RISIS

RESEARCH INFRASTRUCTURE FOR SCIENCE AND INNOVATION POLICY STUDIES

8th RISIS Research Seminar

Title: The labor-market placement of trained PhDs outside academia: measurement and analysis

Presenters: Eric J. Iversen & Marco Capasso

Nordic Institute for Studies in Innovation, Research and Education, Oslo (Norway)

Discussant: Carter Bloch, University of Aarhus, Denmark

Seminar Outline

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1. Introduction
   - Context & Questions
   - Concepts & Measurement
2. Implement a ‘CDH’ based approach on register data
   - Different implementations
   - Strengths & challenges
   - How to address challenges
3. Demonstrate a ‘CDH-Plus’ lens on PhD production & Labor-market placement
   - stocks
   - flows
4. Conclusions

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Context & Questions

Basic motivation

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Trend: ‘non-academic PhDs had outpaced tenure-track academics in the US in 1989 and were outpacing all academics by the mid-1990s’ (Stephan, 2002)
Benefit: "... the export of scientists and engineers from the academy into industrial research is **potentially the most important and salutary among the mechanisms available for effecting knowledge transfers** that bring economically valuable 'spillovers' to the commercial R&D sector, and for creating informational networks that help impart industrial relevant direction to academic researchers and teachers" (Dasgupta & David, 1994: 511. Emphasis added)

But there is also a cost:

A ballpark, back-of-envelope estimate suggests:

- Norwegian HEIs graduated more doctorates in 2019 (1583) than ever before, increasing about 30 percent on a decade earlier.
- The increase corresponds to an estimated additional 1550 ‘R&D years’ which is largely supported by public spending.
- If 20 percent of the 2019 cohort end up outside of the higher-education and/or public research sectors, the public sector would in effect end up exporting its investment of about 1000 ‘R&D years’ to other sectors—or a **conservative lower-bound of 1 billion NOK**.
- But is it a good investment? And what does society expect in terms of a return?

Basic questions

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- Generic questions
  - How many PhDs wind up outside the academia?
  - Is there over-production?
  - In what ways has (is) this share changed (changing)?
- what does this mean for
  - the phd candidate
  - the economy at large and
  - the science system?
- How do we (best) measure this two-headed creature?

Our starting point

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1. RISIS1: **conceptual framework for studying science research careers** (viz Cañibano et al, 2018)
   - Heterogenous situations (production and placement) in Europe
   - Changing dynamics of 'the research career' in general (e.g. mixed-, and hybrid)
   - Increasing need to situate empirical analysis in terms of an informed conceptualization of science research careers
2. RISIS2 work on **Doctoral Degree & Career dataset**
   - Greater emphasis on the share of PhDs who end up outside of HES for part of all their careers
   - Take stock of current lenses, primarily OECD's Careers of Doctorate Holders (CDH)
   - Develop a DDC to complement these efforts using the Dissertation (thesis) as cornerstone (viz 44 slides for Risis Week).
3. Some immediate background
   - NIFU (2021) Risis Working Paper: W10-5.2 CDH-Plus: building empirical lenses with official statistics (forthcoming)*
   - Iversen, Eric, Zach Andreadakis, & Marco Capasso (2021) Labor-market placement of doctorate degree holders in Norway (forthcoming)
     - Source data: Statistics Norway under license

Our questions

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Today's seminar is prompted by the OECD work: what would a successful CDH look like in this context?

1. Could data that are already being collected by the national agencies of ERA countries provide reliable information about the (non-academic) labor-market placement of trained PhDs?

2. What would be needed to do so?

3. What would be possible if this could be done?

Our approach

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1. *Design and implement a "CDH-Plus" dataset (Source Statistics Norway)*
   - *build out the approach taken by CDH-Light (2017) with supplemental national data*
2. *Compare the measurement of PhD production from "CDH-Plus" (e.g. gender, FoS) with the population frame.*
   - The Norwegian doctorate register (NIFU) or the DDC register (Dissertations).
3. *General analysis of the stock: Describe the cumulative 'deployment' of PhDs in the Norwegian economy in terms of FoS and labor placement by industry.*
4. *General analysis of the flow : Use the labor-flows from this exercise to infer skill-relatedness between economic sectors in Norway using the Fitjar and Timmermans (2019) following on Neffke and Henning (2013).*
5. *What patterns are revealed and what implications can be drawn?*

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Concepts & Measurement

Initial observations

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1. Persistent call for a good (reliable, comparative across time and country, safe (confidentiality), reproducible, and reasonable) metric
2. A bridgehead issue joining science and innovation policy with implications for
    - Supply-side: The role of universities in knowledge production/dissemination
    - Meso (labor-market) level: the changing careers of individual PhDs*
    - Demand-side: the role of human capital in the economy at large
3. An intersection of two-markets:
    - Education-market: PhD Production + (import & export)
    - Labor-market: HE/other sectors x (domestic/abroad)
        - Placement: 'freshly-minted' DH
        - Subsequent 'deployment': linear-careers, mixed-, hybrid-careers
4. An intersection of issues for three communities
    - Policy
    - Scientific
    - Statistics & Indicators
5. Heterogeneity
    - Country characteristics matter
        - National Education Systems
        - National Labor Markets
    - Field-of-Science (FoS) characteristics matter
    - Changing international mobility patterns

* "PhDs" is used as shorthand to denote Doctorate Holders

*Literature**

* Iversen, Andreadakis, Capasso (2021)

A **striking increase** (Ates and Brechelmacher 2013; Blank and Stigler 1957; Eurostat 2016, 2017; Germain-Alamartine 2020; Leru 2018; NIFU 2019; OECD 2015, OECD 2017; Thune and Gulbrandsen 2014).

EU area, from 102,000 graduates in 2005 to 130,000 in 2015. In the OECD countries there has been a comparable growth, from 192,000 new doctoral graduates in 2005 to 254,000 in 2014, cf. Leru 2018.

A problem of "**too many PhD graduates" ?** (Blank and Stigler 1957; Bok 2015; Cyranoski et al. 2011; Germain-Alamartine 2018; Germain-Alamartine 2020; Larson et al. 2014),

A question of sustainability and relevance of doctoral training (Auriol 2007, 2010; Auriol et al. 2012; Bao et al. 2018; Bloch et al. 2015; Cyranoski et al. 2011; Fritsch and Krabel 2012; National Science Board 2018; Roach and Sauermann 2017; Sauerman and Roach 2016).

A wide range of empirical research efforts (Andalib et al. 2018; Auriol 2007, 2010; Auriol et al. 2012; Bao et al. 2018; Boud and Tennant 2006; Etmanski et al. 2017; Germain-Alamartine 2020; Mathur et al. 2018; Nyquist 2002; National Science Board 2018; Sauerman and Roach 2012; Stephan 2002, 2006, 2012; Stephan et al. 2015; Zolas et al. 2015).

A concern about transparency, predictability, and fairness of academic recruitment and job market (Bok 2013; Caterine 2020);

rates of financial return from doctoral training (Gaeta et al. 2016; Mertens and Röbken 2013; Van der Steeg et al. 2014; Skovgaard Pedersen 2016);

into the waning attractiveness of the academic career (Germain-Alamartine 2020; Huisman et al. 2002; Sauerman and Roach 2016; Roach and Sauerman 2017);

general relevance of doctoral training (Kyvik and Olsen 2012; Thune et al. 2012).

a mismatch between education and job skills (Allen and Van der Velden 2001; Stenard and Sauermann 2016);

Some uncertainty of early career prospects and initial employment of doctoral graduates (Etmanski et al. 2017; Neumann and Tan 2011);

Academic careers are changing and so is the need for better lenses.

A question about the availability of reliable or comprehensive empirical data on non-academic careers (Kyvik and Olsen 2007; Leru 2018; CDH, 2006, 2009; 2017…

empirical studies into non- traditional or non-academic career trajectories of doctorate holders remain much less common (Canolle & Vinot, 2020; Germain-Alamartine 2020

Basic Premise

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The scientific community, the policy community, as well as the statistical community have traditionally tried to better understand the movement of trained PhDs in terms of three outcomes;

- Placement into the domestic labor-market: this is the traditional focus. See the mainly US literature already referred to on "retention rates of doctoral scientists and engineers", or on the ‘deployment’ or ‘export’ of ‘newly minted PhDs’ ,
- Mobility around the domestic labor-market: this is the most difficult sector of the population to follow: see the work on ‘mobility rates’ between sectors e.g. NSF survey (1989) as well other work stemming from Nelson & Phelps (1966),
- Entry into/Exit out of the domestic labor-market (see the brain-drain and brain-circulation literatures): this population should be better understood

A traditional labor-supply perspective

… And updated scientific research career typology

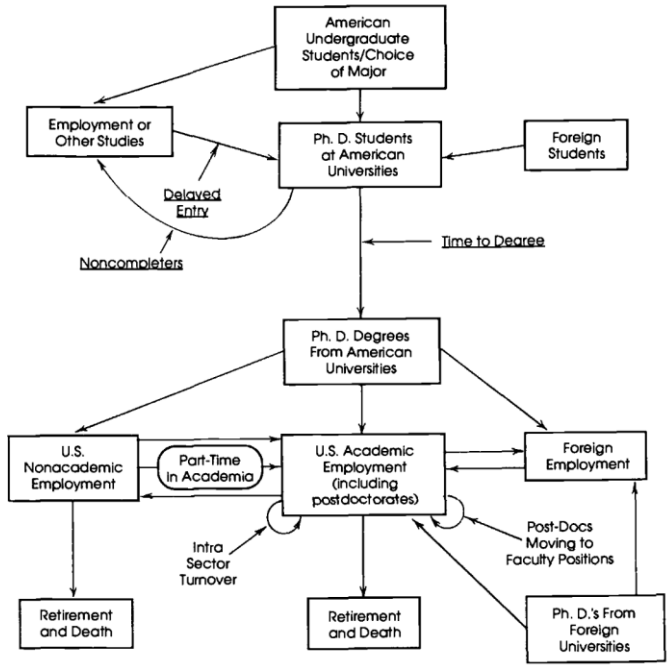

Figure 7.1 Academic labor supply.

Source: Ehrenberg, 1991

RPO type	Sector	Research career type		
Universities	Public or Private	Academic research careers	Mixed careers	Hybrid careers
Combined organizations (i.e. CRCs, ERCs)	Public and Private			
Firms	Private	Industrial R&D careers		
Government laboratories, institutes, organizations (including international organizations)	Public	Government research careers		
Hospitals	Public Private			
Non-profit organizations	Private			

Source: Cañibano et al, 2019

Conceptualizing ‘outcomes’

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Academic vs non-academic ‘outcomes’:

- A traditional academic career (‘retention’) as the PhD moves to faculty positions at home or abroad
- A non-academic career (‘export’) in another (private or government sector), again at home or abroad
- A career of ‘intra sector turnover’ (‘hybrid’ and/or ‘mixed’ career) which involves movement back and forth to the academic sector.

Domestic vs foreign outcomes:

- Foreign-trained PhD who enters labor-market from abroad, and embarks on one of the following
- A domestically trained PhD who moves out of the labor-market (into a foreign labor-market

Conceptualization closely tied to measurement

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- Longstanding and ongoing international work: “Career of Doctorate Holders (CDH)” based on a remarkable collaboration between the OECD, EUROSTAT and UNESCO and supplemented by European Science Foundation (ESF), EU’s Mobility Patterns and Career Paths (MORE) surveys, the RISIS infrastructure project…
- Longstanding national efforts: NSF, the Survey of Earned Doctorates (SED) in the US, Profile in Germany, KOTA in Finland, and Norway’s Doctoral Monitor.
- Emerging patterns
  - First, employment in research and development is growing (European Science Foundation 2017; Eurostat 2017; LERU 2018).
  - Second, the main employment of PhDs happens outside than inside academia (Eurostat 2017; European Science Foundation 2017).
  - Third, the doctorate delivers consistently better rates of employment (ESF 2017; OECD 2016) and better financial rates of return (Mertens and Röbken, 2013; Van der Steeg et al., 2014; Skovgaard Pedersen, 2016) in countries where data is available.
  - Finally, the employment patterns vary greatly from discipline to discipline (Auriol et al. 2013, European Science Foundation 2017) and women are underrepresented in research jobs (Eurostat 2017), while the boundary between research and non-research jobs has become much more permeable (LERU 2018).

Measuring outcomes

Data-sources & empirical strategies

- **Register-based metrics**
  - An adaptation of education and labor-market registers used in official statistics (CDH-Light)
- **Survey-based (or census-based) metrics**
  - An adaptation of existing instruments such as the labor-force study (LSF)
  - Dedicated instruments, such as SED, that target graduating PhD candidates in a given country.
  - Instruments that target researchers internationally
    - Mobility and Research Careers in Europe (MORE)
- **Combinations***
  - Document-centric metrics
    - Publication-based approaches (subsequent OECD work based on GlobSci)
    - Dissertation-based approach (DCC)
  - **Custom databases** combining elements from one or more of the above
    - Bloch et al, 2015. Researcher mobility and sector career choices among doctorate holders
    - Boateng & Nygård, 2019, Nesten alle i arbeid – store inntektsforskjeller
    - Norwegian PhD Monitor, (upcoming)

Measuring outcomes in Norway

Data-sources & empirical strategies

- **Register-based metrics**
  - The Norwegian doctorate register (NIFU)
  - The Norwegian research personnel register (NIFU)
  - **Official Norwegian statistics from Statistics Norway. Cross temporal: 2000-2019***
  - The Norwegian doctorate monitor (NIFU)
- **Survey-based (or census-based) metrics**
  - Labor-force Study (Statistics Norway, AKU)
  - Dedicated target graduating PhD candidates (NIFU, 2020)
- **Combinations**
  - **Custom databases** combining elements from one or more of the above
    - Boateng & Nygård, 2019, Nesten alle i arbeid – store inntektsforskjeller
    - Norwegian PhD Monitor*, under development Statistics Norway & NIFU

Norway provides a good testbed for to study these issues. Some recent work includes…

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NIFU / Projects / Examination of the doctoral candidates' labor market situation (21048)

Examination of the doctoral candidates' labor market situation (21048)

Those who have completed a doctorate in Norway enter into a wide range of jobs both inside and outside academia. Nevertheless, there is little knowledge about their situation in the labor market and how they assess education. The Ministry of Education and Research therefore wants a study related to recent graduates with a doctorate. The survey addresses labor market adjustment and how satisfied doctoral graduates are with their situation in the labor market. In addition, the report will contain an overview of new graduates' assessment of the quality of education and its relevance to the labor market.

PROJECT DETAILS

PROJECT NUMBER	2112135
PROJECT MANAGER	RUNE BORGAN REILING
EMPLOYEES	ALEKSANDER ÅRNES MADSEN, KJERSTI NESJE, SIV-ELISABETH SKJELBRED, MARTE ES ULVESTAD, BO SARPEBAKKEN, NICOLINE FRØLICH, TARAN THUNE
PROJECT PERIOD	01.04.2019 - 31.12.2020
FUNDING	MINISTRY

Report
2018:4

Academic career structures in Europe

Perspectives from Norway, Denmark, Sweden, Finland, the Netherlands, Austria and the UK

Nicoline Frølich, Kaja Wendt, Ingvild Reymert,
Silje Maria Tellmann, Mari Elken, Svein Kyvik, Agnete Vabø, Even Larsen

NIFU

Academic systems (careers) are not uniform

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*Source: Frølich et al, 2018:4

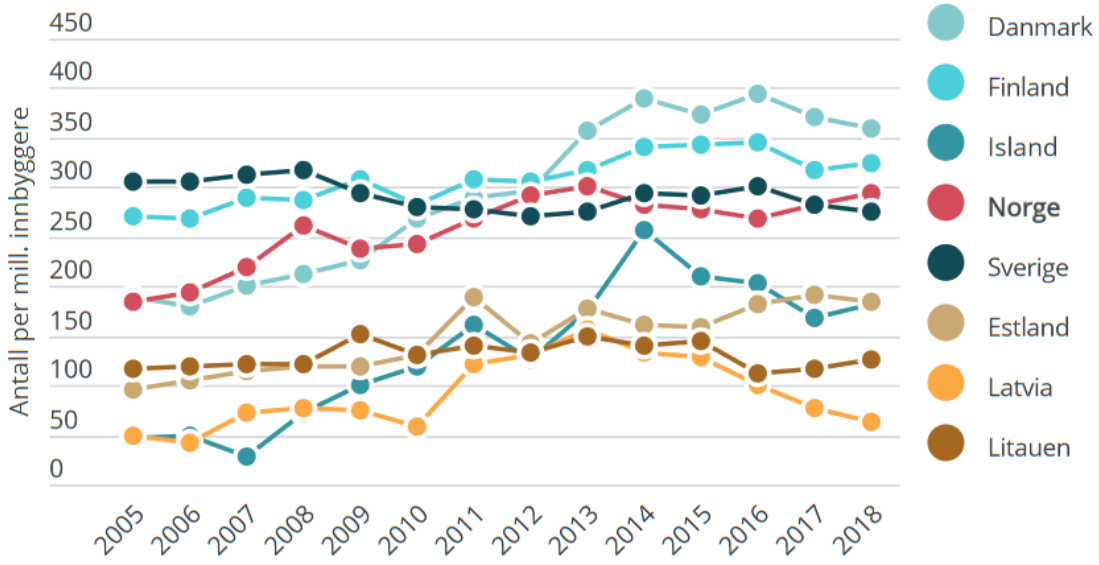
Table 20. Academic Career structure at Universities

	Austria	Denmark	Finland*	the Netherlands	Norway	Sweden	UK**
A	University professor	Professor	Professor	Professor	Professor	Professor	Full professor
A	University professor up to 5/6 years	Professor with special Responsibilities (*Professor med særlige opgaver*)	Senior lecturer (ed)		Docent (*Dosent*)		Reader
B	Associate professor (*Assoziierte/r Professor/in*)	Lektor (Associate professor)	Lecturers, senior assistants	Associate professors	Associate professor (*førsteamanuensis*)	Senior lecturers (*Lektor*)	
B	Assistant professor (*Assistenz-professor/in*)	Senior researchers/advisors		Assistant professors (university lecturers)	Dean, head of department	Other research/teaching staff with a doctorate	Principal/Senior Lecturer, Senior Research Fellow.
B	University docent (*Univ.Dozent*)			'Other scientific personnel' in permanent position. 'Docent'			Lecturer A
C	Senior Scientist/Artist	Assistant professors (*Adjunkt*)	Assistants, full-time teachers	'Other scientific personnel' on temporary contract' 'Docent' (teaching)	Postdoc	Career-development positions	Junior Research fellow
C	University assistant (*Universitätsassistent/in*)	Postdoc			Specialist positions (Physicians, dentists etc.)		Lecturer B
C	Physician in specialist training (*Ärztin/Arzt in Facharztausbildung*)	Researcher (*forsker*)			Senior researcher (with PhD)		Postdoc
C	Academic staff engaged in research, the arts and teaching (expiring category) (*Wiss./künstl. Mitarbeiter/in*)						
D	Academic staff engaged in research, the arts and teaching (expiring category) (*Wiss./künstl. Mitarbeiter/in*)	PhD	Researchers working on PhD (doctoral students)	PhD (employed by the university)	Lecturer (*universitets-lektor*); Assistant professor (*amanuensis*)	Third-cycle students	Research assistant
D	Lecturer (*Lehrbeauftragte/r*)	Research assistant (*forskningsassistent*)		Instructeur/tutor (teaching)	PhD	Lecturers (*Adjunkt*)	PhD candidate
D	(Senior) Lecturer (*Lektor/in*)				Researchers (without PhD)	Other research/teaching staff without a doctorate	
Source:	*Federal Ministry of Science, Research and Economy*	*Statistics Denmark*	*Statistics Finland (+Ministry of Education)*	*Rathenau (WOPI)*	*NIFU*	*Swedish Higher Education Authority (UKÄ)*	*HESA*

Red= expiring categories
** 4 step career model introduced.*
***These are traditional titles, some institutions are now using American titles.*

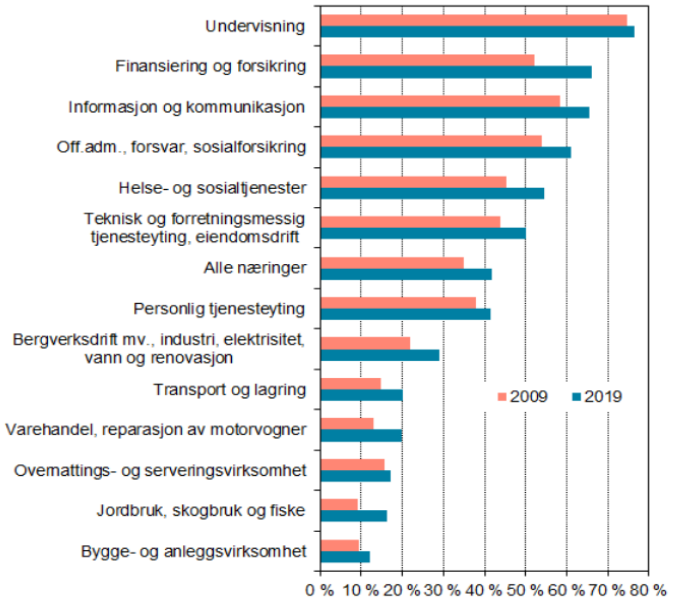
Table 3. Type of higher education system

Norway	Traditionally a binary system, however due to upgrading of university colleges to universities and recent mergers between universities and university colleges the distinction between universities and university colleges is changing.
Sweden	Binary system divided into universities and university colleges.
Denmark	A binary system with a clear division between research-intensive universities and vocational and teaching-oriented colleges.
Finland	Binary system with a clear distinction between universities and universities of applied sciences.
The Netherlands	A binary system with a distinction between research universities and universities of applied sciences.
Austria	A binary system with a distinction between research universities and universities of applied sciences.
UK	A unified but stratified university system since 1992, with a divide between pre- and post-1992 universities. International rankings and REF have heavily influenced the stratification of the system.



International comparison of PhDs per capita
Source: Nobal: presented in NIFU R&D statistics and Indicators 2020

Figur 3.5c Andel høyt utdannede sysselsatte etter næring.[1] 2009 og 2019.



[1] Hovednæringer i henhold til gjeldende Standard for næringsgruppering (SN2007). Sysselsatte i ukjente næringer er ikke tatt med i figuren, som utgjorde om lag 4 000 personer i 2019. Høyt utdannede sysselsatte omfatter sysselsatte med utdanning på universitets- eller høgskolenivå.

Kilde: SSB, Arbeidskraftundersøkelsen

All higher degrees in the economy
Source: SSB: presented in NIFU R&D statistics and Indicators 2020

And it involves a two-sided coin

(flipped in a dynamic, repeated experiment)

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“CDH Plus”

advantages, challenges, potentials of using official statistics

OECD's Career of Doctorate Holders

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- Need: A good (reliable, comparative across time and country, safe (confidentiality), reproducible, and reasonable) source of metrics
- Aim: Given the persistent interest and the challenges, CDH has sought to standardize data collection to improve consistency, and comparability across country and across time
- Data-source: not-yet standardized (CDH-Light, 2017)
- Tradeoffs:
  - data compatibility vs data-richness vs collection costs vs other (e.g. country-level data regulation)
- Costs: coordination (different interests, different rules) and collection costs
- Potential: not yet realized

CDH and the underlying UOE work

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- Different Strategies have relative strengths and weaknesses
- OECD's Careers of Doctorate Holders (CDH)
  - Longstanding effort (>15 years)
  - The current UOE work (based on its founders: the UN, OECD, Eurostat) is a remarkable collaboration which is developing and deploying tools
- Four different CDH approaches in 2017
- "survey-based (or census-based) approaches"
  - Dedicated survey (eg Netherlands)
  - Labor-Force Survey (LFS) (eg Germany)
  - Population Census
- Register data* (eg Norway)

Career of Doctorate Holders as of 2016 by fields-of-science (ISCED)

	Germany	Spain	Netherlands	Norway
Agriculture, forestry, fisheries and veterinary	28 080	-	1 736	1 670
Arts and humanities	63 504	37 200	3 203	5 764
Business administration and law	79 785	16 900	1 077	2 205
Education	26 972	-	533	1 001
Engineering	72 367	-	4 384	2 954
Health and welfare	296 184	44 700	13 565	7 711
ICT	13 808	-	1 067	97
Natural sciences	190 075	63 500	11 484	12 116
Services	2 347	-	-	367
Social sciences	47 283	15 900	7 616	3 082
Not known	6 619	-	-	175
Total	827 024	178 200	44 665	37 142

Note: Norway presents total number of persons (2016) by educational attainment. It includes all resident individuals aged 16 years and above.

Advantages of the ‘light’ register-based approach

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- Collecting data:
  - UOE routines for data collection provides common concepts, definitions, classifications
  - Readily implemented on data already collected by national statistical offices
  - Once implemented, it is relatively easy to update with subsequent years: this makes comparisons across time easier
- Collating data:
  - Existing links between employee-employer data become enriched
  - Data compatibility across countries and time
  - The microdata (education x laborforce) are easily linkable to other (demographic) data.
- Making use of the data
  - Light-weight: Education data (which degree, what field, when) x Employment /social security data
  - The microdata are easily pseudonymized and do not (need) to include sensitive informaton
  - Light-weight data that address prinicipal questions e.g. What happens to PhDs that don’t go into the HE Sector?

Challenges of a register-based approach

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- Data collection standards:

  - Difference in how (when) data is collected (for whom)

- Potential sources of measurement error:
  - Differences in coverage
  - Differences in time of measurement
  - Differences in the application of definitions, particularly in allocating a field-of-science, what is a foreigner
- Need to align with other data including a curated population-frame (eg. Doctorate Register)

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“CDH Plus”

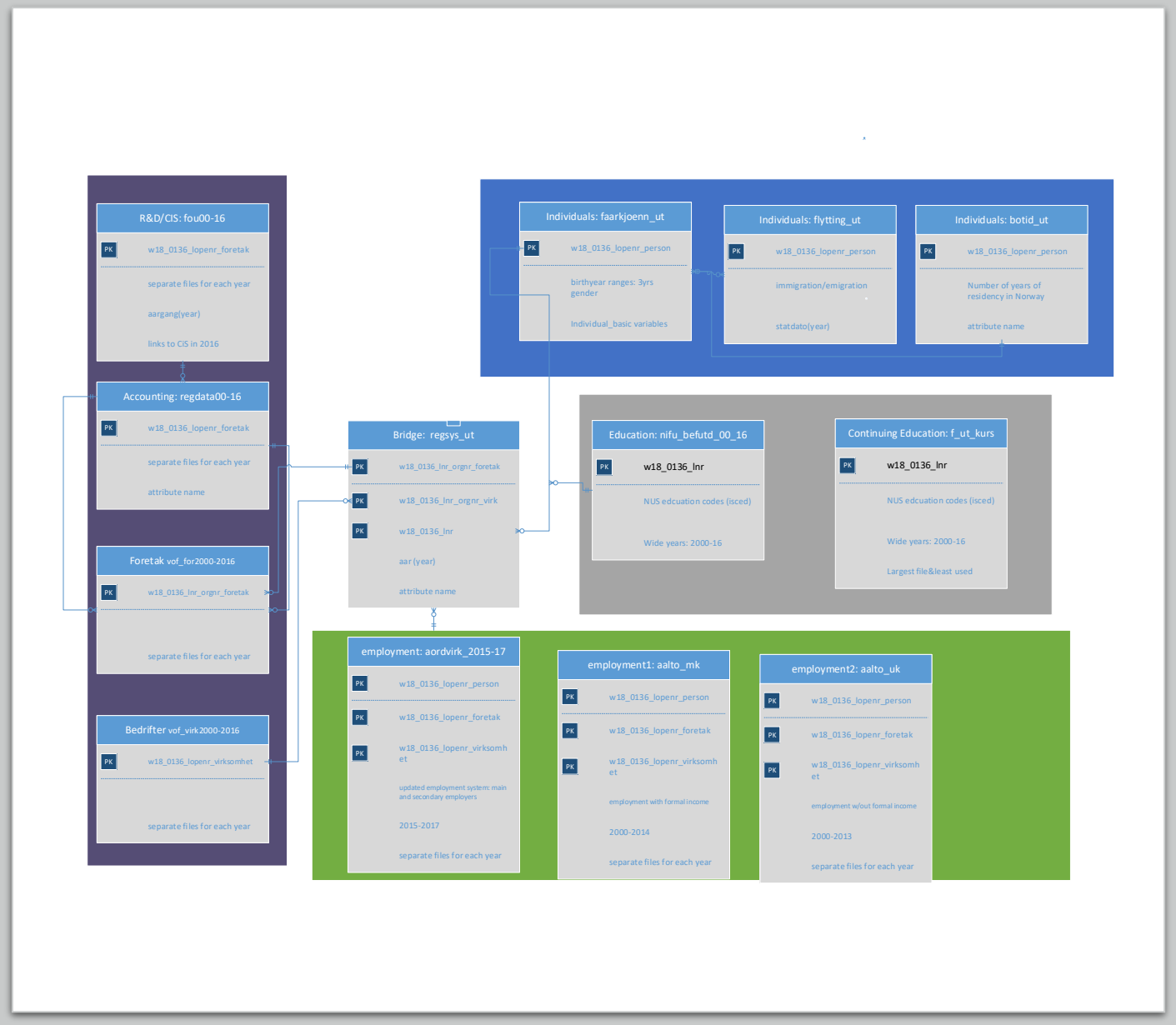
Demonstration of how to address challenges using official statistics

Data architecture

Source: Statistics Norway (DIAN contract)

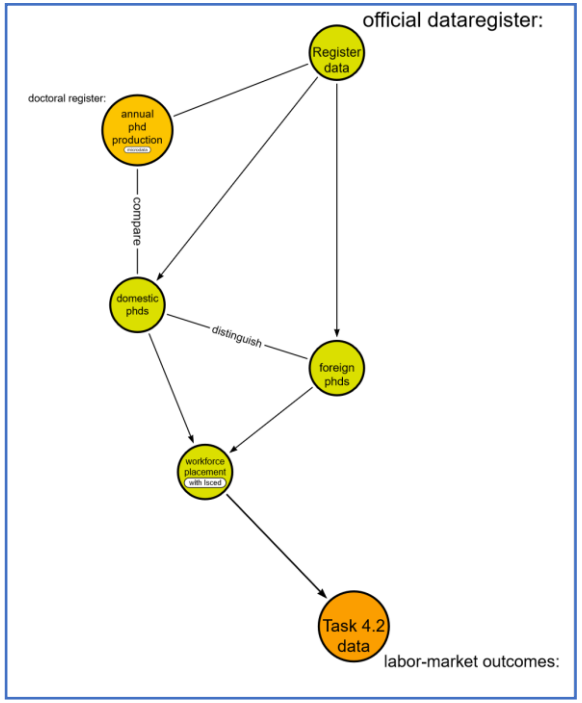
- Blue: Individual data
- Green: Employment data
- Grey: Education data
- Purple: Enterprise data

Time-span: 2000-2016



How to verify the intersection of T1 & T2

Dividing into 4 quadrants, we expect a high correspondence in the upper-left quadrant



		NORWEGIAN LABOR-MARKET	
Degree from		Inside (t2)	outside
Norwegian HEI (t1)	citizenship		
	Norway	xxxx	x
	Foreign	xxx	xx
Foreign HEI (T2)			
	Norway	x	xx
	Foreign	xxx	na

How to verify the intersection of T1 & T2

We distinguish:

1. Doctorate degree from Norway, employment in Norway (T1 ∩ T2)

- a. Norwegian nationals
- b. Foreign nationals

2. Doctorate degree from Norway, not in Norwegian labor-market (foreign, unemployed) (T1 only)

- a. Norwegian nationals
- b. Foreign nationals

3. Doctorate degree from abroad, employment in Norway (T2 only)

Step 0. Include Phds issued to 24-67 year-olds during the period 2001-2016.

Step 1. **Population 1:** Norwegian nationals

- Definition of this group is clear-cut in both databases. This forms the benchmark for comparison as we expect correspondence to be best for this population.
- There are potential discrepancies.
  - Norwegian-nationals awarded a PhDs domestically may subsequently move to a position abroad (or otherwise exit the Norwegian labor-market).
  - Norwegian-nationals awarded a PhDs abroad may subsequently enter the Norwegian labor-market.

Step 2. **Population 2**: Foreign nationals with Norwegian PhD (ie. assumes arrival in Norway before the award of the PhD degree)

- Definitions of foreigner potentially differ: Based on residency (“botid”) in Norway in T2.vs registered nationality (T1)
-

Step 3. **Population 3**: Foreign nationals (who arrived in Norway after PhD degree)

Key variables used to verify overlap between T1 and T2

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- **Gender**
- **Domestic versus foreign**:
  - T1. Based on registered nationality.
  - T2. Based on residency ("botid") in Norway
- **Year of Phd according to each database**
  - T1 Based in information from the awarding university
  - T2 Registration of awarded degree is either based on
    - information from T1, in cases in which the PhD was issued by a Norwegian HEI;
    - ***or on a certification process if the PhD was issued by a foreign HEI.*
- **(Approximate) age of candidate in year the PhD** was rewarded according to each database
  - T1. Based on registered date-of-birth at date of issued PhD (collected once a year?*)
  - T2. Birthdates are provided in three-year bands (e.g. 1981-1983) to avoid the identification of individuals. Date of issued PhD is tallied (collected twice a year?*)
- **Field-of-Science (FoS) of doctorate degree** according to each database.
  - T1. Curated list based on faculty and dissertation information
  - T2. FoS should be aligned in the cases in which labor-market participants received their degree from a Norwegian HEI (subpopulation 1 and 2, below).
  - The assignment of FoS is potentially different for another subpopulation: ie. the case in which a foreign national enters the Norwegian labor-market with a PhD from abroad.
    - ***In this case, the FoS is assigned during the certification process when the employee enters the Norwegian labor-market (see above)

Comparison between T1 and T2 using identificaiton procedure

Table 2.0. Population 1 and 2: Norwegian Doctoral Register ("T1"): Doctorate degrees awarded by Norwegian HEIs

yr_phd	count	of which, unallocated FoS	share (male)	share (foreigners)	median age at PhD
2001-2004	2916	0	.62	.18	35
2005-2008	4032	0	.58	.23	36
2009-2012	5104	0	.53	.31	35
2013-2016	5809	0	.51	.36	35
Total	17861	0	.55	.29	35

Table 2.1. Populations 1 and 2 in the Employee-Education Dataset («T2»): Doctorate degrees awarded by Norwegian HEIs to Populations 1 and 2

yr_phd	count	of which, unallocated FoS**	share (male)	share (foreigners)	median age at PhD
2001-2004	2980	215	.61	.23	35
2005-2008	4068	300	.56	.26	35
2009-2012	5145	472	.52	.32	35
2013-2016	5707	243	.49	.36	35
Total	17900	1230	.53	.3	35

Verification= positive

- Very close correspondence when estimating whether an employee in Norwegian labor-market holds a PhD from a Norwegian HEI
- The Field-of-Science indicator is not strong
- The size of Population 3 (import of doctoral-level accreditation) is large

yr_phd	T1	T2	mismatch
2001-2004	2 916	2 980	2,2 %
2005-2008	4 032	4 068	0,9 %
2009-2012	5 104	5 145	0,8 %
2013-2016	5 809	5 707	-1,8 %
Total	17 861	17 900	0,2 %

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“CDH Plus”

Demonstration of data-stocks

PhD Production

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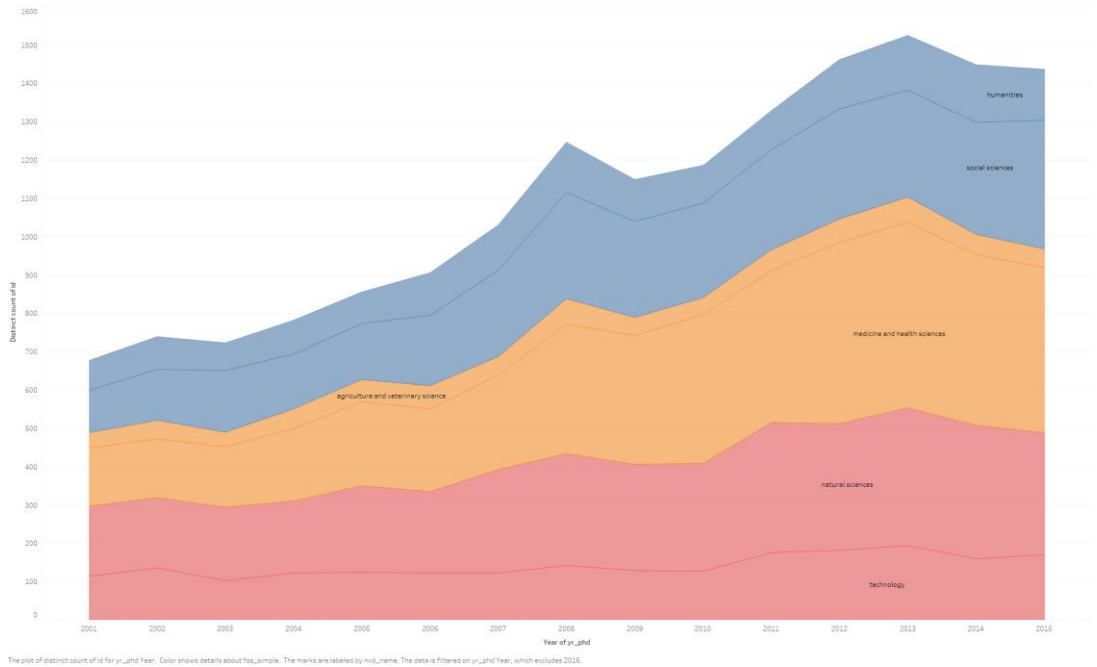
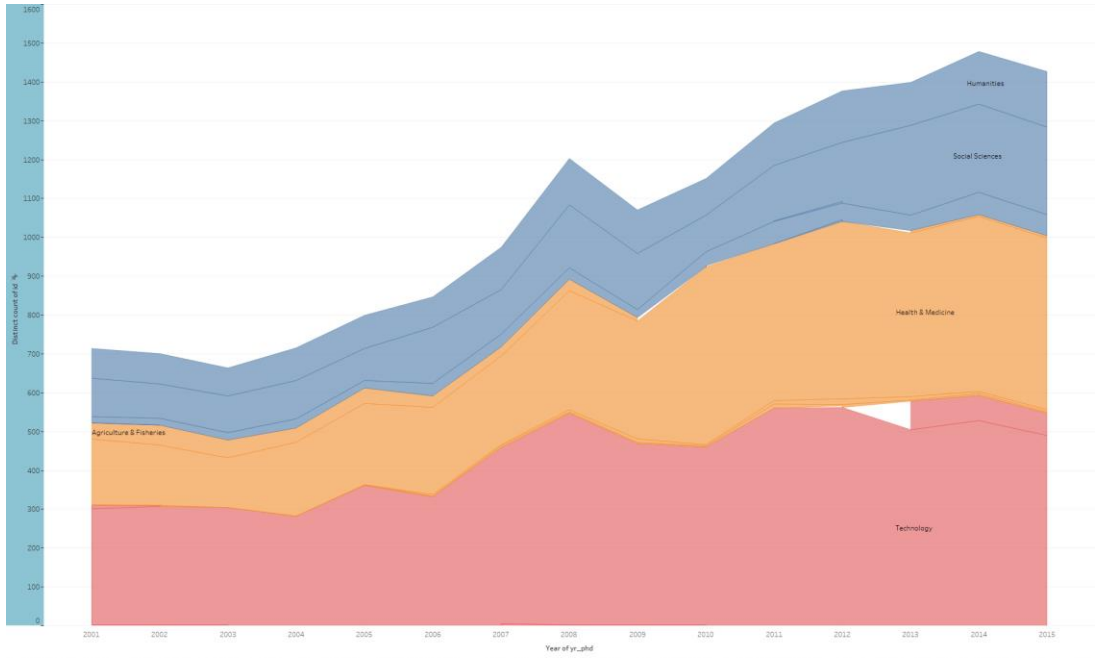
Population Frame: Doctorate Register



The plot of distinct count of id for yr_phd Year. Color shows details about fos_simple. The marks are labeled by nvd_name. The data is filtered on yr_phd Year, which excludes 2016.

CDH-Data

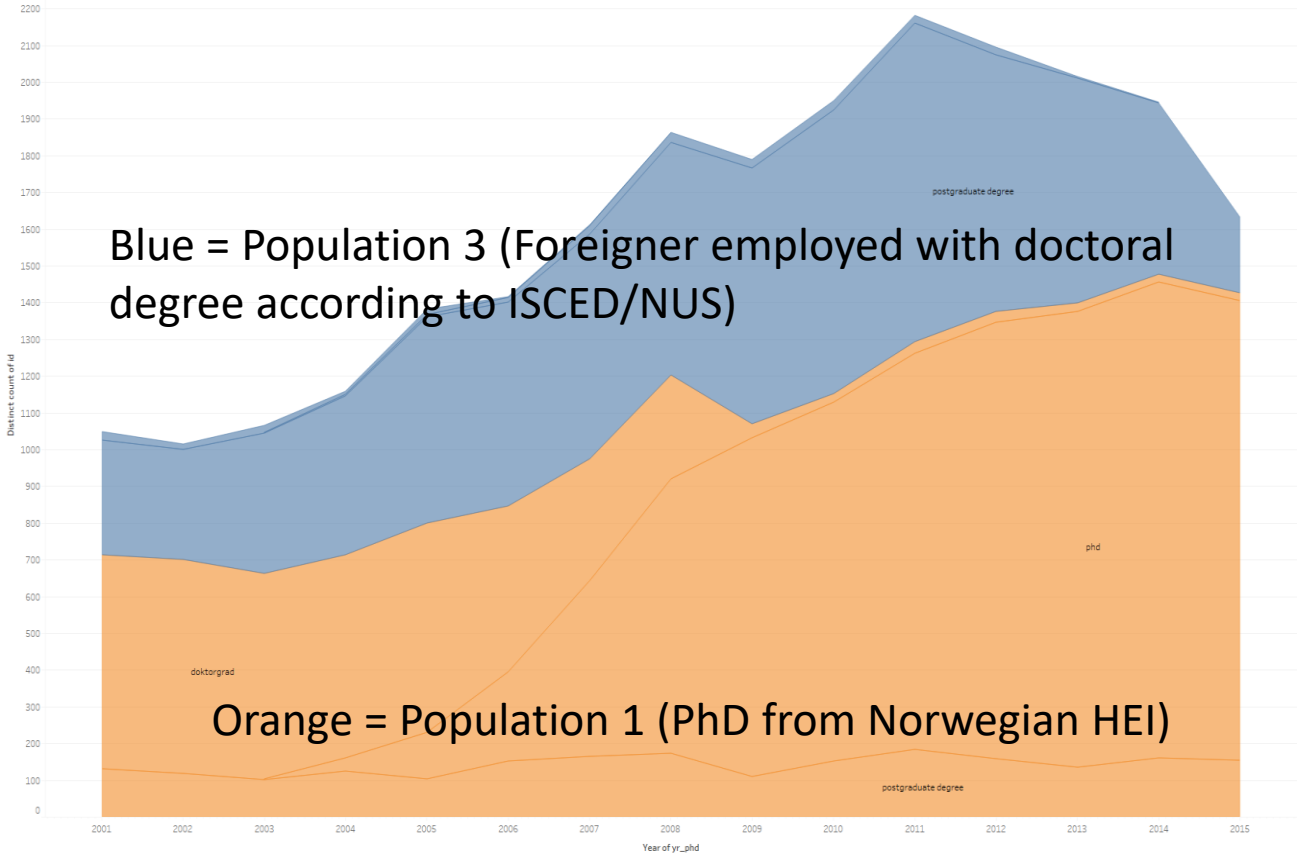


The plot of distinct count of id for yr_phd Year. Color shows details about fos_simple. The marks are labeled by nvd_dig. The data is filtered on yr_phd Year and dr_utland. The yr_phd Year filter excludes Null and 2016. The dr_utland filter keeps phd in norway?. The view is filtered on fos_simple and nvd_dig. The fos_simple filter excludes na. The nvd_dig filter keeps 7 members.

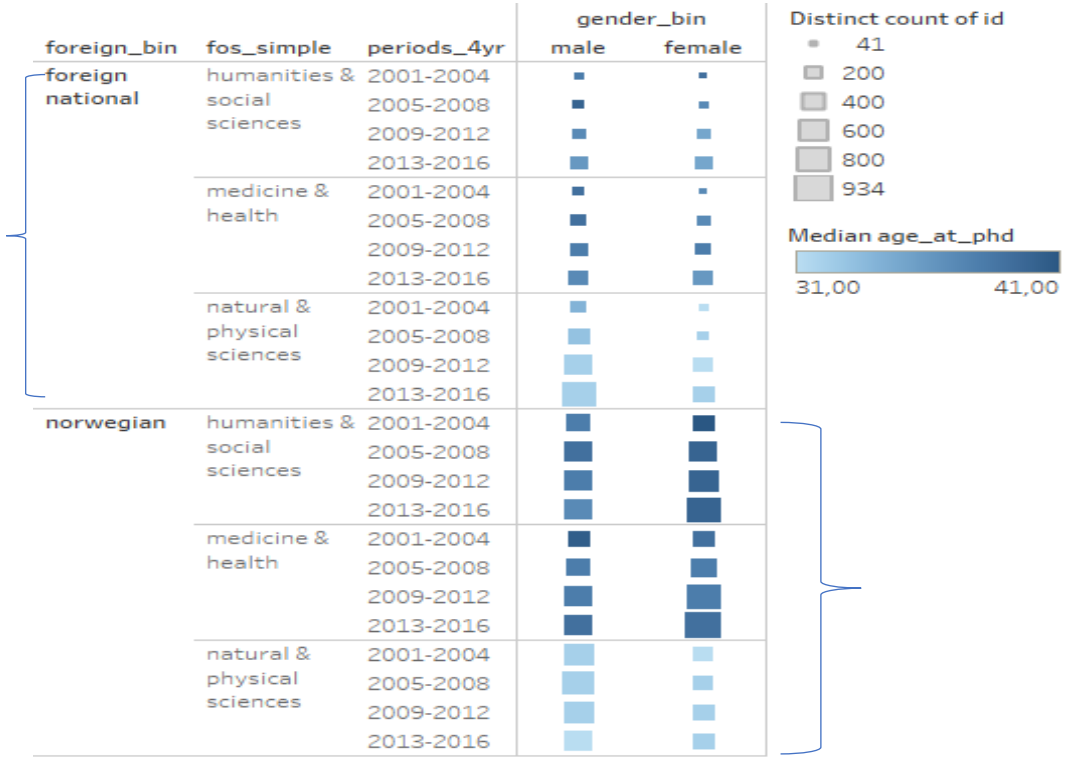
Integrating the Population 3

		NORWEGIAN LABOR-MARKET	
Degree from		Inside (t2)	outside
Norwegian HEI (t1)	citizenship		
	Norway	xxxx	x
	Foreign	xxx	xx
Foreign HEI (T2)			
	Norway	x	xx
	Foreign	xxx	na

Substantial import of doctorate-level competencies from abroad

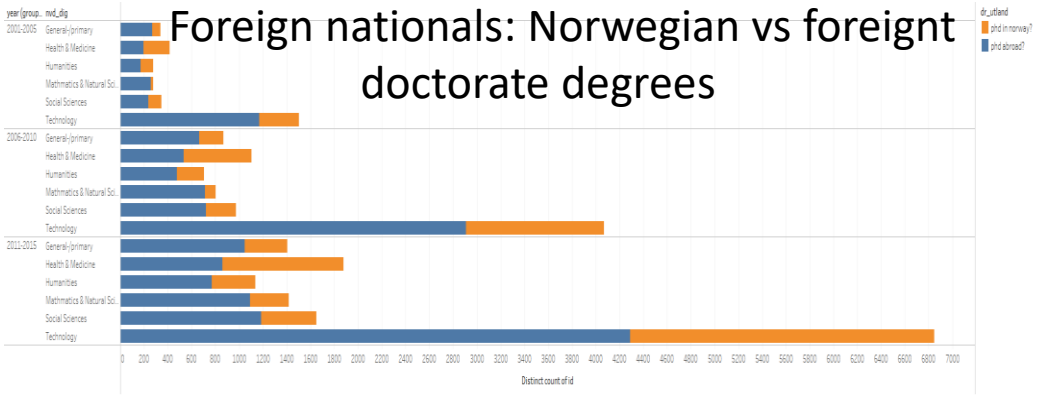


Changing stocks among the three populations



Median of age_at_phd (color) and distinct count of id (size) broken down by gender_bin vs. foreign_bin, fos_simple and periods_4yr.

Foreign nationals: Norwegian vs foreignt doctorate degrees



Distinct count of id for each nvd_dig broken down by year (group) (group). Color shows details about dr_utland. The data is filtered on yr_phd Year and foreign_bin. The yr_phd Year filter excludes Null and 2016. The foreign_bin filter keeps foreign national. The view is filtered on year (group) (group), dr_utland and nvd_dig. The year (group) (group) filter excludes januar 01 2016 12:00AM. The dr_utland filter keeps phd abroad? and phd in norway?. The nvd_dig filter keeps 6 members.

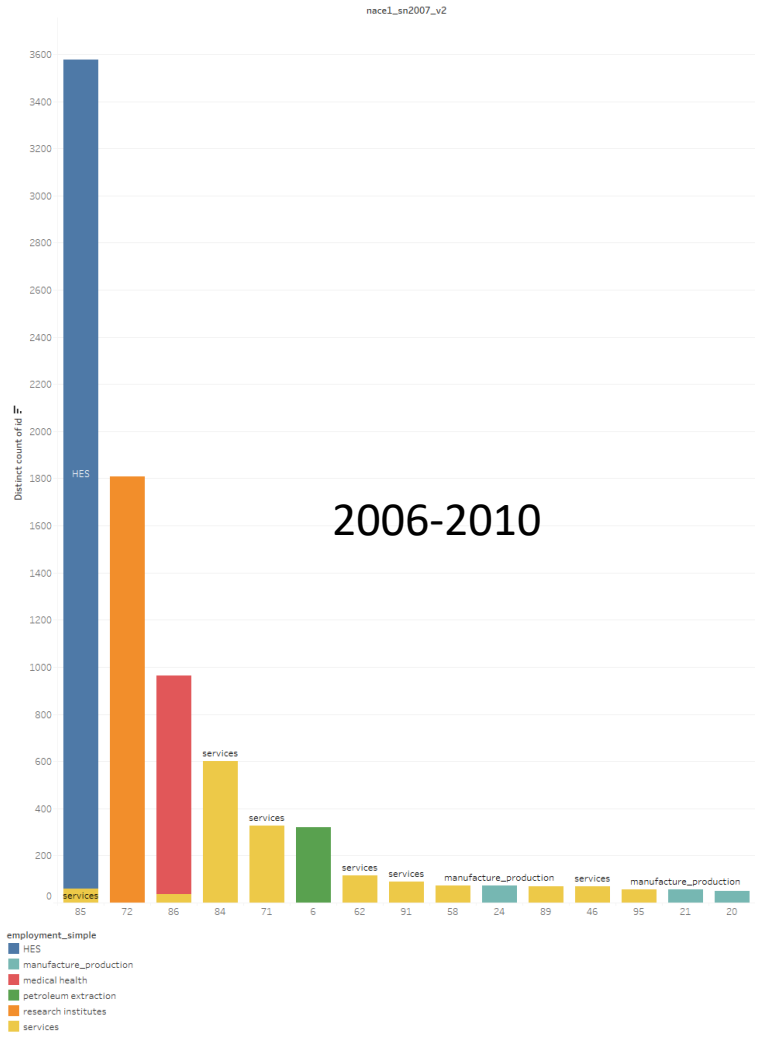
Labor-market placement 5-yrs after degree

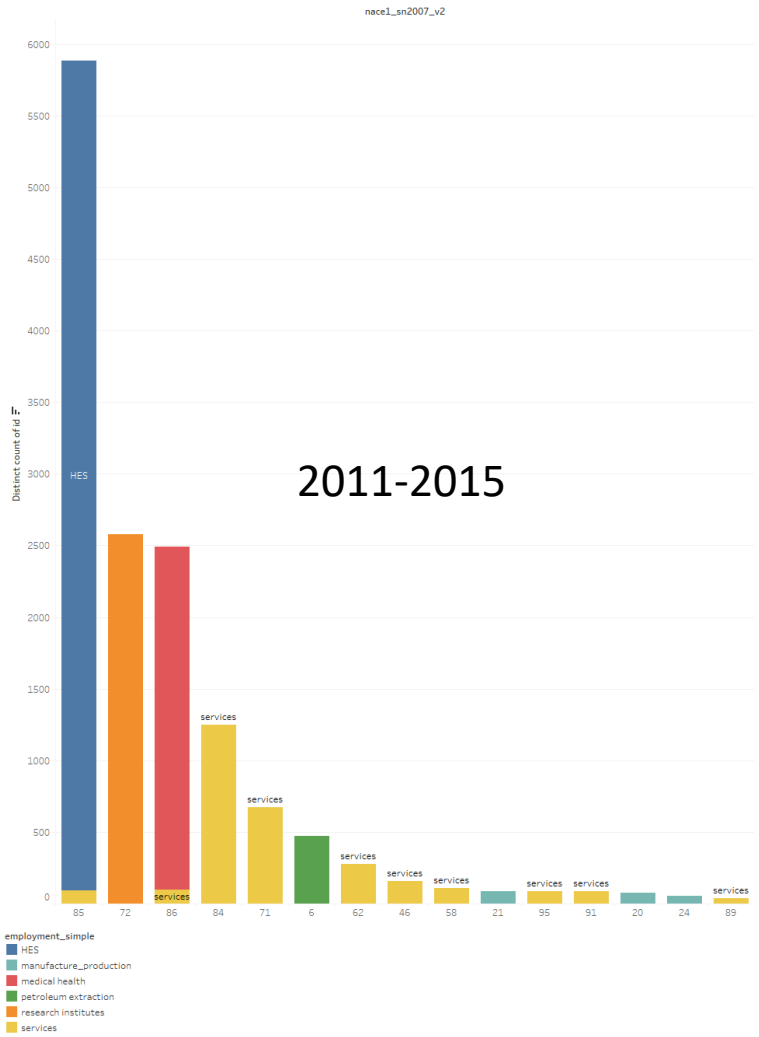
by sector of employment and field of study

nvd_dig	HES	research institutes	medical health	manufac..	petroleum extrac..	services
Agriculture & Fisheries	24%	39%	0%	9%		19%
Health & Medicine	29%	9%	42%	1%	0%	11%
Humanities	68%	3%	1%	0%	0%	18%
Mathmatics & Natural Sci..	54%	13%	0%	3%	4%	19%
Social Sciences	53%	18%	7%	0%	1%	15%
Technology	26%	24%	2%	8%	8%	22%
Grand Total	35%	17%	13%	5%	4%	18%

Employment by top industrial classes (sectors)

Labour-market placement of PhDs from Norwegian HES





Sector deployment (shares employed)

by PhD graduation year

		Year of yr_phd															
	year (group..	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Grand T..
academic_sector	2006-2010	43,5%	36,6%	45,5%	43,9%	41,3%	42,3%	42,0%	42,1%	38,6%	37,9%						41,7%
	2011-2015	42,7%	36,3%	44,3%	39,7%	38,4%	40,6%	38,0%	39,2%	36,8%	37,3%	37,2%	36,1%	36,2%	38,1%	40,4%	38,4%
institute_sector	2006-2010	23%	28%	25%	21%	20%	22%	20%	19%	21%	17%						22%
	2011-2015	20%	25%	24%	20%	19%	20%	18%	17%	17%	16%	15%	15%	14%	14%	14%	17%
hospitals*	2006-2010	4%	4%	4%	7%	9%	8%	10%	13%	17%	23%						9%
	2011-2015	5%	4%	4%	8%	10%	9%	11%	14%	18%	22%	22%	22%	23%	23%	23%	15%
non_research_sector	2006-2010	29%	32%	26%	28%	29%	28%	28%	26%	23%	22%						28%
	2011-2015	32%	35%	28%	32%	33%	30%	33%	30%	28%	25%	27%	27%	26%	25%	23%	29%

* Hospitals changed sector in the period

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Demonstration of data-flows

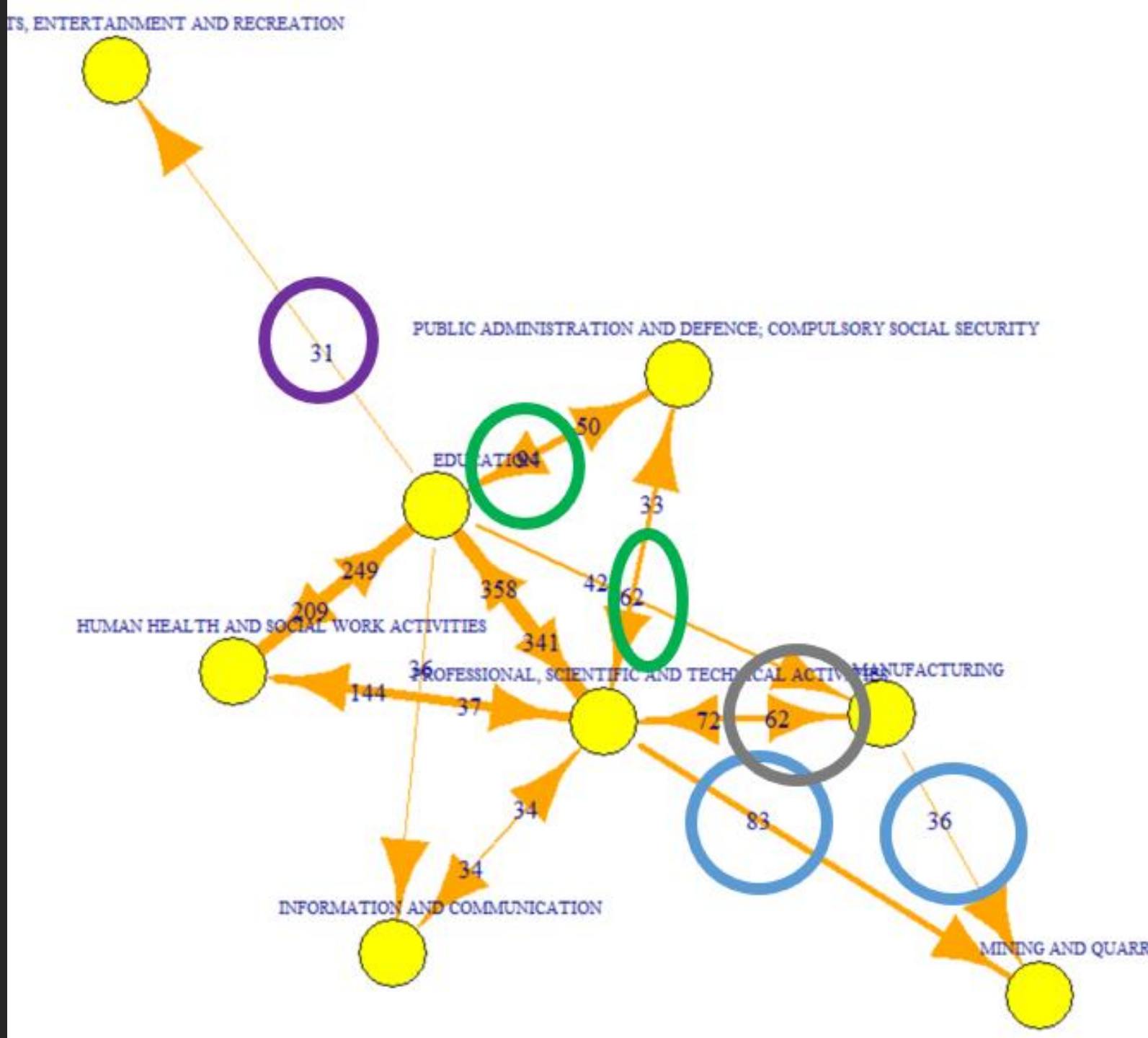
Between 2009 and 2017

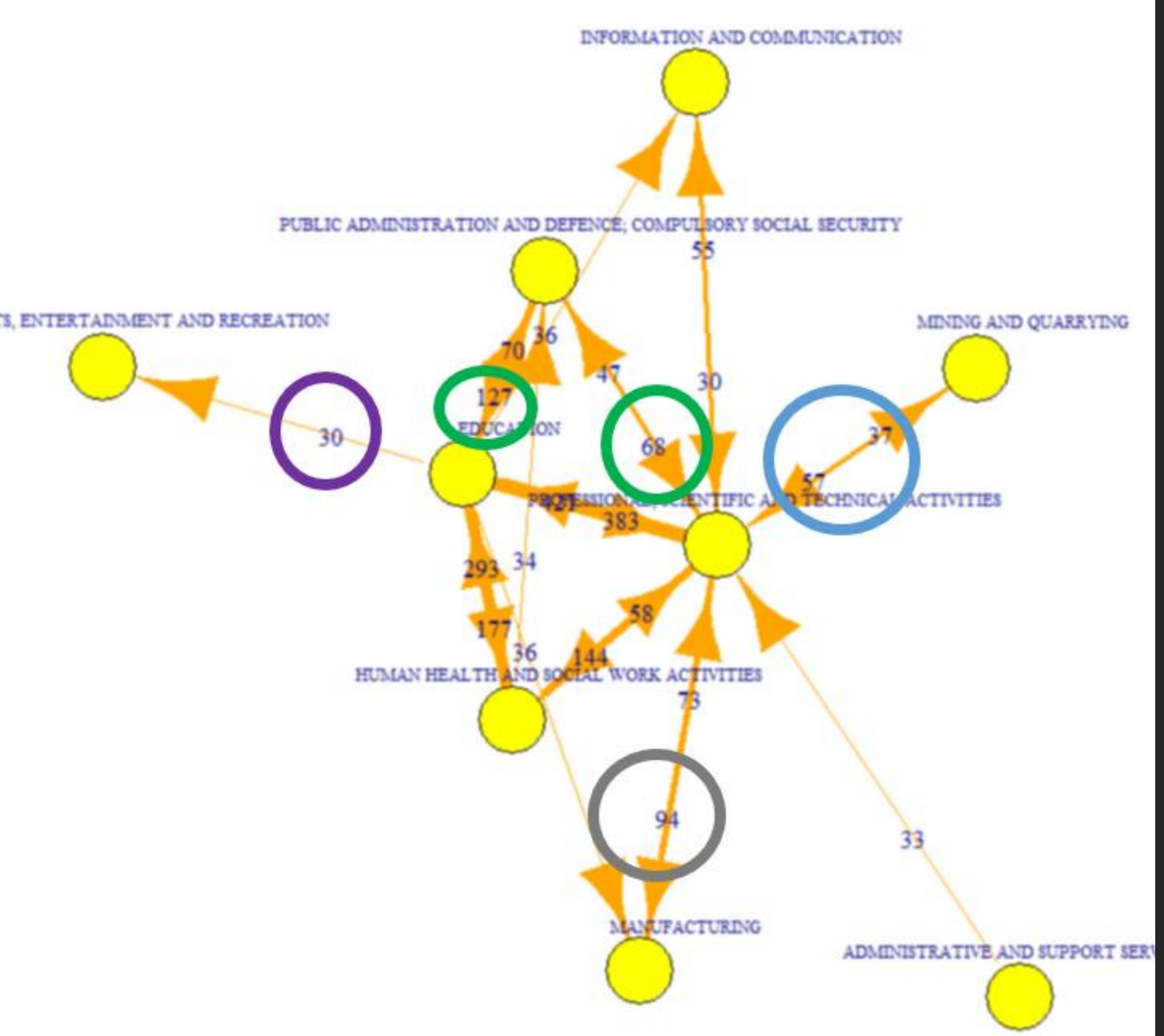
sector code	sector name	all employees 2009	all employees 2017	all empl. difference	PhD employees 2009	PhD employees 2017	PhD difference
85	Education	184811	197324	12513	6325	9363	3038
72	Scientific research and development	12782	14616	1834	2838	4460	1622
86	Human health activities	174911	191179	16268	1780	3216	1436
84	Public administration and defence; compulsory social security	136744	156551	19807	719	1352	633
69	Legal and accounting activities	23847	27347	3500	39	80	41
70	Activities of head offices; management consultancy activities	8221	10522	2301	61	161	100
71	Architectural and engineering activities; technical testing and analysis	38970	44483	5513	653	1089	436
06	Extraction of crude petroleum and natural gas	20030	22400	2370	560	880	320
08	Other mining and quarrying	3191	3111	-80	6	10	4
09	Mining support service activities	17552	24744	7192	55	203	148
62	Computer programming, consultancy and related activities	29686	39348	9662	173	624	451
63	Information service activities	3605	4689	1084	22	43	21
17	Manufacture of paper and paper products	5365	2528	-2837	36	15	-21
30	Manufacture of other transport equipment	26006	14554	-11452	77	83	6

O&G

ICT

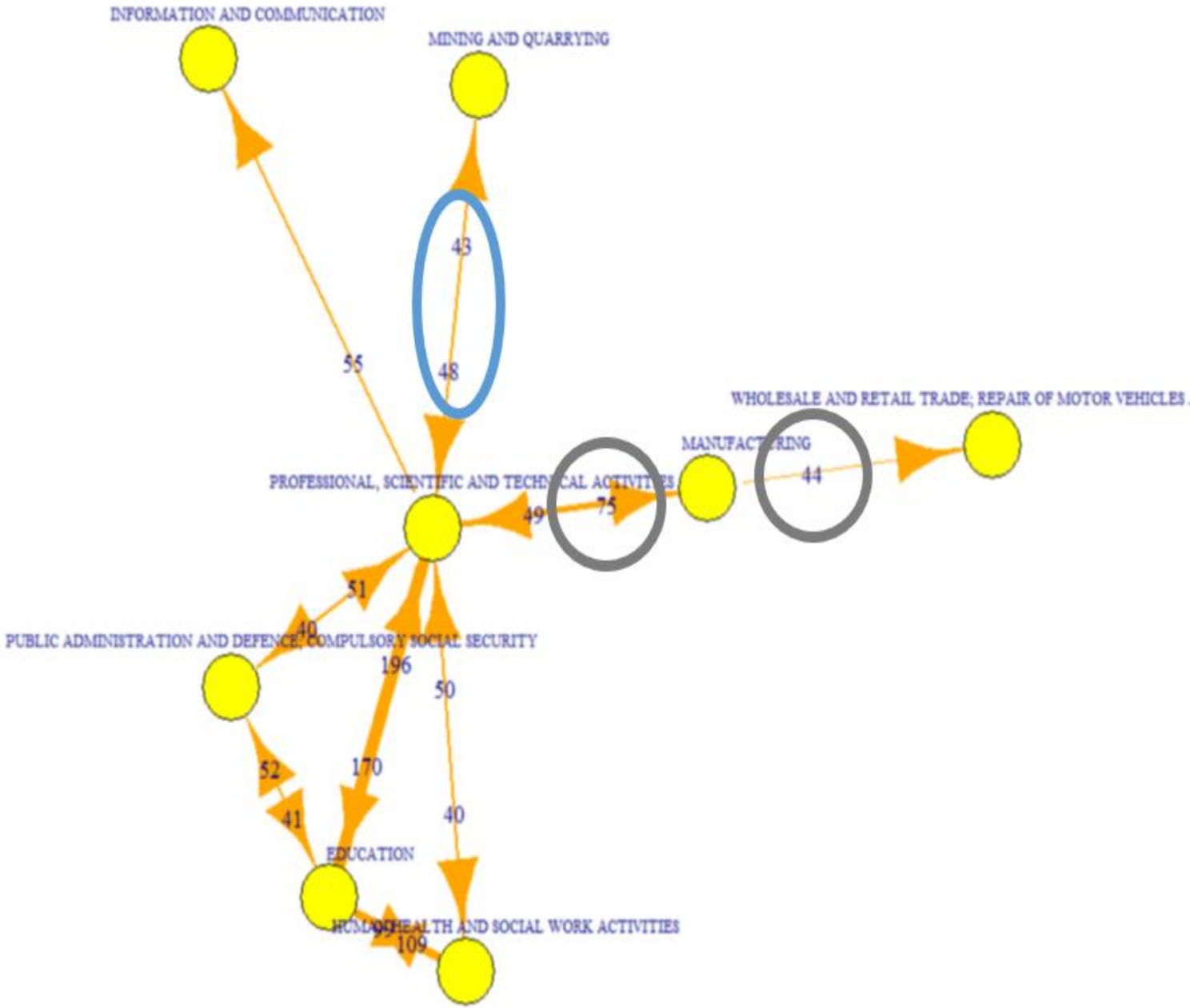
2009-2012

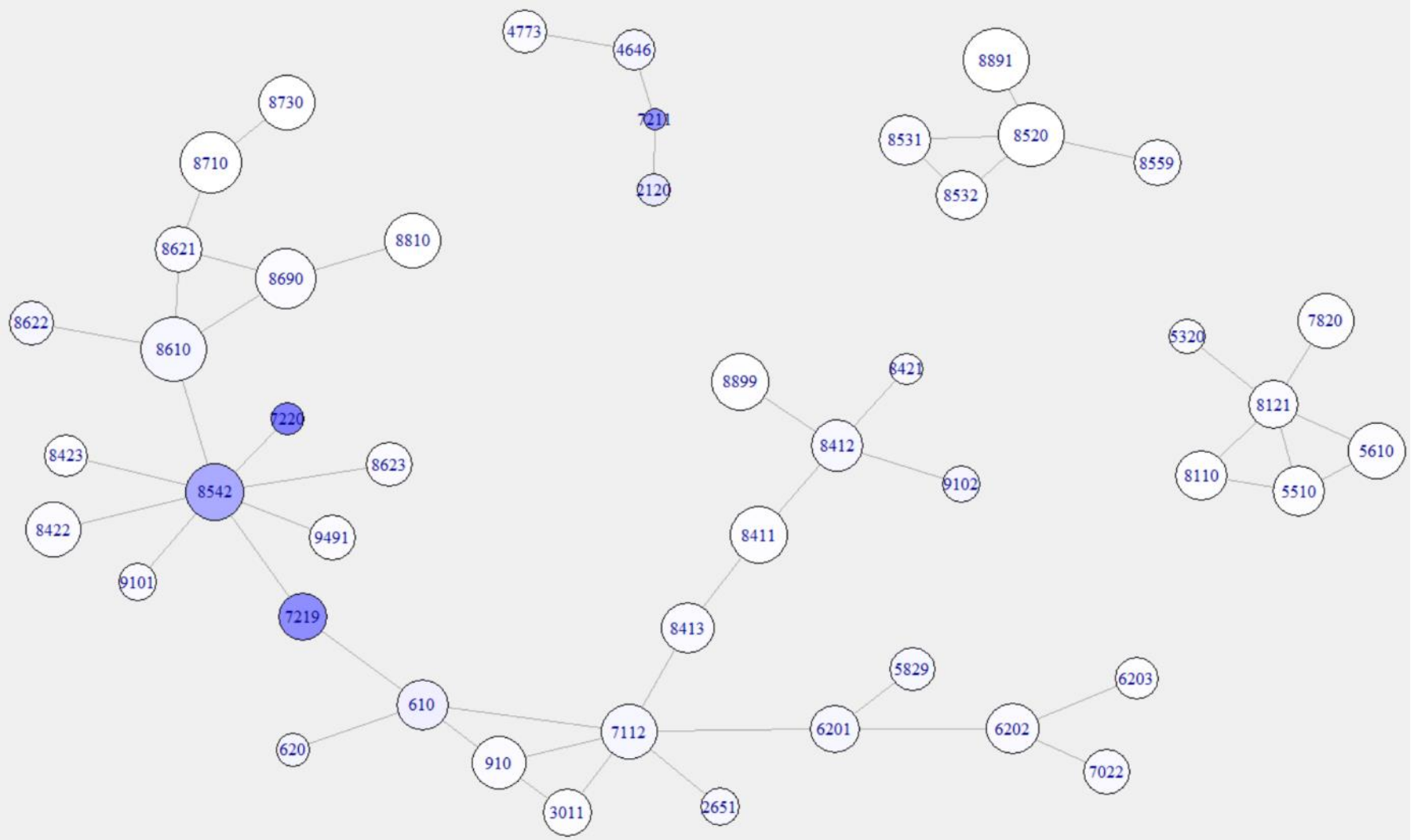

TS, ENTERTAINMENT AND RECREATION
31
PUBLIC ADMINISTRATION AND DEFENCE; COMPULSORY SOCIAL SECURITY
50
EDUCATION
33
249
209
358
42
62
HUMAN HEALTH AND SOCIAL WORK ACTIVITIES
341
144
37
72
62
MANUFACTURING
34
34
83
36
INFORMATION AND COMMUNICATION
MINING AND QUARR

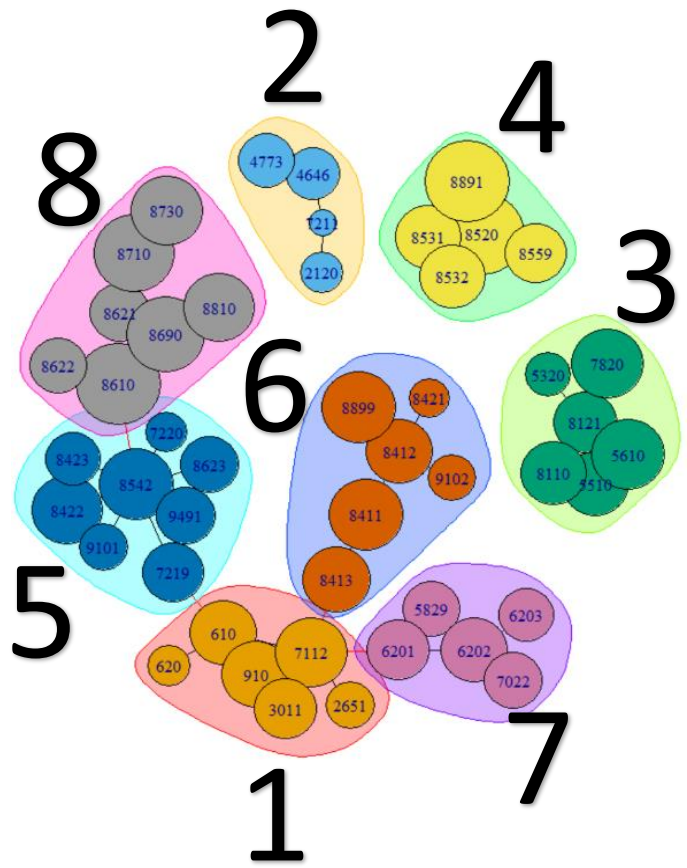

INFORMATION AND COMMUNICATION
PUBLIC ADMINISTRATION AND DEFENCE; COMPULSORY SOCIAL SECURITY
55
S, ENTERTAINMENT AND RECREATION
MINING AND QUARRYING
36
70
47
30
127
30
68
37
57
383
293
34
58
177
36
144
73
94
33
MANUFACTURING

2012-2015

2015-2017


INFORMATION AND COMMUNICATION
MINING AND QUARRYING
43
55
48
WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES
MANUFACTURING
44
PROFESSIONAL, SCIENTIFIC AND TECHNICAL ACTIVITIES
49
75
51
40
PUBLIC ADMINISTRATION AND DEFENCE; COMPULSORY SOCIAL SECURITY
196
50
52
170
41
40
EDUCATION
HUMAN HEALTH AND SOCIAL WORK ACTIVITIES
109





1	Extraction of crude petroleum	Extraction of natural gas	Support activities for petroleum	Engineering activities and relate	Building of ships and floating st	Manufacture of instruments and appliances for measuring, testing and navigation		
2	Wholesale of pharmaceutical g	Dispensing chemist in specialise	Research and experimental dev	Manufacture of pharmaceutical preparations				
3	Other postal and courier activiti	General cleaning of buildings	Hotels and similar accommodat	Restaurants and mobile food se	Combined facilities support acti	Temporary employment agency activities		
4	Primary education	General secondary education	Technical and vocational secon	Child day-care activities	Other education n.e.c.			
5	Other research and experiment	Tertiary education	Research and experimental dev	Defence activities	Justice and judicial activities	Dental practice activities	Library and archive activities	Activities of religious organisatic
6	Regulation of and contribution t	General public administration a	Regulation of the activities of pr	Museum activities	Foreign affairs	Other social work activities without accommodation n.e.c.		
7	Other software publishing	Computer programming activiti	Computer consultancy activities	Computer facilities managemen	Business and other management consultancy activities			
8	Hospital activities	General medical practice activiti	Specialist medical practice activi	Other human health activities	Residential nursing care activitie	Social work activities without ac	Residential care activities for the elderly and disabled	

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Conclusions

Conclusions

- PhD training is an investment
- Pay-off (to universities, to the PhD, to the economy at large) are potentially high
- Important to account for the changing shape of (research) careers, including the flows into (and out of) the economy
- As the landscape of (supply & demand) change, it becomes more important to take stock (and measure flows) stemming from this investment
- Persistent call for a good (reliable, comparative across time and country, safe (confidentiality), reproducible, and reasonable) metric

Conclusions

A missing piece of a well-known puzzle

- what a ‘good’ lens for this metric would look like.
- Is a good lens not already being polished?

In light of longstanding and ongoing interntational efforts (of UOE and OECD in particular) we asked:

- Could a register-based CDH- approach work here?
- What are the challenges? (How) can they be succefully addressed?
- What answers could it provide to the different (policy, statistical, science) communities?

This exercise only carried out for one country (and for another purpose)

- Possible for others
- Does not replace the need for surveys and more general census.

But use the right tool for the right job…