Comparing links in chemistry

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Contents

This document compares the final links we obtain for chemistry.

```
select_fields <- c("biology",
                   "business",
                   "chemistry",
                   "computer science" ,
                   "economics",
                   "engineering",
                   "environmental science",
                   "geography",
                   "geology" ,
                   "history",
                   "materials science",
                   "mathematics",
                   "medicine",
                   "art",
                   "philosophy",
                   "physics",
                   "political science",
                   "psychology" ,
                   "sociology")
```

```
con <- DBI::dbConnect(RSQLite::SQLite(), db_file)
cat("The database connection is: \n")
```

```
## The database connection is:
```

```
src_dbi(con)
```

```
## src:  sqlite 3.46.0 [/mnt/ssd/AcademicGraph/AcademicGraph.sqlite]
## tbls: affil_fields_temp, affiliation_fields, affiliation_outcomes,
##   Affiliations, author_citations, author_coauthor, author_collab,
##   author_field0, author_fields, author_fields_detailed, author_gender,
##   author_info_linking, author_output, author_panel, author_performance,
##   author_sample, author_selfcites, AuthorAffiliation, AuthorNameSplits,
##   Authors, cng_distances, cng_institutions, cohort_career,
##   cohort_career_decomp, conference_citations, crosswalk_fields, current_links,
##   current_links_advisors, estimation_sample_art, estimation_sample_biology,
```

```
##   estimation_sample_business, estimation_sample_chemistry,
##   estimation_sample_computer_science, estimation_sample_economics,
##   estimation_sample_engineering, estimation_sample_environmental_science,
##   estimation_sample_geography, estimation_sample_geology,
##   estimation_sample_history, estimation_sample_materials_science,
##   estimation_sample_mathematics, estimation_sample_medicine,
##   estimation_sample_philosophy, estimation_sample_physics,
##   estimation_sample_political_science, estimation_sample_psychology,
##   estimation_sample_sociology, FieldOfStudyChildren, FieldsOfStudy, FirstNames,
##   FirstNamesGender, graduates_closest_collaborators,
##   graduates_similarity_to_institutions, graduates_similarity_to_self,
##   journal_citations, linked_ids, linked_ids_advisors, linked_ids_grants,
##   linking_info, linking_info_advisors, linking_info_grants, links_new,
##   links_nsf_mag, links_old, links_to_cng, novelty_reuse, NSF_Appropriation,
##   nsf_fields0_collapsed, nsf_fields1_collapsed, NSF_FieldsOfStudy,
##   NSF_FoaInformation, NSF_Fund, NSF_Institution, NSF_Investigator, NSF_MAIN,
##   NSF_Performance_Institution, NSF_ProgramElement, NSF_ProgramReference,
##   nsffos, paper_citations, paper_outcomes, PaperAuthorAffiliations,
##   PaperAuthorUnique, PaperFieldsOfStudy, PaperMainFieldsOfStudy,
##   PaperReferences, Papers, pq_advisors, pq_authors, pq_fields, pq_fields_mag,
##   pq_info_linking, pq_magfos, pq_unis, quantiles_papercites, scinet_links_nsf,
##   sqlite_stat1, UnclearNamesGender
```

```
field_names_id <- tbl(con, sql(paste0(
    "SELECT FieldOfStudyId, NormalizedName
    FROM FieldsOfStudy
    WHERE Level = 0
        AND NormalizedName IN (",
        paste0(paste0("'", select_fields, "'"), collapse = ", "),
        ")"
)))
field_names_id <- collect(field_names_id)


query_mag <- paste0(
 "SELECT AuthorId
        , year
        , fieldofstudy
        , mag_field0
    FROM (
        SELECT a.AuthorId
            , a.YearFirstPub AS year
            , e.NormalizedName AS fieldofstudy
            , e.ParentFieldOfStudyId as mag_field0
        FROM author_sample AS A
        INNER JOIN (
            SELECT AuthorId, NormalizedName, ParentFieldOfStudyId
            FROM author_fields c
            INNER JOIN (
                SELECT FieldOfStudyId, NormalizedName
                FROM FieldsOfStudy
            ) AS d USING(FieldOfStudyId)
            INNER JOIN (
                SELECT ParentFieldOfStudyId
```

```
                    , ChildFieldOfStudyId
                    , ParentFieldOfStudyId
                FROM crosswalk_fields
                WHERE ParentLevel = 0
                    AND ParentFieldOfStudyId IN (",
                        paste0(field_names_id$FieldOfStudyId, collapse = ", "),
                    ")
            ) AS e ON (e.ChildFieldOfStudyId = c.FieldOfStudyId)
            WHERE FieldClass = 'first'
        ) AS e USING(AuthorId)
    )
WHERE year >= 1980 and year <= 2022
")
```

```
linked_ids <- tbl(con, "current_links")
linking_info <- tbl(con, "linking_info") %>%
    filter(mergemode == "1:1" & fieldofstudy_str == "False")
pq_authors <- get_proquest(conn = con, from = "graduates", start_year = 1990, end_year = 2015)
mag_authors <- tbl(con, sql(query_mag))
```

Combine data pq and MAG

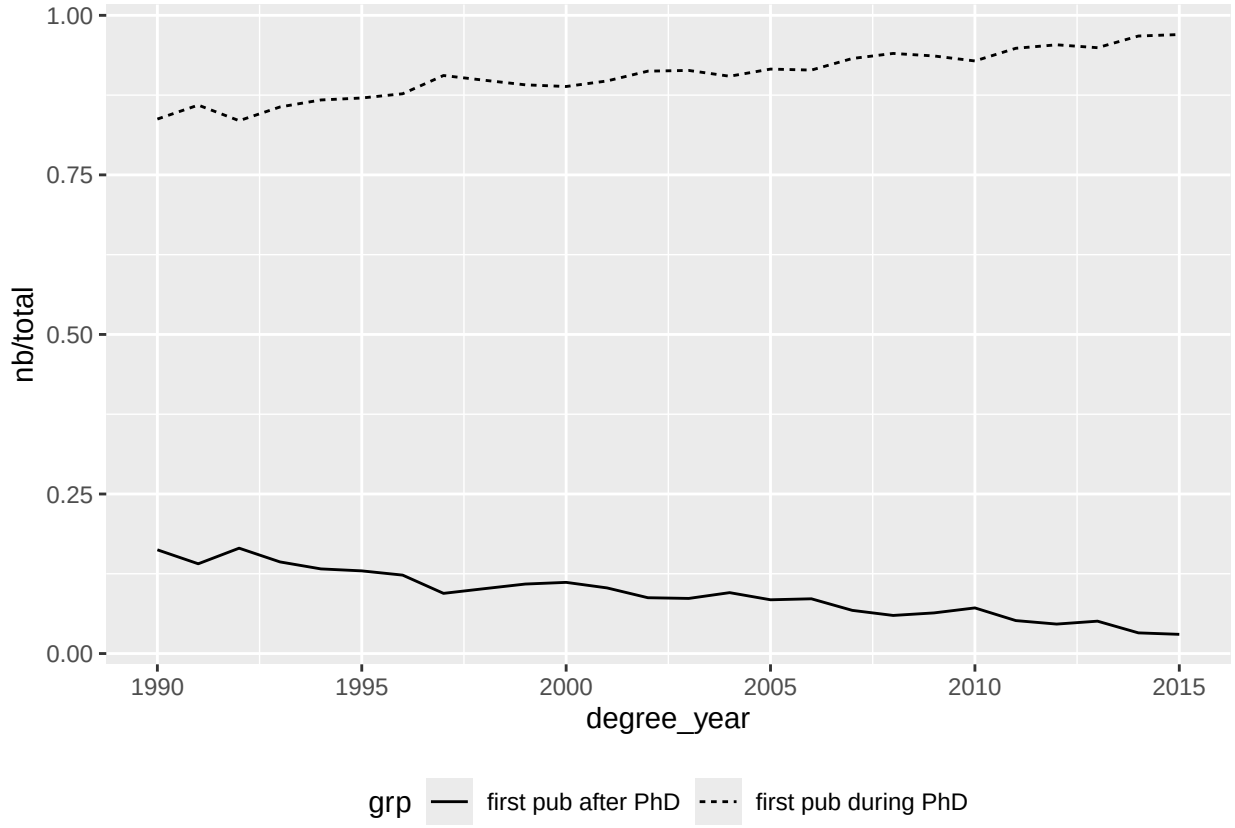
```
d_linked <- linked_ids |>
  select(AuthorId, goid) |>
  left_join(pq_authors |>
              select(-gender),
            by = "goid") |>
  left_join(mag_authors |>
              select(AuthorId, year_firstpub = year),
            by = "AuthorId")
```

Chemistry: first affiliation of MAG authors should be the graduating institution. paper

```
d_main <- d_linked |>
  filter(fieldname0_mag == "chemistry") |>
  mutate(grp = case_when( # some people publish already way before the PhD
    year_firstpub > degree_year ~ "first pub after PhD",
    year_firstpub < degree_year - 6 ~ "first pub before PhD",
    TRUE ~ "first pub during PhD"
  )) |>
  select(AuthorId, goid, degree_year, grp)
```

```
d_main |>
  group_by(grp, degree_year) |>
  summarise(nb = n()) |>
  ungroup() |>
  group_by(degree_year) |>
  mutate(total = sum(nb)) |>
  ggplot(aes(x = degree_year, y = nb/total)) +
  geom_line(aes(linetype = grp)) +
  theme(legend.position = "bottom")
```

```
## `summarise()` has grouped output by 'grp'. You can override using the `.groups`
## argument.
```



Gaule/Piacentini had 21154 graduates from 1999 to 2008; we have

```
d_main |>
  filter(degree_year >= 1999 & degree_year <= 2008) |>
  summarise(n())
```

```
## # A tibble: 1 x 1
##   `n()`
##   <int>
## 1  9407
```

- they had chemists and chemical engineers; we miss the engineers in this sample.

```
query_authors <- unique(d_main$AuthorId)
query_authors <- paste0(query_authors, collapse = ", ")
q_authors_affil <- paste0(
  "SELECT AuthorId, AffiliationId, Year
  FROM AuthorAffiliation
  INNER JOIN (
    SELECT AuthorId, YearFirstPub
    FROM author_sample
  ) USING(AuthorId)
  WHERE AuthorId IN (", query_authors, ")
  AND Year <= YearFirstPub + 20"
)
```

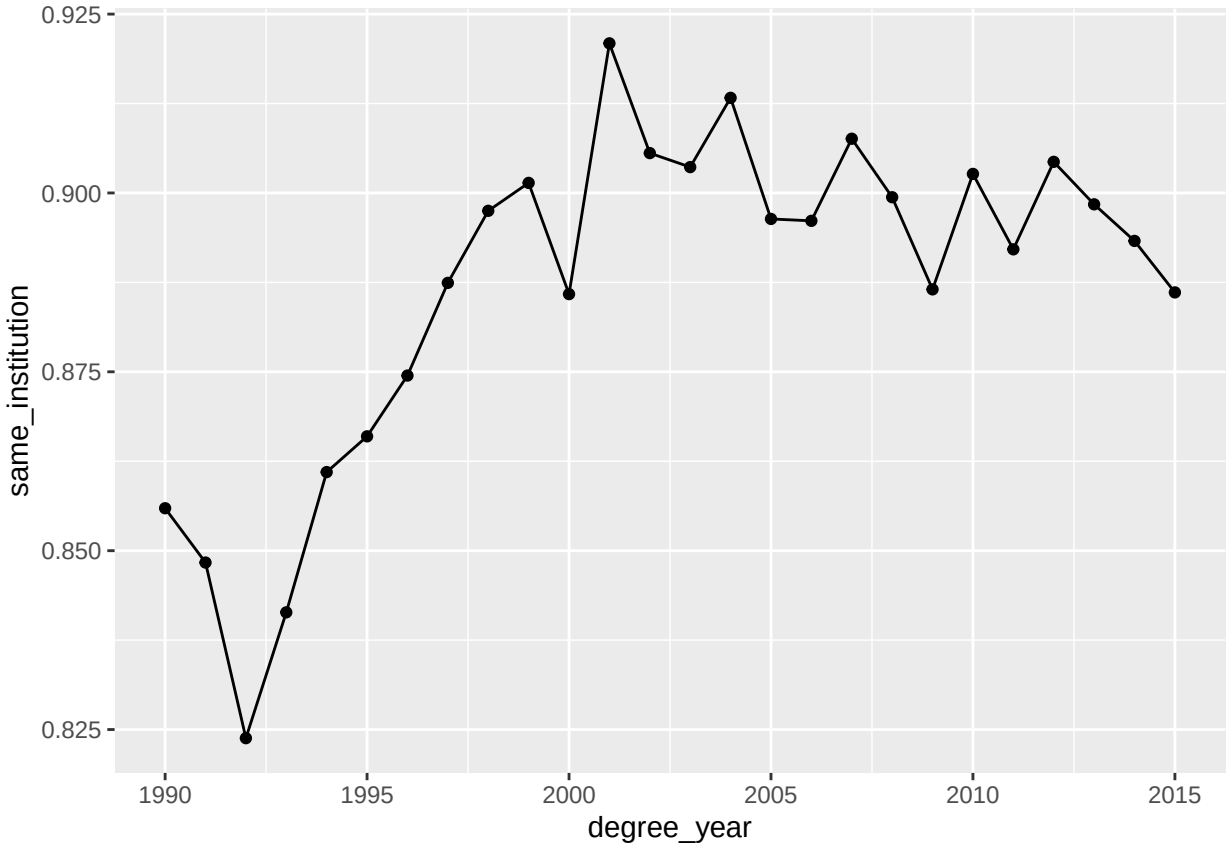
```
authors_affil <- tbl(con, sql(q_authors_affil)) |>
  collect()

authors_first_affil <- authors_affil |>
  group_by(AuthorId) |>
  filter(Year == min(Year)) |>
  filter(!duplicated(AuthorId)) |>
  ungroup()
```

```
links_to_cng <- tbl(con, "links_to_cng") |>
  collect()
```

Place of first publication

```
place_first_pub <- d_main |>
  left_join(pq_authors |>
              select(goid, university_id),
            by = "goid") |>
  inner_join(links_to_cng |>
              filter(from_dataset == "pq") |>
              select(from_id, unitid_graduate = unitid),
            by = c("university_id" = "from_id")) |>
  left_join(authors_first_affil |>
              select(AuthorId, AffiliationId),
            by = "AuthorId") |>
  inner_join(links_to_cng |>
              filter(from_dataset == "mag") |>
              select(from_id, unitid_author = unitid),
            by = c("AffiliationId" = "from_id"))
```

```
place_first_pub |>
  mutate(same_institution = ifelse(unitid_graduate == unitid_author, 1, 0)) |>
  group_by(degree_year) |>
  summarise(same_institution = mean(same_institution, na.rm = T),
            .groups = "drop") |>
  ggplot(aes(x = degree_year, y = same_institution)) +
  geom_line() +
  geom_point()
```



If publishing during PhD, does so at least once at the PhD university?

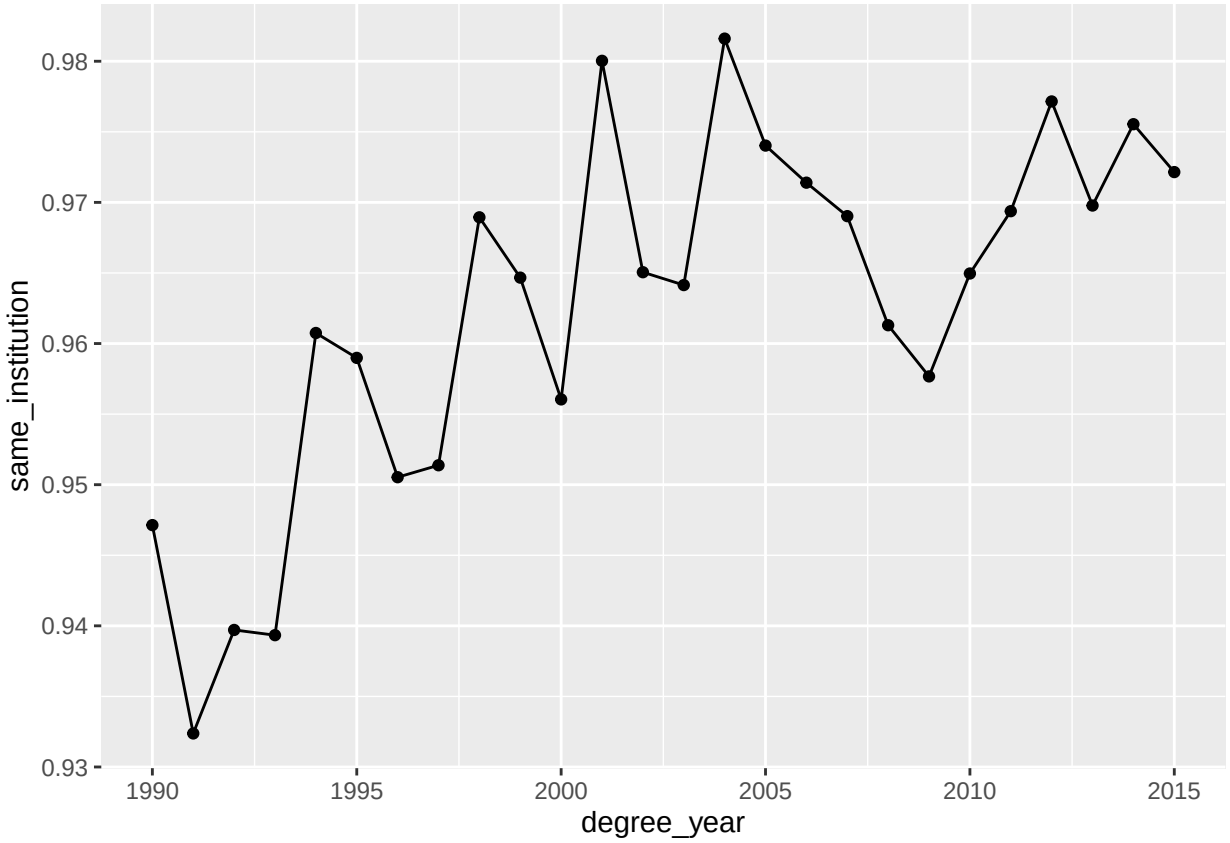
```
publish_during_phd <- authors_affil |>
  left_join(d_main |>
              select(-grp),
            by = c("AuthorId")) |>
  filter(Year <= degree_year & Year >= degree_year - 6) |>
  inner_join(links_to_cng |>
              filter(from_dataset == "mag") |>
              select(from_id, unitid_author = unitid),
            by = c("AffiliationId" = "from_id")) |>
  left_join(pq_authors |>
              select(goid, university_id),
            by = "goid") |>
  inner_join(links_to_cng |>
              filter(from_dataset == "pq") |>
              select(from_id, unitid_graduate = unitid),
            by = c("university_id" = "from_id")) |>
  select(AuthorId, Year, degree_year, unitid_author, unitid_graduate, university_id) |>
  mutate(same_institution = ifelse(unitid_author == unitid_graduate, 1, 0),
         same_institution = ifelse(is.na(same_institution), 0, same_institution))
```

Fraction of students not publishing during PhD:

```
1 - n_distinct(publish_during_phd$AuthorId) / n_distinct(d_main$AuthorId)
```

```
## [1] 0.1776644
```

```
# group by student: at least one pub with the PhD university?
publish_during_phd <- publish_during_phd |>
  group_by(AuthorId) |>
  filter(same_institution == max(same_institution)) |>
  filter(!duplicated(AuthorId))

publish_during_phd |>
  group_by(degree_year) |>
  summarise(same_institution = mean(same_institution, na.rm = T),
            .groups = "drop") |>
  ggplot(aes(x = degree_year, y = same_institution)) +
  geom_line() +
  geom_point()
```




```
summary(publish_during_phd)
```

```
##     AuthorId              Year       degree_year   unitid_author
##  Min.   :    590343   Min.   :1985   Min.   :1990   Min.   :100663
##  1st Qu.:2020547864   1st Qu.:1997   1st Qu.:1999   1st Qu.:141574
##  Median :2130305377   Median :2004   Median :2006   Median :174066
##  Mean   :2039660888   Mean   :2003   Mean   :2005   Mean   :181846
##  3rd Qu.:2318164168   3rd Qu.:2009   3rd Qu.:2011   3rd Qu.:212106
##  Max.   :3163059217   Max.   :2015   Max.   :2015   Max.   :495767
##  unitid_graduate  university_id  same_institution
##  Min.   :100663   Min.   :   1   Min.   :0.0000
```

```
##  1st Qu.:141574   1st Qu.:  29   1st Qu.:1.0000
##  Median :174066   Median :  88   Median :1.0000
##  Mean   :181789   Mean   : 139   Mean   :0.9648
##  3rd Qu.:212106   3rd Qu.: 184   3rd Qu.:1.0000
##  Max.   :495767   Max.   :2589   Max.   :1.0000
```

Notes

- some may publish after phd with the phd affiliation – not captured here
- misses
  - research institutes that are not in Carnegie, ie scripps research institute
  - chemical engineers
- all in all, this is a lower bound on the precision in the sample of chemists publishing during their PhD
- the lower bound on precision for the sample of chemists can be calculated as follows
  - 18% publish after PhD; assume they are all false positives
  - of the remaining 82%, 96% publish at their graduating university
  - thus, our precision is at least 0.82 * 0.96 = 0.78
- this calculation is more difficult in fields where graduates publish more often after graduating