the ten largest institutions (by publication output) were selected by STINT for a written analysis. Throughout the report, these shall be referred to as the "Big 10". In alphabetical order, these are:

- Chalmers University of Technology
- Goteborg University
- Karolinska Institutet
- Linkoping University
- Lund University
- Royal Institute of Technology
- Stockholm University
- Swedish University of Agricultural Sciences
- Umea University
- Uppsala University

For the full methodology, please see the Appendices.
For the complete list of HEIs, please see Appendix B.

Chapter 1
Introduction to Methodology

This chapter explains the different types of researcher mobility analysed in this report, the categories into which researchers are divided based on their publication history, and the indicators used to characterise each category.

1.1 Defining researcher mobility

To define the initial number of researchers for this study, researchers were identified as belonging to a specific Higher Education Institution (HEI) if they listed it as their affiliation on at least one publication (articles, reviews and conference papers) published across the sources included in Scopus during the period 1996-2015. It is important to note that thusly defined researchers are not necessarily currently in the employment of their assigned HEI.

For the analyses in this report, only "active" researchers have been taken into account. Authors are considered active if they produced on average 1 publication every 3 years between their first publication and the end of 2015, and produced at least 1 publication in the last 5 years.

To measure researcher mobility, researchers are divided into four main categories:

- **Sedentary**: researchers who do not appear to have ever left their current affiliation: in the period of 1996 to 2015 they have only published with the institution in focus.
- **Inflow**: researchers coming to an institution. This is divided into:
  - Inflow: researchers who have moved to this institution and remained there.
  - Returnees Inflow: researchers who had left this institution for more than two years, but thereafter returned.
- **Outflow**: researchers leaving an institution. This is divided into:
  - Outflow: researchers who leave the institution in focus and do not return.
  - Returnees Outflow: researchers who had come to the institution from other institutions or countries and stayed for more than two years, but thereafter left again.
- **Transitory**: researchers who stay at the institution or elsewhere for less than two years before moving to other institutions/countries or returning to the institution in focus, respectively. This is divided into:
  - Mainly with the institution in focus: researchers for whom the count of publications with this particular affiliation is greater than the count of publications elsewhere.
  - Mainly outside of the institution in focus: researchers for whom the count of publications with other affiliations is greater than the count of publications with this institution.

For each of these categories, the analysis looks at four metrics to answer the following key questions:

- **Group size**: what percentage of the institution's total researchers belongs to each category?
- **Relative Productivity**: how much research is being published by researchers in each category, compared to the institution's average? This indicator compares the articles per year since the first appearance of each researcher as an author (during the period 1996–2015), relative to all of the institution's researchers in the same period. A value above 1.0 means that a group is relatively more productive than the average researcher, while a value below 1.0 means they are less productive than the average.
- **Relative Age**: how 'old' are the researchers, comparatively? This is not an actual age in years, but rather the length of their publishing history, as measured by the appearance of their first publication in Scopus. While not a definitive answer, it can be used to gauge whether they are early-career researchers or more established ones. Here a value above 1.0 means that a group is relatively older than the average researcher in the institution, while a value below 1.0 means they are younger than the average.
- **Field-Weighted Citation Impact** (FWCI): how impactful is the research, as measured by relative citation rates? FWCI is a normalized measure of citation impact that accounts for differences in

citation behavior between fields, document types, and publication years. This metric is benchmarked against the global average, set at 1.00, meaning that a FWCI of more than 1.00 indicates that the group's publications have been cited more than would be expected based on the global average for similar publications. For example, a FWCI of 1.5 would mean that a publication is cited 50% more often, whereas an FCWI of 0.5 would mean that it is cited 50% less often.

For more details on this methodology, please see Appendix B.

1.2 Defining (inter)national researcher mobility

In Chapter 3, a distinction is made between those who move between institutions within Sweden, and those who move between institutions in Sweden and institutions abroad. However, these are not mutually exclusive. The two types of mobility are defined as follows:

- National mobility: authors who have published with two or more Swedish institutions, regardless of publications with non-Swedish institutions.
    - For example, researchers who published with Chalmers University of Technology and with Uppsala University are regarded as showing national mobility, even if they also published with an institution abroad.
- International mobility: authors who have published at least one publication with a Swedish institution and at least one publication with a non-Swedish affiliation, regardless of publications with multiple Swedish institutions.
    - For example, researchers who published with Blekinge Institute of Technology and with an institution abroad are regarded as showing international mobility, even if they also published with University West.

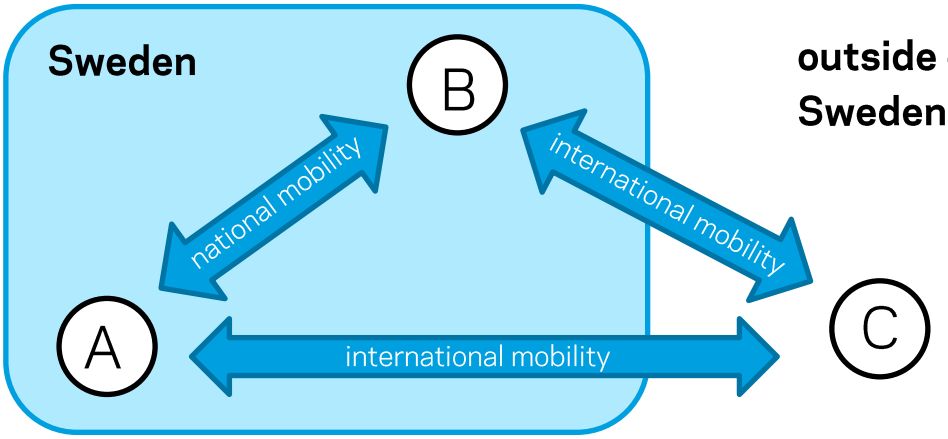

Figure 1.0— *Example diagram of national and international mobility*

- A researcher who has worked at A and B shows only national mobility: (s)he was affiliated with 2 Swedish institutions, but no non-Swedish ones.
- A researcher who has worked at A and C shows only international mobility: (s)he was affiliated with a non-Swedish institution, but only 1 Swedish institution.
- A researcher who has worked at A, B, and C would be counted among both the national and international mobility.
- A researcher who has worked only at A, B or C does not show mobility at all, and would not be included in this chapter.

Please note:

- Using the above definitions of national and international mobility means there is an overlap between the two groups, as an author may have published with multiple affiliations both in Sweden and outside of Sweden.
- The percentages of each mobility category are based on the institution's total number of active researchers. As Chapter 3 excludes sedentary researchers, the percentages in those analyses do not add up to 100%.

Chapter 2
Overall researcher mobility

This chapter examines in depth the overall researcher mobility of ten Swedish higher education institutions (HEIs), divided into four categories, for which the (relative) group size, productivity, age, and citation impact are calculated. For another eighteen HEIs, mobility charts are provided.

2.1 Key Findings

TRANSITORY MAJORITY

48.8%

Researchers with transitory mobility form the largest category for all HEIs, averaging about half of their total researchers.

SEDENTARY YOUNGEST

25.6%

At all HEIs, researchers that have not moved between institutions are the youngest, the least productive, and have the lowest citation impact.

HIGHEST NUMBER OF ACTIVE RESEARCHERS

Karolinska Institutet

During the period of 1996-2015, 19,407 different currently active researchers have at least once authored a publication with Karolinska Institutet as their affiliation.

HIGHEST CITED INFLOW

Stockholm School of Economics

The researchers coming to Stockholm School of Economics have a field-weighted citation impact of 2.53 (or 153% above the world average).

2.2 General comparison

Sedentary

Among the institutions, between a fifth and a third of their active researchers have only published at the HEI they are currently affiliated with. Dalarna University has the lowest share of sedentary researchers, at just 20.4% of its total researchers, while the highest share is a two-way tie between Karlstad University and Lulea University of Technology; both at 34.7%. For the Big 10 these shares are between 22.9% and 28.8%. Researchers in this category are the least impactful mobility group for a large majority of the examined HEIs (22 out of 28), and achieve FWCIs that are lower than the HEIs' overall average FWCIs for active researchers in all cases. Nevertheless, these FWCI values are at or above the world average for a majority of the HEIs (23). For one outlier - the Stockholm School of Economics -, publications by sedentary researchers even manage to achieve a FWCI of 131% above the world average.

Outflow

The outflow researchers generally form the second smallest category for the HEIs in this report. On average, they make up 15.3% of the HEIs' total researchers (see Table 2.1). University West has by far the lowest share of outflow: only 7.5% of its researchers leave the institution for more than two years. It also happens to have the lowest FWCI for outflow researchers among all HEIs, at 1.15. Interestingly, Dalarna University has the 2nd lowest outflow share, but it has the highest FWCI for this category, meaning they lose much more significant contributors to their overall FWCI. The top 5 HEIs with the largest shares of outflow are all among the Big 10, with Chalmers University of Technology topping the list at 17.3% outflow. Out of the 28 HEIs, 25 have a net outflow of researchers, ranging from 10.4% for the Stockholm School of Economics to 0.5% for Kristianstad University.

Transitory

Researchers that display transitory mobility form the largest mobility group for all HEIs. Even at Karlstad University – the institution with the lowest transitory share – they account for 43% of its active researchers, followed closely by Lulea University of Technology with 43.3%. On top of this, transitory researchers are the most impactful among the mobility categories for all HEIs in this report. For a quarter of them the FWCI of such researchers is more than twice the world average. Given its low shares in other categories, it is perhaps unsurprising that Dalarna University has the highest share of transitory researchers, at 63.1%. While the differences between most HEIs in this category are minimal, it leads by a significant gap: the second highest share – that of Jonkoping University – is 54.2%. At the same time it also has the highest FWCI in this category among all HEIs: publications by Dalarna University's transitory researchers are cited almost three times as much as the world average (FWCI 2.96). Among the Big 10, Stockholm University achieves the highest FWCI, at 2.38, and Linkoping University the lowest, at 1.55.

Inflow

On average, Swedish HEIs show researcher inflows of 10.3%, making these the smallest categories among their total researcher base for all but three institutions (University West, Malmo University, and Orebro University). These three are also the only ones with a net inflow. Malmo University has the highest inflow among all HEIs in this report (14%), the Stockholm School of Economics the lowest (5.5%). The FWCI of the inflow researchers is above the world average for all but one HEI (Dalarna University, FWCI 0.96), with the Stockholm School of Economics ranking first at 2.53 (i.e. cited more than 2.5 times as much as the world average). At each of the Big 10, inflow researchers achieve a FWCI of 1.5 or higher, with the most impactful being those at Stockholm University (FWCI 2.0).

Institution	Active Researchers, 1996-2015	Sedentary %	Outflow %	Transitory %	Inflow %
Karolinska Institutet	19,407	23.8	15.4	49.6	11.1
Lund University	15,947	25.9	15.4	48	10.7
Uppsala University	14,908	23.4	16.5	49.8	10.3
University of Gothenburg	10,524	26.4	14.2	48.1	11.3
Royal Institute of Technology	8,931	25	16.8	50.1	8.1
Stockholm University	7,613	22.9	16.4	51.7	9
Linkoping University	6,647	28.5	14.4	46.4	10.7
Umea University	6,308	28.8	14.3	46.5	10.3
Chalmers University of Technology	6,075	25.1	17.3	48.5	9.1
Swedish University of Agricultural Sciences	4,625	25.1	16.5	47	11.4
Lulea University of Technology	1,950	34.7	14.5	43.3	7.6
Orebro University	1,836	25.7	10.5	53.1	10.8
Linnaeus University	1,064	31.1	12.4	45	11.5
Mid Sweden University	823	31	13.9	44	11.2
Malmo University	772	30.4	9.8	45.7	14
Malardalen University	736	30.2	14.4	45.4	10.1
Karlstad University	683	34.7	12.7	43	9.5
Jonkoping University	609	25.1	12.5	54.2	8.2
Blekinge Institute of Technology	499	32.3	12.4	47.1	8.2
University College of Boras	411	25.3	13.6	48.9	12.2
Dalarna University	401	20.4	8.7	63.1	7.7
University of Gavle	397	23.4	14.4	52.1	10.1
University of Skovde	383	25.8	12.8	51.4	9.9
Stockholm School of Economics	383	25.6	15.9	53	5.5
Halmstad University	380	30.5	11.8	47.6	10
Sodertorn University	355	22.8	14.1	51.8	11.3
University West	239	34.3	7.5	46	12.1
Kristianstad University	209	28.7	12	47.8	11.5
Weighted average	-	**25.6**	**15.3**	**48.8**	**10.3**

Table 2.1— *Total active researcher count and share of the total per mobility category, for 28 Swedish higher education institutions, 1996-2015. Source: Scopus*

Institution	Publications by active researchers	Sedentary FWCI	Outflow FWCI	Transitory FWCI	Inflow FWCI	Overall FWCI
Karolinska Institutet	841,375	1.63	1.67	2.04	1.87	1.94
Lund University	689,735	1.48	1.81	1.99	1.83	1.92
Uppsala University	674,090	1.46	1.82	2.17	1.87	2.05
Royal Institute of Technology	435,858	1.39	1.69	1.77	1.62	1.73
Goteborg University	404,363	1.51	1.85	2.04	1.87	1.97
Stockholm University	343,769	1.55	2.17	2.38	2.00	2.29
Linkoping University	240,146	1.47	1.50	1.72	1.58	1.63
Chalmers University of Technology	228,512	1.41	1.51	1.55	1.56	1.54
Umea University	225,749	1.40	1.69	1.92	1.68	1.82
Swedish University of Agricultural Sciences	126,385	1.38	1.70	1.62	1.72	1.64
Orebro University	68,836	1.24	1.76	2.37	1.76	2.20
Lulea University of Technology	51,201	1.00	1.42	1.52	1.31	1.44
Linnaeus University	22,509	1.15	1.61	1.97	1.62	1.79
Dalarna University	21,361	1.53	2.60	2.96	0.96	2.87
Karlstad University	20,760	1.34	1.56	1.44	1.53	1.46
Mid Sweden University	20,686	0.80	1.70	1.88	1.29	1.70
Malmo University	19,951	1.10	1.67	1.85	1.39	1.71
University of Skovde	18,632	1.06	1.44	1.18	1.05	1.19
Malardalen University	15,353	1.03	1.71	1.71	1.25	1.60
Jonkoping University	14,434	0.97	1.57	1.75	1.31	1.64
Blekinge Institute of Technology	13,582	1.15	1.38	1.16	1.27	1.22
University of Gavle	10,373	1.40	1.32	1.43	1.46	1.41
Stockholm School of Economics	10,220	2.31	2.29	2.89	2.53	2.73
Halmstad University	9,210	1.29	1.47	1.57	1.19	1.49
University College of Boras	9,140	0.87	1.44	1.49	1.17	1.40
Sodertorn University	6,818	0.87	2.20	1.65	1.34	1.73
Kristianstad University	4,436	0.70	1.53	1.28	1.42	1.34
University West	3,942	1.16	1.15	1.38	1.21	1.31
Weighted average	-	1.47	1.76	1.98	1.77	1.90

Table 2.2— *Total publications by active researchers and field-weighted citation impact (FWCI) per mobility group, for 28 Swedish higher education institutions, 1996-2015. Source: Scopus*

2.3 Analyses of the Big 10

From the 28 Swedish HEIs in this report, STINT selected ten for a detailed analysis, based on the size of the institutions. In the following section the HEIs are listed in alphabetical order.

Chalmers University of Technology

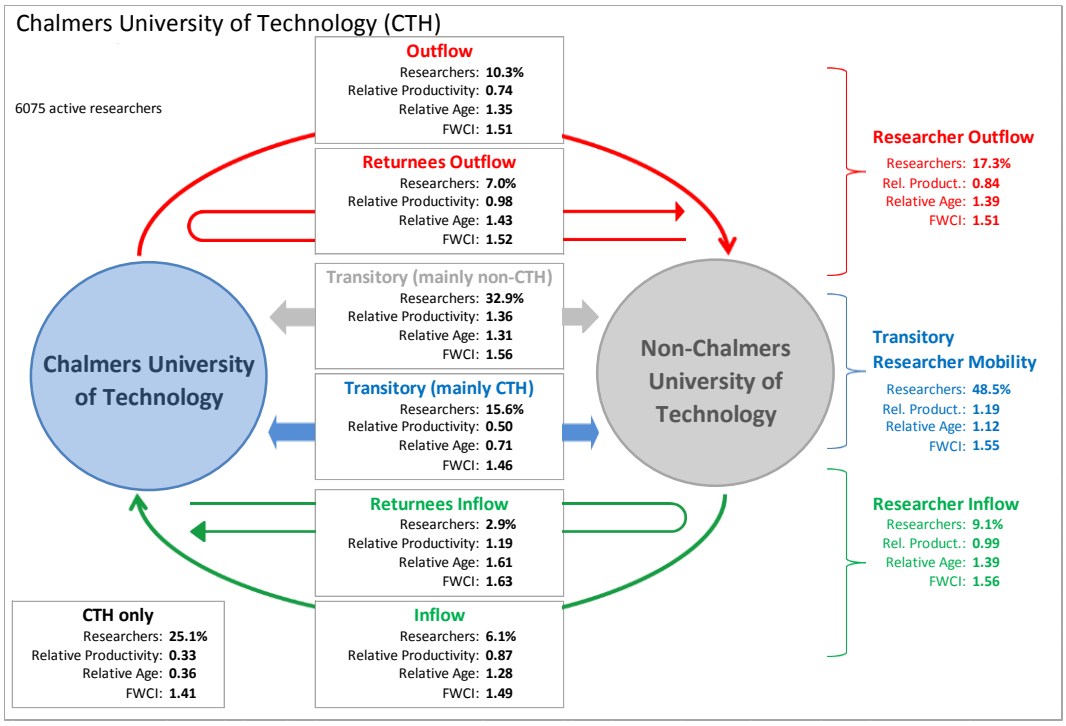

Figure 2.1— *Overall researcher mobility for Chalmers University of Technology, 1996-2015. Source: Scopus*

Chalmers University of Technology's researchers are quite mobile. Only a quarter of its researchers have published articles solely with CTH. As is the case for most HEIs in this report, these researchers are far less productive, but also far 'younger' than the average researcher at CTH. The articles that they do publish are of high quality, as indicated by a citation rate that is 41% above the world average, yet their FWCI is the lowest among CTH's mobility categories.

CTH has the highest share of total outflow among all HEIs in this report (17.3%). Additionally, its inflow share is the third lowest among the Big 10. At 9.1%, it is just 0.1 percentage point higher than the second lowest inflow share, that of Stockholm University. The combination of these two factors gives CTH the third highest net outflow among all HEIs, after the Royal Institute of Technology (KTH) and Stockholm School of Economics. On a more positive note, the outflow researchers are neither as productive nor as impactful as the inflow researchers or those with transitory mobility.

Nearly half of CTH's researchers display transitory mobility, meaning they stay at CTH for less than two years before moving on, or have been affiliated elsewhere for less than two years before returning to CTH. They are the most productive category, thanks to researchers that are affiliated mostly with non-CTH institutions. The mainly CTH transitory researchers actually show a relative productivity that is half of CTH's average, but are also still relatively 'young' (29% below CTH's average).

The inflow researchers are the smallest group of researchers for CTH, making up less than 10% of its total researcher base. That being said, they have the highest FWCI of 1.56, meaning their publications

are cited on average 56% more than the world average. The returnees (those who first published at CTH, left for more than 2 years, then returned) show a greater productivity and a higher citation impact than the regular inflow researchers.

Goteborg University

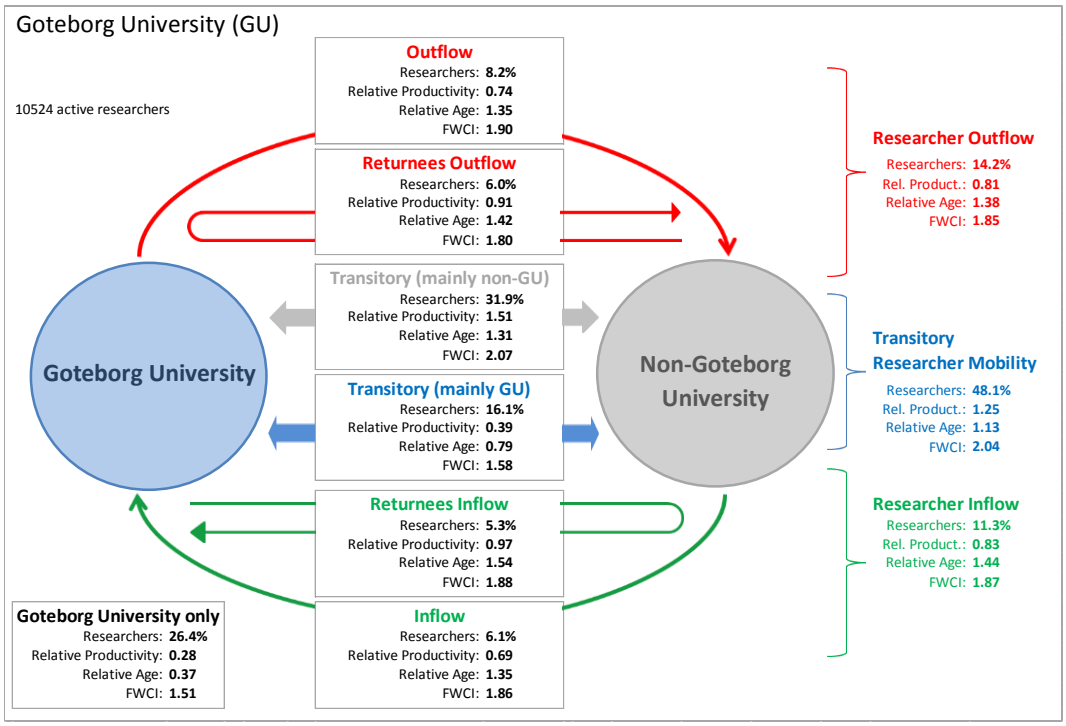

Figure 2.2— *Overall researcher mobility for Goteborg University, 1996-2015. Source: Scopus*

Among the Big 10, Goteborg University has the third largest percentage of sedentary researchers (26.4%), though among all 28 institutions in this report it ranks a fairly average 13th. The field-weighted citation impact (FWCI) of these researchers also happens to be the third highest in this category among the Big 10 (5th out of 28). Publications of Goteborg University's sedentary researchers are cited 51% more often than the world average.

Similarly, Goteborg University's outflow rate (14.2%) is 14th among all 28 HEIs, but it is the lowest among the Big 10. Although its inflow rate is lower still, meaning there is a net researcher outflow, this net outflow is again the lowest among the Big 10, at just 2.9%. On the one hand this is fortunate, as Goteborg University's outflow researchers are the second highest cited outflow researchers among the top HEIs. They achieve a FWCI of 1.85 – or 85% above the world average. On the other hand, there is little cause for concern, since the university's transitory and inflow researchers are both cited higher still.

The researchers with transitory mobility are – as is the case for most institutions – the most highly cited mobility category for Goteborg University. Their publications are cited 104% more often than the world average. Additionally, the transitory researchers are the most productive category of researchers, thanks to those affiliated mainly with institutions other than Goteborg University publishing 51% more than the average researcher there. It should be noted however, that these particular transitory researchers have also been publishing for considerably longer: their relative age is 31% higher than the average Goteborg University researcher.

While inflow researchers form Goteborg University's smallest mobility category, at 11.3% this is the second largest group of such researchers among the Big 10. They have the highest relative age, in particular the returnees (54% above the university's average), and are very highly cited. Overall, the FWCI

of Goteborg University's inflow researchers is the 3rd highest among all 28 HEIs – 87% above the world average – though it shares this spotlight with Karolinska Institutet and Uppsala University.

Karolinska Institutet

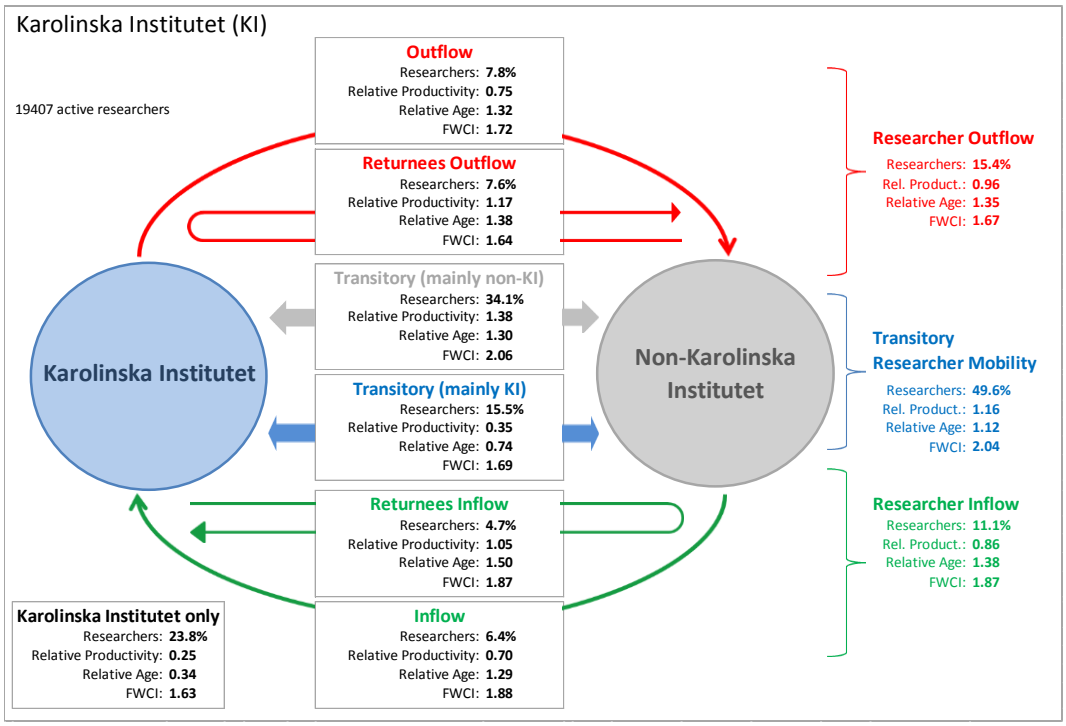

Figure 2.3— *Overall researcher mobility for Karolinska Institutet, 1996-2015. Source: Scopus*

Karolinska Institutet shows a high degree of mobility among its researchers. With only 23.8% of its researchers never having published with other affiliations, it ranks 3rd among the Big 10 institutions in this metric, and 6th among all 28 HEIs in this report. Although the relative productivity and relative age of researchers in this category are far below that of the average researcher at Karolinska Institutet, their publications achieve a field-weighted citation impact (FWCI) of 63% above the world average.

Outflow researchers achieve a slightly higher FWCI than the sedentary researchers, but have also been publishing for a much longer time. Their relative age is the second highest among the mobility categories of Karolinska Institutet, at 35% above average. Among these outflow researchers there is a nearly even share of those who leave Karolinska Institutet for the first time and those who return to other institutions after stays of 2+ years. The main difference between the two groups is that the former are more impactful, whilst the latter are more productive.

Nearly half of Karolinska Institutet's researchers (49.6%) display transitory mobility, of which the majority is mainly affiliated with other institutions. This subgroup is both the most productive (at 38% above Karolinska Institutet's average) and the most impactful among the institution's mobility groups, achieving a FWCI of 2.06 (106% above the world average). Mainly Karolinska-affiliated transitory researchers on the other hand are the second youngest after the sedentary researchers, and produce the second fewest publications (65% below Karolinska's Institutet's average researcher).

Researchers who come to Karolinska Institutet for more than 2 years (or return after long periods elsewhere) are the 'oldest' category of researchers: their publication history is 38% longer than that of the average researcher at Karolinska Institutet. They do not publish as often as either the outflow or transitory researchers, as indicated by their relative productivity of 0.86 (14% below Karolinska's average), but their research is highly cited. At 87% above the world average, they achieve the 3rd highest

FCWI among all inflow researchers of Swedish HEIs (tied with Goteborg University and Uppsala University).

Linkoping University

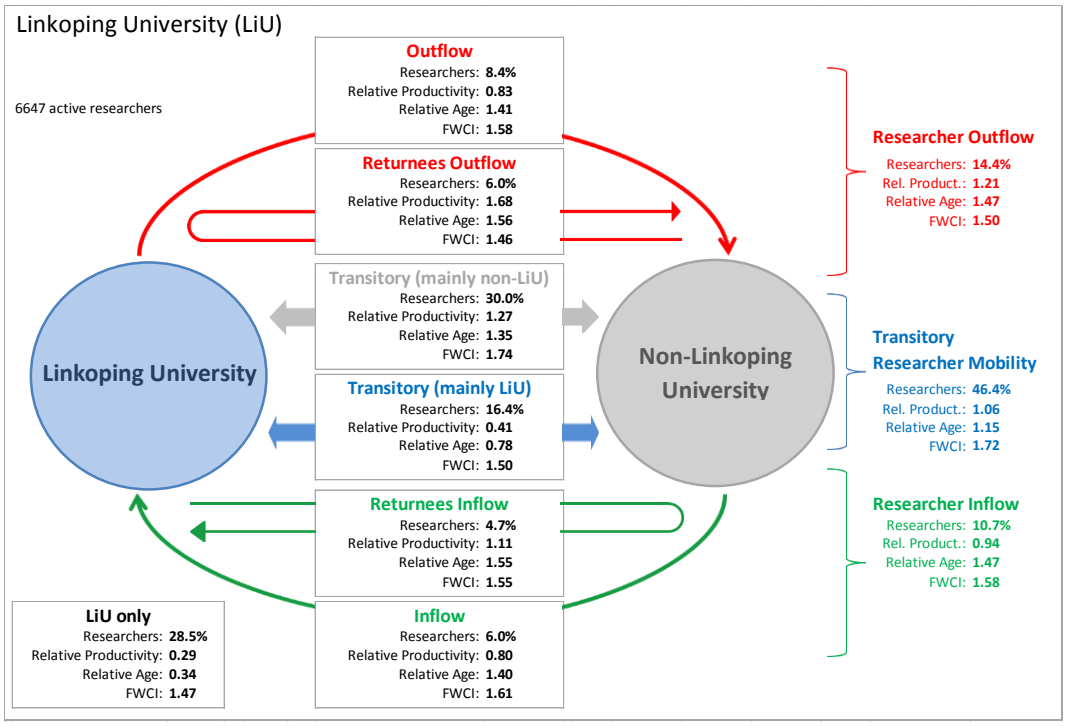

Figure 2.4— *Overall researcher mobility for Linkoping University, 1996-2015. Source: Scopus*

Over a quarter of Linkoping University's researchers (28.5%) do not show any mobility, which is the second highest sedentary rate among the Big 10, topped only by Umea University (28.8%). In terms of relative age and productivity the sedentary researchers are well below Linkoping University's average. However, with their publications being cited 47% more often than the world average, the field-weighted citation impact (FWCI) of these researchers is the 7th highest among all 28 HEIs.

While having a low FWCI is rarely a good thing, one could argue that is less so for Linkoping University's outflow researchers, as it implies a lesser loss of research quality for the institution. At 'only' 50% above world average, outflow researchers at Linkoping's University have the lowest FWCI among the Big 10 (8th lowest among the 28). Although they do not make up a particularly large part of Linkoping University's total researchers (14.4%), they do have the highest relative productivity. Publishing 68% more than the average researcher at Linkoping University, the outflow returnees in particular make a significant contribution to the university's publication output.

Mirroring the high number of sedentary researchers, Linkoping University has the lowest percentage of researchers with transitory mobility among the Big 10. At 46.4% of the university's total researchers, they nevertheless form the largest category of Linkoping University's mobility categories. On top of this they achieve the highest FWCI among its researchers, at 72% above the world average.

Inflow researchers account for just over a tenth of the university's total researchers. They show a publication history that is 47% longer than the average Linkoping University researcher, on par with that of the outflow researchers. The returnees are more productive than new inflow researchers, bringing the relative productivity for the inflow as a whole up to just below Linkoping University's average. It is the group of new inflow researchers however, that bring in a higher citation impact: at 61% above the world average, they outperform all mobility groups except for the mainly non-Linkoping affiliated transitory researchers.

Lund University

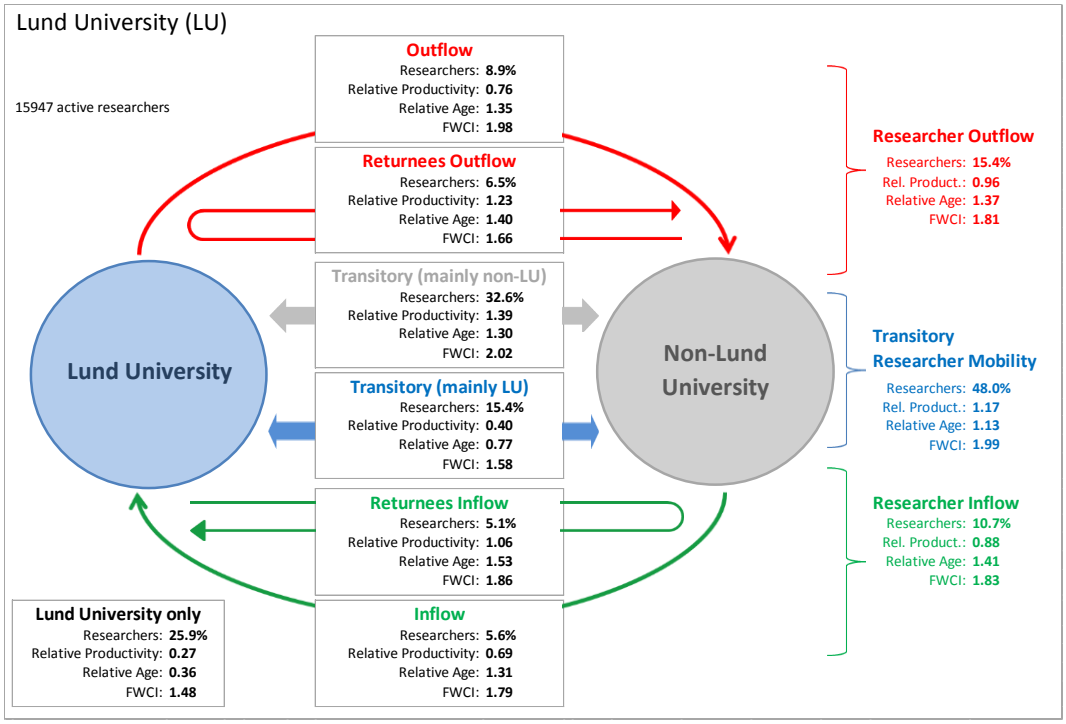

Figure 2.5— *Overall researcher mobility for Lund University, 1996-2015. Source: Scopus*

Lund University's percentage of sedentary researchers is neither high nor low when compared to the other Swedish HEIs in this report. At 25.9%, it ranks 14th out of the 28 institutions. While their field-weighted citation impact (FCWI) is well below that of Lund University's other mobility categories, it is actually fairly high for this type of non-mobility, ranking 6th among the 28 HEIs' sedentary researchers.

With a share of 15.4% of its total researchers, Lund University's outflow is among the lower ones of the Big 10, yet it ranks 7th from the top among all 28 HEIs. Similarly, the FWCI of the outflow researchers is the 7th highest among these institutions, at 1.81. As far as Lund University's researchers are concerned, they show a high relative age (only slightly below that of the inflow researchers) and a high relative productivity (second only to the transitory researchers).

Aside from making up the largest share of Lund University's total researcher base, researchers with transitory mobility show the highest relative productivity among the university's mobility categories. These researchers produce 17% more publications than its average researchers, which also achieve the highest FWCI of all mobility categories at the university, being cited nearly twice as often as the world average. Those who are affiliated mainly with institutions other than Linkoping University even go slightly over this mark, being cited 102% more than the world average.

To Lund University's benefit, the inflow researchers' FWCI (1.83) is slightly higher than that of the outflow researchers (1.81). In contrast to the outflow category, the returnees to Lund University achieve a higher citation impact than the new inflow researchers. The returnees also have the highest relative age among all Lund University's mobility groups, at 53% above the institution's average.

Royal Institute of Technology

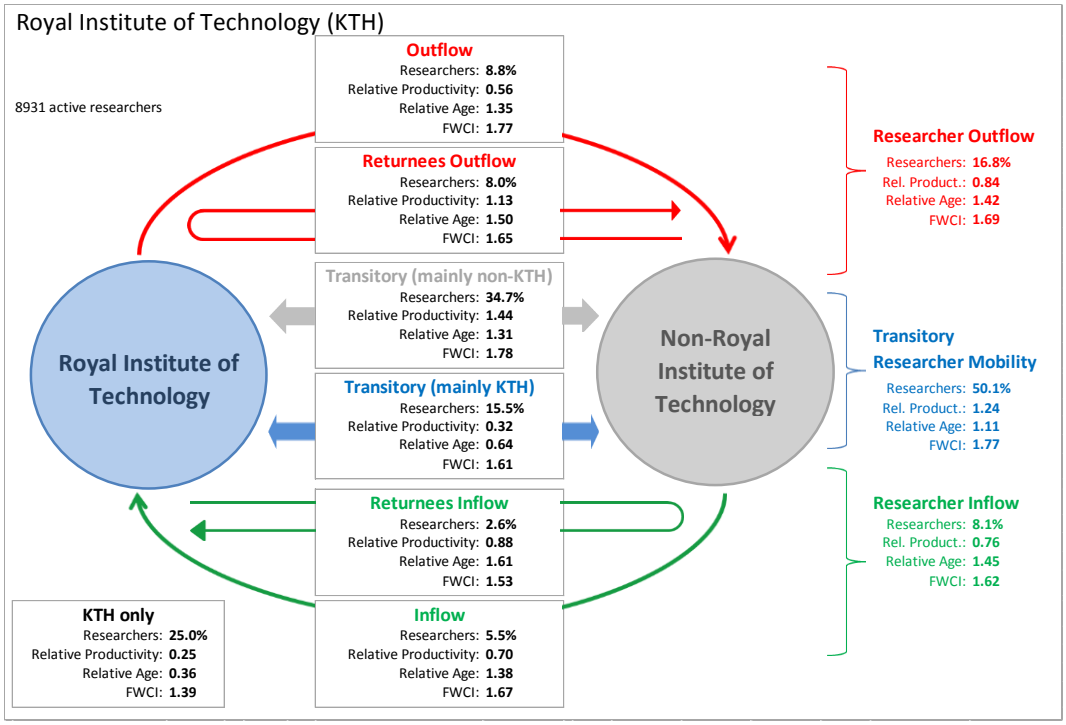

Figure 2.6— *Overall researcher mobility for the Royal Institute of Technology, 1996-2015. Source: Scopus*

With precisely 25% of its total researchers not having published with any affiliation other than the Royal Institute of Technology (KTH), the institution shows a high degree of mobility. Its sedentary rate is 7th lowest among the 28 HEIs in this report. Although the field-weighted citation impact (FWC) of these sedentary researchers is the second lowest FWCI for this category among the Big 10, it is still 39% above the world average, and higher than the majority of the HEIs.

KTH has a high outflow of researchers; not just compared to its other mobility categories, but also compared to the other HEIs. With 16.8% of its researchers leaving for other institutions, it has the second highest outflow of all 28 HEIs in this report. Given that KTH also has one of the lowest inflow rates, this results in the second highest net outflow of all HEIs, at 8.7%. Unfortunately, both the relative productivity and FWCI of the outflow researchers are higher than those of the inflow researchers (0.84 vs 0.76 and 1.69 vs 1.62, respectively).

On a more positive note: researchers showing transitory mobility are not only KTH's largest category of researchers – making up just over half its total researchers (50.1%) – but they are by far the most productive and highly cited. Overall these researchers produce 24% more publications than the average researcher at KTH, which is 40 percentage points higher than the next most productive category, the outflow researchers. On top of this, their publications are cited 77% more than the world average.

As mentioned above, KTH has a low inflow rate of researchers (8.1%). They do show the highest relative age among KTH's mobility categories, with the returnees taking the cake: their relative age is 61% higher than the average KTH researcher.

Stockholm University

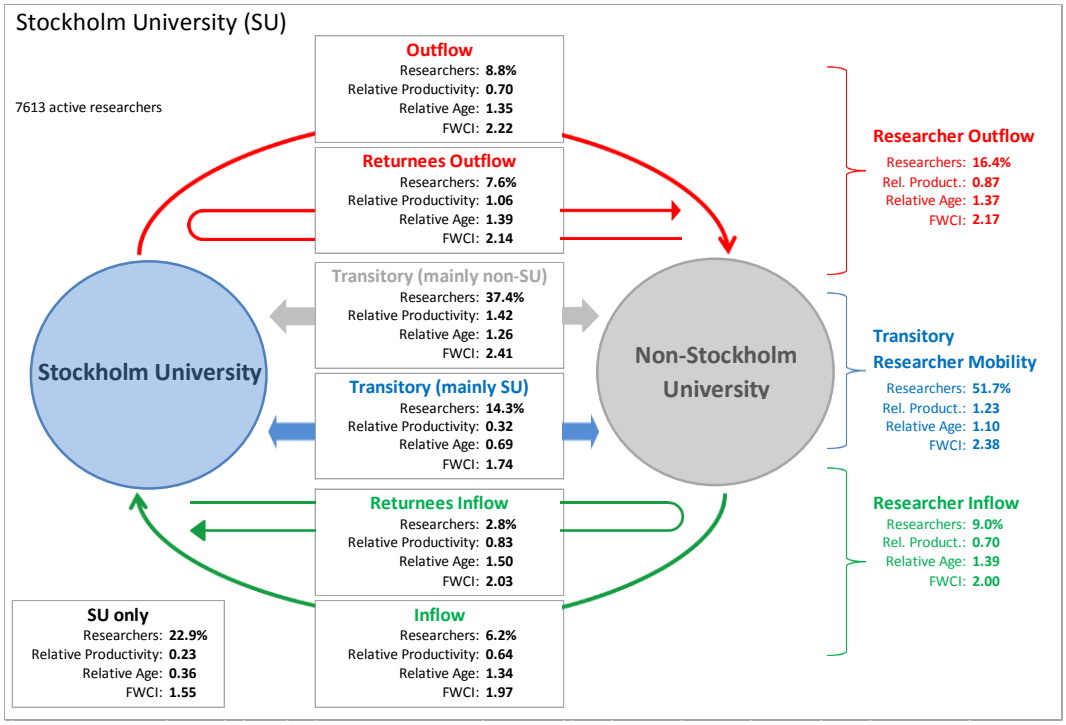

Figure 2.7 — *Overall researcher mobility for Stockholm University, 1996-2015. Source: Scopus*

Researchers at Stockholm University are highly mobile: only 22.9% of them have not published with other affiliations. This is the lowest percentage of sedentary researchers among the Big 10, and third lowest among all 28 HEIs. Despite their low relative age, their publications are highly impactful. With a field-weighted citation impact (FWCI) of 1.55 – or 55% above the world average – Stockholm University's sedentary researchers are the second most cited of such researchers among the Big 10 (after Karolinska Institutet), and third overall.

Stockholm University's outflow is on the high side, ranking 5th (both overall and among the Big 10) with 16.4%. Although their overall relative productivity is 13% lower than the average researcher at Stockholm University, they are more productive than inflow researchers (at 30% below average). Both the returnees and the first-time outflow researchers show a FWCI that is more than twice as high as the world average. Combined, their publications are cited 117% more often than the world average, making them the second most impactful mobility category for Stockholm University.

The researchers with transitory mobility are by far the most impactful; being cited 138% more often than the world average puts them in first place among the Big 10. Stockholm University also has a greater percentage of such researchers than any among the largest ten: 51.7% of its researchers have been there or affiliated with other institutions for periods shorter than 2 years. On top of this, these researchers are the most productive among Stockholm University's mobility categories, at 23% above average.

Inflow researchers make up only a small percentage of Stockholm University's total researchers (2nd lowest inflow after the Royal Institute of Technology), resulting in a net outflow of 7.4%. However, with a FWCI of 2.0 – i.e. twice the world average – they are the most impactful inflow researchers among the Big 10 (3rd overall). Among these, the returnees form the smaller share, but have a higher relative age, higher relative productivity and a higher FWCI than new inflow researchers.

Swedish University of Agricultural Sciences

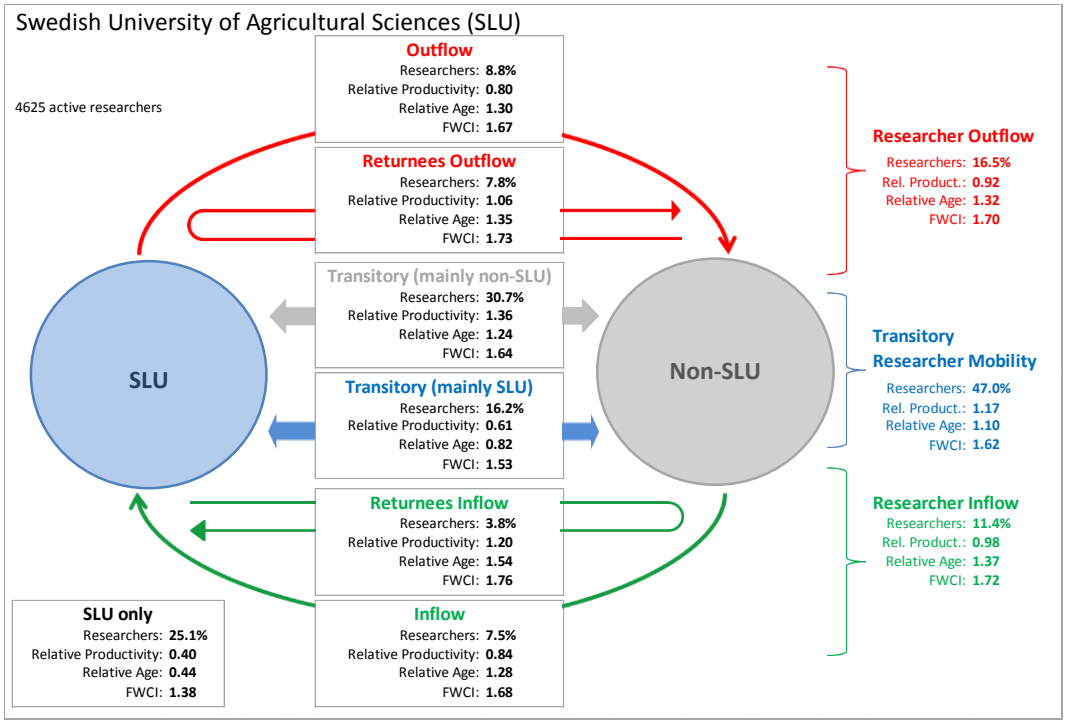

Figure 2.8— *Overall researcher mobility for Swedish University of Agricultural Sciences, 1996-2015. Source: Scopus*

The Swedish University of Agricultural Sciences (SLU) has quite a mobile researcher base, with just slightly more than a quarter (25.1%) of them belonging to the sedentary category. Although their field-weighted citation impact (FWCI) of 1.38 is the lowest citation impact of such researchers among the Big 10, their relative productivity is noticeably higher than that of most other sedentary researchers. As is the case for most institutions, this category consists of researchers with a low relative age (benchmarked by the average of SLU), yet they are the 'oldest' sedentary researchers among the Big 10.

At 16.5% of its total researchers, SLU's outflow is one of the highest among all HEIs in this report (tied for 3rd place with Uppsala University). This gives it a net outflow of 5.1%, despite its considerable inflow. On the bright side, the researchers leaving SLU are slightly less productive and impactful than its inflow researchers (0.92 vs 0.98 and 1.70 vs 1.72, respectively).

Among SLU's mobility categories, researchers with transitory mobility form the largest share of its total researchers (47%). However, this is on the low end compared to the rest of the Big 10: SLU ranks 3rd from last among them, just above Umea University and Linkoping University. Somewhat surprisingly, SLU's transitory researchers show a lower FWCI (1.62) than both its outflow and inflow researchers. They are however the most productive of its mobility categories (17% above SLU' average).

SLU has the highest percentage of inflow researchers among the Big 10 (11.4%). Among them, the new inflow researchers outnumber the returnees almost 2:1, and have a lower relative productivity than the average researcher at SLU (as opposed to the returnees, who are more productive than average). Overall these researchers differ from the majority of inflow researchers by being the most impactful mobility category for SLU, at 72% above the world average.

Umea University

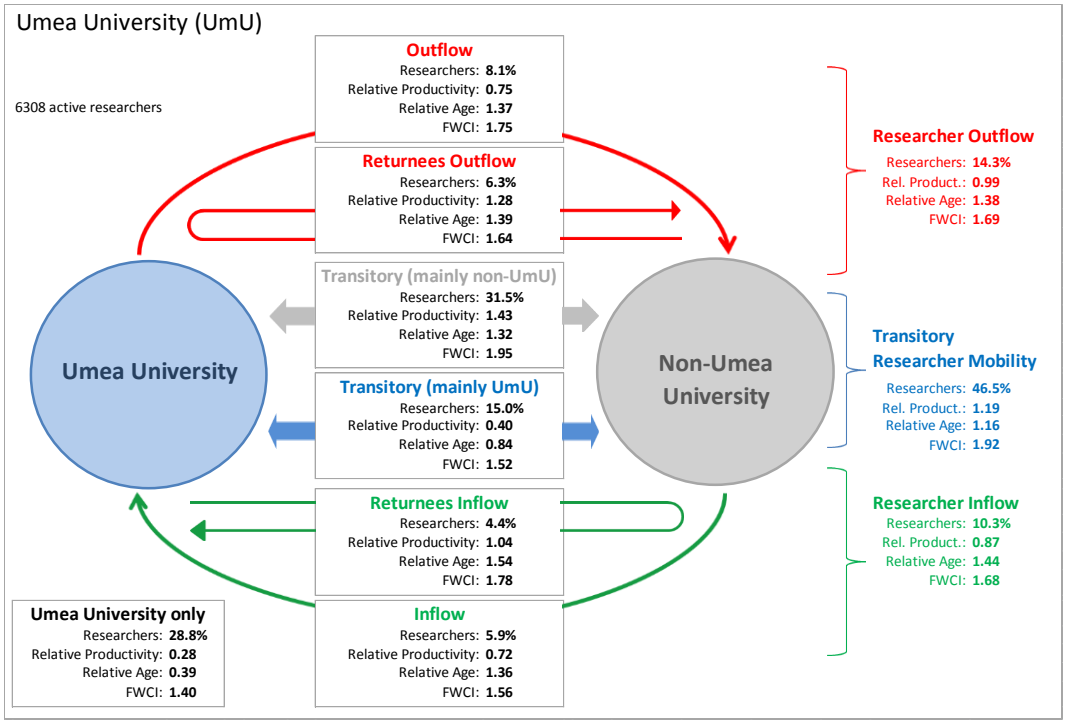

Figure 2.9— *Overall researcher mobility for Umea University, 1996-2015. Source: Scopus*

Umea University has a comparatively high percentage of sedentary researchers (28.8%), ranking 1st among the Big 10 for this category. While being cited 40% more than the world average, Umea University's sedentary researchers are the least impactful among its mobility categories. They are also by far the 'youngest', showing a relative age that is less than half of that of the next youngest group – the mainly Umea-affiliated transitory researchers.

Outflow from Umea University on the other hand is relatively low. While all of the Big 10 show a higher outflow than the majority of the 28 institutions in this report, Umea University ranks second to last among these 10, with 14.3% of its researchers going elsewhere. Their relative productivity is very nearly on par with the average researcher at Umea University, and their FWCI is marginally higher than that of the inflow researchers. Overall the publications of outflow researchers are cited 69% more often than the world average.

Also low is the percentage of transitory researchers among Umea University's total researchers: 'just' 46.5% have spent short periods at – or away from – the university, which is the second lowest among the Big 10. Among Umea University's mobility categories, these researchers are quite productive (19% more so than the average researcher there), and highly impactful. Although a third of the transitory researchers only outperform the sedentary researchers in terms of citation impact, the remaining two-thirds (mainly non-Umea University affiliated researchers) pull their overall FWCI up to 92% above the world average.

Inflow to Umea University is right at the average of all 28 HEIs, at 10.3%. This is the smallest category of researchers, as well as the one with the highest relative age (44% higher than the average researcher at Umea University). While their relative productivity is below the university 's average, the inflow researchers are overall fairly impactful: with an FWCI of 1.68, they rank 9th among the 28 HEIs.

Uppsala University

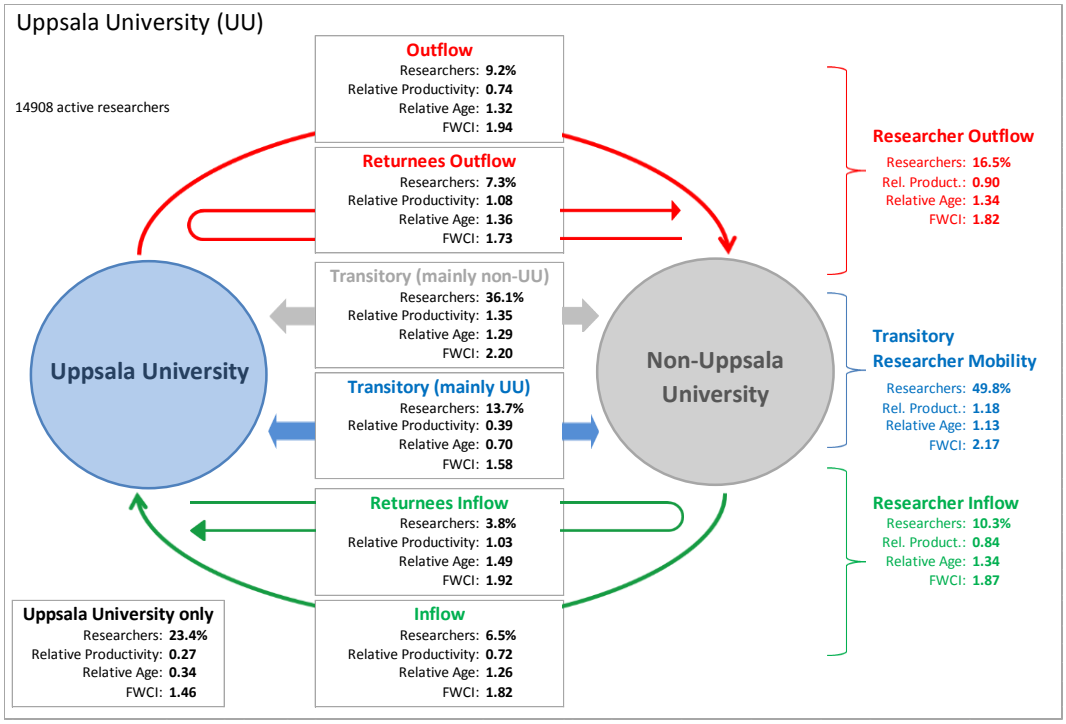

Figure 2.10— *Overall researcher mobility for Uppsala University, 1996-2015. Source: Scopus*

Uppsala University shows a very high degree of mobility: only 23.4% of its researchers have not published with other affiliations. This is the second lowest sedentary rate among the Big 10, and fifth lowest among all 28. Sedentary researchers at Uppsala University are – like at most institutions – the 'youngest', the least productive, and the least cited. The latter is of course relative only to Uppsala's other mobility categories, as their field-weighted citation impact (FWCI) is 46% above the world average.

With 16.5% of its researchers leaving long-term, Uppsala University is tied with the Swedish University of Agricultural Sciences for the 3rd highest outflow rate among all 28 HEIs. While the resulting net outflow of 6.2% is unfortunate, they are neither the most productive nor the most impactful mobility category for Uppsala University. Although their relative productivity is a little higher than that of the inflow researchers, their FWCI is a little lower.

When it comes to relative productivity and citation impact, the transitory researchers outperform Uppsala University's other mobility categories by quite a margin. The difference is most striking for the FWCI, which is 117% above the world average. The transitory researchers mainly affiliated with other institutions make the greatest contribution to this citation impact. Those mainly affiliated with Uppsala University actually have the second lowest FWCI among its mobility groups, but they are only half as large of a group. In total, transitory researchers account for just under half of Uppsala University's total researchers (49.8%). This gives it the third largest transitory mobility share among the Big 10.

In terms of Uppsala University's total researchers, the inflow researchers make up the smallest percentage (10.3%). In terms of citation impact, Uppsala University's inflow researchers' FWCI – at 87% above the world average – is the 3rd highest among all 28 HEIs (together with Karolinska Institutet and Goteborg University). Overall, inflow researchers have a relative age that is 34% higher than the average researcher at Uppsala University. Although their relative productivity is a little lower than that of the outflow researchers, their FWCI is a little higher.

2.4 Mobility charts of HEIs (excluding the Big 10)

In the below section, Figures 1.11-1.28 present the researcher mobility analyses for the remaining Swedish Higher Education Institutions. Here too, the institutions are listed in alphabetical order.

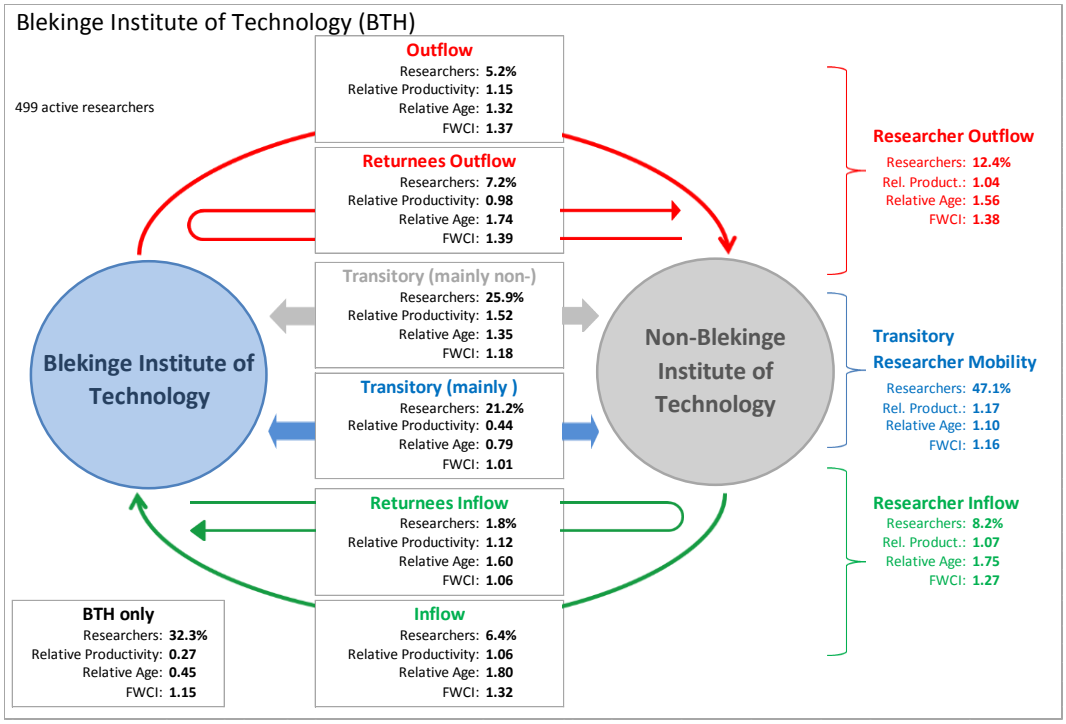

Figure 2.11— *Overall researcher mobility for Blekinge Institute of Technology, 1996-2015. Source: Scopus*

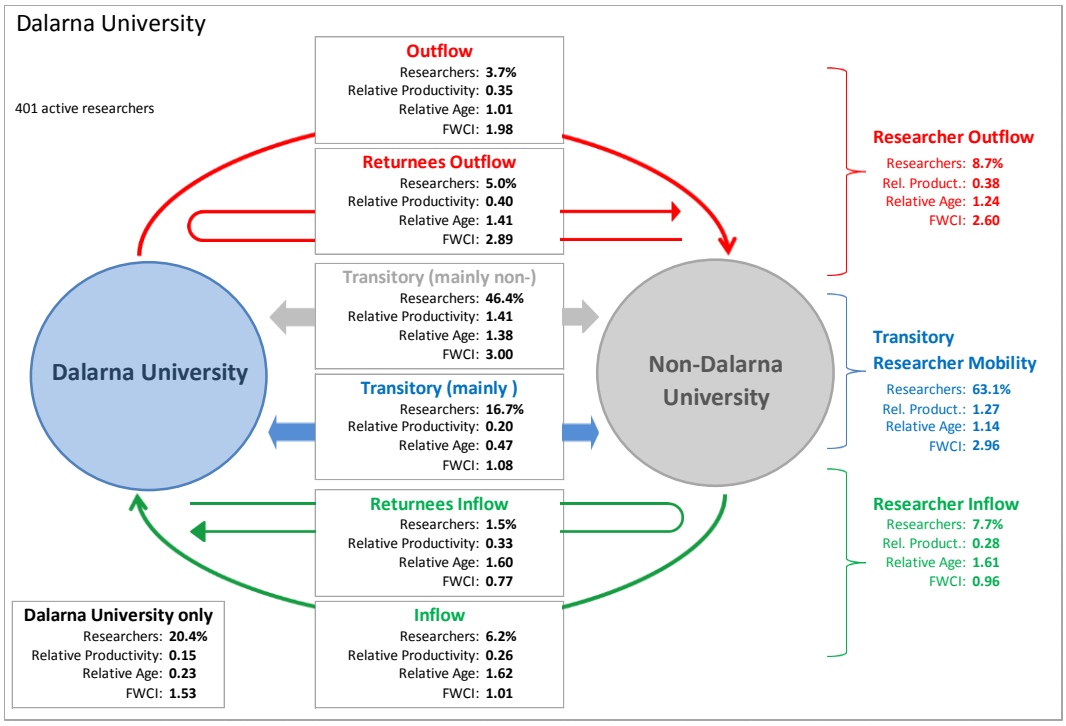

Figure 2.12— *Overall researcher mobility for Dalarna University, 1996-2015. Source: Scopus*

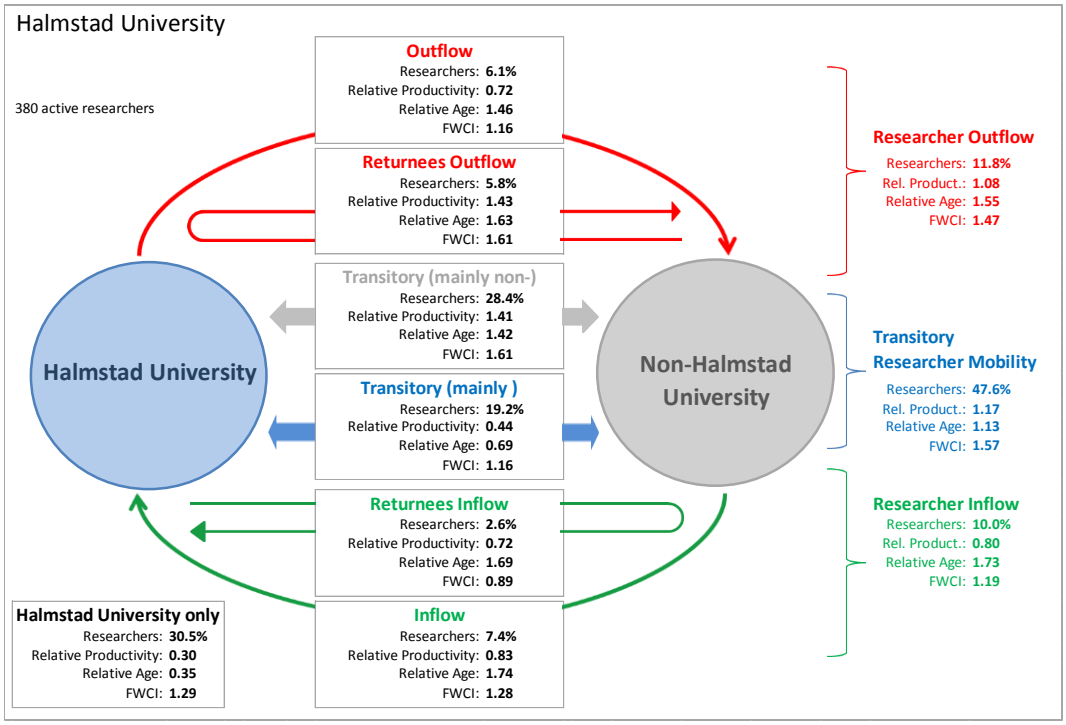

Figure 2.13— *Overall researcher mobility for Halmstad University, 1996-2015. Source: Scopus*

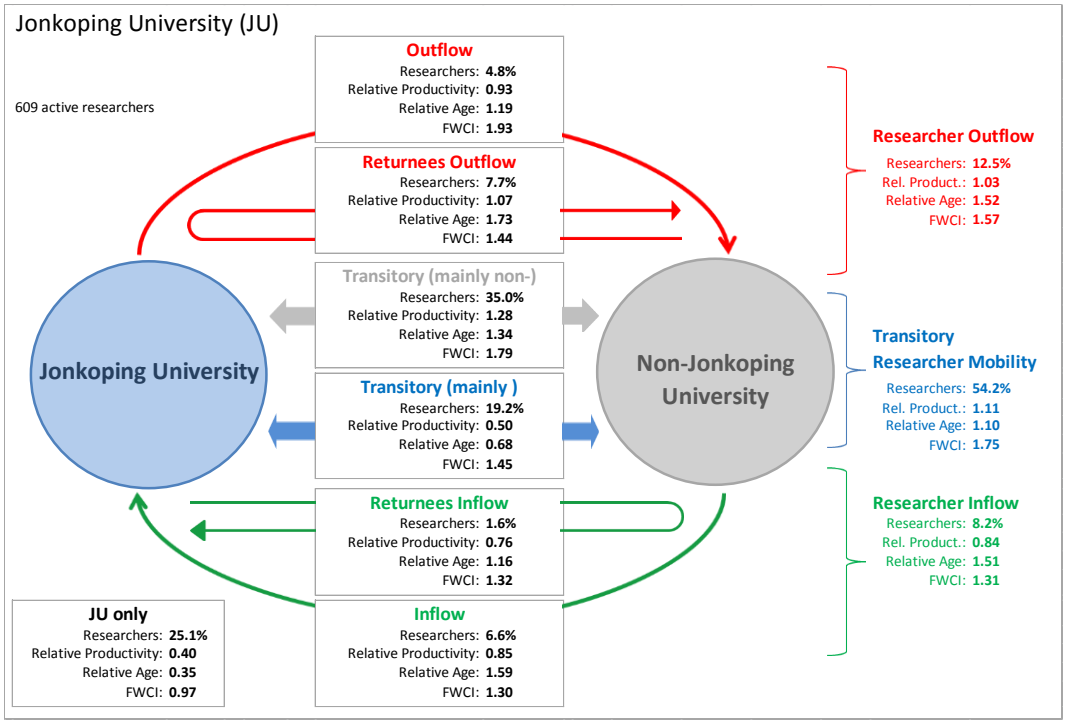

Figure 2.14— *Overall researcher mobility for Jonkoping University, 1996-2015. Source: Scopus*

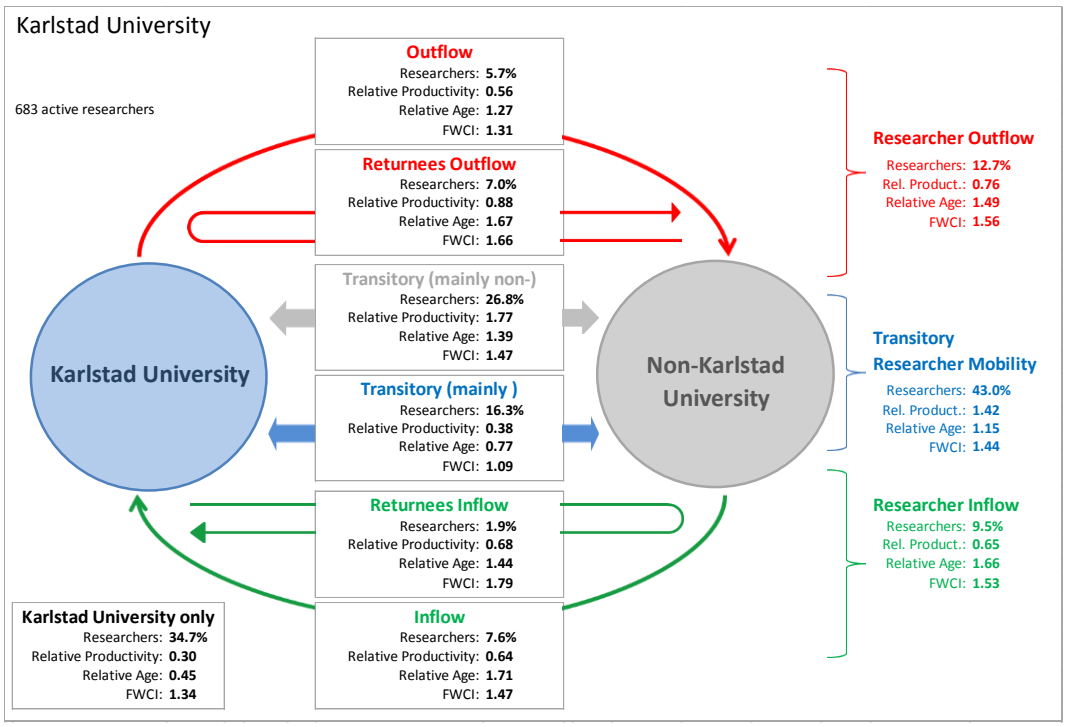

Figure 2.15— *Overall researcher mobility for Karlstad University, 1996-2015. Source: Scopus*

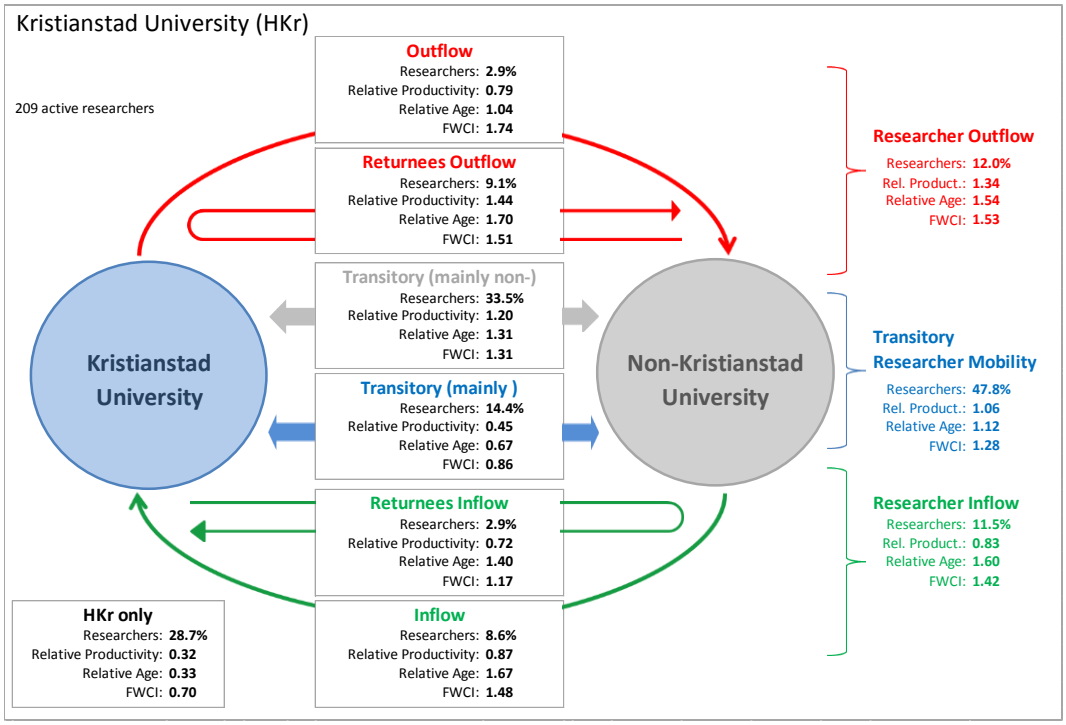

Figure 2.16— *Overall researcher mobility for Kristianstad University, 1996-2015. Source: Scopus*

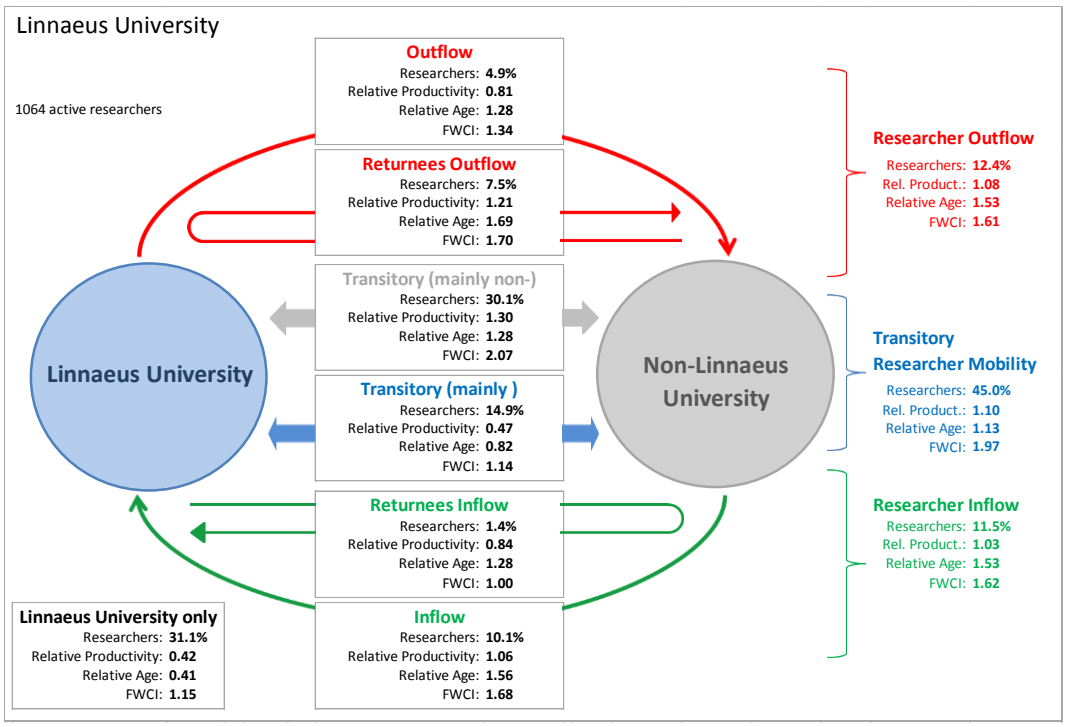

Figure 2.17— *Overall researcher mobility for Linnaeus University, 1996-2015. Source: Scopus*

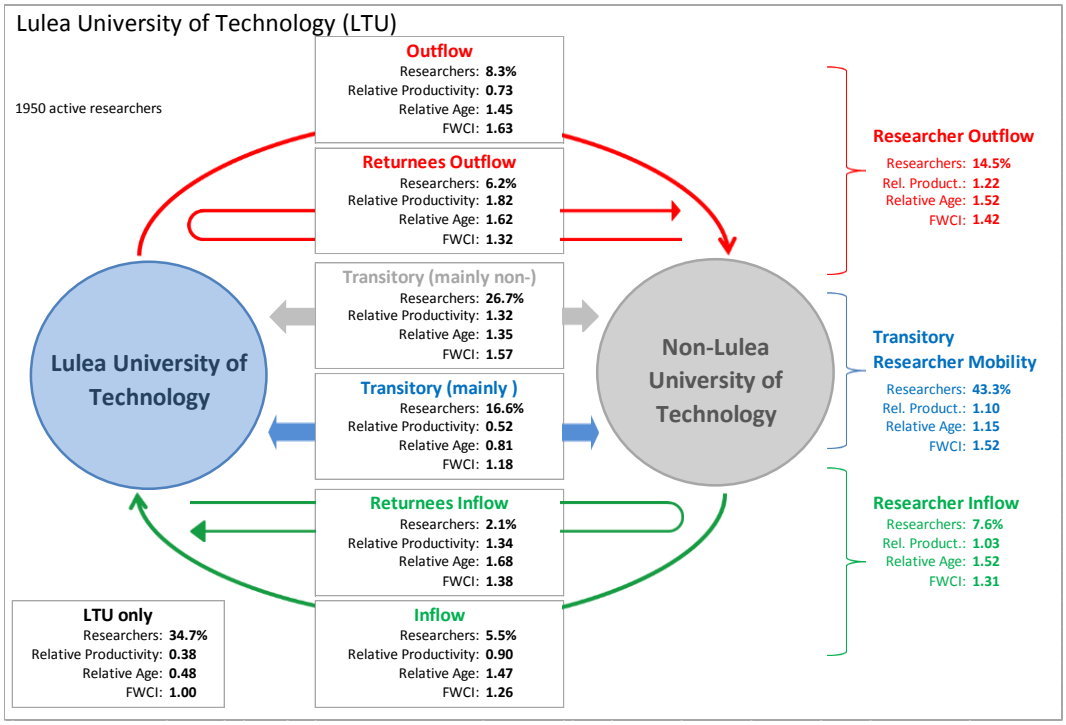

Figure 2.18— *Overall researcher mobility for Lulea University of Technology, 1996-2015. Source: Scopus*

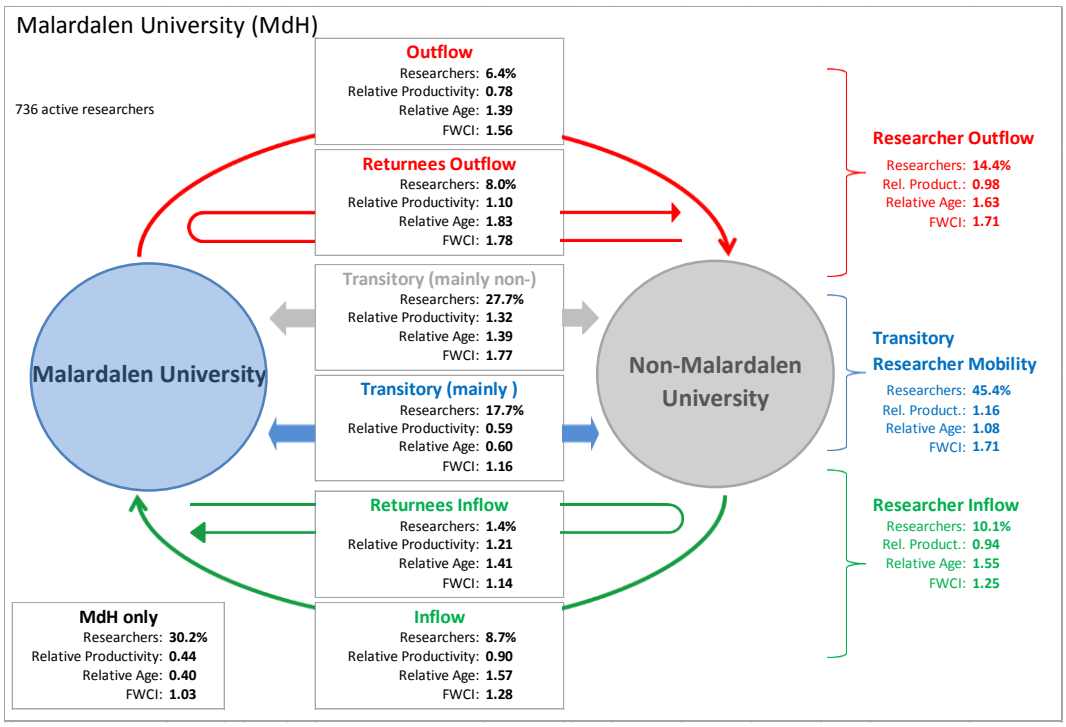

Figure 2.19— *Overall researcher mobility for Malardalen University, 1996-2015. Source: Scopus*

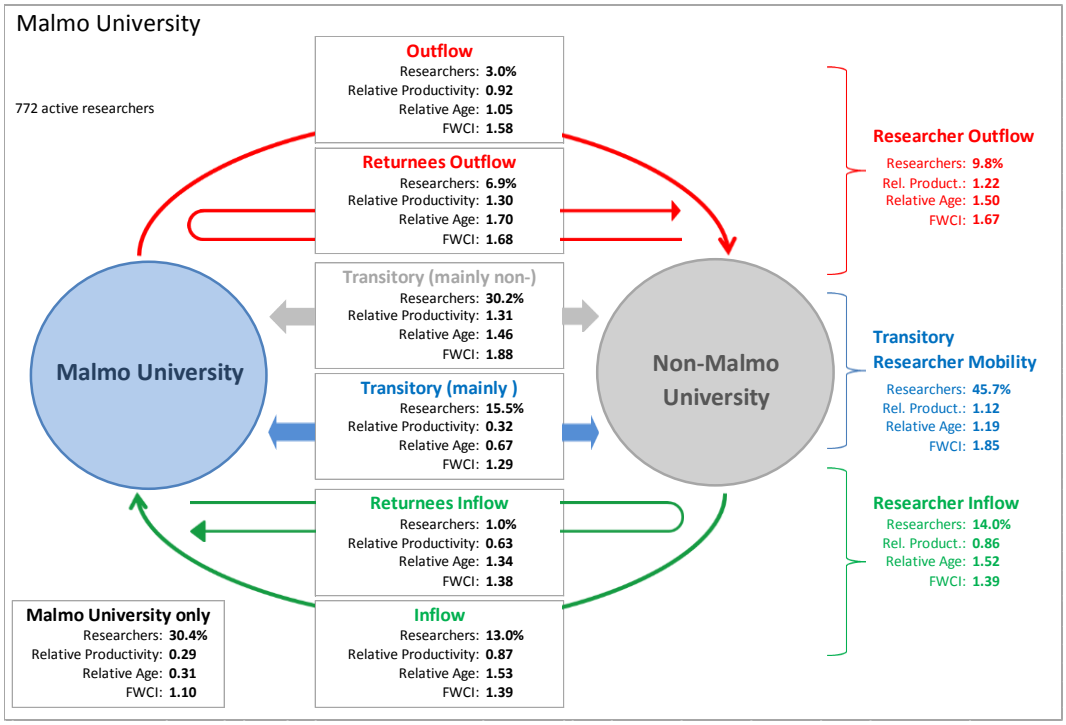

Figure 2.20— *Overall researcher mobility for Malmo University, 1996-2015. Source: Scopus*

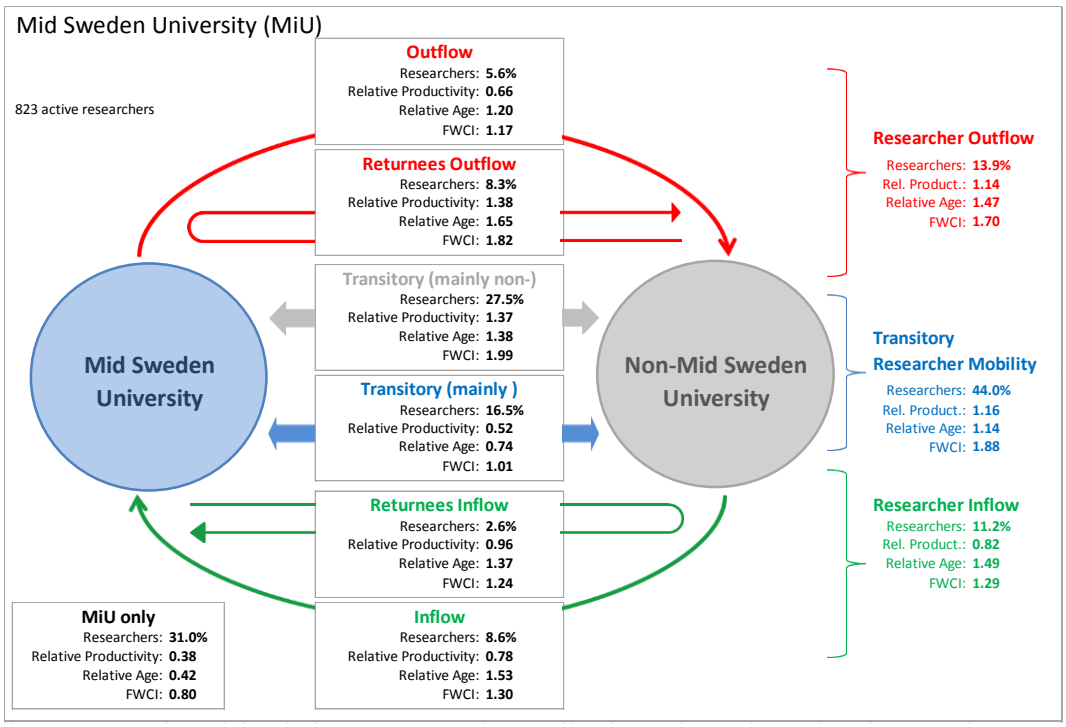

Figure 2.21— *Overall researcher mobility for Mid Sweden University, 1996-2015. Source: Scopus*

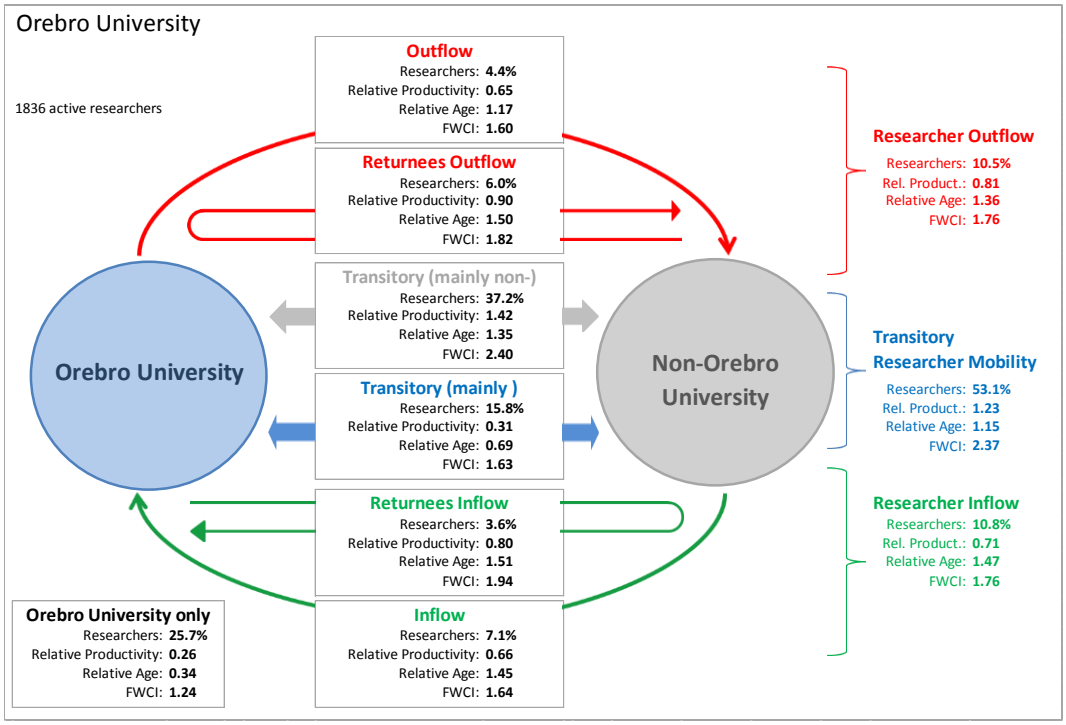

Figure 2.22— *Overall researcher mobility for Orebro University, 1996-2015. Source: Scopus*

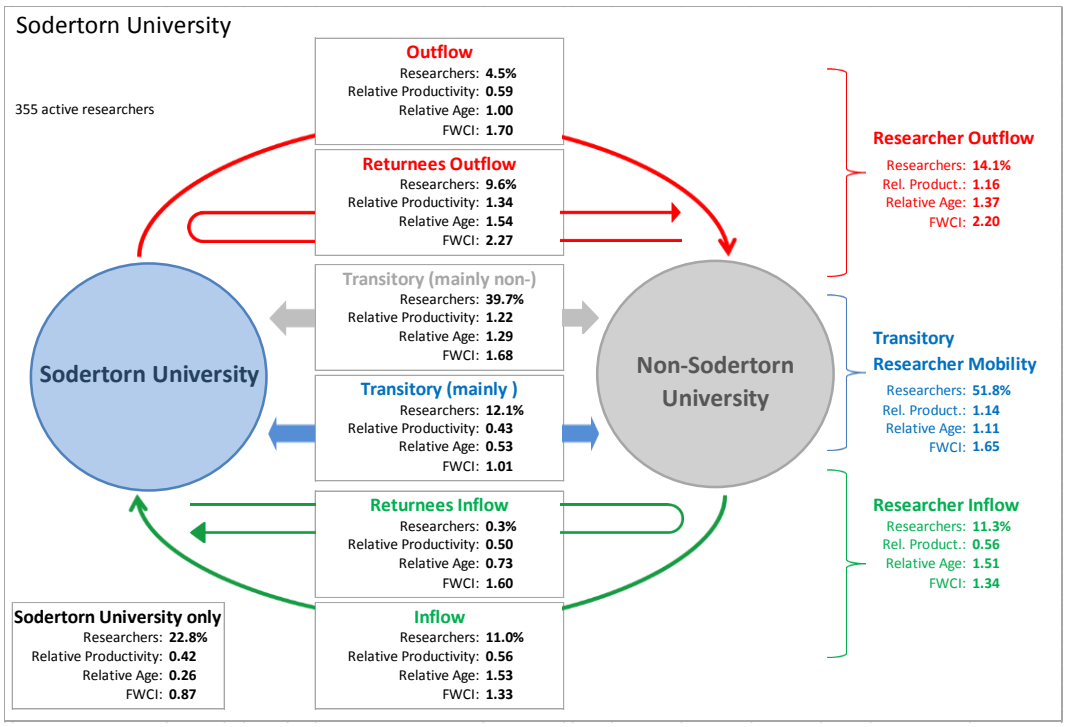

Figure 2.23— *Overall researcher mobility for Sodertorn University, 1996-2015. Source: Scopus*

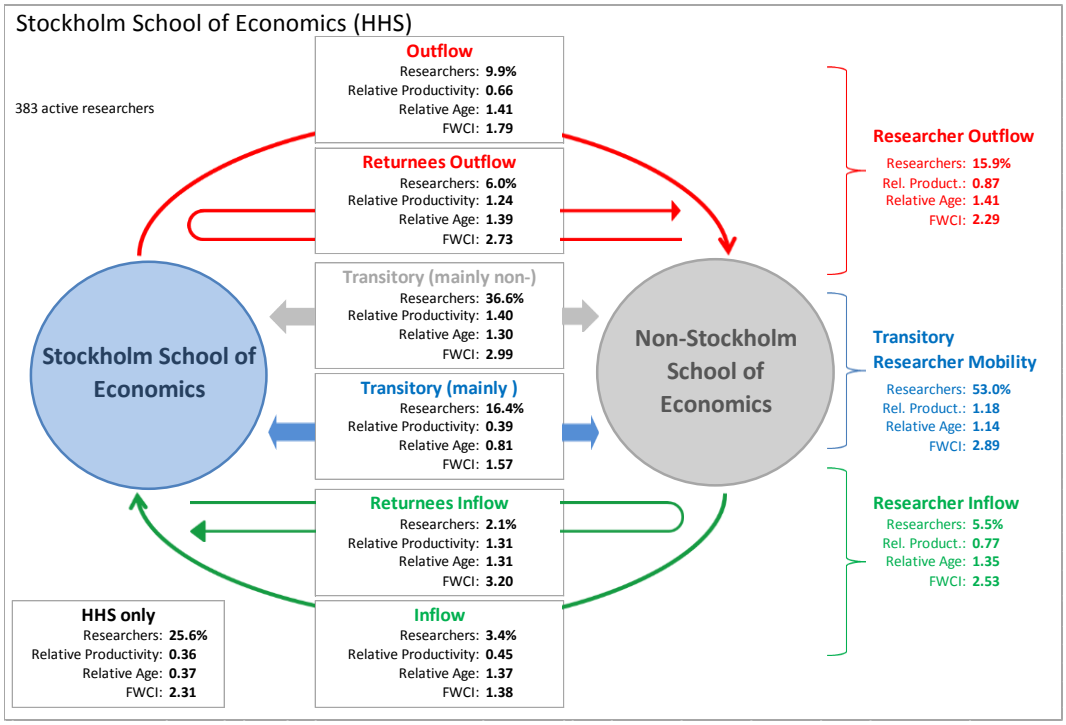

Figure 2.24— *Overall researcher mobility for Stockholm School of Economics, 1996-2015. Source: Scopus*

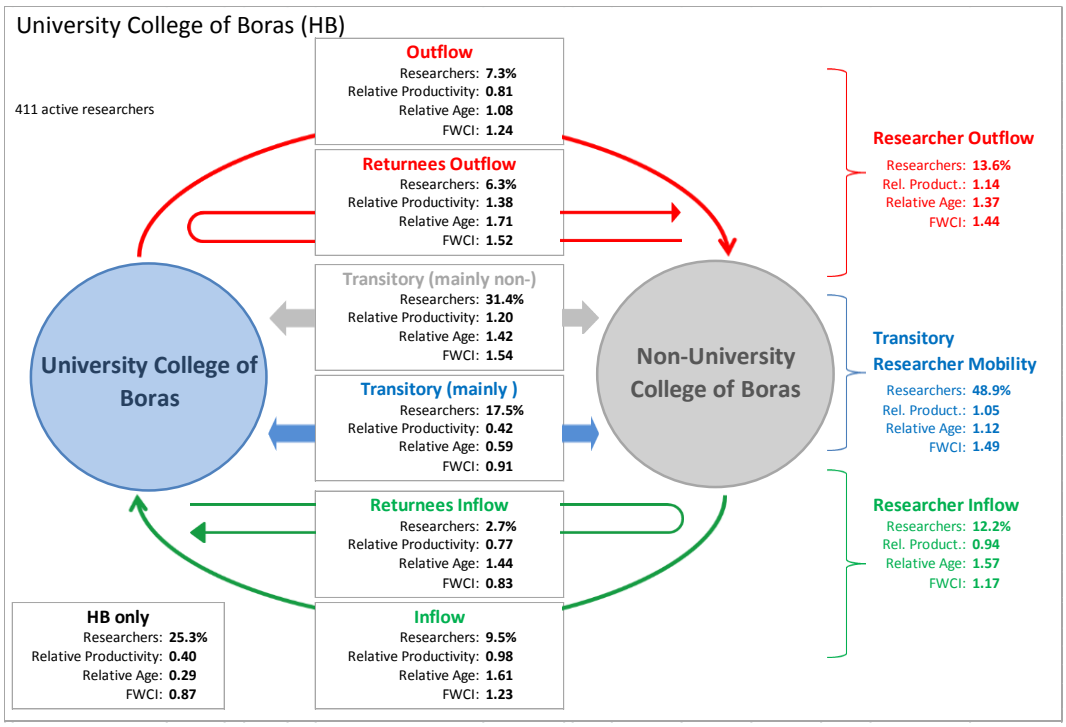

Figure 2.25— *Overall researcher mobility for University College of Boras, 1996-2015. Source: Scopus*

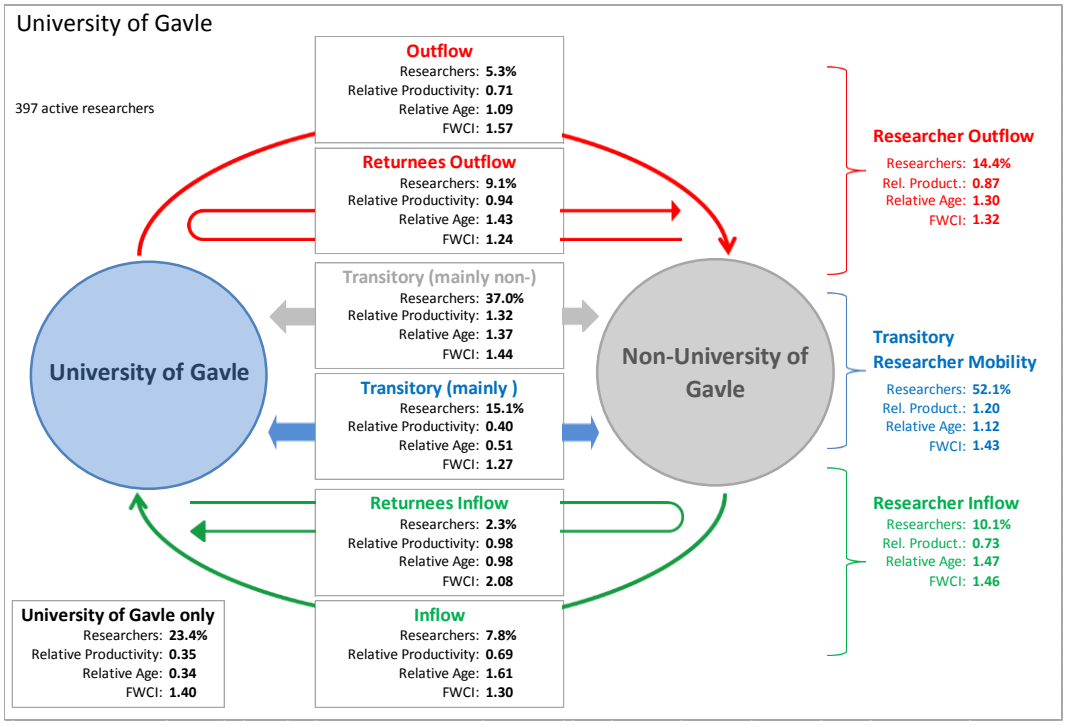

Figure 2.26— *Overall researcher mobility for University of Gavle, 1996-2015. Source: Scopus*

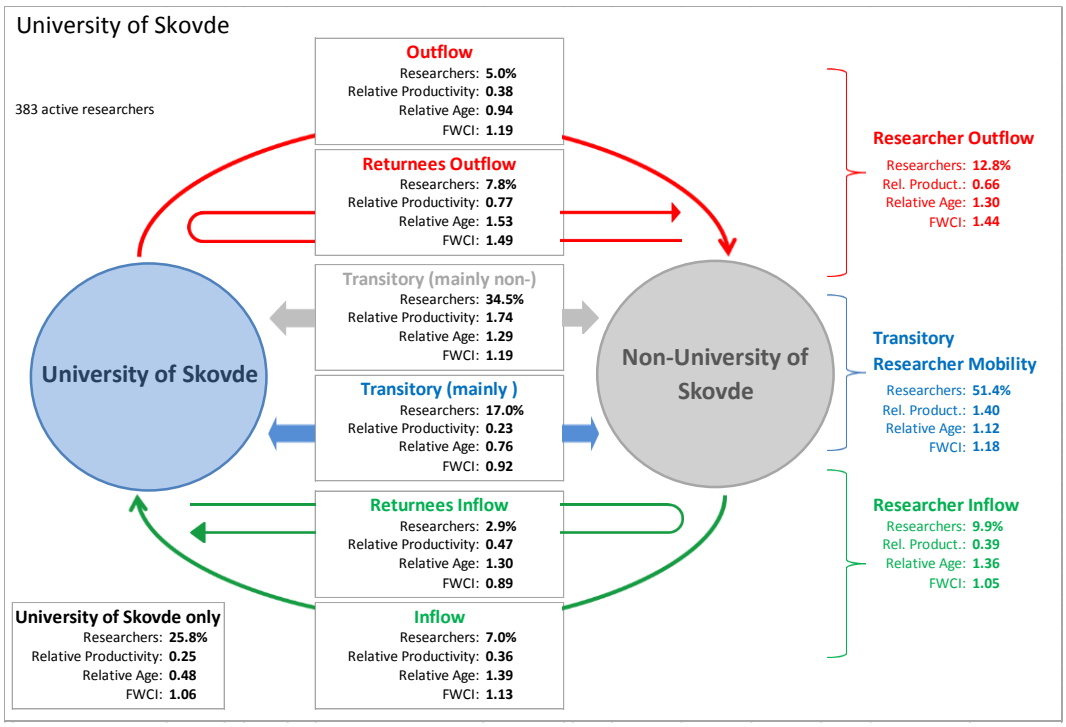

Figure 2.27 — *Overall researcher mobility for University of Skovde, 1996-2015. Source: Scopus*

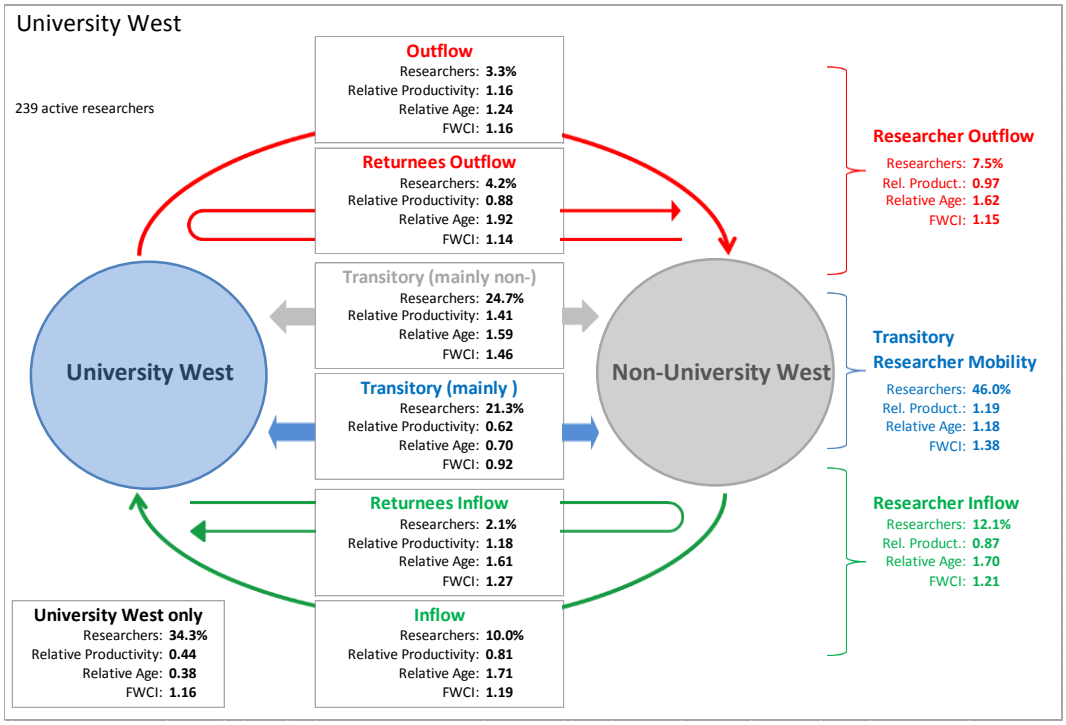

Figure 2.28 — *Overall researcher mobility for University West, 1996-2015. Source: Scopus*

Chapter 3
National & International mobility

This chapter analyses only those researchers who show national and/or international mobility. Hence, there is no 'sedentary' category. For national mobility we look at researchers who have published with at least two Swedish institutions. For international mobility we look at researchers who have published at least one publication with a Swedish affiliation, and at least one with a non-Swedish affiliation.

3.1 **Key Findings**

INTERNATIONAL MOBILITY

50.4%

On average, more than half of the researchers at the 28 HEIs have been affiliated with institutions abroad during 1996-2015.

NATIONAL MOBILITY

39.8%

On average, nearly 2/5 of researchers at the 28 HEIs have been affiliated with more than one Swedish institution during 1996-2015.

IMPACT OF INTERNATIONAL TRANSITORY MOBILITY

Dalarna University

With a field-weighted citation impact of 3.04 (or 204% above the world average), Dalarna University's international transitory researchers have the highest impact; much higher than the corresponding figure for national transitory researchers (1.79).

3.2 General comparison

Outflow

Nationally mobile researchers who leave their current institution for two years or more make up on average 6.9% of the Swedish HEIs' total active researchers. The highest outflow is that of the University of Gavle (10.8%), which also has the second greatest net outflow, at 4.0%.[3] While this is not always the case, the institution with the lowest outflow – University West (4.6%) – also happens to have the greatest net inflow, at 5.0%. The Big 10 are fairly evenly spread among the 28 HEIs in terms of national outflow, having shares as low as 5.6% (Lund University, ranking 2nd lowest) to as high as 8.2% (Chalmers University of Technology, 5th highest). As can be gleaned from these percentages, the differences between each HEI and those ranking above and below them are quite small.

Outflow to international institutions varies considerably more among the Swedish HEIs, from a mere 0.8% share of University West's researchers, to 8.5% of the Royal Institute of Technology's researchers. While 16 out of the 28 HEIs have international outflow shares of 4.7% or lower, the Big 10 all have shares of 5.0% or higher. In other words, they attract more international researchers (as mentioned under 'Inflow'), but also have more researchers leaving them for institutions abroad, resulting in a net outflow for 7 out of 10 of these institutions.

Transitory

As with the overall mobility, the transitory category forms the majority of Swedish HEIs' national mobility. On average, a little over a quarter (26.3%) of all HEIs' nationally mobile researchers stay for periods of two years or less before moving to other institutions. Among the internationally mobile researchers, well over a third (37.0%) shows transitory mobility. Interestingly, the Big 10 all rank among the bottom half in terms of national transitory mobility (from 22.4% to 29.2%, for Lund University and the Goteborg University, respectively) yet with the exception of Linkoping University, these same HEIs rank among the top half when it comes to international transitory mobility, with shares of up to 40.4% (Stockholm University).

As seen in previous sections of the report, transitory mobility in general tends to go hand in hand with high citation impact. Such is also the case for transitory mobility at national and international levels, with researchers who move abroad achieving a higher FWCI than those moving within Sweden (19 out of 28 HEIs). The lowest FWCI for both kinds of transitory researchers is achieved by the Blekinge Institute of Technology, with FWCIs of 1.10 (national) and 1.16 (international). The highest FWCI of international transitory researchers is that of Dalarna University, which, at 3.04, is considerably higher than its FWCI of national transitory researchers, at 1.79. The FWCI values of the Big 10 are fairly evenly spread among the 28 HEIs for both kinds of transitory mobility.

Inflow

While the inflow of nationally mobile researchers is different from the HEIs' overall inflow, the 'top' and 'bottom' of the list are the same: Malmo University has the highest inflow, at 10.6%, and the Stockholm School of Economics has the lowest inflow, at just 2.1%. Conversely, the latter's FWCI is by far the highest among all HEIs in this report. The researchers that form Stockholm School of Economics' inflow are cited more than three times as often as the world average: their FWCI of 3.35 is much higher than the 28 HEIs' weighted average of 1.75. The second highest FWCI of national inflow belongs to Stockholm University, at 1.92, though for this university it is actually the lowest FWCI among its mobility categories. Ten institutions have a net inflow of researchers from other Swedish HEIs, three of which belong to the Big 10.

[3] Net outflow occurs when the number of outflow researchers is greater than the number of inflow researchers. Conversely, if the number of inflow researchers is greater than the number of outflow researchers, we speak of a net inflow.

Internationally, the picture looks quite different. Here, the Big 10 also form the top 10 institutions with the highest inflow shares, ranging from the Royal Institute of Technology's 5.0% to Lund University's 8.0%. Furthermore, 16 out of 28 HEIs have a net inflow, albeit at slightly lower rates than the net inflow for national mobility. Although the differences are small to minimal, for a majority of the HEIs in this report (15) the FWCI of inflow researchers with experience abroad is higher than the FWCI of those who have not spent time abroad. Only one institution shows inflow with a FWCI below the world average: Dalarna University (FWCI 0.89, versus 0.95 for national mobility).

Institution	Active Researchers, 1996-2015	Outflow %	Transitory %	Inflow %
Karolinska Institutet	19,407	6.0	23.2	7.2
Lund University	15,947	5.6	22.4	6.7
Uppsala University	14,908	7.6	26.3	6.1
University of Gothenburg	10,524	7.6	29.2	8.2
Royal Institute of Technology	8,931	6.6	24.5	4.4
Stockholm University	7,613	7.2	28.5	5.0
Linkoping University	6,647	7.8	28.8	7.5
Umea University	6,308	6.9	26.5	6.8
Chalmers University of Technology	6,075	8.2	24.9	5.0
Swedish University of Agricultural Sciences	4,625	7.9	23.8	7.5
Lulea University of Technology	1,950	7.4	23.8	4.3
Orebro University	1,836	6.5	40.6	8.7
Linnaeus University	1,064	6.1	31.3	7.4
Mid Sweden University	823	8.3	32.3	8.1
Malmo University	772	6.2	35.0	10.6
Malardalen University	736	10.1	32.6	7.6
Karlstad University	683	7.0	29.3	6.1
Jonkoping University	609	8.0	44.8	6.4
Blekinge Institute of Technology	499	7.2	27.1	5.2
University College of Boras	411	8.8	34.3	9.5
Dalarna University	401	6.5	36.7	6.2
University of Gavle	397	10.8	43.3	6.8
University of Skovde	383	8.1	39.2	8.1
Stockholm School of Economics	383	6.3	27.7	2.1
Halmstad University	380	6.6	35.0	6.8
Sodertorn University	355	7.9	42.8	7.6
University West	239	4.6	35.6	9.6
Kristianstad University	209	7.7	39.2	10.5
Weighted average	-	6.9	26.3	6.6

Table 3.1— *Total active researcher count and share of the total per national mobility category, for 28 Swedish higher education institutions, 1996-2015. Source: Scopus*

Institution	Publications by active researchers	Outflow FWCI	Transitory FWCI	Inflow FWCI	Overall FWCI
Karolinska Institutet	841,375	1.71	2.05	1.86	1.94
Lund University	689,735	1.80	1.97	1.83	1.92
Uppsala University	674,090	1.85	2.11	1.90	2.05
Royal Institute of Technology	435,858	1.89	1.87	1.58	1.73
Goteborg University	404,363	1.81	1.96	1.83	1.97
Stockholm University	343,769	2.33	2.35	1.92	2.29
Linkoping University	240,146	1.66	1.68	1.54	1.63
Chalmers University of Technology	228,512	1.48	1.61	1.57	1.54
Umea University	225,749	1.85	2.01	1.70	1.82
Swedish University of Agricultural Sciences	126,385	1.68	1.67	1.68	1.64
Orebro University	68,836	1.66	2.46	1.74	2.20
Lulea University of Technology	51,201	1.54	1.63	1.35	1.44
Linnaeus University	22,509	1.32	2.01	1.74	1.79
Dalarna University	21,361	3.01	1.79	0.95	2.87
Karlstad University	20,760	1.58	1.48	1.57	1.46
Mid Sweden University	20,686	1.74	1.76	1.31	1.70
Malmo University	19,951	1.59	1.84	1.28	1.71
University of Skovde	18,632	1.28	1.17	1.05	1.19
Malardalen University	15,353	1.98	1.55	1.25	1.60
Jonkoping University	14,434	1.54	1.81	1.36	1.64
Blekinge Institute of Technology	13,582	1.14	1.10	1.22	1.22
University of Gavle	10,373	1.30	1.45	1.73	1.41
Stockholm School of Economics	10,220	2.38	2.94	3.35	2.73
Halmstad University	9,210	1.42	1.72	1.08	1.49
University College of Boras	9,140	1.38	1.41	1.12	1.40
Sodertorn University	6,818	1.31	1.61	1.37	1.73
Kristianstad University	4,436	1.66	1.19	1.43	1.34
University West	3,942	1.40	1.36	1.18	1.31
Weighted average	-	**1.80**	**1.97**	**1.76**	**1.90**

Table 3.2— *Total publications by active researchers and field-weighted citation impact (FWCI) per national mobility group, for 28 Swedish higher education institutions, 1996-2015. Source: Scopus*

Institution	Active Researchers, 1996-2015	Outflow %	Transitory %	Inflow %
Karolinska Institutet	19,407	7.9	39.6	7.5
Lund University	15,947	8.4	38.6	8.0
Uppsala University	14,908	7.4	39.6	7.0
University of Gothenburg	10,524	5.0	35.1	7.0
Royal Institute of Technology	8,931	8.5	39.6	5.4
Stockholm University	7,613	7.4	40.4	5.6
Linkoping University	6,647	5.2	31.9	6.5
Umea University	6,308	5.8	35.1	6.9
Chalmers University of Technology	6,075	7.4	36.3	6.3
Swedish University of Agricultural Sciences	4,625	7.1	35.1	6.7
Lulea University of Technology	1,950	5.9	30.1	4.7
Orebro University	1,836	2.0	34.9	4.5
Linnaeus University	1,064	3.6	27.2	4.4
Mid Sweden University	823	3.9	25.8	4.0
Malmo University	772	1.6	27.8	4.0
Malardalen University	736	2.2	24.7	3.3
Karlstad University	683	2.9	25.5	4.7
Jonkoping University	609	2.1	26.9	2.3
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Dalarna University	401	1.5	39.2	2.2
University of Gavle	397	1.0	29.7	4.3
University of Skovde	383	2.6	32.6	2.9
Stockholm School of Economics	383	8.4	43.6	4.7
Halmstad University	380	4.7	22.9	5.0
Sodertorn University	355	3.4	34.4	3.7
University West	239	0.8	25.5	3.8
Kristianstad University	209	2.9	21.5	2.4
Weighted average	-	6.8	37.0	6.6

Table 3.3— *Total active researcher count and share of the total per international mobility category, for 28 Swedish higher education institutions, 1996-2015. Source: Scopus*

Institution	Publications by active researchers	Outflow FWCI	Transitory FWCI	Inflow FWCI	Overall FWCI
Karolinska Institutet	841,375	1.65	2.06	1.89	1.94
Lund University	689,735	1.80	2.01	1.86	1.92
Uppsala University	674,090	1.82	2.19	1.88	2.05
Royal Institute of Technology	435,858	1.58	1.78	1.62	1.73
Goteborg University	404,363	1.93	2.07	1.97	1.97
Stockholm University	343,769	1.99	2.40	2.12	2.29
Linkoping University	240,146	1.37	1.74	1.61	1.63
Chalmers University of Technology	228,512	1.53	1.56	1.57	1.54
Umea University	225,749	1.50	1.94	1.75	1.82
Swedish University of Agricultural Sciences	126,385	1.61	1.64	1.80	1.64
Orebro University	68,836	1.52	2.43	1.94	2.20
Lulea University of Technology	51,201	1.34	1.54	1.32	1.44
Linnaeus University	22,509	1.72	2.11	1.45	1.79
Dalarna University	21,361	2.17	3.04	0.89	2.87
Karlstad University	20,760	1.15	1.45	1.63	1.46
Mid Sweden University	20,686	1.45	2.01	1.27	1.70
Malmo University	19,951	1.67	1.91	1.62	1.71
University of Skovde	18,632	1.39	1.18	1.02	1.19
Malardalen University	15,353	1.38	1.78	1.20	1.60
Jonkoping University	14,434	1.95	1.84	1.28	1.64
Blekinge Institute of Technology	13,582	1.68	1.16	1.28	1.22
University of Gavle	10,373	1.28	1.45	1.36	1.41
Stockholm School of Economics	10,220	2.40	2.92	2.60	2.73
Halmstad University	9,210	1.59	1.65	1.21	1.49
University College of Boras	9,140	1.75	1.55	1.18	1.40
Sodertorn University	6,818	4.33	1.69	1.27	1.73
Kristianstad University	4,436	1.38	1.34	1.07	1.34
University West	3,942	0.81	1.39	1.28	1.31
Weighted average	-	**1.71**	**2.00**	**1.81**	**1.90**

Table 3.4— *Total publications by active researchers and field-weighted citation impact (FWCI) per international mobility group, for 28 Swedish higher education institutions, 1996-2015. Source: Scopus*

3.3 Analyses of the Big 10

Please note:

- The percentages of each mobility category are based on the institution's total number of active researchers. As sedentary researchers are excluded, the percentages do not add up to 100%.

Chalmers University of Technology (CTH)

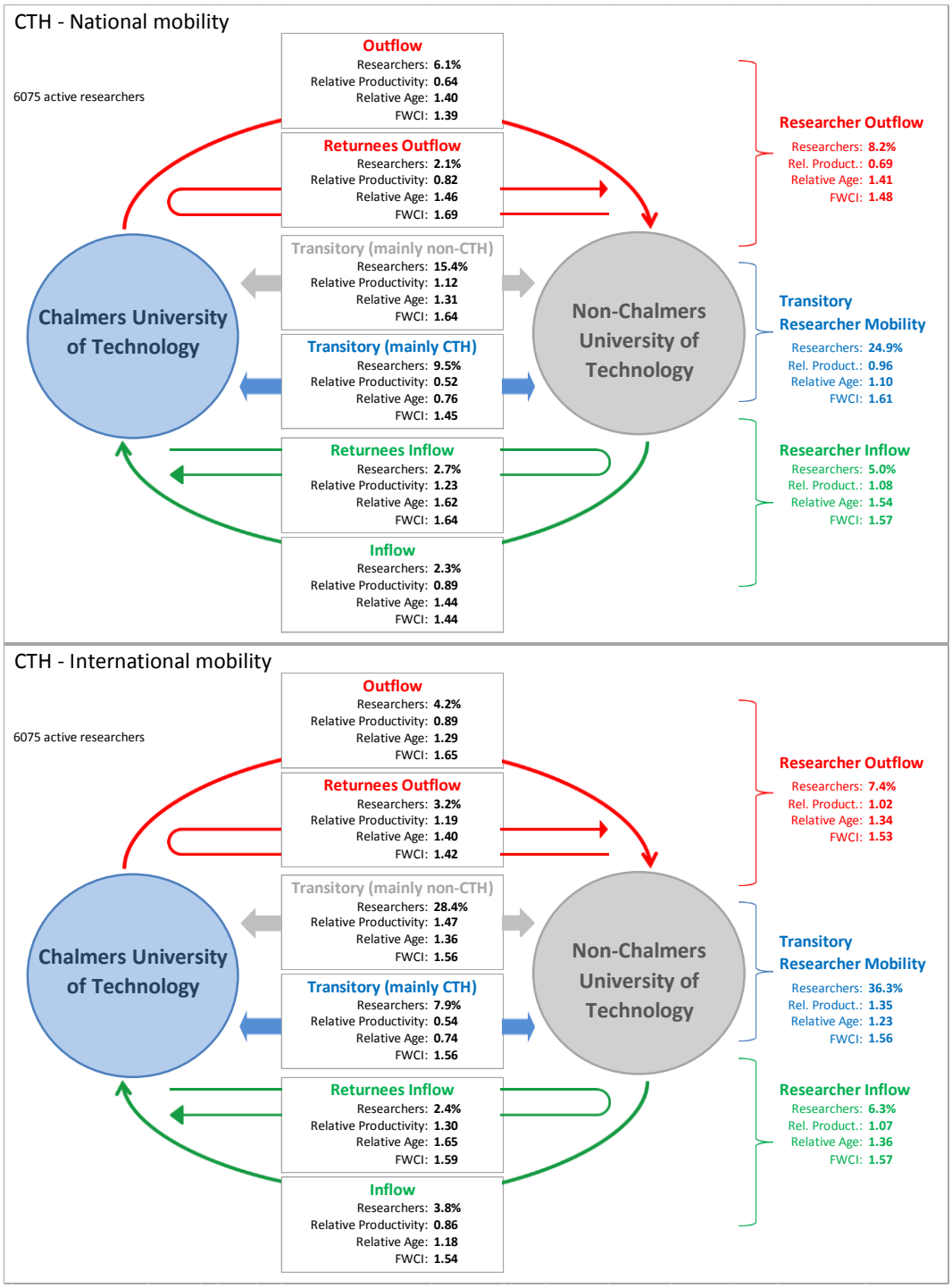

Figure 3.1 — *National and international researcher mobility of Chalmers University of Technology, 1996-2015. Source: Scopus*

For CTH the researchers with national mobility have a larger outflow category than those with international mobility. The latter are of a lower relative age, but are more productive and achieve a slightly higher field-weighted citation impact (FWCI). As a group, internationally transitory researchers are about 1.5x as numerous as a group as nationally transitory researchers. Both groups produce highly cited publications, though in the case of international mobility, it is not the highest among the mobility categories. That title goes to the inflow researchers, albeit with a marginal difference of 0.1 percentage point. On the other hand, the internationally transitory researchers are considerably more productive than the nationally transitory researchers. While the latter have a relative productivity of 4% below CTH's average researcher, the former are 35% above the average. Inflow is the smallest category for both national and international mobility, made up of researchers with the highest relative age. In the case of CTH, both have the same FWCI. Among internationally mobile researchers, the inflow is greater than for the nationally mobile researchers, which – combined with the lower outflow – results in a higher net inflow.

Goteborg University (GU)

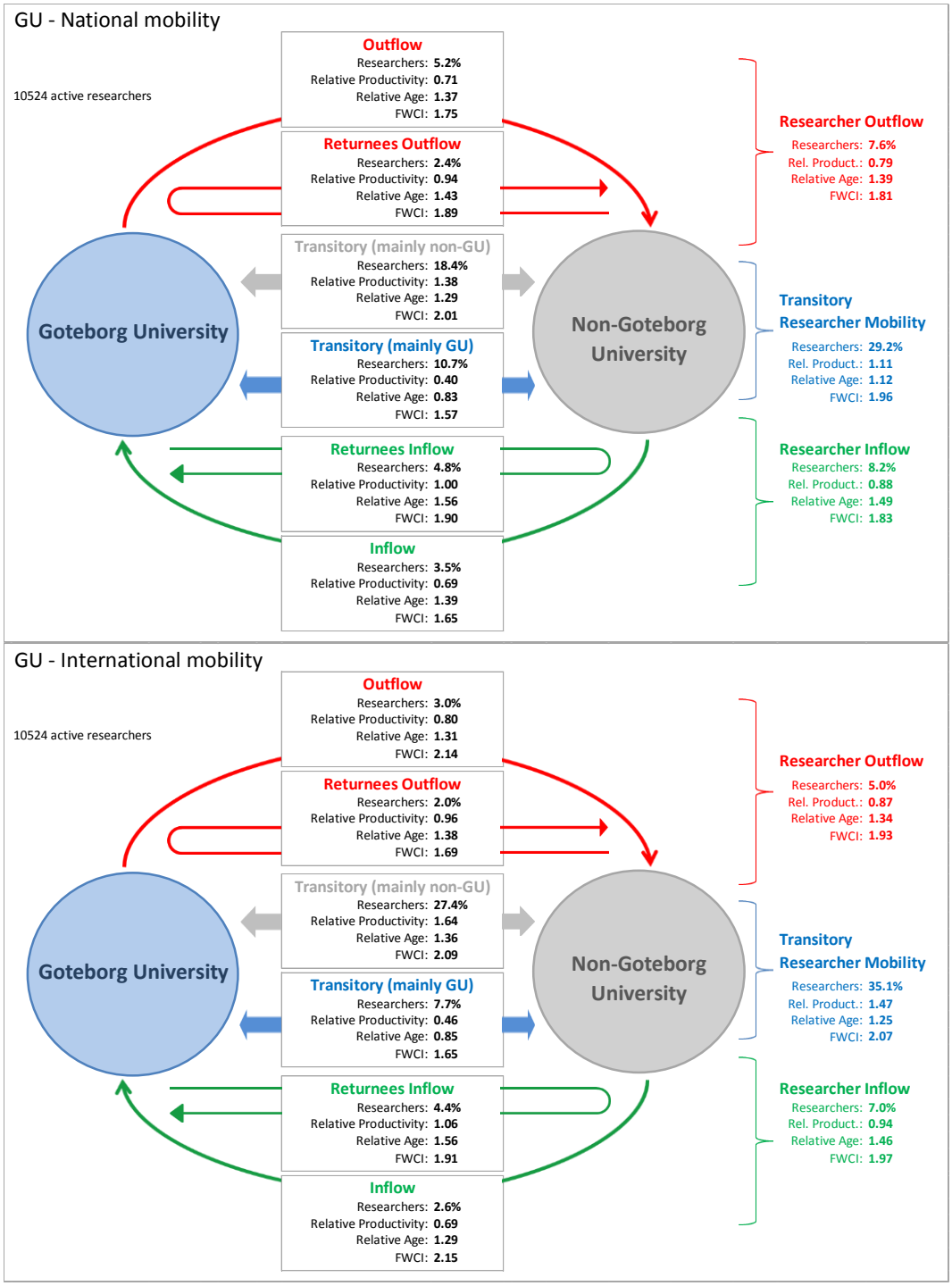

Figure 3.2— *National and international researcher mobility of Goteborg University, 1996-2015. Source: Scopus*

Goteborg University is the only institution among the Big 10 to have a net inflow of both national (0.8%) and internationally mobile researchers (2%). Outflow researchers are the least productive and least impactful mobility category for both national and international mobility. Comparing the two, we see that international outflow researchers are of a slightly lower relative age, and make up a smaller percentage of the total researchers than the national outflow, but have a higher relative productivity and FWCI. Aside from being more numerous, transitory and inflow researchers show similar differences between national and international mobility as the outflow researchers. Goteborg University's transitory and inflow researchers with international experience are more productive and more highly cited than their nationally mobile counterparts. In the case of the transitory researchers, those that are internationally mobile are also of a higher relative age. For the inflow researchers, those that are nationally mobile have a higher relative age. National inflow researchers form a larger part of the university's total researchers than the international inflow researchers, in contrast to the transitory mobility categories.

Karolinska Institutet (KI)

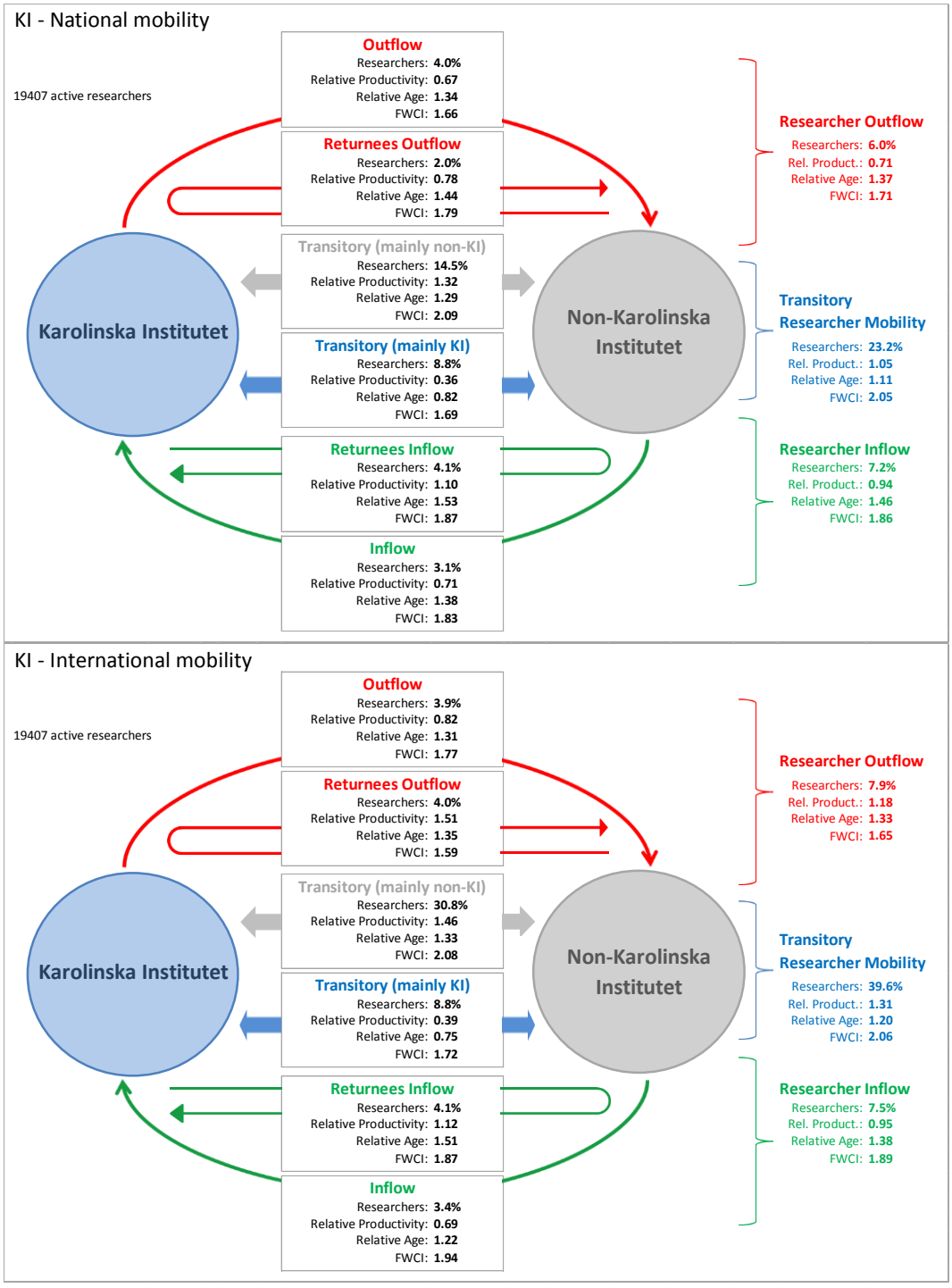

Figure 3.3— *National and international researcher mobility of Karolinska Institutet, 1996-2015. Source: Scopus*

At Karolinska Institutet the outflow researchers make up a larger percentage among those with international mobility than they do among those with national mobility, but the international outflow shows a lower relative age and lower FWCI. Looking at transitory mobility, we see that this group forms a considerably larger share of international mobility than that of national mobility. Although these internationally transitory researchers have both a higher relative age and a higher relative productivity, the FWCI of their publications is just 0.1 percentage point higher than that of the nationally transitory researchers. In terms of inflow the percentage of the total researchers is again higher when it comes to international mobility. However, as its outflow is higher still, there is a slight net outflow in this case, whereas the national mobility shows a net inflow. International inflow researchers are slightly more impactful.

Linkoping University (LiU)

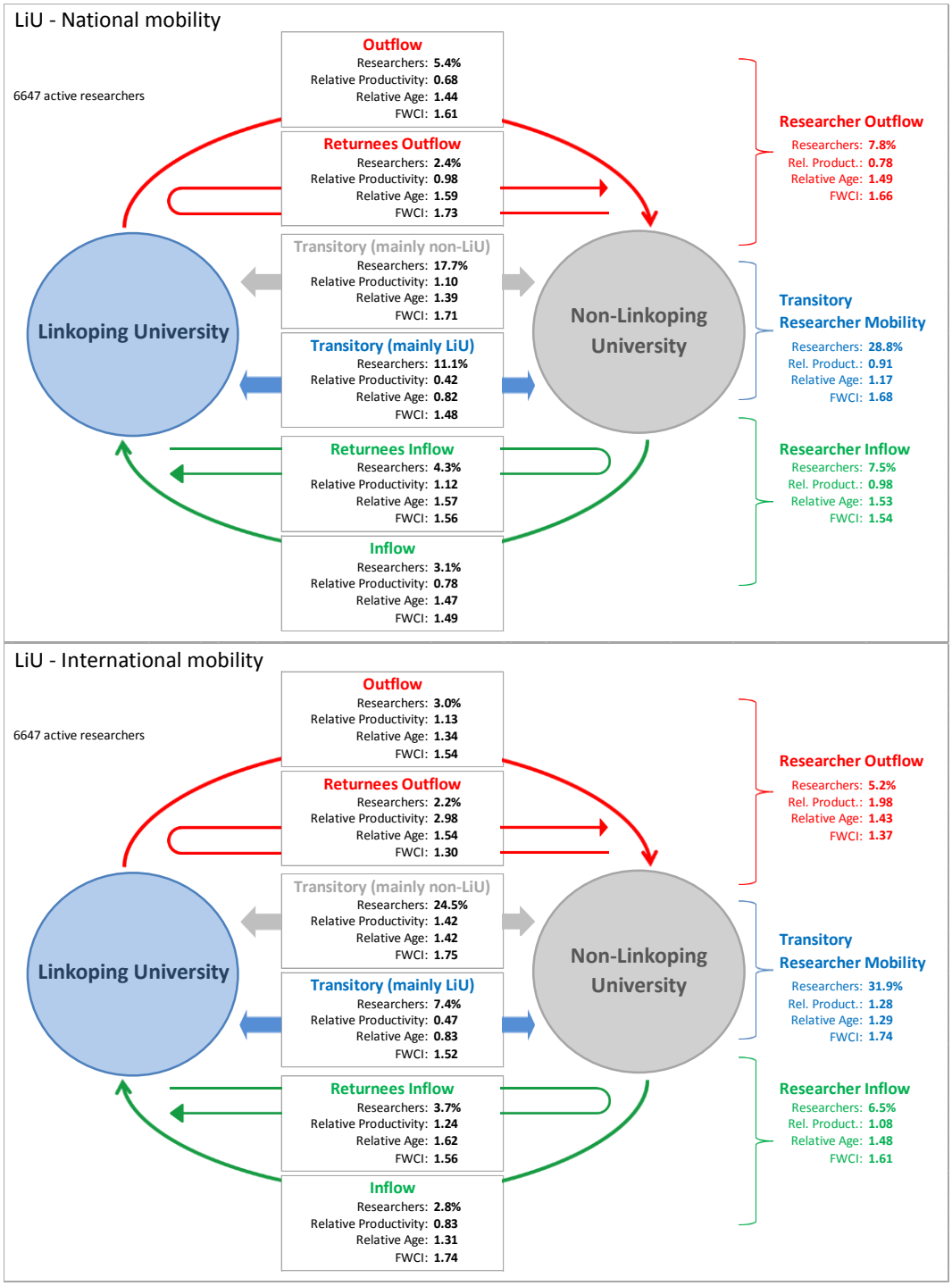

Figure 3.4— *National and international researcher mobility of Linkoping University, 1996-2015. Source: Scopus*

The percentages of both outflow and inflow are higher for Linkoping University's national mobility than they are for its international mobility, which instead has a much larger percentage of researchers with transitory mobility. For national mobility there is a little bit of net outflow (0.3%), wherein the outflow researchers have a higher FWCI than the inflow (12 percentage points difference). For international mobility this is the other way around and with larger differences: there is a net inflow (1.3%), and the inflow researchers have a higher FWCI (24 percentage points difference). Interestingly, while there is only a small difference between the relative productivity of the outflow and inflow researchers with national mobility (0.78 vs 0.98), the difference between the same categories with international mobility is quite large (1.98 for outflow vs 1.08 for inflow). With the exception of relative productivity, the internationally transitory researchers rank first in every metric, both when compared to the other international mobility categories and compared to the national ones.

Lund University (LU)

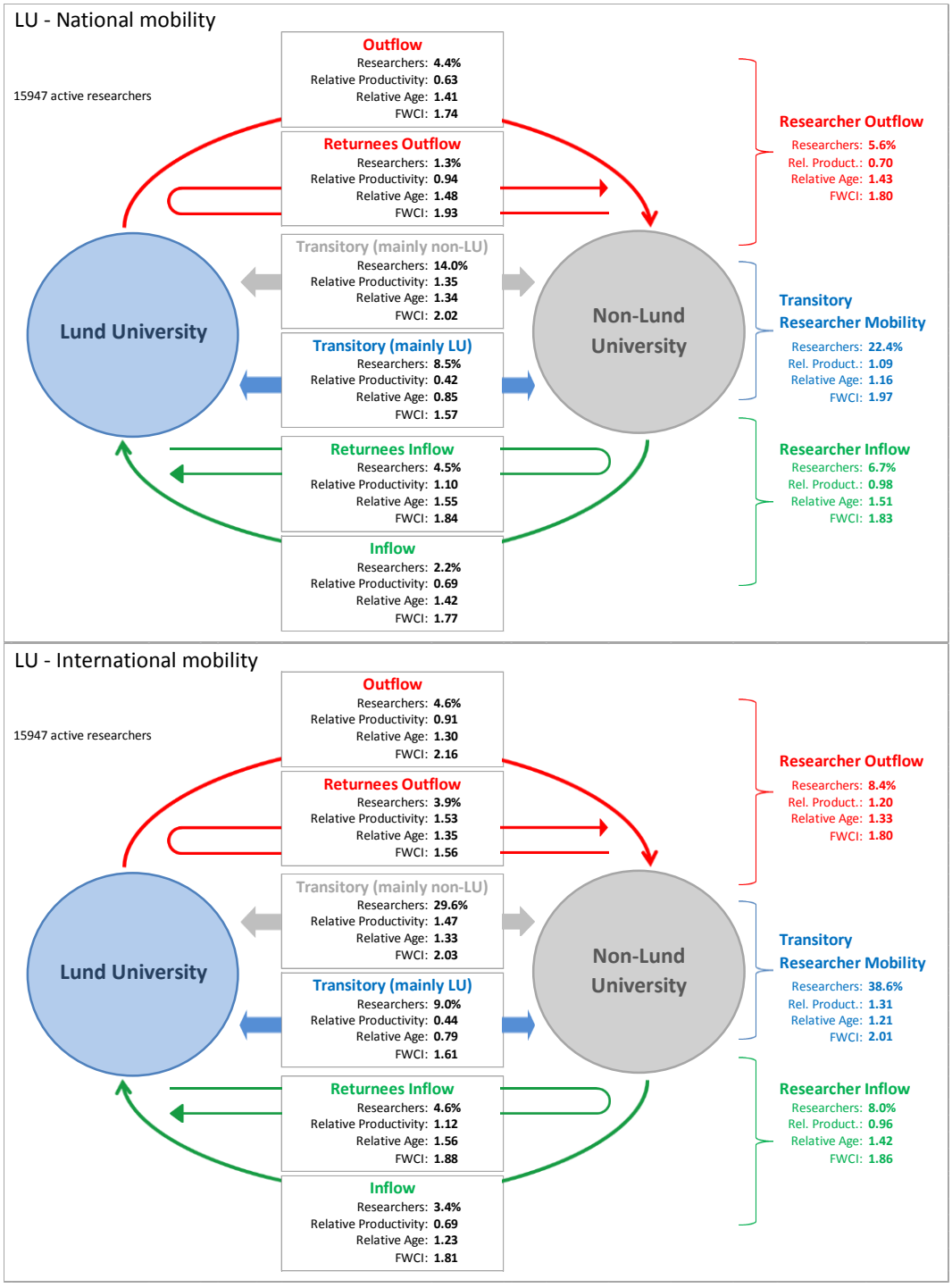

Figure 3.5— *National and international researcher mobility of Lund University, 1996-2015. Source: Scopus*

Lund University shows a higher outflow of researchers to institutions abroad than to institutions in Sweden. The national outflow researchers have a higher relative age (10 percentage points), while the international outflow researchers have a much higher relative productivity (50 percentage points), and yet both groups achieve the same FWCI of 80% above world average. A key difference is the fact that on a national level there is a net inflow of 1.2%, and on an international level there is a small net outflow of 0.4%. The international inflow researchers are marginally less productive than the national inflow ones, potentially tied to their lower relative age. However, their publications are cited slightly more often. Lund University's transitory researchers form the largest part of its total researchers, whether it is national or international mobility, and show the highest relative productivity and FWCI, with the international researchers coming out on top.

Royal Institute of Technology (KTH)

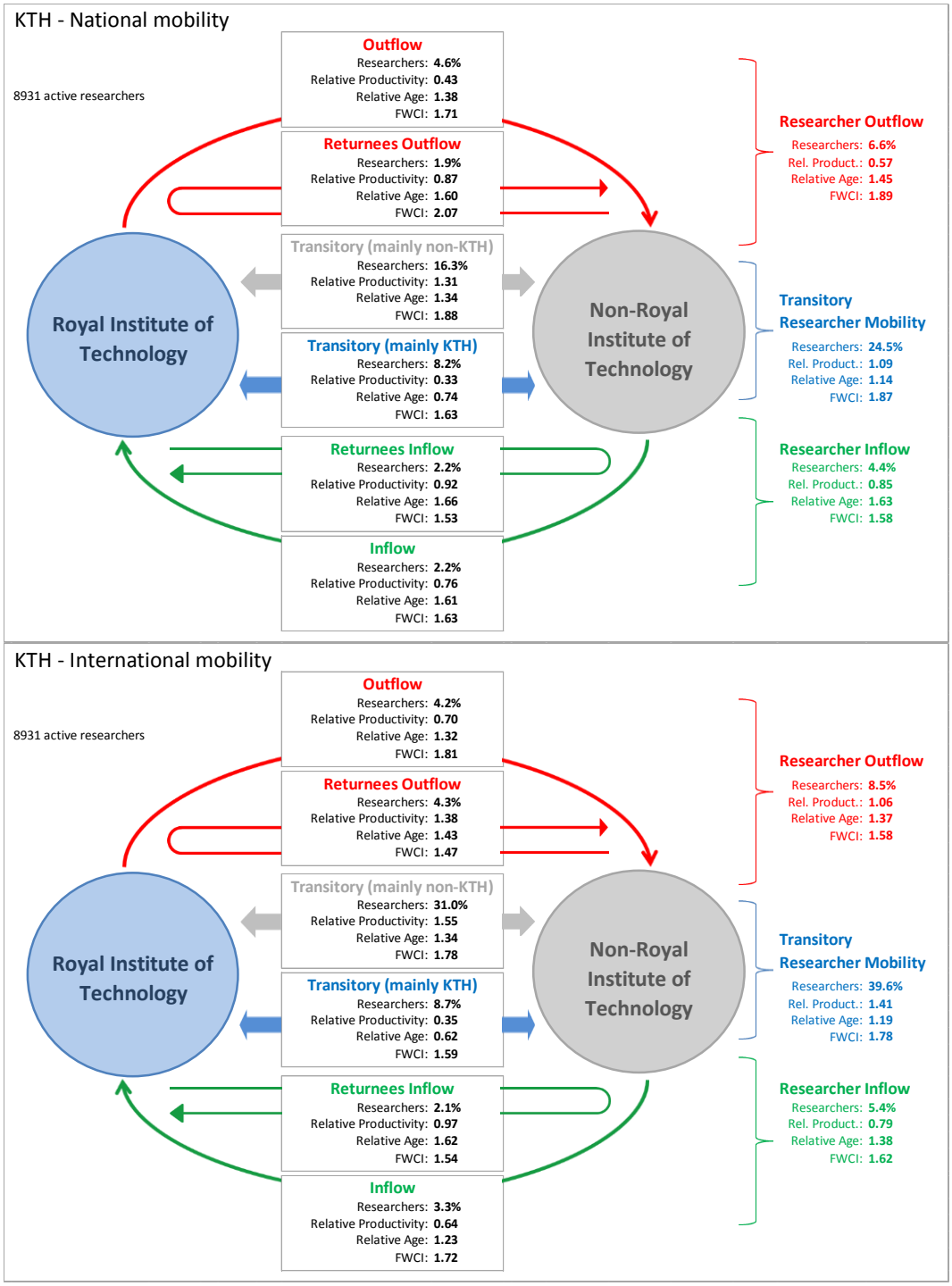

Figure 3.6— *National and International researcher mobility of Royal Institute of Technology, 1996-2015. Source: Scopus*

In all mobility categories, researchers moving around internationally form a larger percentage of the Royal Institute of Technology's total researchers than those moving within Sweden. The outflow of researchers is greater than its inflow, both on a national and international level, with the net outflow of the latter being a little higher (1.1 percentage point). Among the nationally mobile researchers, those coming to the Royal Institute of Technology show a higher relative productivity, but a lower FWCI than those leaving. For the internationally mobile researchers, the opposite is true: inflow researchers have a higher FWCI, but a lower relative productivity. Transitory researchers make up the largest category, both national and international, but show a few differences. Those with short stays abroad are the most cited researchers among the international mobility categories, but have a lower FWCI than those with short stays at other Swedish institutions. However, the latter do not have the highest FWCI among the national mobility categories; at 1.87 their citation impact is slightly below that of the outflow researchers (1.89).

Stockholm University

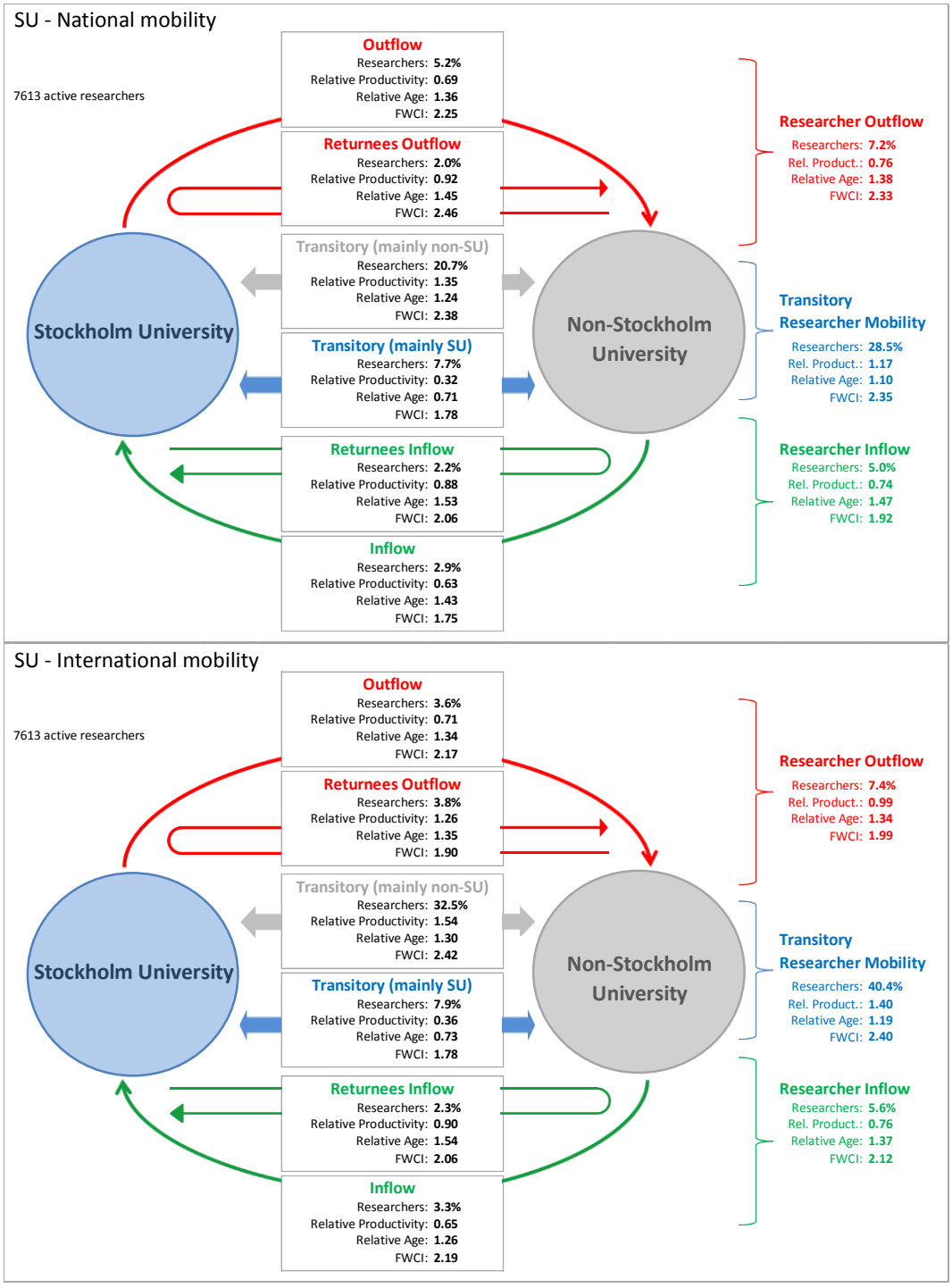

Figure 3.7— *National and international researcher mobility of Stockholm University, 1996-2015. Source: Scopus*

Researchers leaving Stockholm University for institutions abroad are slightly more numerous than those leaving for Swedish institutions, and they have a lower FWCI. Although they are cited almost twice as often as the world average, international outflow researchers still have the lowest FWCI among the international mobility categories, with a 13 percentage points difference between them and the inflow researchers. The national outflow researchers on the other hand come in second place, being cited almost as often as the transitory researchers (2.33 vs 2.35). For both national and international mobility, Stockholm University shows a net outflow, though the latter is a little lower. Transitory researchers form the largest percentage of researchers, and considerably more so for the international mobility (40.4%) than the national mobility (28.5%). Both are more productive than the average researcher at Stockholm University, and are the most highly cited, with the internationally transitory researchers leading by 5 percentage points. The inflow researchers from within Sweden have the lowest FWCI of Stockholm University's national and international mobility categories. Although they are cited 92% more often than the world average, this is 20 percentage points below the international inflow researchers.

Swedish University of Agricultural Sciences (SLU)

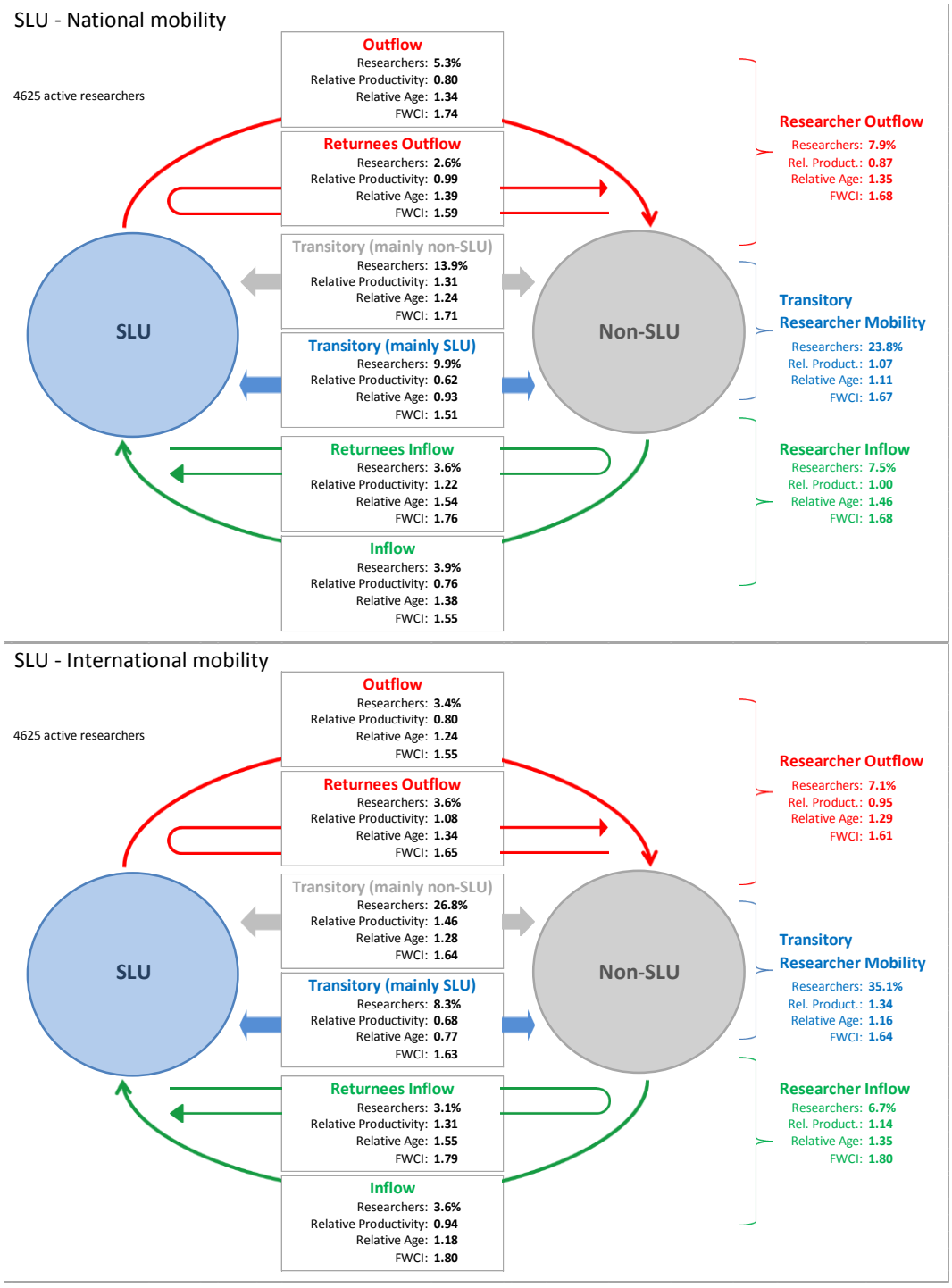

Figure 3.8— *National and international researcher mobility of Swedish University of Agricultural Sciences, 1996-2015. Source: Scopus*

For the Swedish University of Agricultural Sciences, outflow and inflow is higher among the national mobility categories than among the international ones. Coincidentally, both show the same 0.4% net outflow. The FWCI of the national mobility categories is almost exactly the same for all three, though the transitory researchers are cited marginally less (1 percentage point difference) than the national outflow and inflow researchers. Among the internationally mobile researchers, the outflow researchers are cited less than either transitory or inflow researchers, and have a lower relative productivity. The international inflow researchers have the highest FWCI, surpassing all other mobility categories, national and international. The Swedish University of Agricultural Sciences' internationally transitory researchers are less impactful than its nationally transitory researchers. On the upside, they are the most productive among all categories, and they have a lower relative age than most.

Umea University (UmU)

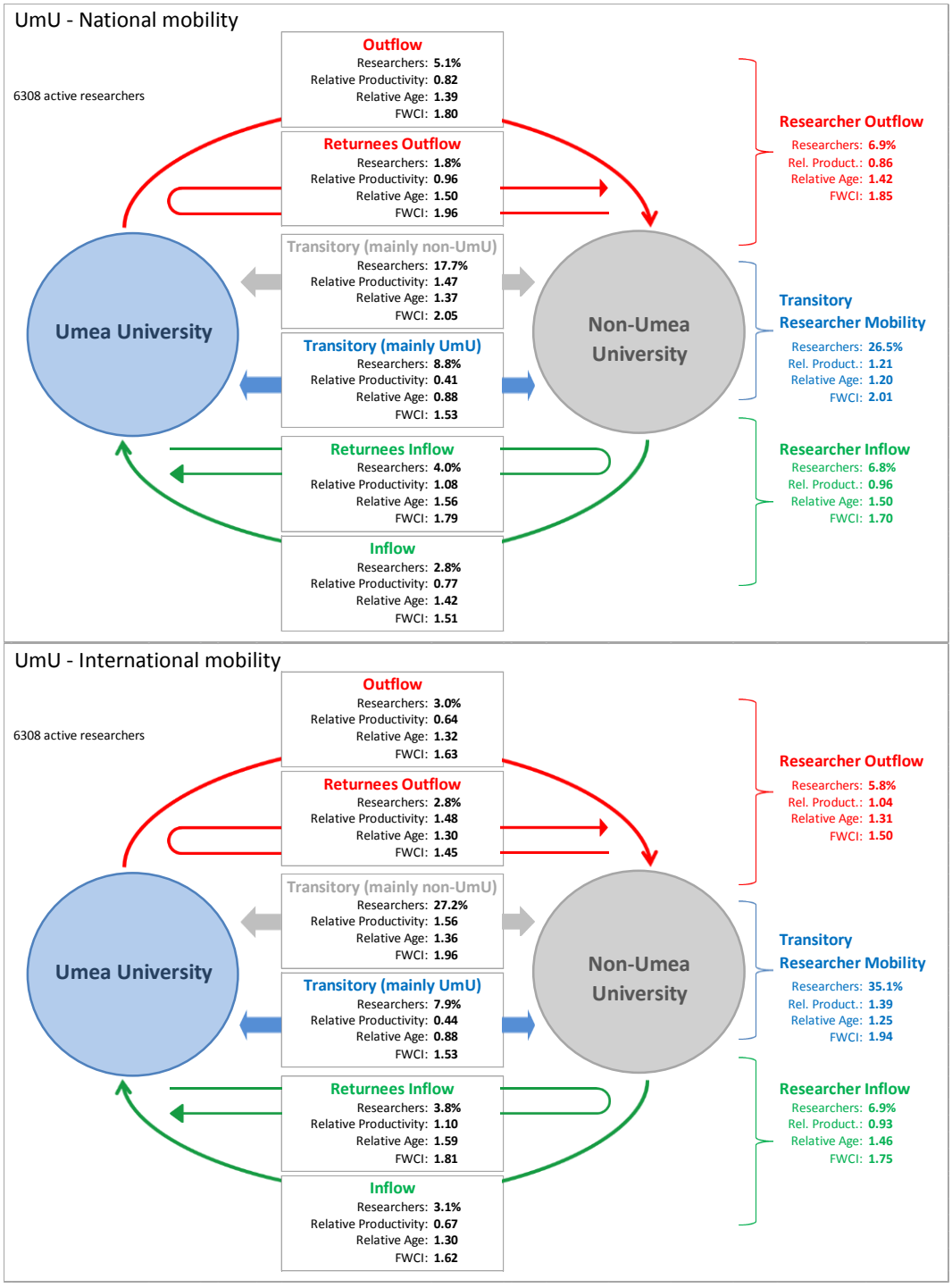

Figure 3.9— *National and international researcher mobility of Umea University, 1996-2015. Source: Scopus*

Umea University's percentages of inflow and outflow of nationally mobile researchers are very nearly equal, with a marginal net outflow of just 0.1%. The national outflow researchers have a lower productivity, but a higher FWCI than the international outflow researchers. However, the latter form a lower percentage of Umea University's total researchers. Combined with a high inflow of internationally mobile researchers, Umea University has a small net inflow in international mobility of 1.1%. As with the outflow, the national transitory researchers have a lower productivity, but a higher FWCI than the international transitory researchers. When it comes to inflow this is turned around; those coming from abroad have the higher FWCI, but show a lower relative productivity (though the differences are smallest for this category). Among both the national and international mobility categories, transitory researchers still rank first in size, relative productivity, and FWCI.

Uppsala University (UU)

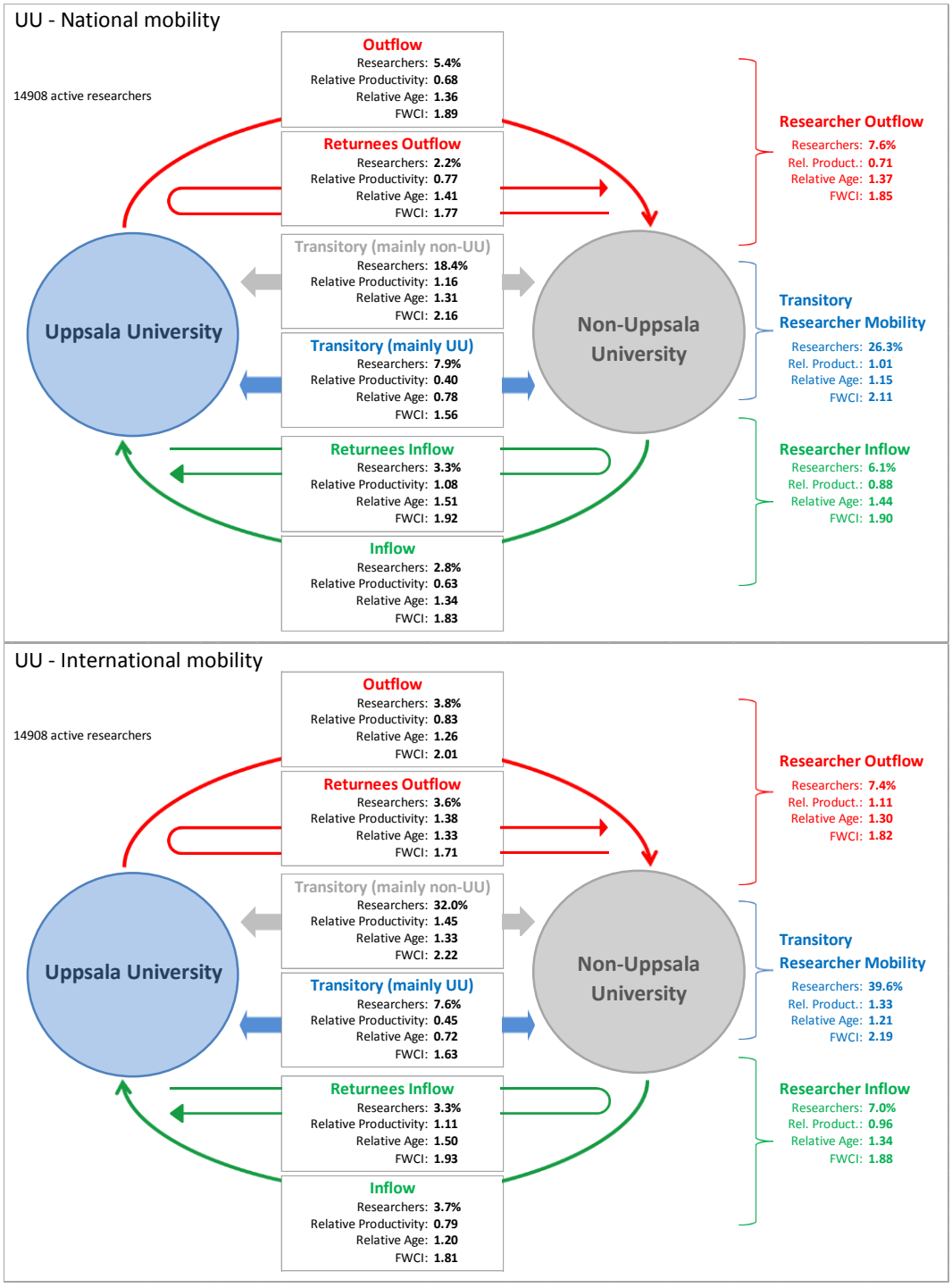

Figure 3.10— *National and international researcher mobility of Uppsala University, 1996-2015. Source: Scopus*

The outflow of researchers with international experience is a little lower than that of researchers who have moved only to and from Swedish institutions. Those internationally mobile outflow researchers also show a slightly lower field-weighted citation impact, but have a higher relative productivity than the national outflow researchers. Transitory researchers – as usual – make up the largest percentage of Uppsala University's total researchers, and are the most productive and impactful researchers among their respective mobility categories, while at the same time having the lowest relative age. However, while the nationally transitory researchers are just about on par with the average Uppsala University researcher in terms of productivity, the internationally transitory researchers rise above it by 33%. Contrary to the outflow, the international inflow of researchers is higher than the national inflow. The outflow is higher than the inflow in both cases, resulting in net outflows of 1.5% (national mobility) and 0.4% (international mobility). Similar to the outflow, those with international experience show a slightly lower FWCI, in addition to having a lower relative age.

3.4 Mobility charts of HEIs (excluding the Big 10)

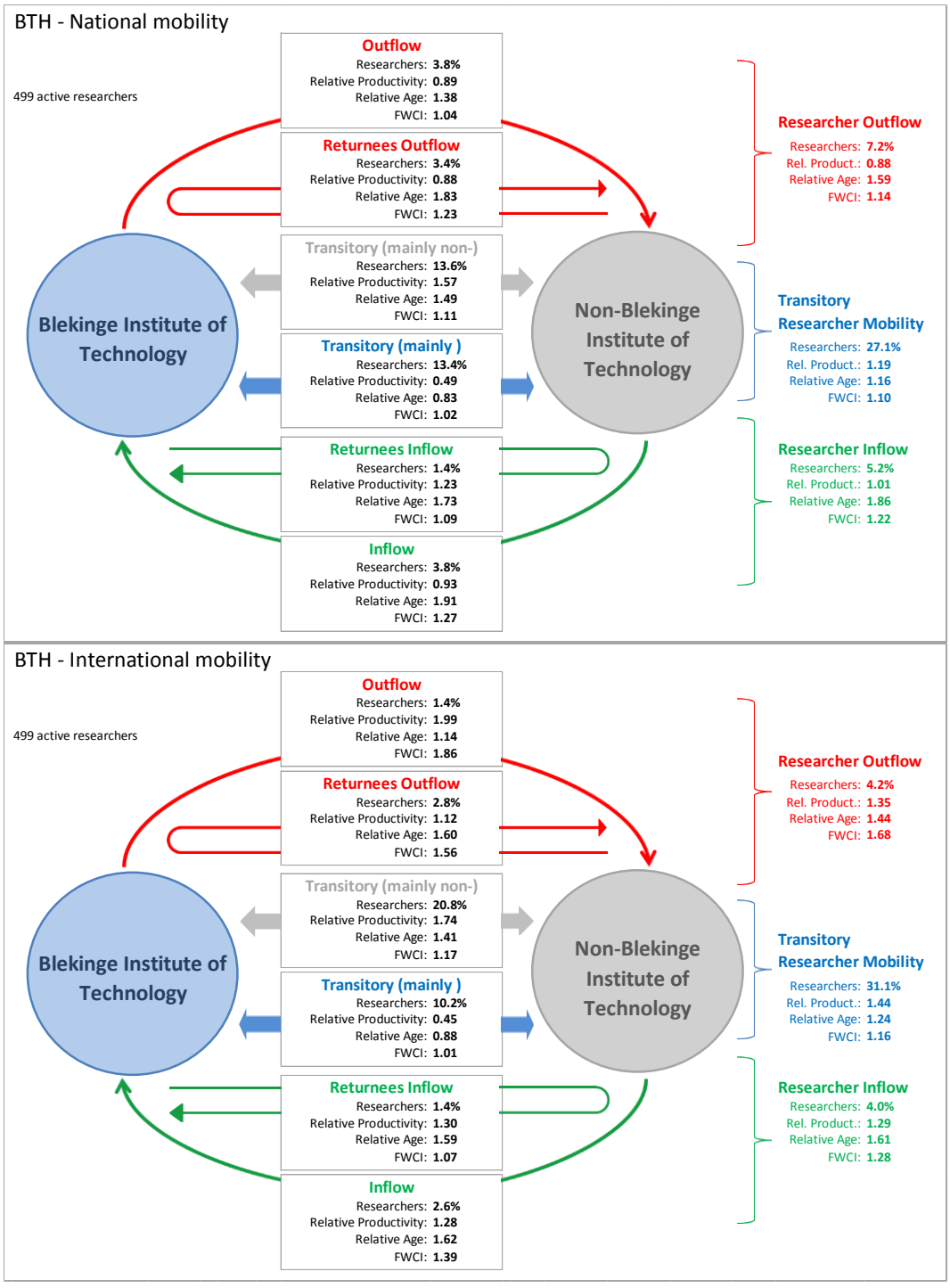

Figure 3.11— *National and international researcher mobility of Blekinge Institute of Technology, 1996-2015. Source: Scopus*

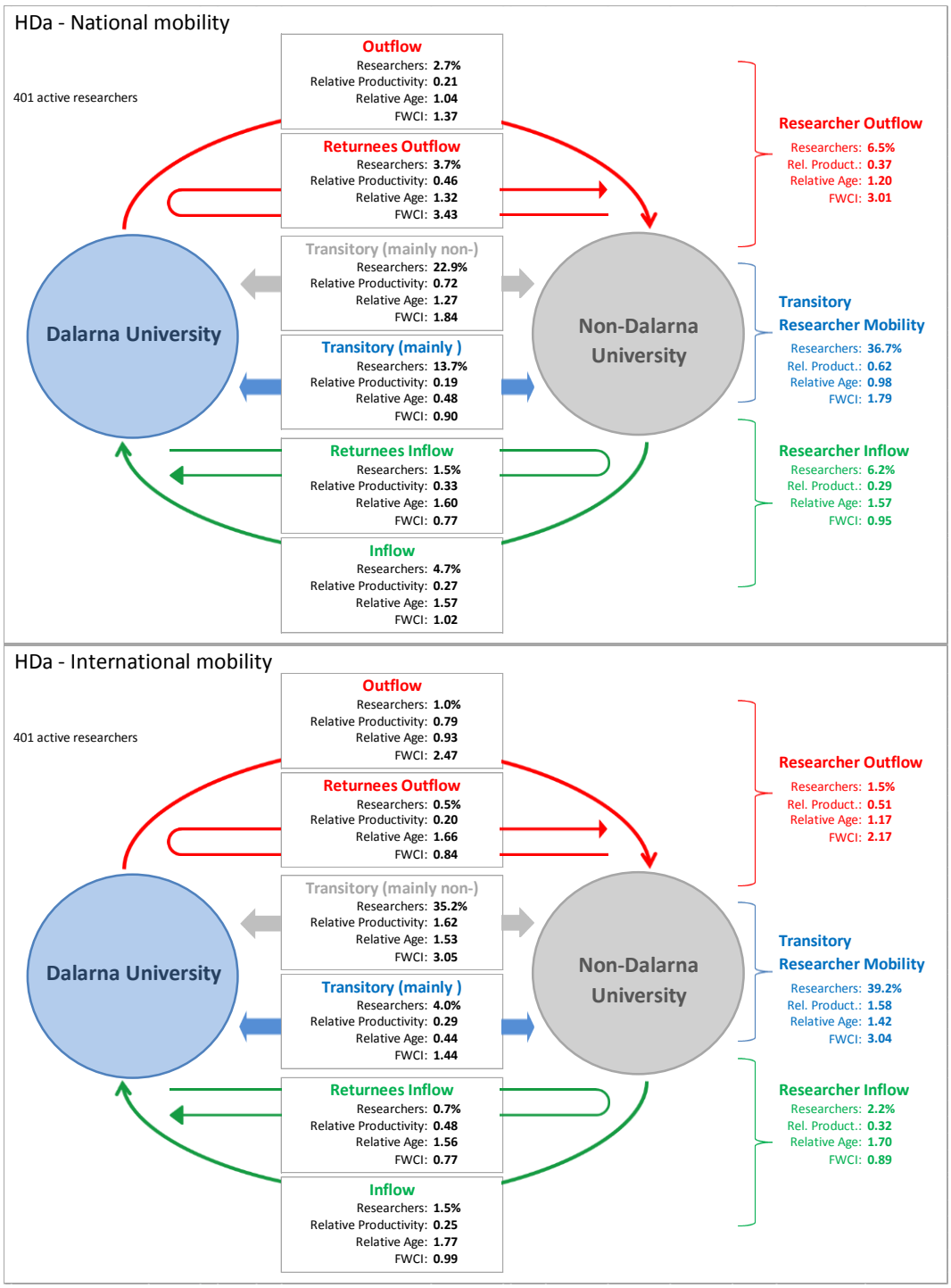

Figure 3.12— *National and international researcher mobility of Dalarna University, 1996-2015. Source: Scopus*

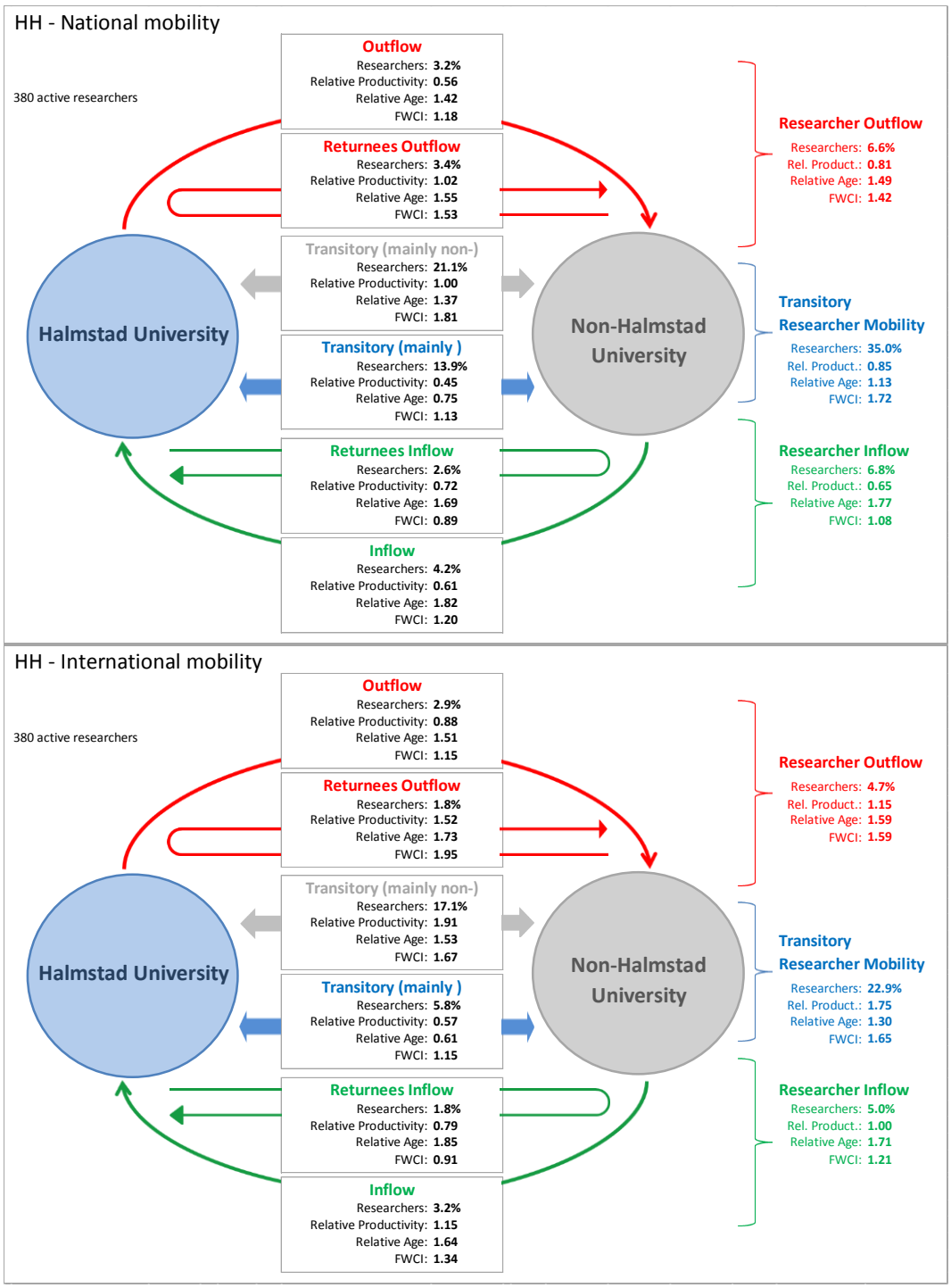

Figure 3.13— *National and international researcher mobility of Halmstad University, 1996-2015. Source: Scopus*

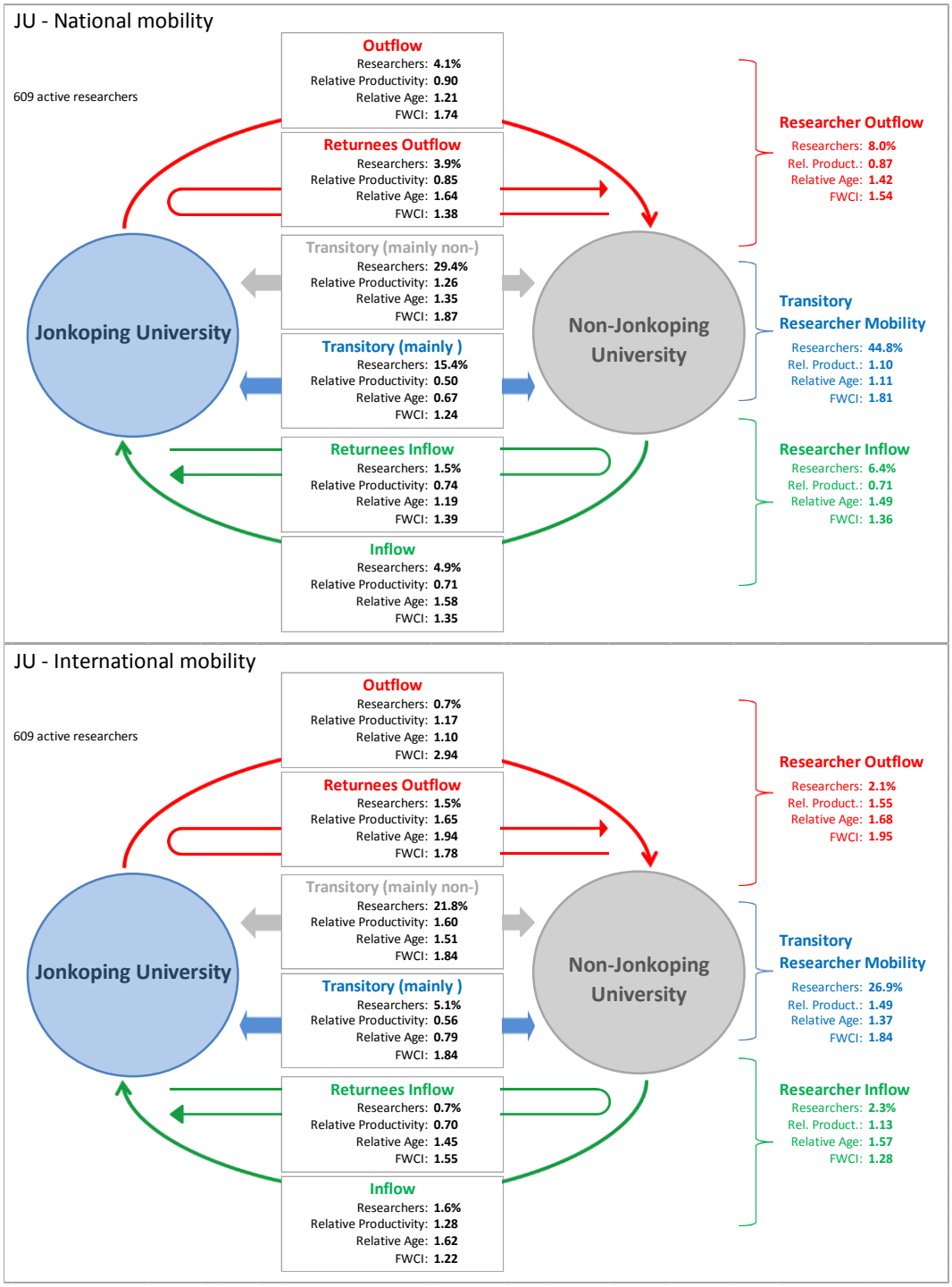

Figure 3.14— *National and international researcher mobility of Jonkoping University, 1996-2015. Source: Scopus*

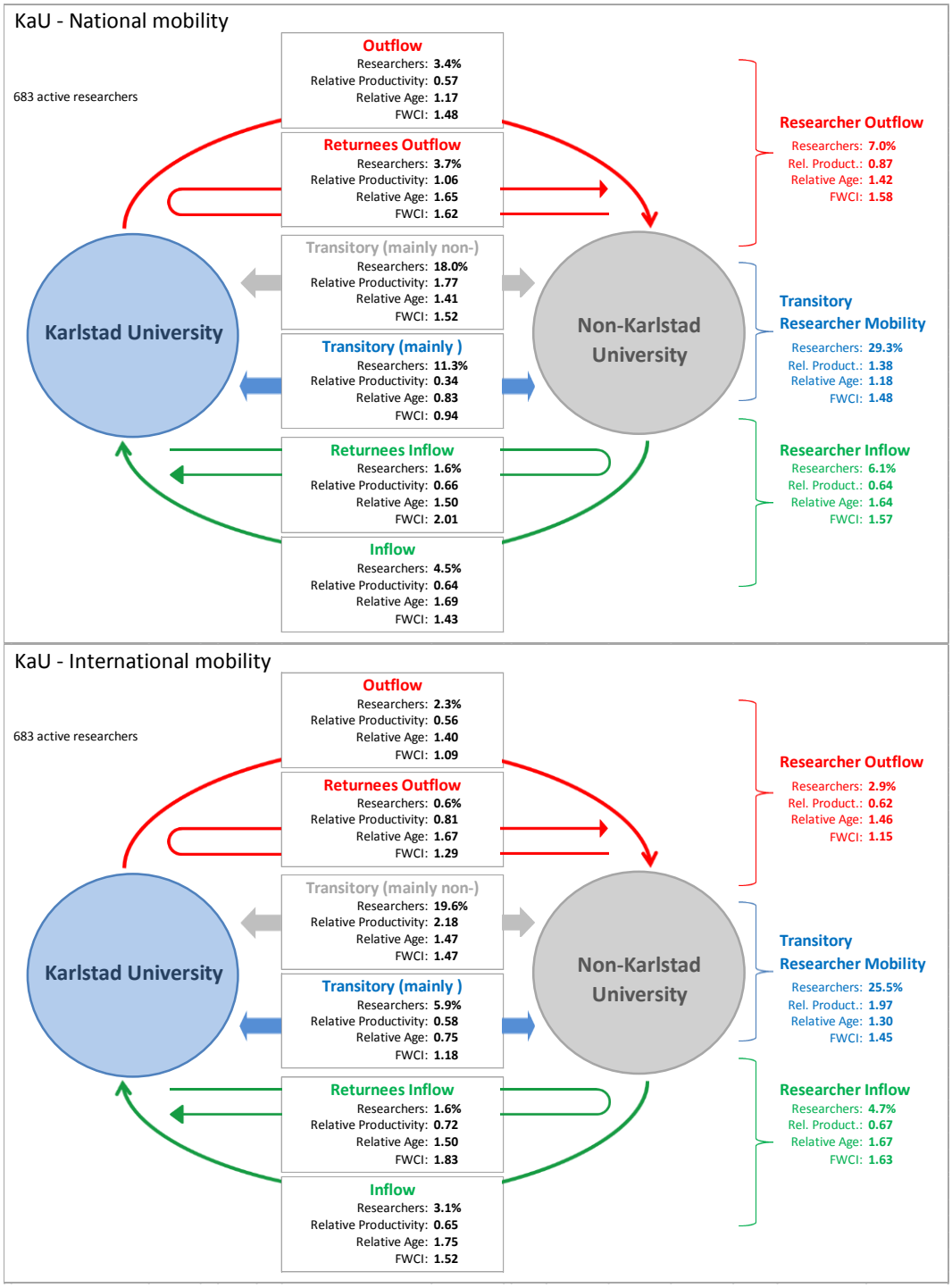

Figure 3.15— *National and international researcher mobility of Karlstad University, 1996-2015. Source: Scopus*

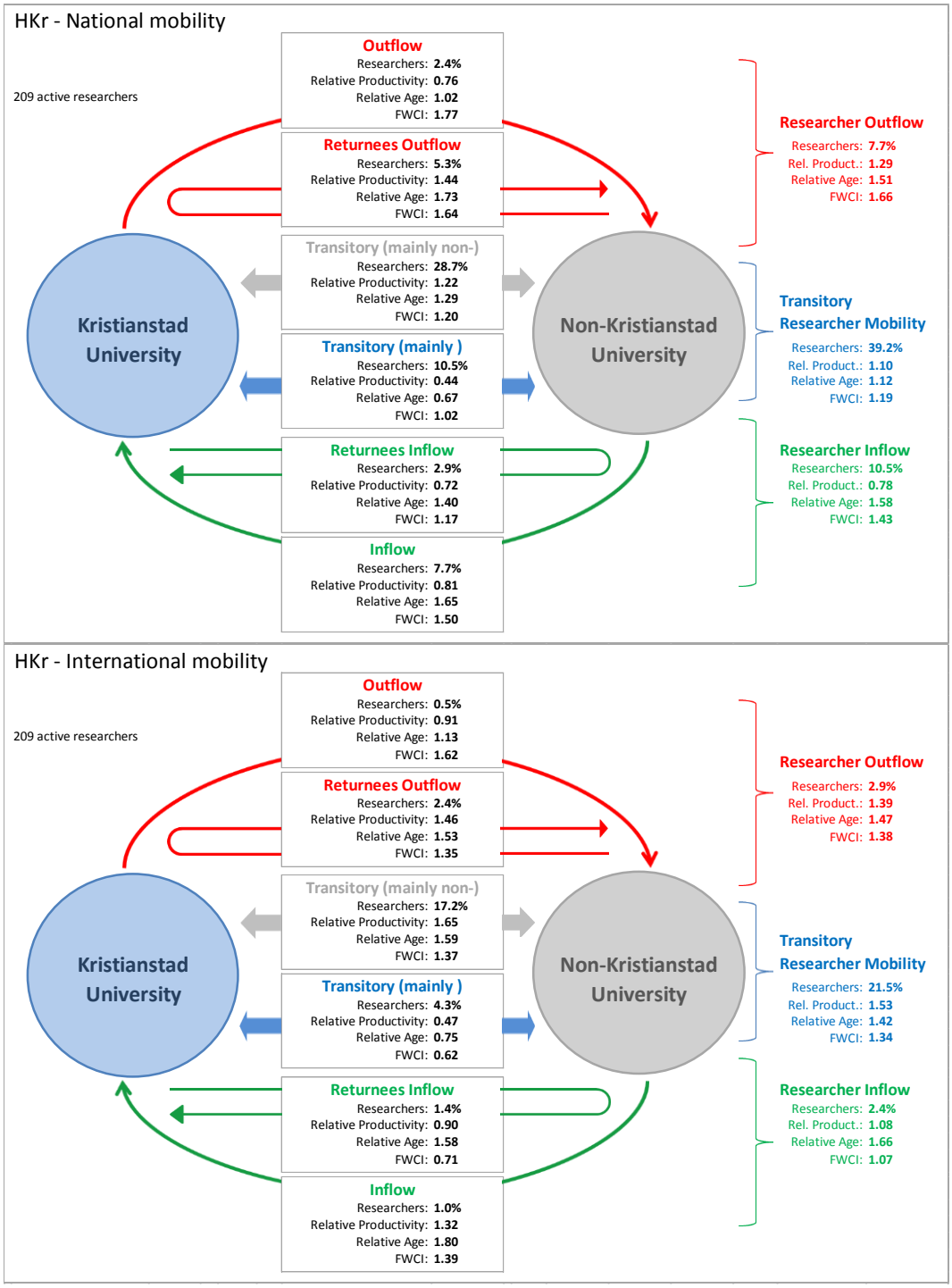

Figure 3.16— *National and international researcher mobility of Kristianstad University, 1996-2015. Source: Scopus*

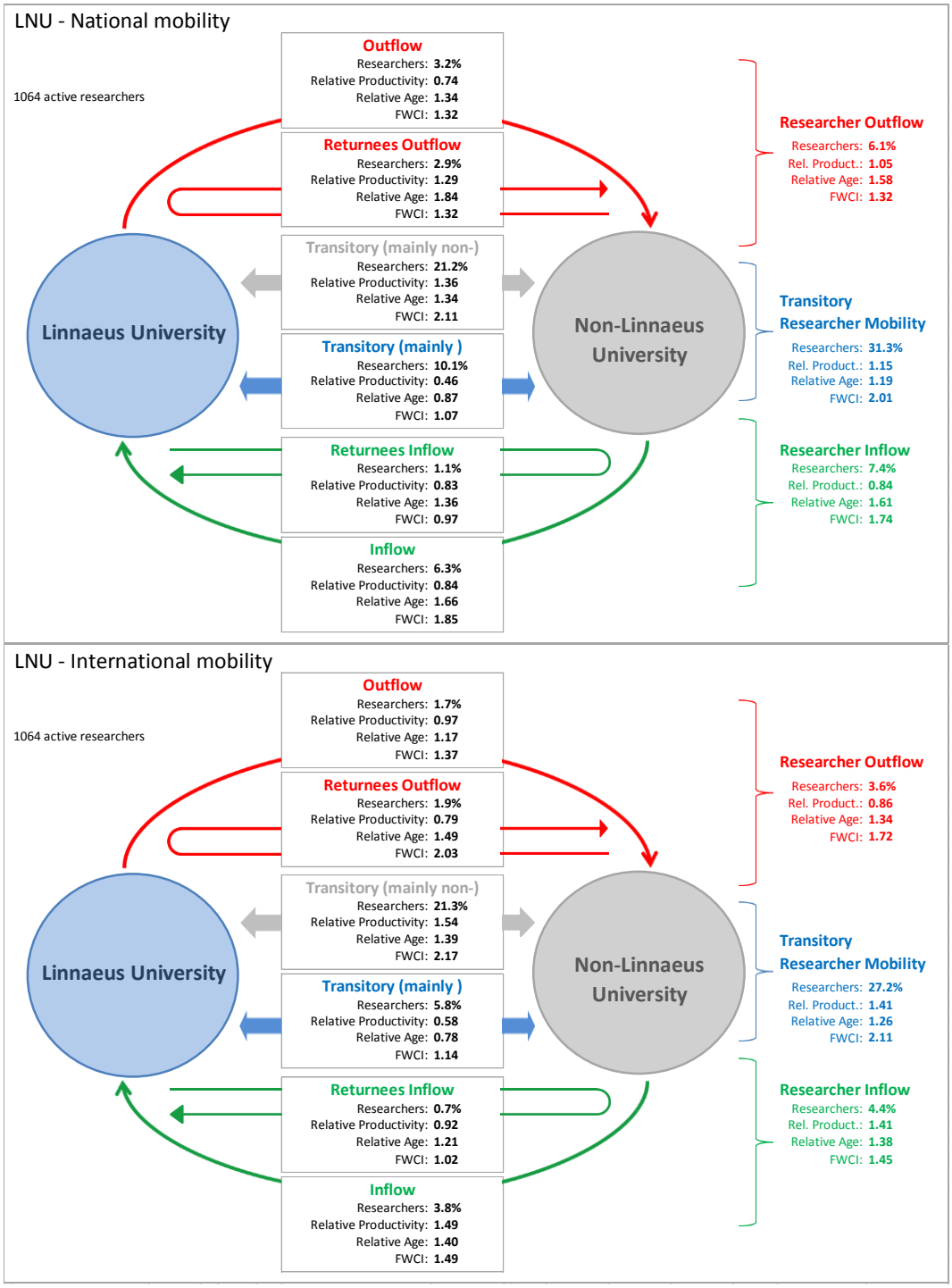

Figure 3.17 — *National and international researcher mobility of Linnaeus University, 1996-2015. Source: Scopus*

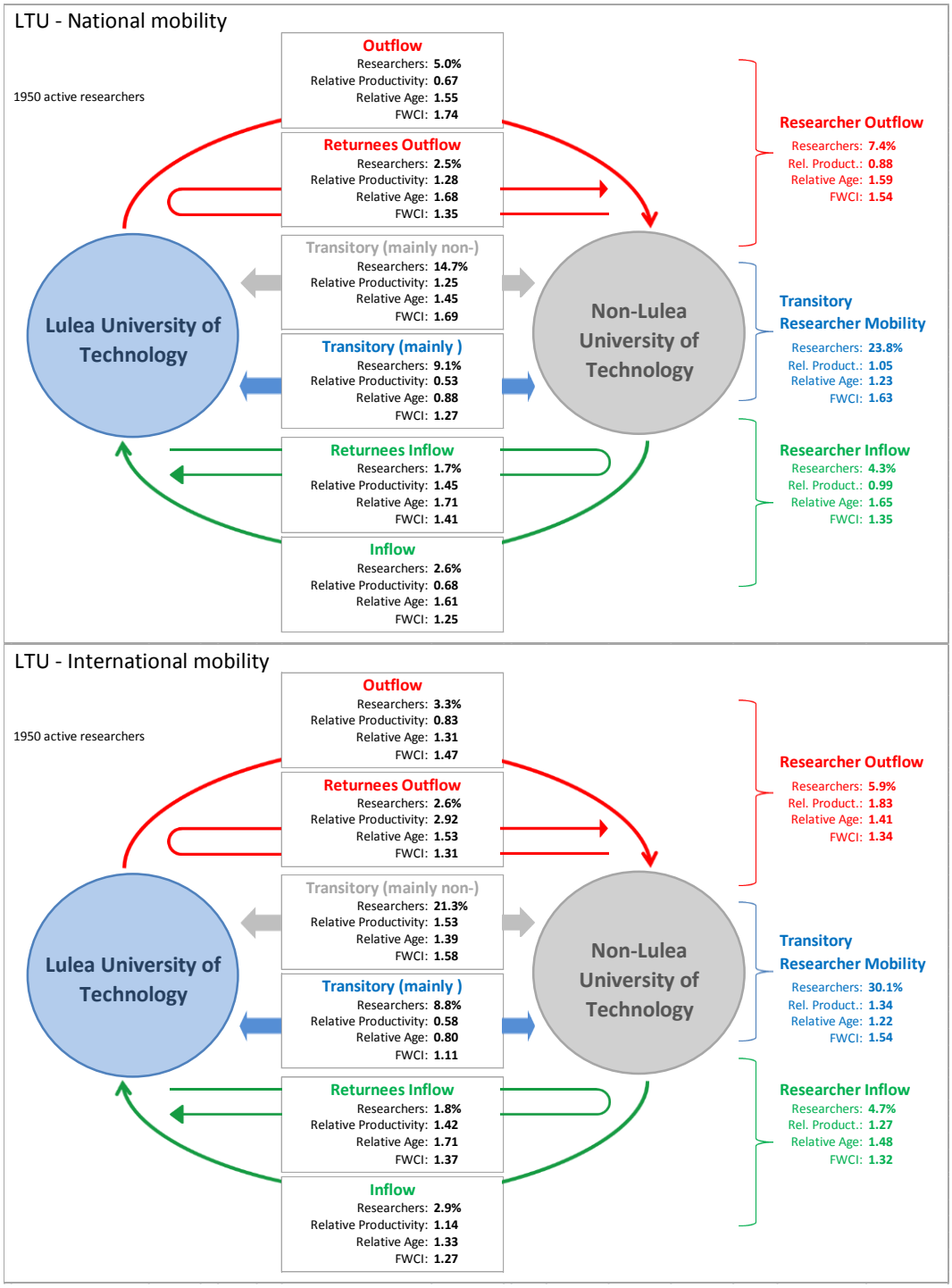

Figure 3.18— *National and international researcher mobility of Lulea University of Technology, 1996-2015. Source: Scopus*

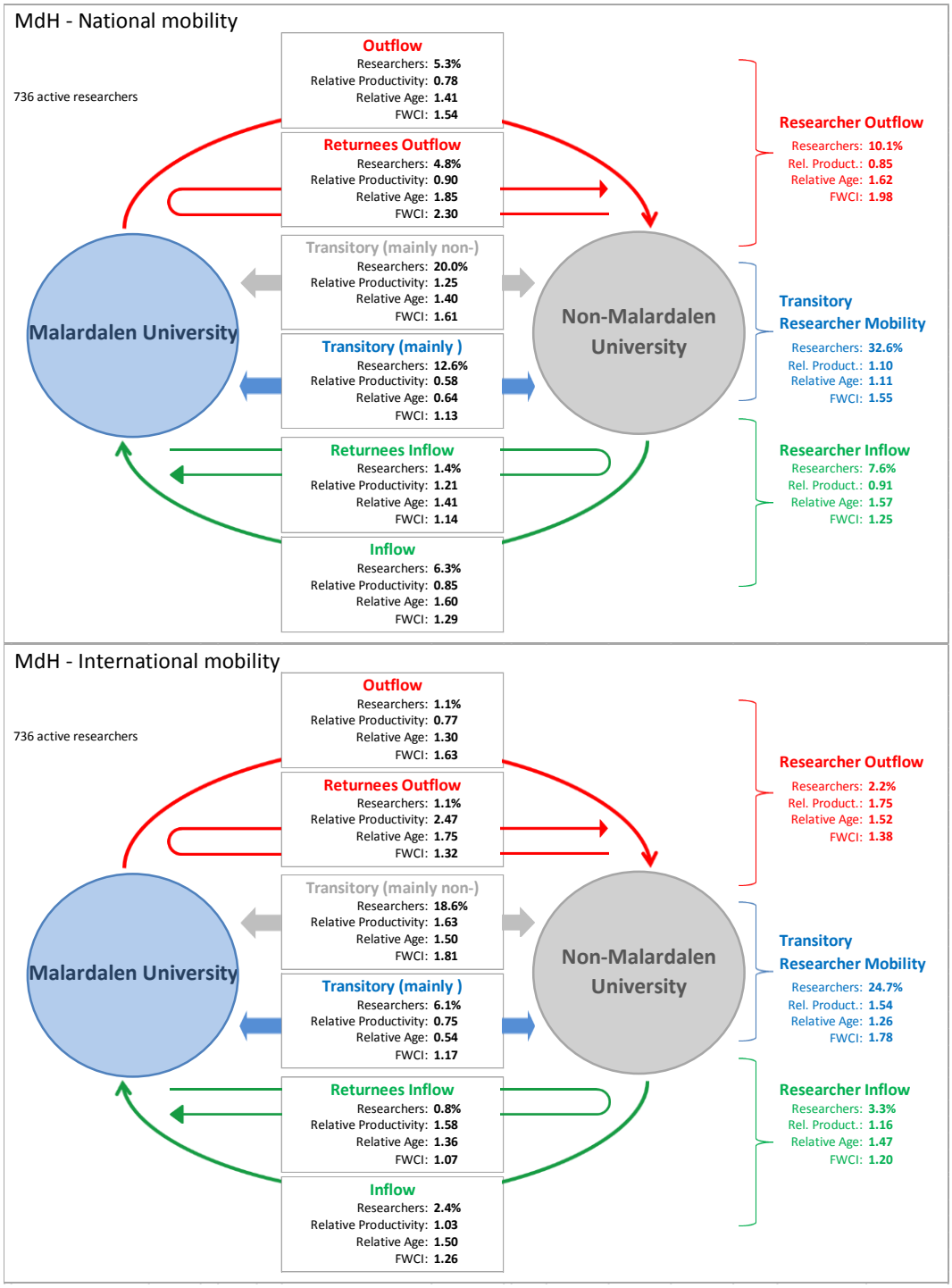

Figure 3.19— *National and international researcher mobility of Malardalen University, 1996-2015. Source: Scopus*

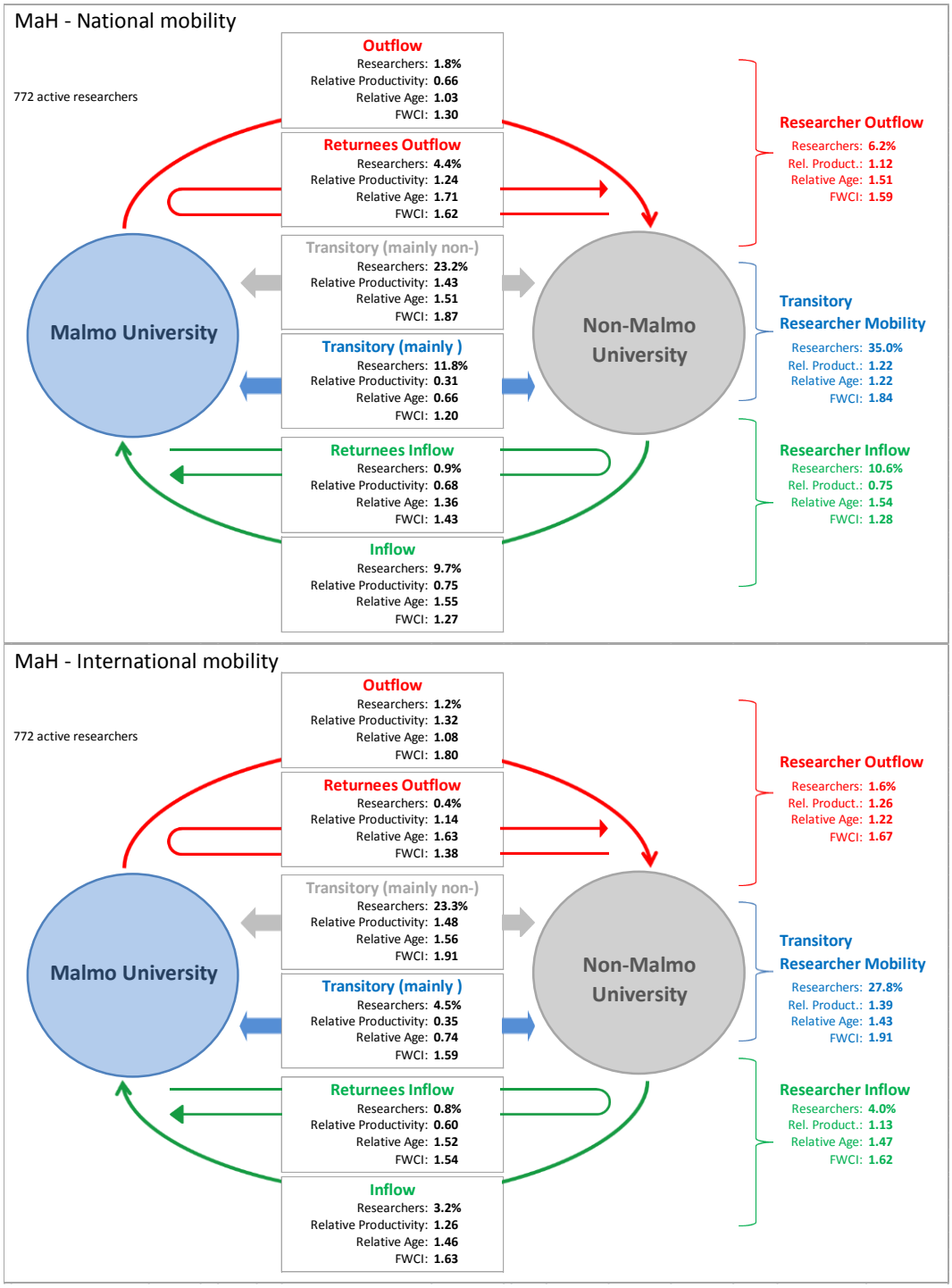

Figure 3.20— *National and international researcher mobility of Malmo University, 1996-2015. Source: Scopus*

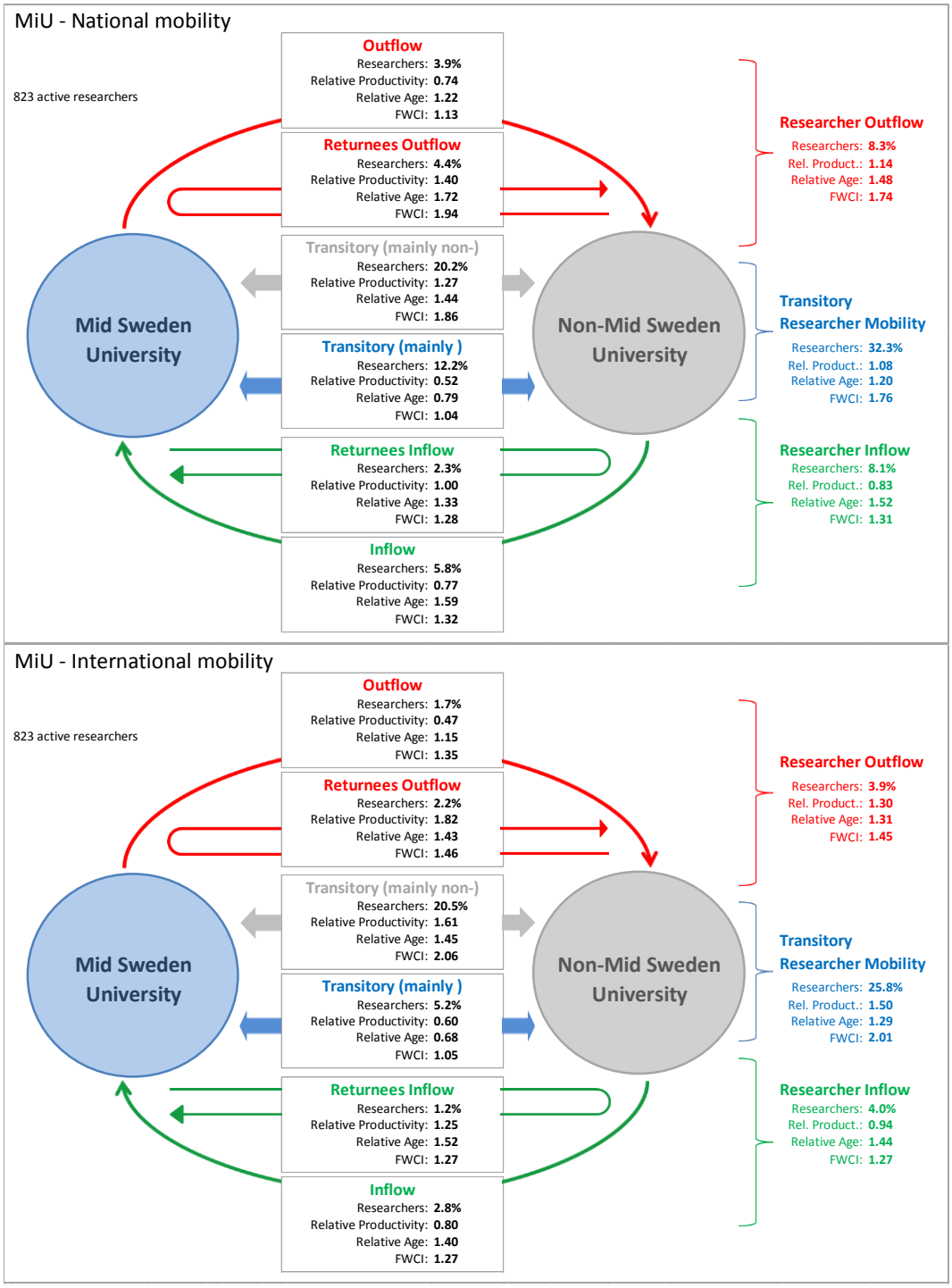

Figure 3.21 — *National and international researcher mobility of Mid Sweden University, 1996-2015. Source: Scopus*

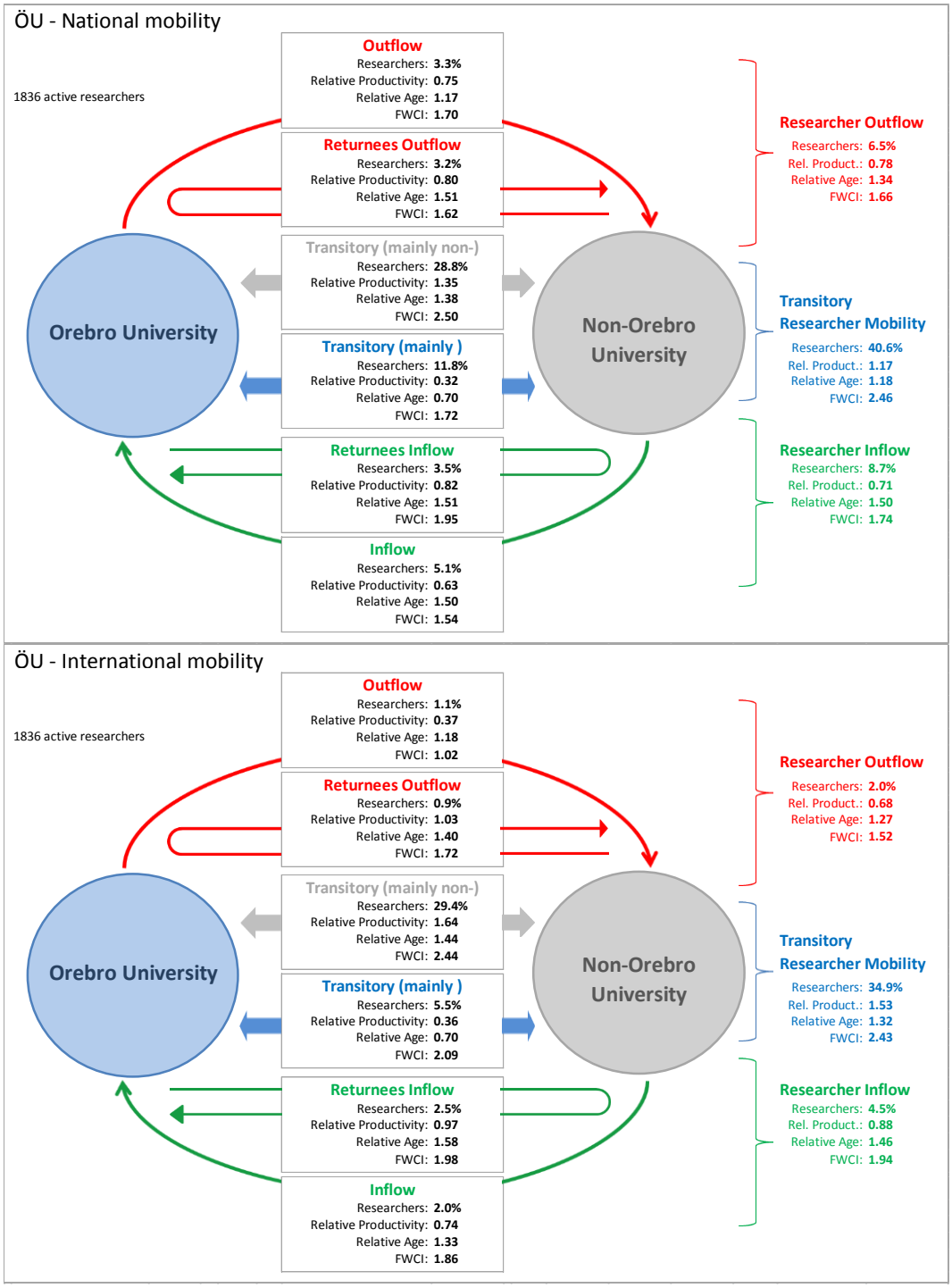

Figure 3.22— *National and international researcher mobility of Orebro University, 1996-2015. Source: Scopus*

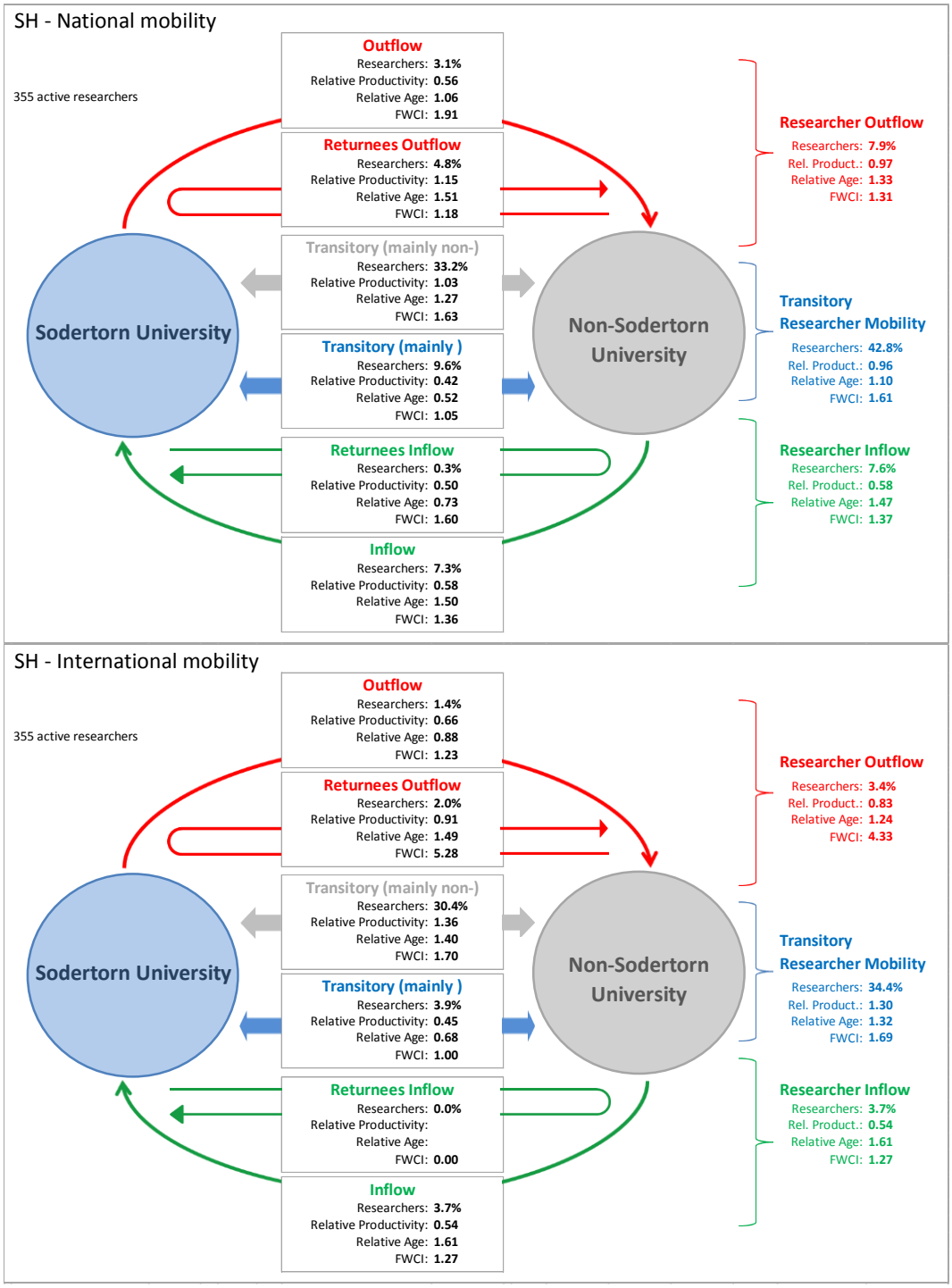

Figure 3.23— *National and international researcher mobility of Sodertorn University, 1996-2015. Source: Scopus*

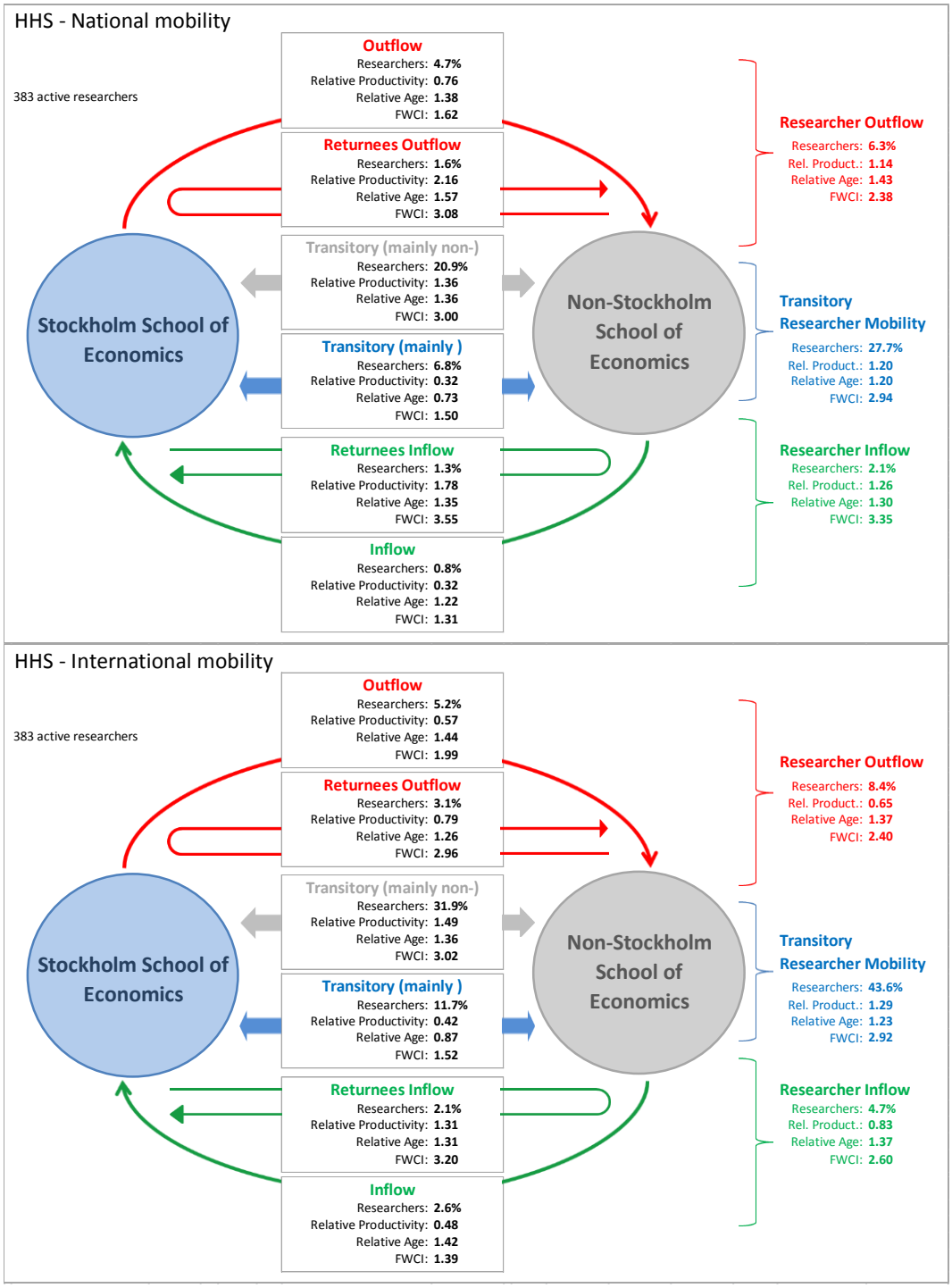

Figure 3.24— *National and international researcher mobility of Stockholm School of Economics, 1996-2015. Source: Scopus*

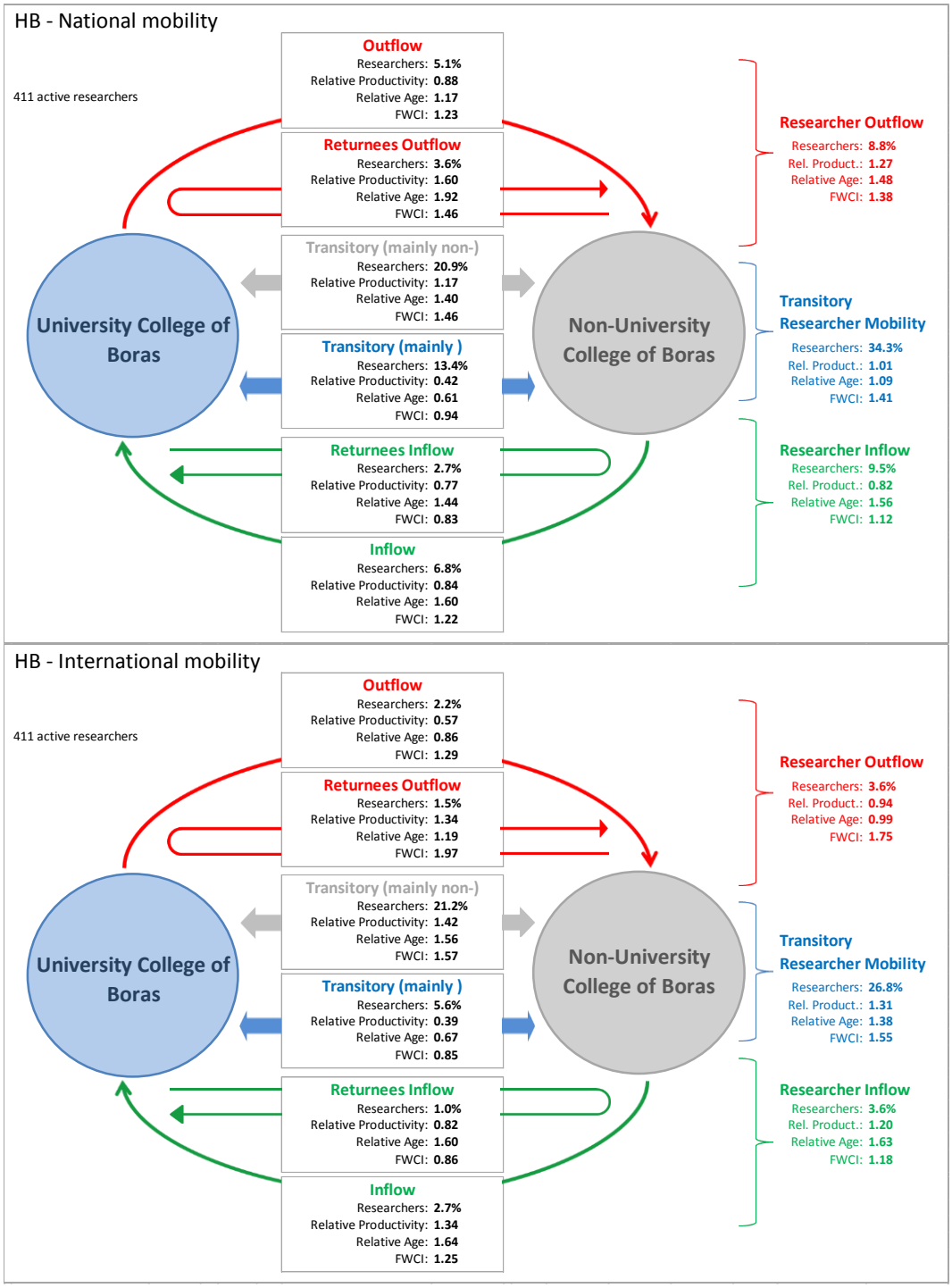

Figure 3.25— *National and international researcher mobility of University College of Boras, 1996-2015. Source: Scopus*

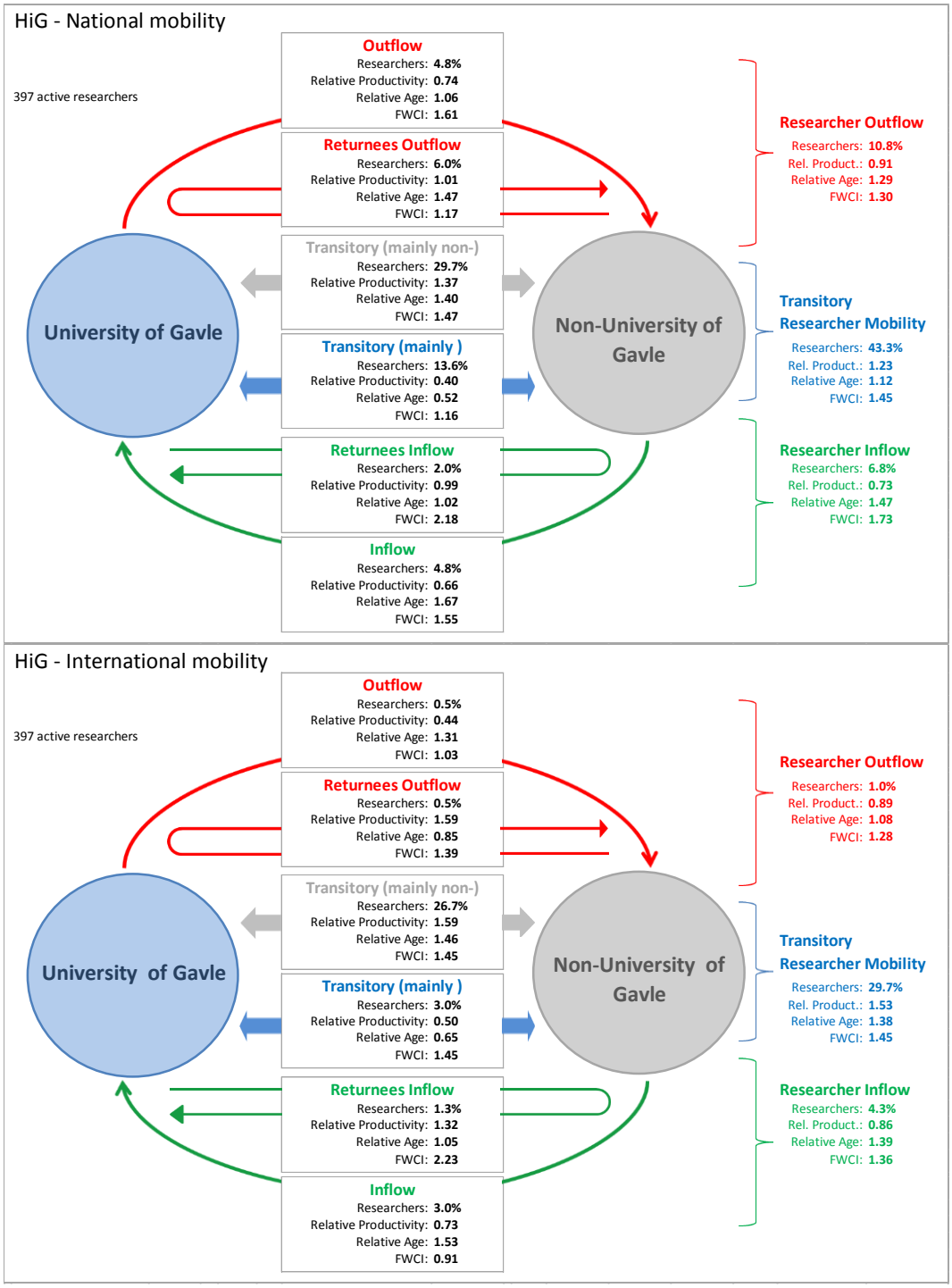

Figure 3.26— *National and international researcher mobility of University of Gavle, 1996-2015. Source: Scopus*

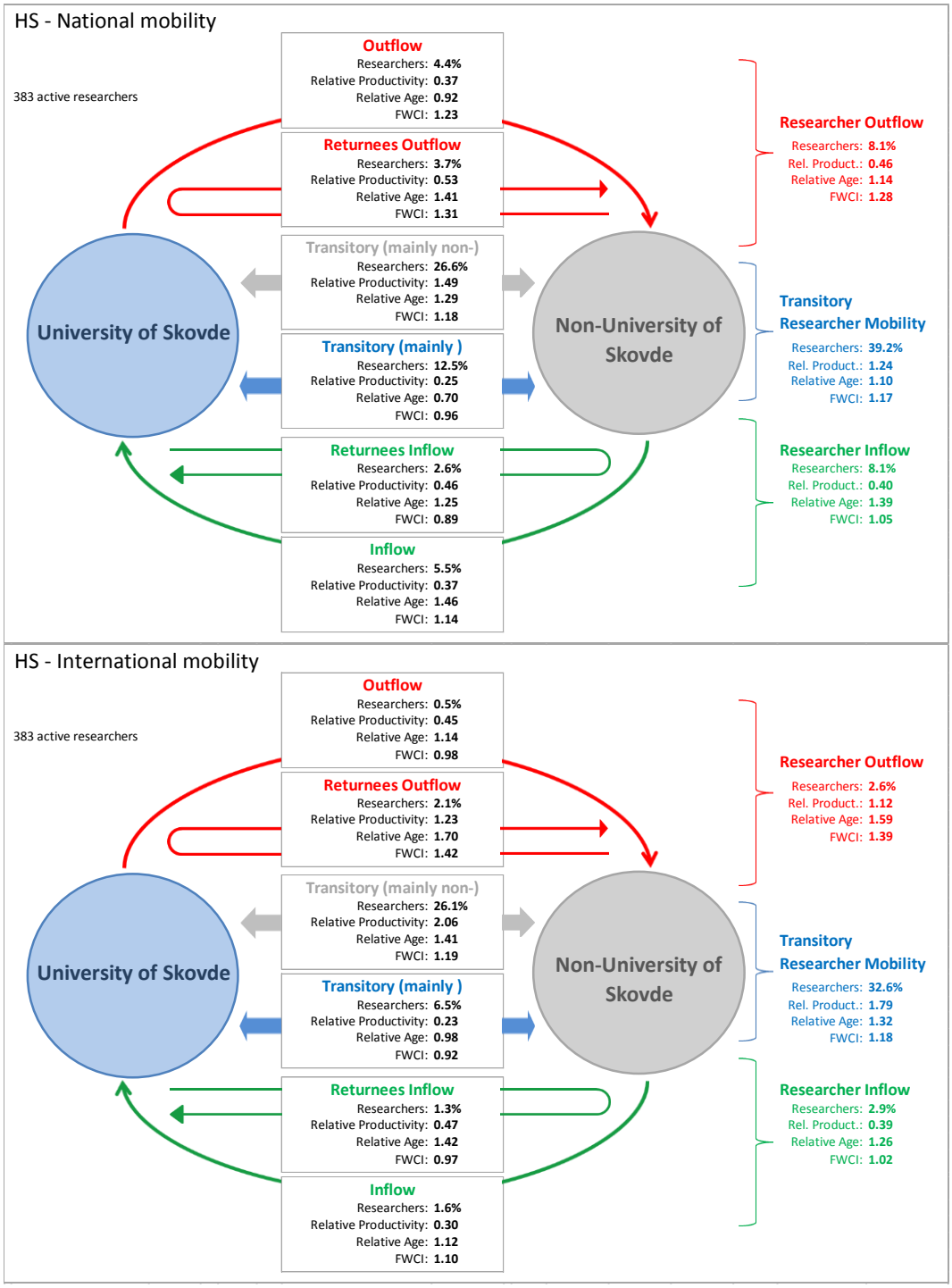

Figure 3.27 — *National and international researcher mobility of University of Skovde, 1996-2015. Source: Scopus*

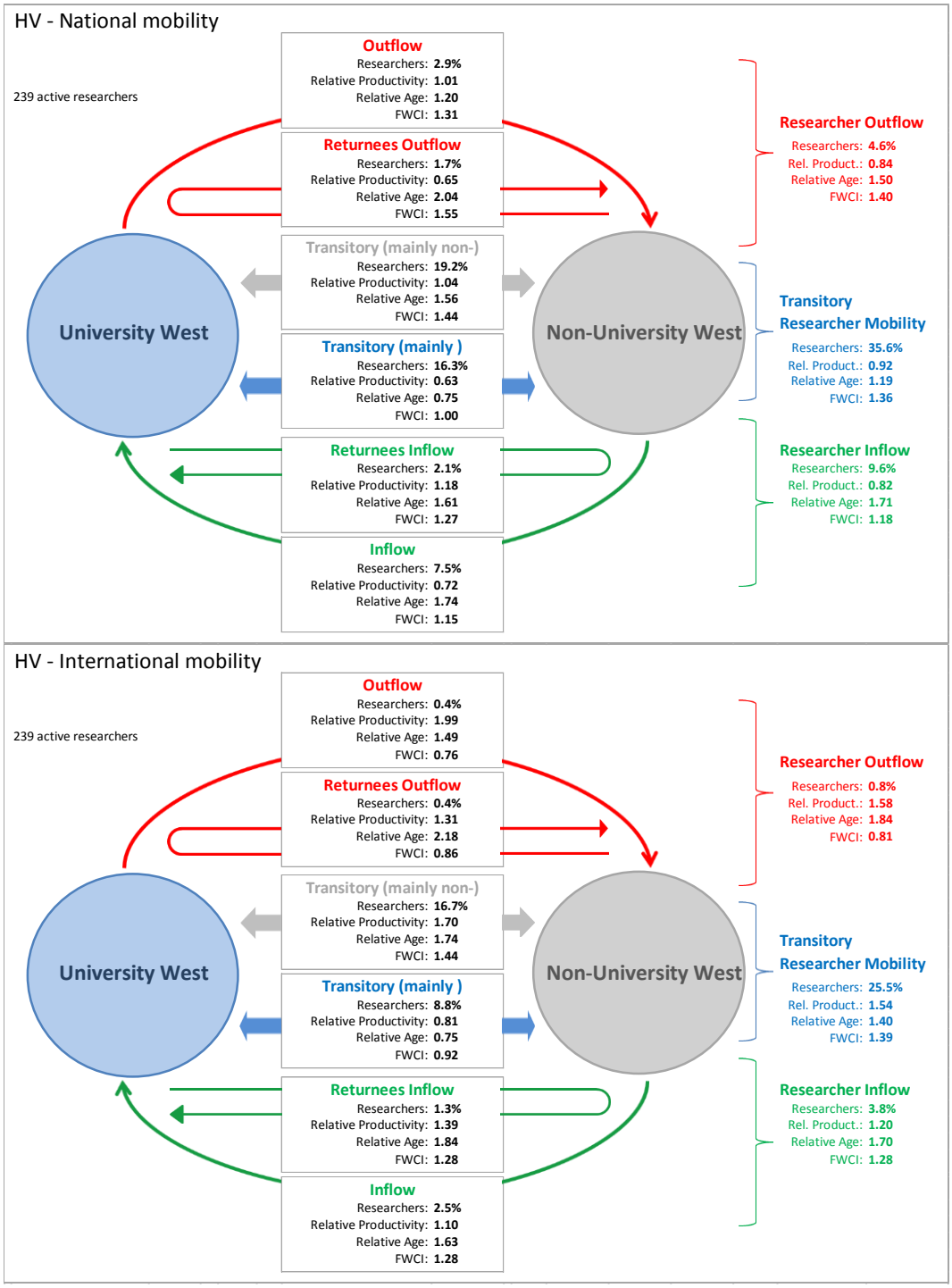

Figure 3.28— *National and international researcher mobility of University West, 1996-2015. Source: Scopus*

Appendix A
Methodology and data sources

Methodology and rationale

Our methodology is based on the theoretical principles and best practices developed in the field of quantitative science and technology studies, particularly in science and technology indicators research. The Handbook of Quantitative Science and Technology Research: The Use of Publication and Patent Statistics in Studies of S&T Systems (Moed, Glänzel and Schmoch, 2004)[4] gives a good overview of this field and is based on the pioneering work of Derek de Solla Price (1978),[5] Eugene Garfield (1979)[6] and Francis Narin (1976)[7] in the USA, and Christopher Freeman, Ben Martin and John Irvine in the UK (1981, 1987)[8], and in several European institutions including the Centre for Science and Technology Studies at Leiden University, the Netherlands, and the Library of the Academy of Sciences in Budapest, Hungary.

The analyses of bibliometric data in this report are based on recognized advanced indicators (e.g., the concept of relative citation impact rates). Our base assumption is that such indicators are useful and valid, though imperfect and partial measures, in the sense that their numerical values are determined by research performance and related concepts, but also by other, influencing factors that may cause systematic biases. In the past decade, the field of indicators research has developed a best practices which state how indicator results should be interpreted and which influencing factors should be taken into account. Our methodology builds on these practices.

Year range

All analyses in this report are based on data that range from 1996 to 2015. To measure trends in publication output over time, it is customary to group publications (and other indicators based on publication outputs, such as citations or co-authorships) based on the calendar year in which they were published.

Article types

For all bibliometric analysis, only the following document types are considered:

- Article (ar)
- Review (re)
- Conference Proceeding (cp)

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[4] Moed, H. F., Glänzel, W., & Schmoch, U. (Eds.). (2005). Handbook of Quantitative Science and Technology Research. Dordrecht: Kluwer Academic Publishers. doi:10.1007/1-4020-2755-9

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[8] Irvine, J., Martin, B. R., Abraham, J., & Peacock, T. (1987). Assessing basic research: Reappraisal and update of an evaluation of four radio astronomy observatories. Research Policy, 16(2-4), 213–227. doi:10.1016/0048-7333(87)90031-X

In bibliometric studies, these article types are generally considered to be article types with scholarly content that has been peer-reviewed. That is, such article types have been scrutinized by experts in the same field and were determined by said experts to be suitable for publication. In contrast, our analyses exclude document types such as letters, notes, editorials, etc. that are also published in journals and other serials titles, but are not necessarily peer-reviewed.

Field-weighted citation impact (FWCI)

Field-weighted citation impact (FWCI) indicates how the number of citations received by an entity's publications compares with the average number of citations received by all other similar publications in the data universe: how do the citations received by this entity's publications compare with the world average? A field-weighted citation impact of 1.00 indicates that the entity's publications have been cited exactly as would be expected based on the global average for similar publications; the FWCI of "World", or the entire Scopus database, is 1.00. A FWCI of more than 1.00 indicates that the entity's publications have been cited more than would be expected based on the global average for similar publications; for example, 2.11 means 111% more cited than world average. A FWCI of less than 1.00 indicates that the entity's publications have been cited less than would be expected based on the global average for similar publications; for example, 0.87 means 13% less cited than world average.

The Field-Weighted Citation Impact (FWCI) for a set of N publications is defined as:

$$FWCI = \frac{1}{N}\sum_{i=1}^{N}\frac{c_i}{e_i}$$

c_i = citations received by publication i
e_i = expected number of citations received by all similar publications in the publication year plus up to following 5 years.

Data Sources

Scopus is Elsevier's abstract and citation database of peer-reviewed literature, covering 62 million documents published in over 22,500 journals, book series and conference proceedings by some 6,000 publishers. Reference lists are captured for nearly 39 million records published from 1996 onwards, and the additional 23.3 million pre-1996 records reach as far back as the publication year 1823.

Scopus coverage is multi-lingual and global: approximately 15% of titles in Scopus are published in languages other than English (or published in both English and another language). In addition, more than half of Scopus content originates from outside North America, representing many countries in Europe, Latin America, Africa and the Asia Pacific region. The database contains titles from more than 120 different countries and over 50 languages in all geographic regions. Scopus covers approximately 18,000 titles from Europe, 10,500 from North-America, 3,600 from Asia-Pacific, 900 from Central and South America, and 1,050 titles from the Middle East and Africa.

Scopus coverage is also inclusive across all major research fields, with 11,700 titles in the Physical Sciences, 12,900 in the Health Sciences, 6,300 in the Life Sciences, and 9,800 in the Social Sciences (the latter including some 3,200 Arts & Humanities related titles). Titles which are covered are predominantly serial publications (journals, trade journals, book series and conference material), but considerable numbers of conference papers are also covered from stand-alone proceedings volumes (a major dissemination mechanism, particularly in the computer sciences). Acknowledging that a great deal of important literature in all fields (but especially in the Social Sciences and Arts & Humanities) is published in books, Scopus has begun to increase book coverage in 2013, and currently covers more than 121,000 books.

More information can be found on www.elsevier.com/online-tools/scopus.

Appendix B
Defining authors and mobility

Defining Swedish Higher Education Institutions

The Swedish Foundation for International Cooperation in Research and Higher Education (STINT) requested that Elsevier analyse the following 28 Swedish Higher Education Institutions (HEIs). Among these, ten have been selected to be included in the report's narrative, based on the size of their publication output. For all others, mobility charts have been created.

Name	Acronym	Publication output (2011-2015)	Field-weighted citation impact (2011-2015, source: SciVal)	Mobility analysis chart	Mobility analysis narrative
Blekinge Institute of Technology	BTH	1,008	1.41	yes	
Chalmers University of Technology	CTH	10,922	1.54	yes	yes
Dalarna University	HDa	577	1.48	yes	
Goteborg University	GU	15,295	1.91	yes	yes
Halmstad University	HH	679	1.24	yes	
Jonkoping University	JU	1,194	1.34	yes	
Karlstad University	KaU	1,207	1.35	yes	
Karolinska Institutet	KI	25,267	2.09	yes	yes
Kristianstad University	HKr	383	1.13	yes	
Linkoping University	LiU	11,228	1.76	yes	yes
Linnaeus University	LNU	1,921	1.26	yes	
Lulea University of Technology	LTU	3,582	1.32	yes	
Lund University	LU	24,026	1.84	yes	yes
Malardalen University	MdH	1,379	1.15	yes	
Malmo University	MaH	1,382	1.33	yes	
Mid Sweden University	MiU	1,533	1.27	yes	
Orebro University	OU	2,894	1.83	yes	
Royal Institute of Technology	KTH	16,990	1.62	yes	yes
Sodertorn University	SH	424	1.13	yes	
Stockholm School of Economics	HHS	515	2.18	yes	
Stockholm University	SU	12,391	1.90	yes	yes
Swedish University of Agricultural Sciences	SLU	7,268	1.62	yes	yes
Umea University	UmU	9,359	1.73	yes	yes
University College of Boras	HB	731	1.20	yes	
University of Gavle	HiG	699	1.38	yes	
University of Skovde	HS	687	1.21	yes	
University West	HV	428	1.02	yes	
Uppsala University	UU	22,380	1.86	yes	yes

Table B.5 — *Swedish Higher Education Institutions (HEIs) included in this report*

Assigning Articles

Author Profiles in Scopus

Scopus is the only database in the world which has invested in automatically grouping the publications it indexes into those published by a single affiliation. We have algorithmically created over 27 million author profiles, representing 8 million researchers, and these profiles can be manually updated and corrected.

These author profiles are not necessarily tied to the institution with which an author is affiliated for a given publication but rather span their entire career. In fact, using the raw publication data, it is possible to derive a chronological listing of all the institutional affiliations that an author has published with, so it is possible to track the "research history" of an author.

Groups of publications belonging to one author are called Author Profiles, and they have two modes of input:

1. Publications are automatically grouped into Author Profiles using a multifactorial matching algorithm:
    - This algorithm looks for similarities on metadata such as author surname, first name and initials; e-mail address; affiliation; co-authors; subject area the author is active in; source title, publications date range , and keywords entered by the author to match publications together. Users may notice that multiple name variants are grouped within one Author Profile, which indicates the value of this algorithm. Scopus makes use of an authoritative database that contains over 70,000 manually verified institutional name variants to match publications together.
    - The information provided by authors is not always consistent or complete, so that there is always some doubt about whether some publications belong together; in situations like these, a balance needs to be made between the precision, or accuracy, of matching, and the recall, or completeness of the groups formed, and increasing one will reduce the other
    - Scopus's strategy in terms of automatic disambiguation of authors and institutions is geared towards higher precision (accuracy) over recall. This means that if an author who published in his career 100 publications, Scopus aims at assigning as many publications as possible to this author ensuring highest precision. In this example, a scenario of 90 publications grouped into one single profile – where by the accuracy of this assignment is 99% - and 10 other publications spread over 10 profiles thus: 90, 1,1,1,1,1,1,1,1,1 is preferred over a scenario where we have 99 in one profile (with an accuracy of 95%) and 1 in another thus: 99,1.

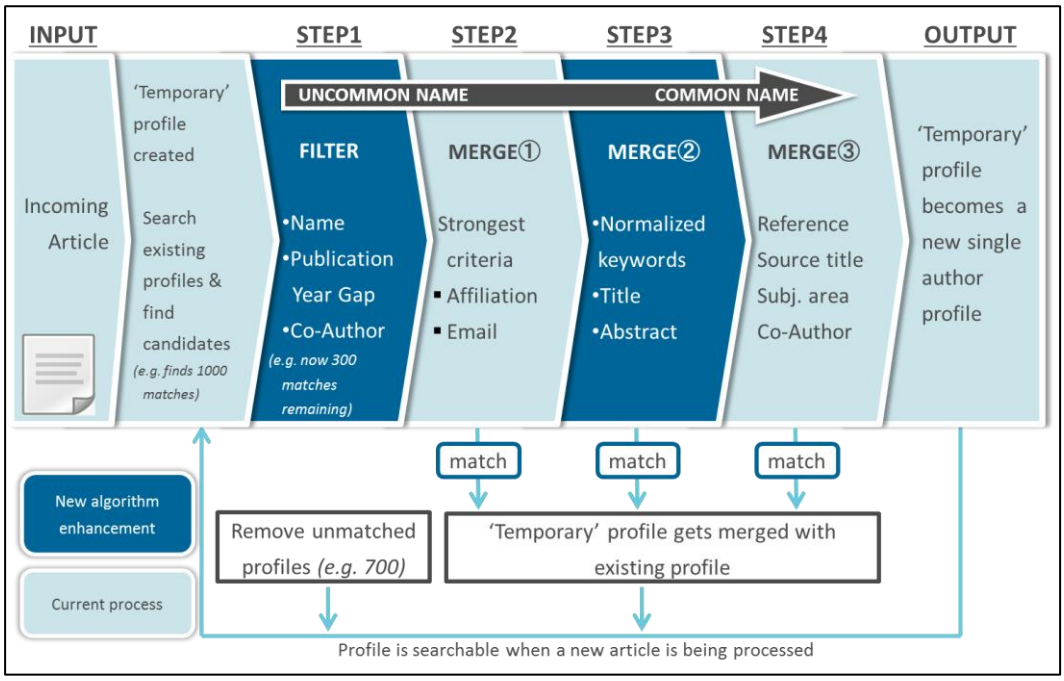

Figure B.29— *Process of Clustering Articles into Profiles*

2. Publications are manually reassigned based on feedback.
    - The matching algorithm can never be 100% correct because the data it is using to make the assignments are not 100% complete or consistent. The algorithm is therefore supplemented by feedback received from official authorities of the affiliation in question. These feedback channels include but are not limited to: researchers who link their ORCID iD to their Scopus profile, researchers and librarians who manually provide feedback to Scopus through the author feedback wizard (either on their own or through a national research assessment exercise, such as REF 2014), and quality-assured publication data from implementations of the Pure Experts Portal.

Affiliations, Institutions, and Countries in Scopus

Publications are automatically grouped into institutional affiliation profiles using a matching algorithm based on the metadata provided by the affiliation details provided by an author on a given record. Actual institutions often comprise multiple institutional affiliation profiles – for example, a medical school will have a separate institutional affiliation profile than the main university. For attributing authorship and citation credit, aggregation of numbers of publications and citations can be done at the level of one or multiple affiliation IDs.

Each affiliation profile has an associated name (institution name) and geographic location (city, state/province, and country). For this project, all publications associated with affiliation profiles in a given country were analysed.

Measuring International Researcher Mobility

The approach presented here uses Scopus author profile data to derive a history of active [HEI x] author affiliations recorded in their published articles and to assign them to mobility classes defined by the type and duration of observed moves.

How are individual researchers unambiguously identified in Scopus?

Scopus uses a sophisticated author-matching algorithm to precisely identify articles by the same author. The Scopus Author Identifier gives each author a unique ID and groups together all the documents published by that author, matching alternate spellings and variations of the author's last name and

distinguishing between authors with the same surname by differentiating on data elements associated with the article (such as affiliation, subject area, co-authors, and so on).

What does a '[HEI x] researcher' mean?
To define the initial population for this study, [HEI x] authors were identified as those that had listed [HEI x] as their affiliation on at least one publication (articles, reviews and conference papers) published across the sources included in Scopus during the period 1996-2015. It is important to note that thusly defined '[HEI x] authors' are not necessarily currently in the employment of [HEI x]. Authors of other institutions are defined similarly.

What is an 'active researcher'?
The [HEI x] authors identified includes a large proportion with relatively few articles over the entire 19-year period of analysis. As such, it is assumed that they are not likely to represent career researchers, but individuals who have left the research system. A productivity filter was therefore implemented to restrict the analysis to those authors that produced on average 1 publication every 3 years between their first publication and the end of 2015, and produced at least 1 publication in the last 5 years.

How are mobility classes defined?
The measurement of researcher mobility by co-authorship in the published literature is complicated by the difficulties involved in teasing out long-term mobility from short-term mobility (such as doctoral research visits, sabbaticals, secondments, etc.), which might be deemed instead to reflect a form of collaboration. In this study, stays of 2 years or more were considered migratory and were further subdivided into those where the researcher remained at their current institution or where they subsequently returned to their original institution. Stays of less than 2 years were deemed transitory, and were also further subdivided into those who mostly published with [HEI x] or mostly with other institutions. Authors are assumed to be from the institution where they first published (for migratory mobility) or from the institution where they published the majority of their articles (for transitory mobility). In individual cases, these criteria may result in authors being assigned migratory patterns that may not accurately reflect the real situation, but such errors may be assumed to be evenly distributed across the groups and so the overall pattern remains valid. Researchers without any apparent mobility based on their published affiliations were considered sedentary.

<u>Migratory</u>
► Outflow: active [HEI x] researchers whose Scopus author data for the period 1996-2015 indicates that they have moved from [HEI x] to another institution (or institutions) for at least 2 years without returning.
► Returnees Outflow: active [HEI x] researchers whose Scopus author profile data for the period 1996-2015 indicates that they have moved to [HEI x] from another institution (or institutions) for at least 2 years, and then subsequently migrated to another institution for at least 2 years.
► Total Outflow: the sum of Outflow and Returnee Outflow groups.

► Inflow: active [HEI x] researchers whose Scopus author data for the period 1996-2015 indicates that they have moved to [HEI x] from another institution for at least 2 years without leaving [HEI x].
► Returnees Inflow: active [HEI x] researchers whose Scopus author data for the period 1996-2015 indicates that they have moved from [HEI x] to another institution for at least 2 years, and then subsequently moved back to [HEI x] for at least 2 years.
► Total Inflow: the sum of Inflow and Returnee Inflow groups.

<u>Transitory</u>
► Transitory (mainly non-[HEI x]): active [HEI x] researchers whose Scopus author data for the period 1996-2015 indicates that they are affiliated with [HEI x] for less than 2 years at a time but are predominantly affiliated with another institution (or institutions).
► Transitory (mainly [HEI x]): active [HEI x] researchers whose Scopus author data for the period 1996-2015 indicates that they are affiliated with another institution (or institutions) for less than 2 years at a time but are predominantly affiliated with [HEI x].

► Total Transitory: the sum of Transitory (mainly non-[HEI x]) and Transitory (mainly [HEI x]) groups.

Sedentary

► Sedentary: active [HEI x] researchers whose Scopus author data for the period 1996-2015 indicates that they have not published outside [HEI x].

What indicators are used to characterise each mobility group?

To better understand the composition of each group defined on the map, three aggregate indicators were calculated for each to represent the productivity and seniority of the researchers they contain, and the field-weighted citation impact of their articles. Relative Productivity represents a measure of the articles per year since the first appearance of each researcher as an author during the period 1996–2015, relative to all [HEI x] researchers in the same period. Relative Seniority represents years since the first appearance of each researcher as an author during the period 1996–2015, relative to all [HEI x] researchers in the same period. Field-weighted citation impact is calculated for all articles in each mobility class. All three indicators are calculated for each author's entire output in the period (i.e., not just those articles listing a [HEI x] address for that author).

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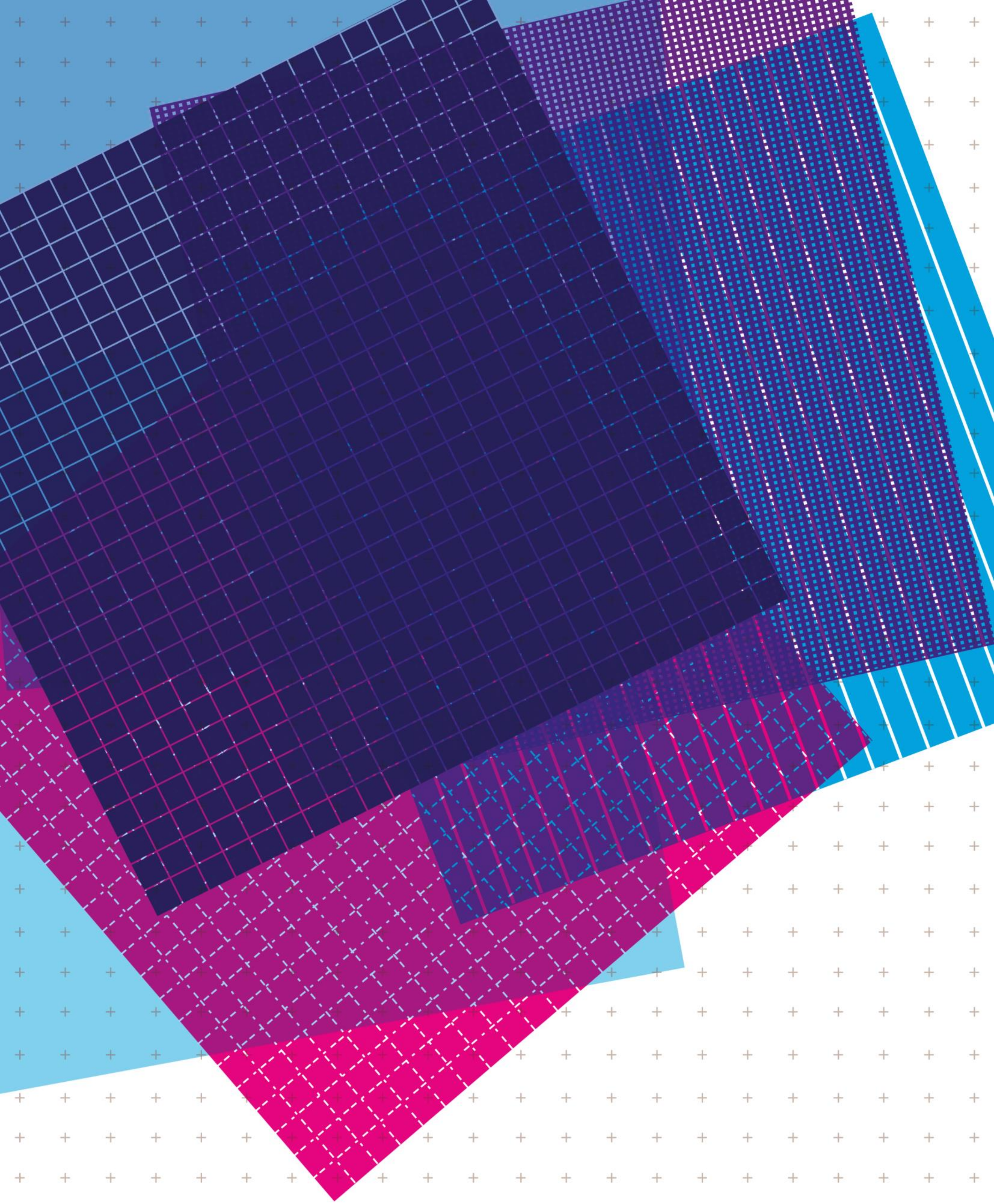

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