High and Rising Institutional Concentration of Award-Winning Economists

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Abstract

We analyze the institutional clustering of award-winning researchers. We collect nearly 300,000 annual education and career affiliations of nearly 6,000 award-winning researchers across 18 major academic fields in the natural sciences, engineering, and social sciences. All fields, except for economics, exhibit a low and decreasing concentration, which suggests a trend toward decentralized knowledge production. Conversely, economics shows a high and rising concentration. We investigate potential reasons for this anomaly, including researcher mobility, reliance on physical assets, the age of fields, the role of prestige, and the influence of the United States in shaping disciplinary norms.

Keywords: Nobel, talent, concentration
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1 Introduction

Scientific research is evolving toward greater decentralization: International research collaborations are spreading to broader and more diverse regions (Gui et al., 2019; Leydesdorff et al., 2013), and research institutions in emerging economies are progressively expanding their scientific capacities to higher standards (Kapur and Crowley, 2008). This broad distribution of knowledge production enhances the accessibility and dissemination of scientific insights (Czaika and Orazbayev, 2018). However, it is less clear whether this pattern is mirrored in the distribution of top researchers. Investigating the concentration of academic talent reveals the mechanisms that underpin intellectual progress and its impact on society. By examining where these leading researchers work, we gain insight into how ideas spread, the pace at which they are embraced, and the overall trajectory of scientific and scholarly advancements.

Our research aims to address two primary questions: (i) how has the distribution of top talent across institutions evolved within various academic disciplines over time, and (ii) what are the underlying causes and implications of these distribution patterns, including their variations across fields? These inquiries have rarely been explored, largely due to the absence of comprehensive and coherent data on the educational and professional trajectories of researchers from diverse academic domains.

To explore these questions, our study zeroes in on the institutional concentration of recipients of prestigious awards. Such awards are often bestowed to acknowledge groundbreaking innovations and contributions to science (Borjas and Doran, 2015), and serve not only to highlight significant scientific achievements but also as markers of scientific prestige (Ma and Uzzi, 2018). This approach enables us to pinpoint a cohort of exceptional scientists who play a crucial role in advancing the frontier of knowledge. We gather data on the educational and professional affiliations of nearly 6,000 recipients across 170 notable awards in 18 fields, spanning the natural sciences, engineering, and social sciences, with six fields in each category.[1] Our data collection covers the education and employment histories of these laureates, beginning with their college education, and our database contains nearly 300,000 year-affiliation-position entries. Based on this extensive dataset, we analyze the patterns of institutional concentration among elite scientists.

We start by examining the Nobel Prize, the most prestigious accolade in academia. Figure 1 illustrates the trend in the institutional concentration of Nobel laureates, as quantified by the Herfindahl-Hirschman Index (HHI), across various disciplines starting in 1950.[2] Notably,

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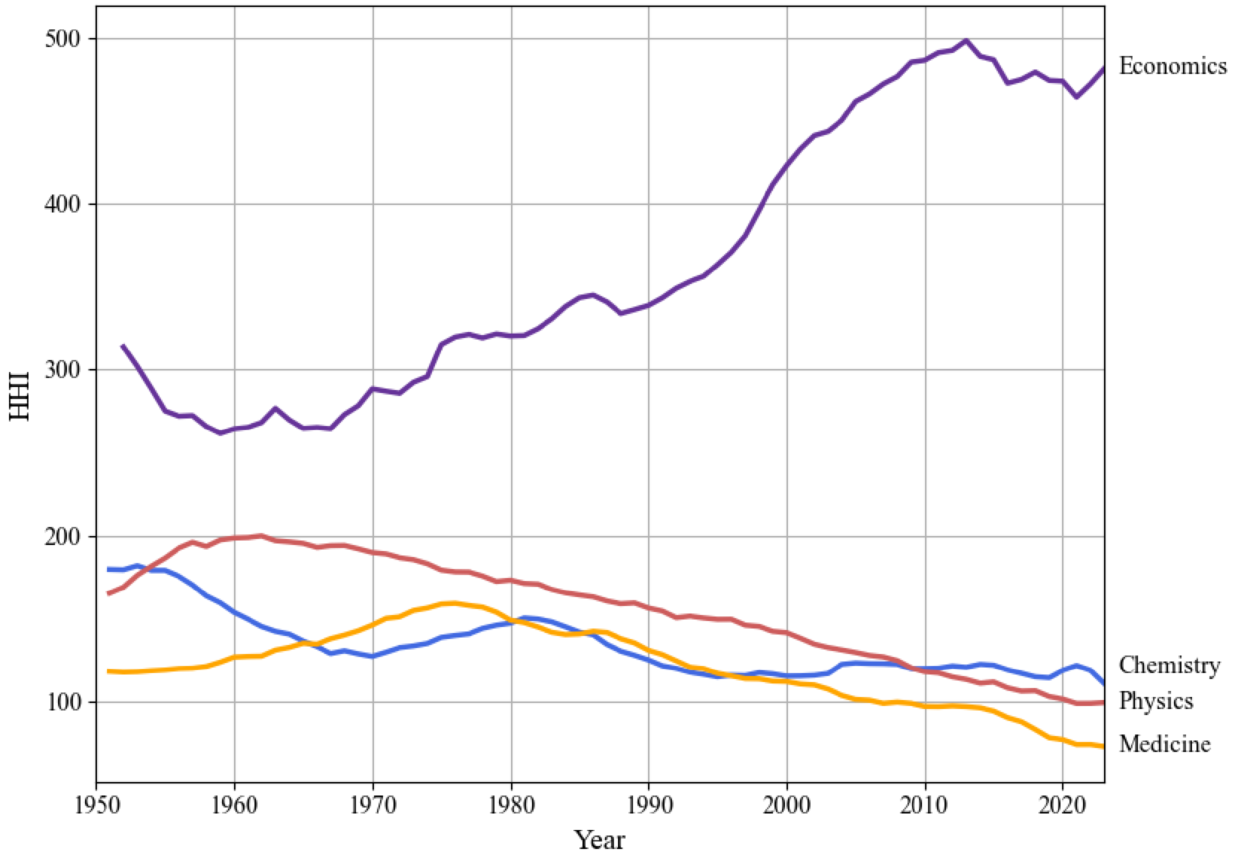
[1] Natural sciences are mathematics, physics, chemistry, life science, astronomy, and earth science; engineering fields are electrical and information, civil, energy, environmental, materials, and mechanical engineering; and social sciences are economics, political science, sociology, law, education, and psychology.

[2] We use the normalized HHI as our primary measure of institutional concentration, which ranges from 0—

economics stands out as the sole field that demonstrates both a high degree of concentration and an ascending trend over time. Conversely, chemistry, physics, and medicine all display low levels of concentration, with a general trend toward further decentralization.

Figure 1: Institutional concentration of Nobel laureates from 1950



Note: A field's institutional concentration in year t is calculated by the HHI of year t academic affiliations of Nobel laureates up to year t as well as those after year t.

Upon expanding our analysis to include 170 awards across 18 fields and using alternative metrics of concentration, we find that all fields show a declining level of concentration, while economics remains a significant outlier, marked by its uniquely high and increasing levels of concentration. This distinction is evident in the concentration of both the educational and professional affiliations of its laureates (Figure 2). Moreover, economics is the only field in which the concentration continues to grow over time. Our further analysis, which aims to assess the centralization of academic fields from an inequality perspective, use the Lorenz curve and Gini coefficient (Table 1). Remarkably, economics is identified as the most concentrated field at the 50% threshold level, with half of the laureates' academic time

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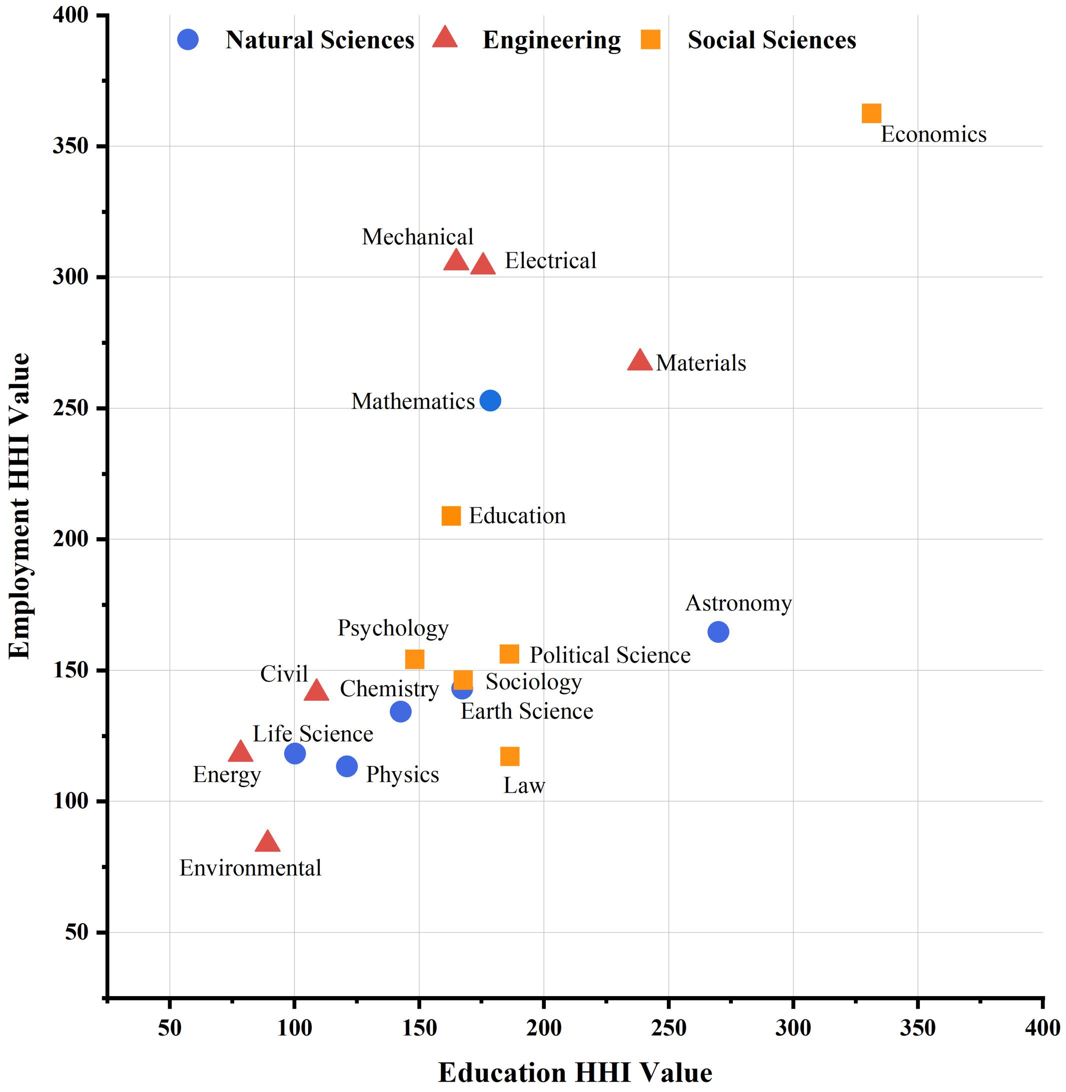
when all laureates come from different institutions—to 10,000, when all laureates come from one institution.

spent at just 8 institutions, which account for only 3.3% of all institutions with awards.[3] In addition, economics boasts the highest Gini coefficient of 0.812.

Figure 2: Education and employment institutional concentration across different fields



Note: The x-axis demonstrates the overall HHI of the educational affiliations of all award recipients. The y-axis demonstrates the overall HHI of the employment affiliations of all award recipients.

Next, we delve into potential reasons behind the decentralization of science and the distinct patterns observed in economics compared with other fields. It is important to clarify that our analysis neither aims for nor achieves a comprehensive comparison with all other disciplines under consideration. Rather, our focus is identifying the general patterns behind the spread of science and specific traits inherent to economics that set it apart. We

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[3] The 8 institutions are, in the order of the percentage of laureate years spent, Harvard (10.9%), Chicago (8.0%), MIT (7.6%), Stanford (6.4%), Princeton (4.9%), Yale (4.2%), Berkeley (4.0%), and Columbia (3.3%)

find that the observed patterns are consistent with the dependence on physical equipment, the developmental stage of the field, and the role of prestige. Economics is distinguished by its high mobility, relative novelty, and the significant role prestige plays within the field. For each of these distinguishing features, we present supporting evidence and explore their implications for the field's dynamics. This exploration contributes to our understanding of the factors that drive concentration and distribution trends within academic disciplines and sheds light on the unique nature of economics.

Our study extends the literature on institutional concentration within the scientific community. Understanding how elite researchers—those at the forefront of their fields—are clustered within certain institutions is critical for grasping the dynamics that drive knowledge production and innovation across various disciplines. We build on previous research that has either focused on specific disciplines (Lotka, 1926; Hodgson and Rothman, 1999; Kocher and Sutter, 2001; Glötzl and Aigner, 2019; Lin and Li, 2023) or comparative analyses of a select few fields (Fourcade et al., 2015; Varga, 2011; Tollison and Goff, 1986). Our contribution lies in providing a thorough investigation of institutional concentration across a diverse spectrum of scientific fields. Addressing institutional concentration is crucial, because the formation of elite echelons in various aspects of science, from publication records to institutional ties, could potentially stifle creativity and innovation (Heckman and Moktan, 2020). This phenomenon, often reflected in academic rankings, may establish an incentive structure that discourages researchers from delving into and disseminating findings on vital but non-mainstream topics within their disciplines (Hudson, 2013). Consequently, such a concentration could serve as a hindrance to creativity and originality (Heckman et al., 2017).

Furthermore, our results on the field disparities of concentration also contribute to identifying the production mechanism of knowledge and innovation. We go beyond documenting empirical facts to probe the underlying causes of variations in institutional concentration across disciplines and their implications for how innovation is generated. Past research has identified that scientific production is positively correlated with faculty quality (Waldinger, 2010); international collaborations (Iaria et al., 2018); research teams (Jones, 2021); innate talent (Agarwal and Gaule, 2020), and superstar spillover (Azoulay et al., 2010). Moreover, research grants and fellowships can significantly increase scientific productivity (Azoulay et al., 2011; Ganguli, 2017; Jacob and Lefgren, 2011), though it may be influenced by the preferential bias *Matthew effect* (Bol et al., 2018). Our research contributes to this body of knowledge by suggesting that scientific output may also depend on factors such as available physical resources, the developmental stage of the field, the prestige of institutions, and specific disciplinary norms. We hope that these results will open avenues for further exploration of the determinants of scientific creativity.

The paper proceeds as follows. Section 2 describes the main stylized facts regarding the concentration of elite researchers. Section 3 presents the conceptual framework. Section 4 discusses potential channels for observed patterns. Section 5 concludes.

2 Stylized facts

2.1 Data

The data we need to answer our questions is not readily available and must be meticulously collected and organized. We start by identifying the list of awards for each academic field. We primarily rely on the scientometric data on highly prestigious international academic awards discussed in previous studies (Zheng and Liu, 2015; Jiang and Liu, 2018; Meho, 2020). Prior studies constructed such a list using tiered-checklist methods, surveys distributed to experts in the profession and the ratio of award recipients rated as highly cited researchers in their respective fields to the number of award recipients. We modified the list to exclude prizes that were (i) awarded with a strong preference on nationality and/or region, such as the TWAS prize for developing countries and (ii) presented by an organization that is no longer operating, such as the World Technology Award. We also included prizes that were established relatively recently but with high prestige, such as the Breakthrough Prize in Mathematics. We then searched for the individuals who were awarded these prizes, starting from the year the prize was distributed and ending in 2022. For individuals who are awarded multiple prizes in the same discipline, we only count them once. For recipients of multiple prizes in different disciplines, we include the data in multiple disciplines. We ended up with a list of 170 awards and a total of 5,782 award-winning individuals. Appendix Table O1 provides a summary description of the academic fields and awards as well as the full list of awards, along with the link to their official websites and the number of recipients for each award.

We then construct the lifetime affiliations of the award recipients. We use Microsoft Academic Graph to identify the yearly affiliation of the researchers using publication data (Wang et al., 2020). Microsoft Academic Graph is a large-scale open dataset for global research that integrates items and their connections across multiple datasets. It contains extensive information on a wide range of publication records, authors, institutions, and citation records among publications. For years without any documented publication data and for the education history of the laureates, we manually searched for the biographical description of the award winner based on the official website of the award, Wikipedia, scholarly homepages and university faculty pages. We also manually updated affiliations when there was a lag

Table 1: Different measures of institutional concentration of laureates

Academic Field	Employment HHI	Education HHI	50% share of laureate time in #/% institutions	90% share of laureate time in #/% institutions	Gini coefficient
			Natural Sciences		
Mathematics	252.90	178.57	13 (5.5%)	76 (32.8%)	0.761
Physics	113.36	121.03	26 (6.6%)	142 (36.5%)	0.731
Chemistry	134.28	142.52	27 (5.5%)	173 (35.2%)	0.750
Life Sciences	117.73	100.19	32 (4.6%)	236 (34.7%)	0.760
Astronomy	164.64	269.98	18 (7.1%)	96 (37.5%)	0.722
Earth Sciences	143.09	167.28	23 (5.8%)	152 (39.2%)	0.725
			Engineering		
Electrical Engineering	303.95	175.54	12 (3.7%)	100 (29.5%)	0.793
Civil Engineering	141.33	108.75	17 (9.8%)	71 (40.3%)	0.669
Energy Engineering	118.10	78.37	29 (10.5%)	133 (47.2%)	0.635
Environmental Engineering	83.71	89.17	32 (10.6%)	134 (44.5%)	0.645
Materials Engineering	267.42	238.53	10 (6.1%)	63 (38.9%)	0.715
Mechanical Engineering	305.55	164.85	11 (6.6%)	65 (38.5%)	0.719
			Social Sciences		
Economics	362.54	332.66	8 (3.3%)	67 (27.0%)	0.812
Political Science	156.24	186.12	18 (8.1%)	94 (41.2%)	0.693
Sociology	146.27	167.61	19 (7.0%)	107 (40.5%)	0.707
Law	117.21	186.34	22 (8.7%)	109 (43.1%)	0.677
Education	208.94	162.85	17 (5.1%)	118 (35.3%)	0.746
Psychology	154.22	148.21	18 (5.1%)	101 (28.2%)	0.784

Note: This table presents results from different measures of concentration for the 18 fields: (1) Employment Herfindahl-Hirschman Index (HHI); (2) Education HHI; (3) Number or percentage of institutions accounting for a 50% share of laureates' career time; (4) Number or percentage of institutions contributing to a 90% share of laureates' career time; and (5) Gini coefficient reflecting the distribution of laureates' affiliations over time.

in publication affiliation. If there are multiple affiliations for a given year, we assigned each an equal weight. We coded the position of the award winner at each institution into three categories: (1) Pre-PhD Education (everything aside from the doctoral degree), (2) PhD Education, and (3) Employment.

We unified institutions names using the affiliation list provided in the dataset *SciSciNet* (Lin et al., 2023). *SciSciNet* is a large-scale open data lake for the science of science research. It is built upon Microsoft Academic Graph (MAG), and performs substantial pre-processing and data-cleaning. *SciSciNet* covers over 134 million scientific publications and includes the names of 26,998 institutions. We mapped all institutions' names to this list of affiliations. For cases in which the institution is not on the list, we use the full English name of the institution.

Besides institution names, *SciSciNet* contains the ISO3166 Country Code for each institute. We further aggregated countries into 10 geographic regions based on their location: (1)United States, (2) North America, (3) South America, (4) Europe, (5) East Asia, (6) South Asia, (7) Africa, (8) the Middle East, (9) Oceania, and (10) Eastern Europe (Russia). We use this to control for geographic heterogeneity when conducting our analysis.

Our final dataset consists of 288,894 entries with information on year, affiliation, and position on 5,782 award-winning researchers that span from 1786 to 2022.

2.2 Results

We use the Herfindahl-Hirschman Index (HHI) as a measure of institutional concentration. The HHI has been used in various economic contexts, including the concentration of household income and market competition (Rhoades, 1993). Here, we employ the HHI to measure how the concentration of our set of high-achieving individuals evolves over time. Furthermore, the concentration of scientists can be translated into the concentration of knowledge production. The academic market can be viewed as consisting of institutions as "firms." Denote the market share of each institution as

$$s_{i,t} = \frac{\text{Total time of laureates affiliated with institution } i \text{ in year } t}{\text{Total number of laureates in year } t}.$$

The (normalized) HHI for $N > 1$ is given by[4]

$$HHI_t^* = \frac{\sum_{i=1}^{N} s_{i,t}^2 - 1/N}{1 - 1/N}.$$

To reduce variability, we smooth our results by calculating the HHI on a 20-year basis. Figure 1 shows the 20-year HHI for four Nobel Prize subjects: physics, chemistry, medicine and economics. This graph is derived using employment data for all Nobel Prize laureates after 1950. The results show that Economics has a visibly high and increasing concentration, while the three subjects in the natural sciences have a low and falling concentration.

We further perform a robustness check of this result to determine whether economics is the only subject with a rising trend. We broaden our scope to 18 subjects in the natural sciences, engineering and social sciences, which includes 10-15 prizes for each discipline. Figure O1 provides results of the HHI trends for these 18 disciplines for their entire history. Results with the full list of subjects expand the results using Nobel laureates: Economics is the only academic field that displays an increasing level of institutional concentration. The other subjects, despite initial peaks and troughs, exhibit a generally decreasing level of institutional concentration.

Much of the variation in the HHI comes from earlier time periods when the science discipline is significantly different than today. In addition, historical events such as World War I and II have had an external impact on the concentration of scientists. These variations are especially observable for disciplines that date to the 1800s (e.g., medicine, astronomy, and earth sciences). We provide several additional robustness checks in the Appendix, including the unnormalized HHI, HHI that incorporates education data, HHI calculated until 1950, and HHI calculated until the laureate year.

We proceed by calculating the aggregate level of institutional concentration for all years. To differentiate between human capital formation and knowledge production, we calculate the HHI concentration for education and employment separately, as shown in Figure 2.

We find that economics has the highest level of institutional concentration at both education and employment level (Education HHI of 331.35 and Employment HHI of 362.54). Energy engineering has the lowest institutional concentration on education (HHI of 78.37),

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[4] The HHI without considering the number of firms is given by

$$HHI_t = \sum_{i=1}^{N} s_{i,t}^2.$$

The range of the HHI would fall into $\left[\frac{1}{N}, 1\right]$, where N is the number of unique institutions. We want to rescale the HHI to eliminate the effect of N.

and environmental engineering has the lowest concentration on employment (HHI of 83.71). Except for economics outlier, all other social sciences have a similar level of concentration and are position in proximity to each other. In the realm of natural sciences, mathematics stands out for its notably high employment concentration, with an HHI of 252.90. Conversely, astronomy is distinguished by its particularly high concentration in education, with an HHI of 269.98. The remaining four subjects exhibit more balanced concentrations. For engineering, we observe that lab-and-product-oriented subjects (mechanical, electrical, and materials engineering) have a higher employment and education HHI than construction-and-project-oriented subjects (environmental, energy and civil engineering).

We further proceed to calculate the ratio of employment concentration to education concentration. Ratios $R < 1$ indicate that employment is relatively more concentrated than education, and ratios $R > 1$ indicate that education is relatively more concentrated than employment. We find that astronomy has the lowest ratio ($R = 0.61$), followed by law ($R = 0.63$), political science ($R = 0.84$), earth science ($R = 0.86$), and sociology ($R = 0.87$). Mechanical engineering has the highest ratio ($R = 1.85$), followed by electrical engineering ($R = 1.73$), energy engineering ($R = 1.51$), mathematics ($R = 1.42$) and civil engineering ($R = 1.30$). In general, engineering fields are more concentrated on an employment level, and social sciences are more concentrated by education.

We now examine the concentration of award-winning researchers from an inequality perspective using the Lorenz curve and Gini coefficient. Lorenz curves and Gini coefficients are common indices for quantifying the inequality in a distribution (Gastwirth, 1972). They have recently been applied to the setting of science innovation to identify universal inequality in the production of US-trained faculty (Wapman et al., 2022). For every subject, we count the number of laureates associated with each unique affiliation weighed by the number of years spent there, then sort these counts in descending order to obtain the Lorenz curve (See the Appendix). We proceed to calculate the percentage of affiliations that had 50% and 90% of the laureates, and the Gini coefficient. The Gini coefficient $G = 0$ represents perfect equality and $G = 1$ maximal inequality.

Results in Table 1 suggest that economics has the largest Gini coefficient (0.812), followed closely by electrical engineering (0.793), psychology (0.784), and mathematics (0.761). Energy engineering has the smallest Gini coefficient (0.635). In general, the natural sciences display a more pronounced disparity in distribution, whereas subjects in engineering tend toward a more equitable spread.

Focusing on the share of laureates versus the share of institutions, we find that in 16 of 18 disciplines, half of the laureates are associated with fewer than 10% of award-winning institutions; this highlights a significant concentration. Economics stands out for its extreme concentration, whereby 50% of its laureates come from only 3.3% of institutions, and 90% of its laureates come from 27% of institutions. In contrast, engineering fields such as energy and environmental Engineering show a less pronounced concentration, with half of the laureates affiliated with around 10.5% of institutions and 90% of laureates associated with around 45% of institutions for both fields.

3 Conceptual framework

We present a conceptual framework for subsequent discussions of potential factors that influence the distribution of talent.

3.1 Setup

Knowledge production functions are widely used to assess the effects of research and development inputs on invention and innovation (Griliches, 1979). We can denote the production function of knowledge in subject s for each institution i as

$$f_s^i(\text{Land}_i,\ \text{Equipment}_i,\ \text{Expenditures}_i,\ \text{Labor}_i,\ \text{Talent}_i, \ldots). \tag{1}$$

The production function takes in various input variables. We treat land, equipment, and expenditures as "endowments" of the institutions. Take a constant elasticity of substitution knowledge production function with multiple inputs:

$$f_s^i(\mathbf{x}^i) = F^i \cdot \left[\sum_j (\alpha_j^i)^{\frac{1}{\sigma_s^i}} (x_j^i)^{\frac{\sigma_s^i - 1}{\sigma_s^i}}\right]^{\frac{\sigma_s^i}{\sigma_s^i - 1}},$$

where $\mathbf{x}^i$ is the vector of inputs x_j's, F^i is the factor productivity, σ_s^i is the constant elasticity of substitution between different factors for institution i in subject s, and α_j^i is input j's share parameter in institution i. An institution's objective is to maximize the net output of knowledge production:

$$\pi^i(\mathbf{x}^i, \mathbf{p}^i) = f_s^i(\mathbf{x}^i) - \mathbf{x}^i \cdot \mathbf{p}^i = F^i \cdot \left[\sum_j (\alpha_j^i)^{\frac{1}{\sigma_s^i}} (x_j^i)^{\frac{\sigma_s^i - 1}{\sigma_s^i}}\right]^{\frac{\sigma_s^i}{\sigma_s^i - 1}} - \sum_j p_j^i x_j^i,$$

where $\mathbf{p}^i$ is the price vector of shadow costs of inputs. Note that across subjects, many factors may differ: the share parameters of inputs, prices of inputs, and elasticity of substitution.

The first-order condition for any input k can be rearranged as

$$\frac{(\alpha_j^i)^{\frac{1}{\sigma_s^i}}(x_j^i)^{\frac{\sigma_s^i-1}{\sigma_s^i}}}{\sum_k \alpha_k^i (x_k^i)^{\frac{\sigma_s^i-1}{\sigma_s^i}}} = \frac{p_j^i x_j^i}{f_s^i(\mathbf{x}^i)}. \tag{FOC}$$

Any optimal quantities x_j^i and x_k^i of inputs j and k satisfy

$$\log\left(\frac{x_j^i}{x_k^i}\right) = \log\left(\frac{\alpha_j^i}{\alpha_k^i}\right) - \sigma_s^i \cdot \log\left(\frac{p_j^i}{p_k^i}\right).$$

The relative demand for factor j decreases when the (i) share parameter α_j^i decreases, (ii) price p_j^i increases, and/or (iii) elasticity of substitution σ increases when $p_k^i > p_j^i$ or the elasticity of substitution σ_s^i decreases when $p_k^i < p_j^i$.

3.2 Distribution of talent

The following stylistic model provides closed-form solutions to characterize the distribution of talent in an academic field. Suppose there are (potential) award-winning researchers and non-award-winning researchers, who are treated as two factors of production. Let r_A denote the proportion of award winners and r_N that of non-winners, so $r = r_A/r_N$ is the ratio of award winners to non-winners. Suppose research institutions are distinguished by endowment E. The endowment encompasses land, equipment, and prestige. Let E be continuously distributed on $\left[\underline{E}, \overline{E}\right]$. Let the knowledge production function of an institution be

$$f(E, A, N) = E^{\alpha_E} A^{\alpha_H} N^{\alpha_L},$$

where A and N are the number of award winners and non-winners at the institution. Let $\alpha_E + \alpha_A + \alpha_N = 1$, so the production is constant returns to scale. Let the net output of an institution with endowment E be

$$\pi(E, H, L) = E^{\alpha_E} A^{\alpha_A} N^{\alpha_N} - w_A A - w_N N,$$

where wages w_A and w_N for high-type and low-type researchers are competitively determined.

We consider the competitive equilibrium in which researchers are competitively paid, institutions maximize their net output, and the lowest-endowment institution breaks even. The first-order conditions of the institutions are

$$\frac{\partial \pi(E, A(E), N(E))}{\partial A} = E^{\alpha_E}[A(E)]^{\alpha_A - 1}[N(E)]^{\alpha_L}\alpha_A - w_A = 0,$$

$$\frac{\partial \pi(E, A(E), N(E))}{\partial N} = E^{\alpha_E}[A(E)]^{\alpha_H}[N(E)]^{\alpha_N - 1}\alpha_N - w_N = 0.$$

The ratio of the two FOCs implies that for all E,

$$\log\left(\frac{A(E)}{N(E)}\right) = \log\left(\frac{\alpha_A}{\alpha_N}\right) - \log\left(\frac{w_A}{w_N}\right).$$

Hence, there is a constant proportion of awardees and non-awardees in each firm, but the institution size will differ. We have $A(E)/N(E) = r$. Plugging this in the FOCs, we have

$$E^{\alpha_E}/[A(E)]^{\alpha_E} \cdot [N(E)/A(E)]^{\alpha_L}\alpha_A = w_A \Rightarrow [A(E)/E]^{\alpha_E} = \alpha_A r^{\alpha_N}/w_A.$$

Hence,

$$A(E) = E \cdot r^{\alpha_N/\alpha_E}(\alpha_A/w_A)^{1/\alpha_E}.$$

Therefore, in this simplistic model, $A(E)$ is proportional to E. With the proportion of awardees fixed in the population, we have

$$N(E) = r_A \cdot E \Big/ \int_{\underline{E}}^{\overline{E}} \widetilde{E} dF(\widetilde{E}).$$

Similarly,

$$N(E) = r_N \cdot E \Big/ \int_{\underline{E}}^{\overline{E}} \widetilde{E} dF(\widetilde{E}).$$

Wages are determined by the break-even condition. In fact, given constant returns to scale of the production function, all firms break even.

In this model, the distribution of awardees is the same as the distribution of endowment, $A(E) \propto E$. (i) If the endowment is more for physical resources (e.g., land, equipment, resources), E will be more evenly distributed. The distribution of awardees $A(E)$ would also be more evenly distributed. (ii) If the endowment is more reflective of intangible resources, such as prestige, E may be more skewed. The concentration of awardees would also be skewed toward more prestigious institutions. For the natural sciences and engineering, physical capital is an important component of E. For the social sciences, E primarily consists of intangible endowments. Among intangibles, prestige is an especially skewed endowment. If a discipline relies heavily on prestige, such as economics, the distribution of awardees would reflect a larger degree of concentration.

Moreover, when a field is more mature, it possesses a well-defined disciplinary structure and has disseminated knowledge widely. The value-added importance of a brilliant idea or individual (such as Newton or Einstein) diminishes. Consequently, the discrepancy between

α_A and α_N would decrease. This further indicates that the wage difference between ω_A and ω_N would also decrease. Institutions can choose to hire awardees or non-awardees, since the productivity of awardees or non-awardees would be more similar. Therefore, the distribution of $A(E)$ would be more even.

4 Potential channels

We explore the mechanisms behind the decentralization of science and examine why economics is an exception. We examine several plausible pathways through which scientific fields may become decentralized: mobility probabilities, field maturity, and institutional prestige. Later sections delve into additional factors that influence this process to provide a comprehensive view of the forces that shape the distribution of scientific activities.

4.1 Knowledge production

Academic disciplines exhibit diverse production methods for generating knowledge, with a key distinction being their dependence on physical resources. Fields that engage in experimental research, such as chemistry, life sciences, and materials engineering, require specialized laboratories with custom equipment. Other fields in the natural sciences, such as physics and astronomy, extend this requirement and rely on expansive, government-supported facilities, such as the Stanford Linear Accelerator Center (SLAC), Facility for Rare Isotope Beams (FRIB) at Michigan State, and European Organization for Nuclear Research (CERN), to conduct their investigations. In contrast, theoretical domains, which include mathematics and social sciences, achieve their scholarly outputs with minimal reliance on tangible assets. This underscores differences in the need for physical equipment when conducting scientific research.

This divergence in resource dependence has immediate effects on the mobility of scholars. Those engaged in experimental disciplines face challenges when moving between institutions, since physical equipment is hard to transfer. Conversely, scholars from fields less encumbered by the need for specialized equipment can navigate institutional changes more easily once they have attained a certain level of reputation. Consequently, we anticipate that researchers in experimentally focused areas will exhibit reduced mobility compared with their counterparts in disciplines that are less reliant on physical capital.

Differences in knowledge production functions across academic fields can partially contribute to the observed disparities in institutional concentration. To begin with, given the finite nature of institutional endowments, it is impractical for a single institution to possess the requisite infrastructure to support research across all disciplines. Consequently, institutions tend to specialize by providing the necessary land and equipment for a selected set of researchers in specific areas. This requires experimental researchers to diversify their institutional affiliations to access the requisite physical capital for their work. Also, reliance on specialized equipment impedes the mobility of these researchers, which makes it less feasible for them to cluster in a few institutions, and further explains the differences in institutional concentration observed across disciplines.

We implement a simple linear regression to estimate the field differences in mobility:

$$\mathrm{Y}_{i,t} = \alpha + \beta_i \cdot \mathrm{Field}_i + \mathbf{X}_{i,t} + \epsilon_{i,t}, \tag{2}$$

where i indexes award recipients and t indexes years. $\mathrm{Y}_{i,t}$ is a binary variable that takes the value 0 or 1 to indicate whether there is a move or not in the given year. Field_i is a categorical variable that indicates the academic field award winner i is in. $\mathbf{X}_{i,t}$ are control variables that include year t and i's years since the PhD. We run the regression using economics as the base categorical variable. All coefficients for the subject field are interpreted in comparison with economics.

Figure 3: Average annual moving probabilities of elite researchers by field

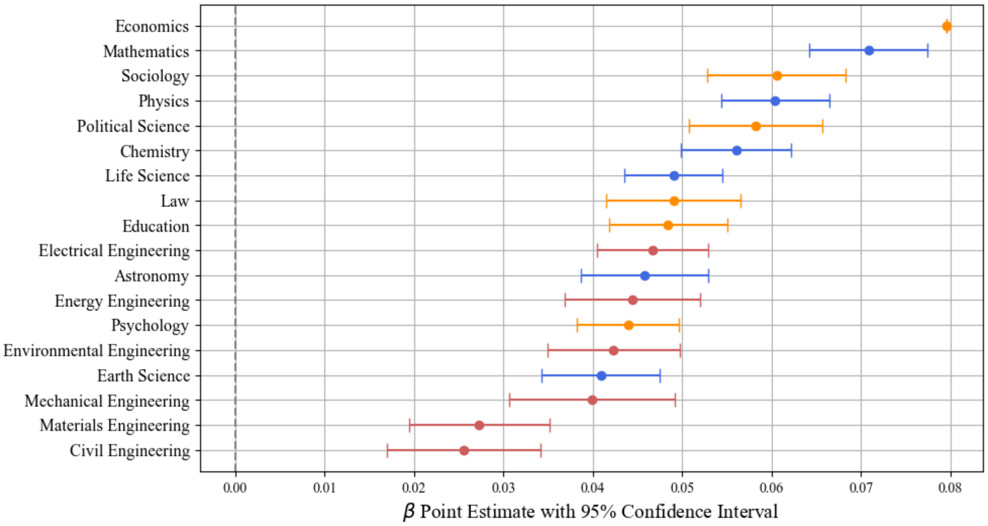

Figure 3 plots the coefficient estimates with each corresponding 95% confidence interval for the regression that controls for year and years since the PhD.[5] Our result reveals that among all academic fields, economics exhibits the highest mobility rate. Compared with

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[5] Appendix Table O4 presents results of the regression with several different specifications.

economics, all other academic subjects are significantly less likely to move. For instance, civil engineering is the least mobile subject, being 5.41% less prone to institutional changes compared with economics. Following civil engineering, materials engineering (5.23%), mechanical engineering (3.97%), earth sciences (3.88%) and environmental engineering (3.73%) show similar tendencies of lower mobility. Conversely, mathematics ranks as the second most mobile field, with only a 0.88% difference from economics. These findings suggest a correlation between a field's reliance on physical resources and its mobility, with higher mobility possibly linked to the ease with which researchers in certain fields, such as economics, can transition to more prestigious institutions during their careers.

4.2 Homophily

We proceed to examine how the structure of social interaction networks influences institutional concentration outcomes. Individuals tend to associate with those who are similar to themselves, a phenomenon known as homophily (Currarini et al., 2009). Homophily has been documented across various characteristics, including race, ethnicity, sex, age, religion, education, occupation, and behavior patterns (McPherson et al., 2001). It is observed in economic outcomes such as job contacts, friendship formations, and employment (Calvó-Armengol, 2004; Calvo-Armengol and Jackson, 2004; Ioannides and Loury, 2004; Currarini et al., 2009). We propose that homophily significantly contributes to the patterns observed in institutional concentration.

We specify a network of contacts among n prize winning individuals. The social structure is given by a $n \times n$ matrix $\mathbf{A}$, with entries of social attachments: $A_{ij} > 0$, if i is connected to j; $A_{ij} = 0$, if i is not connected to j. We allow the network to be directed: $A_{ij} \neq A_{ji}$ or $A_{ij} = A_{ji}$. The weights in the matrix A_{ij} is determined by the degree of homophily between prize winners. We use citation data from the database *SciSciNet* to determine the weights A_{ij} within the matrix. We hypothesize that greater similarity leads to higher likelihoods of citation. However, the *degree* of which homophily effects citation data is different by subject. Homophily plays a less important role in subjects with a high level of concentration, because the discipline values established reputations over personal characteristic. For example, an economist is more likely to cite an article from a leading journal such as the *American Economic Review* than to cite a peer's work. This tendency reinforces an academic hierarchy, where recognition is heavily weighted towards prestigious publications and institutions. In contrast, in less concentrated fields, citations are more evenly distributed, and personal relationships have a greater influence. For instance, a biologist may cite a fellow lab member's work because it is the most relevant and familiar. This practice leads to a more decentralized network of citations, fostering smaller, more interconnected circles within the field, which leads to a lower level of concentration.

We investigate how homophily influences citation patterns by regressing citation A_{ij} on a vector of six homophily traits $\mathbf{X_{ij}}$: gender, discipline, ethnicity, PhD graduation institution, age difference and colleague years. Gender, discipline, ethnicity, and PhD are binary variables indicating whether two individuals share the same gender, discipline, ethnicity, and PhD institution, respectively. Age difference and colleague years are continuous variables, with colleague years representing the duration two individuals have been colleagues. Formally, for individual i and j, A_{ij} is given by:

$$A_{ij} = \alpha + \beta \mathbf{X_{ij}} + \epsilon_{\mathbf{ij}} \tag{3}$$

The results are shown in Table O5. The analysis shows that prize winners are more likely to cite individuals of the same gender, discipline, PhD graduation institution, with a small age difference, and with whom they have longer colleague years. However, they are slightly less likely to cite individuals of the same ethnicity. Among the homophily variables, PhD graduation institution has the largest coefficient, indicating it has the most significant impact on citation patterns.

Furthermore, we conduct a regression analysis to examine how the effects of various factors (gender, ethnicity, PhD, age difference, and colleague years) on citation counts of prize winners vary between Economics and other disciplines. By using Economics as the baseline category, we aim to compare the coefficients against those of other fields:

$$\mathbf{y} = \boldsymbol{\beta}\mathbf{X} + \boldsymbol{\delta}\mathbf{W} + \boldsymbol{\epsilon} \tag{4}$$

where $\mathbf{Y}$ is a vector of citations after normalization. We normalized the citations for each discipline to take out the effect of different discipline size. $\mathbf{X}$ is a matrix of the main effect variables, including gender, ethnicity, PhD, age difference and colleague years. $\mathbf{W}$ is a matrix of interaction terms, where each of the dummy variables interact with a discipline. We set Economics as the base variable, the coefficients for the interaction terms should be compared against Economics.

The regression results are shown in Table O6. Researchers are more likely to cite others who share the same gender, graduated from the same PhD institution, are closer in age, and have been colleagues for a longer period. This aligns with the findings in Table O5. However, examining the interaction terms for the dummy variables (Gender, Ethnicity, and PhD) reveals a notable trend. With few exceptions, the impact of these variables on citations is generally greater in other disciplines compared to Economics. This suggests that economists are *less likely* to cite individuals of the same gender, ethnicity, and PhD institution than researchers in other fields. It indicates that personal relationships have a smaller effect in Economics, where the discipline prioritizes prestige and quality of work over personal characteristics, consistent with our previous findings on high levels of institutional concentration.

4.3 Field maturity

Another explanation for variations in institutional concentration involves differences in the historical age of the subjects. Fields such as astronomy, geography and physics have long histories dating back hundreds of years, which allows them to cultivate a well-defined disciplinary structure and disseminate knowledge widely. This longevity means that more institutions are able to produce frontier knowledge. Conversely, newer domains, including the social sciences and engineering, have emerged more recently. During their initial development, the production of knowledge was concentrated within a select number of pioneering "start-up" institutions. As a result, the diffusion of knowledge in these nascent fields to the wider academic community is ongoing. This historical context suggests that younger disciplines are likely to exhibit greater institutional concentration compared with their older counterparts.

We test this hypothesis by examining the rate of new institution emergence within various academic disciplines. In well-established fields, knowledge is sufficiently widespread such that new institutions appear slowly. Conversely, nascent fields see the swifter emergence of new institutions, since more and more institutions are capable of scientific production. By analyzing the cumulative number of unique institutions that debuted post-1950 and comparing this with the entry of new award recipients from the same period, we can gauge a field's maturity. A rapid increase in institutions affiliated with recent laureates suggests an evolving field, whereas a slower growth rate indicates a discipline with a foundational, preexisting network of institutions.

Figure O8 illustrates the emergence of new institutions across Nobel Prize disciplines and highlights Economics as the most dynamically growing field in terms of institutional development. This reflects its relative novelty and high concentration. To validate these findings, Figure O9 extends the analysis to all 18 fields, and reveals that emerging disciplines such as environmental and energy engineering, sociology, and political science have also experienced the swift influx of new institutions. This supports the notion that the rapid establishment of new institutions is indicative of a field's developmental stage.

4.4 Prestige

It is widely perceived that the field of science and innovation has a reputation of favoring prestige (Nowogrodzki, 2022; Wapman et al., 2022). Half a century ago, Robert Merton famously coined the term *Matthew effect*: Small differences in initial standing tend to accumulate over time to generate significant advantages. Furthermore, status not only affects quality assessments, but scientists with high status are more likely to attract substantial resources, including research grants and exceptional graduate students. These resources can subsequently be used to produce scientific results of higher quality (Merton, 1968). There is rising concern that academia itself has become an oligopoly market, in whic elite universities have larger market shares and more influence over innovation (Glötzl and Aigner, 2019; Hodgson and Rothman, 1999; Kocher and Sutter, 2001).

Despite the general consensus on the role of status in science, economics stands out for its emphasis on prestige compared with other subjects. Tollison and Goff (1986) discovered that within their respective fields, prominent economists receive significantly more citations than prominent physicists do. Varga (2011) compared economics, sociology and biophysics, and concluded that the production mechanism in sociology is more disintegrated because of the lack of cumulative and consensual knowledge. Prior research also reveals that economics has a unique and pronounced hierarchy within the discipline, which sets the subject apart from other social sciences (Fourcade et al., 2015). Driven by these observations, we further investigate the distinctive factors that position economics differently within the social sciences, which do not depend heavily on physical capital and share comparable historical timelines. We suggest that the significance of institutional prestige is particularly pronounced in economics and influences knowledge production. This emphasis on prestige likely contributes to greater field concentration, with researchers gravitating toward more prestigious institutions.

To validate our hypothesis regarding institutional prestige's impact on economics, we assess the average rankings of laureates' affiliations over time, post-PhD. To avoid confounding factors, our analysis is confined to affiliations based in the U.S. and post-1950. We use the 2024 U.S. News Best National University Rankings as a consistent benchmark. This approach is justified for two main reasons. First, U.S. News only provides comprehensive rankings for more than the top 25 universities from 1996 onward. Since 1996, most top universities have remained among the top universities over time. Second, the stability of top universities in these rankings aligns with our focus on elite researchers, who are typically associated with high-ranking institutions. Figure O10 compares affiliation rankings of six social science fields. Smaller numbers in rankings denote higher rankings for institutional prestige.

The findings reveal a markedly higher average institutional ranking for economics compared with other social sciences, which typically hover around 35-40. In contrast, economics consistently maintains a threshold around 15. This suggests a notable concentration of award-winning economists within the highest-ranked institutions, and offers a possible explanation for the discipline's observed high level of concentration.

4.5 Other factors

We move forward to explore additional forces that could be integrated into this framework, none of which are mutually exclusive; it is likely that several are at work simultaneously. We posit that the level and trend of institutional concentration is the combined result of many factors, and each discipline has unique characteristics. Below, we outline the factors we have identified that advances the development of science and innovation.

4.5.1 Evaluation methods

To begin with, variations in recognition approaches could account for differences in concentration levels across disciplines. Conventionally, the most widely agreed upon method of evaluation is on the basis of publication records and citations. The productivity of scientists and universities, measured in terms of publications and citations, has become increasingly important as the determinants of individual and organizational rewards over time (Walker et al., 2010). Yet measuring contributions in certain fields extends beyond publications. For example, in applied sciences such as life sciences and engineering, recognition can also be gained through patents, inventions, clinical discoveries, and research grants. Similarly, in the social sciences, books and monographs play a crucial role in idea dissemination. This broader spectrum of recognition metrics may foster inclusivity among researchers from diverse backgrounds, and potentially leads to more dispersed concentration of academic awards.

Recognition and credit in many applied fields of science can take forms other than scholarly publications—for instance, patents and inventions for engineering or a new treatment of or cure for a disease in clinical medical research. Take engineering as an example: The prestigious IEEE Medal of Honor and the IEEE Edison Medal in Electrical Engineering often go to individuals outside academic circles. In early times, many were inventors and engineers working for electrical companies—such as Alexander Graham Bell, the inventor of the telephone, and Nikola Tesla, who designed the alternating current electricity supply system (Beauchamp, 2015). Contemporary figures such as Kees Schouhamer Immink, known for his contributions to digital storage media, highlight the ongoing recognition of non-academic innovation. Similarly for social sciences, research output significantly includes books and monographs. In a study of publication patterns in 8 European countries (Kulczycki et al., 2018), an average of 56.5% of the research results in social sciences and humanities were published in journal articles and 43.5% in books. In addition, many prestigious prizes in the social sciences are given on the basis of books, such as the ISA Book of the Decade Award within the field of political science and the Viviana Zelizer Best Book Award in within sociology. This diversity in recognition mechanisms facilitates broader acknowledgment of scholars from different backgrounds, which dilutes the concentration of top-tier researchers within traditional academic institutions.

In the field of economics, while book chapters contribute to scholarly discourse, journal publications are often held in higher status. Evaluators typically prioritize the prestige of the publication channel, with articles in top-tier journals receiving greater recognition (Hammarfelt, 2017). 2000 Nobel Prize laureate James Heckman argues that publication in the top five journals “has become a professional standard” (Heckman and Moktan, 2020). However, several leading economic journals edited at prestigious universities have a strong preference for in-house authors. During 2000-2003, 13.89% of articles published in the *Journal of Political Economy* (*JPE*) were by authors at its publishing home, the University of Chicago, and 15.3% and 12.8% of articles published in the Cambridge-based *Quarterly Journal of Economics* (*QJE)* were by authors affiliated with Harvard and MIT, respectively (Wu, 2007). During 2000-2016, the numbers further rose to 14.3% for Chicago affiliates in *JPE*, and 24.7% for Harvard affiliates and 13.9% for MIT affiliates in *QJE* (Heckman and Moktan, 2020). This suggests that the reliance on journal publications as a metric of academic excellence, coupled with a preference for authors from prestigious institutional affiliations, may exacerbate the concentration of recognition within the field of economics.

4.5.2 Field insularity

Field insularity, which is characterized by a preference for intradisciplinary collaboration and a high rate of self-citation within the same field, might also explain variations in institutional concentration. Disciplines characterized by greater insularity are more frequently cited by researchers from other fields than they cite external disciplines, in contrast, fields with a strong interdisciplinary focus are more inclined to reference work from other areas than they are to be cited by them. Furthermore, fields with high interdisciplinarity and frequent collaboration across disciplines tend to exhibit lower levels of institutional concentration, as a result of the contributions of practitioners from diverse backgrounds and the differing prestige of institutions across these backgrounds. Conversely, a field marked by considerable insularity tends to attract researchers from homogeneous backgrounds, which leads to clustering around elite institutions within that discipline.

Prior studies have explored the varying degrees of disciplinary insularity by analyzing citation patterns, and find distinct differences across academic fields. As of 2005, Mathematics emerged as the most insular of six STEM disciplines, with 69.1% of citations occurring within its own category. This sharply contrasts with biotechnology and medicine, with self-citation rates of 11.0% and 9.3%, respectively (Porter and Rafols, 2009). These findings correlate with our analysis, which shows Mathematics displaying a notably higher level of institutional concentration compared with other STEM subjects. Further research, including an examination of publications in the prestigious multidisciplinary journal *Nature*, found that articles with references predominantly from engineering and technology were more likely to be cited by papers from various fields (72%) than by those within the same domain (28%). Conversely, earth and space science papers tended to be cited more frequently within their own field (72%) than by other disciplines (28%) (Gates et al., 2019). Disciplines such as energy, environmental science, and chemistry have notably enhanced their interdisciplinary citation connections (Yan, 2016), which aligns with our observation that these areas have the lowest levels of concentration.

In the realm of social sciences, there is a marked asymmetry in cross-disciplinary citations, with economics as the outlier. During 2000-2009, *American Political Science Review* cites the top 25 economics journals more than five times more frequently than *American Economic Review* cites the leading 25 political science journals. This imbalance is even more pronounced in interactions between economics and sociology, with only 2.3% of citations in *American Sociological Review* directed toward economic literature, compared with a mere 0.3% of economists' citations acknowledging sociological work (Fourcade et al., 2015). Focusing on citations between the top five most influential journals in each discipline, previous research has shown that 43.29% of citations of economics journals are from other disciplines; the percentage is 8.08% for political science, 12.41% for psychology, and 24.75% for sociology (Pieters and Baumgartner, 2002). Furthermore, economics, psychology, and business are identified as the top three exporters in terms of both citations and knowledge surplus (Yan et al., 2013). These outcomes are consistent with our observations on institutional concentration, and suggest that the high and increasing level of concentration in economics may be due to its comparative insularity and upstream position in citation patterns.

4.5.3 Common goals within a field

The degree to which an academic field is centralized may also depend on the presence of a consensual framework of knowledge. This aspect notably distinguishes the natural sciences from the social sciences and further sets economics apart within the latter category. During their long history, the natural sciences have built a highly agreed-upon set of truths as their academic foundation. For example, in 1900, as Lord Baron Kelvin famously stated to the British Association for the Advancement of Science, "There is nothing new to be discovered in physics now. All that remains is more and more precise measurement..." (Passon, 2021). In the 20th century, these exceptions were mainly addressed by the theory of special relativity and quantum mechanics. Furthermore, universal facts are testable in natural sciences through replicable experiments, which allows the scientific finding to be confirmed or discarded. In contrast, the social sciences face challenges in achieving such unity, since findings that are applicable in one social setting may not exist in another; this presents challenges in building a unified structure within the discipline.

The development of a general framework corresponds to three stages of institutional concentration: In the absence of a consensus, the field is naturally fractured into disparate schools and parties. When the field is moving toward a consensus, it is usually concentrated in pioneering schools that push the knowledge frontier forward. And finally, when the general academic framework is agreed upon, the field will proceed to disseminate knowledge further and be divided into specialized subfields. Take physics as an example, in its early development, more than a dozen astronomical systems were used around the world in ancient Greece, India, and China (Collins, 1994). From Newton to Einstein, when the frameworks of modern physics were being established, the discipline was extremely concentrated in European institutions such as Cambridge University and the University of Göttingen (Einstein and Infeld, 1966). Modern physics is a collection of specialized subfields—for example, biophysics, astronomical physics, and nuclear physics are almost non-overlapping subfields within the same discipline. Consequently, different institutions may possess distinct advantages within specific sub-disciplines.

The relationship between institutional focus and consensus formation within a discipline suggests that the observed low concentration in both the natural sciences and social sciences may be due to distinct causes. In the case of the natural sciences, such as life science, chemistry and physics, the low concentration and the decreasing trend of the HHI may be a result of specialization and diversification. Conversely, a general academic framework is still largely under construction for Social Sciences, and results in generally low levels of concentration due to the absence of a unified approach. Furthermore, economics within the social sciences is an exception. Studies have indicated that economists tend to operate within a more cohesive and integrated theoretical framework compared with their peers in other social scientists (Fourcade et al., 2015). Research on interdisciplinary fellowship panels also reveals that economists demonstrated more uniform criteria for evaluating research, greater confidence in their assessments of research quality, and a stronger inclination to align as a group (Lamont, 2009). In contrast, assessments in the humanities and other social sciences were more varied and less unified, which complicates the recognition of significant contributions both internally and externally. Thus, the distinctive concentration in economics may reflect its relatively advanced stage of developing a consensus-based framework—a phase that may also apply to other highly concentrated fields such as electrical engineering and materials engineering.

4.5.4 The role of the United States

Geographic differences could contribute to the variations in institutional concentration observed across academia. The United States, in particular, exhibits a pronounced geographic concentration, which inherently contributes to a narrower institutional focus within the region as opposed to a global context (Maisonobe et al., 2017). Our analysis reveals that the influence of the United States is subject-specific, which in turn affects the degree of institutional concentration and results in academic inequality.

The dominance of the United States is especially evident in the social sciences when compared with the natural sciences. Prior research has found that 78% of Nobel Prize-level discoveries in economics were conducted in the United States; this percentage was 41%, 45%, and 47% for physics, chemistry, and life sciences, respectively (Krauss, 2024). Our dataset shows similar results: 77% of award recipients in economics were employed within the United States, while percentages for the three corresponding Natural Sciences are 48%, 54%, and 61%. Broadening the scope to encompass all tenure-track faculty at U.S. institutions reveals that Social Sciences have lower international representation in doctorate origins—only 7% versus 19% in Natural Sciences (Wapman et al., 2022). Specifically, the field of Psychology not only exhibits the highest rate of U.S.-earned doctorates at 92%, but this insularity is reflected in our findings as well, with 88% of faculty holding U.S. doctorates. Consistent with these patterns of concentration, psychology also registers the third highest Gini coefficient among academic disciplines (0.784), which signals considerable disparities in the distribution of academic prestige.

The prominence of the United States may also account for the observed discrepancies in institutional concentration among the six selected engineering disciplines. Prior findings indicate that electrical, materials, and mechanical Engineering show notably higher levels of concentration than civil, energy, and environmental engineering. This is further illustrated by the proportion of U.S. employment: The former group exhibits an approximately 80% U.S. employment ratio, in contrast to the latter's substantially lower 55%. Such geographic disparities are mirrored in the degree of institutional concentration observed within these fields.

However, these data should be interpreted with caution. Selection bias favors the United States in terms of both the selection of the prizes and the recognition for seminal contributions, U.S. organizations have founded many prestigious awards across various fields, including those from the Lasker Foundation, the Institute of Electrical and Electronics Engineers (IEEE), the Franklin Institute, and the American Psychological Association (APA). These awards, although international in scope, may tend to favor own-country candidates (Crawford, 2002). Furthermore, this national preference extends beyond awards to journals, journal editors (Hodgson and Rothman, 1999), and citation practices (Gomez et al., 2022), all of which potentially influence the evaluation of scientific contributions. While a correlation exists between geographic and institutional concentration, it is crucial to recognize that selection bias may intensify this relationship.

We provide a further robustness check by calculating the institutional concentration of U.S. based institutions only. Results are shown in Figure O11. Economics remains the discipline with the highest concentration in terms of both education and employment. While the overall distribution aligns with previous observations, highly concentrated subjects with a large U.S. employment rate—such as psychology and materials engineering—exhibit a decrease in relative HHI position. This underscores the influence of geographic concentration on institutional concentration; however many other mechanisms could be in play.

4.5.5 Transferring knowledge to the industry

Variations in collaboration patterns between academia and industry may also contribute to the observed disparities in concentration levels across different fields. Disciplines that frequently engage with industry in *consulting roles*, such as economics and electrical engineering, tend to demonstrate higher concentration levels. This is attributed to the fact that consulting opportunities are often associated with higher-ranked universities. In contrast, fields that engage with industry primarily for *research purposes*, such as life sciences and chemistry, or those with minimal industry collaboration, such as mathematics and earth sciences, are characterized by lower concentration levels. For the former group, research collaborations encourage a wider distribution of academic activity, and thereby reduce concentration. As for disciplines less reliant on industry collaboration, institutional concentration is less influenced by reputational factors due to their limited industry interactions.

Previous research finds that departments and institutions that focus on engineering, the natural sciences, and economics/management exhibit a higher propensity for engaging in knowledge and technology transfer with the private sector, as opposed to those specialized in fields such as medicine, mathematics, or physics (Arvanitis et al., 2008). Also, it has been found that educational interactions surpass research collaborations as the primary mode of academia-industry engagement, with the latter significant only in technical disciplines (Kotiranta et al., 2020). This distinction underscores the difference between knowledge *transferred into* the industry versus conducting *industry-based research*, such as medical research undertaken in hospitals and clinics. Prestige plays a critical role in the former mechanism, while the latter lowers concentration by offering researchers alternative platforms for conducting research.

In focusing on the comparison of economics with other social sciences, it is clear that economics stands apart based on its deep involvement with public administration, corporate strategy, and international organizations. Economists apply their knowledge across the spectrum of public policy: They are heavily represented within finance ministries, central banks, government branches, global organizations, and leading consultancy firms, and often play influential roles (Montecinos et al., 2009). In contrast, disciplines such as sociology and political science typically adopt a more contemplative and critical stance; And seldom stepping in with fixes and remedies—a reflection of both opportunity and inclination (Fourcade et al., 2015). Economics' affinity to applied research in finance, management, and public policy fosters a nexus with both the corporate and governmental sectors. This proclivity for practical intervention is correlated with a higher concentration of economists in prestigious academic institutions.

5 Conclusion

We collect the lifetime biographical data on a set of award-winning scientists at the very right tail of the academic productivity distribution. By doing so, we are able to document the institutional concentration of high-achieving individuals.

By comparing 18 disciplines from the natural sciences, engineering, and social sciences, we find that economics is the only discipline that exhibits a high and increasing trend of institutional concentration. Other subjects show a low and decreasing trend of concentration. This suggests that the production of knowledge may differ fundamentally in economics. We identify factors that could explain this anomaly, and show that the institutional concentration of researchers could be explained by the reliance on physical capital, maturity of the discipline, role of prestige, and other disciplinary norms. These channels are not meant to be comprehensive. Further investigation is essential for a more holistic explanation of observed phenomenon.

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Online Appendix

A Additional tables and figures

Table O1: Awards

Award name and website	# recipients
Mathematics	
The Abel Prize	25
Fields Medal	64
Wolf Prize in Mathematics	65
Crafoord Prize in Mathematics	13
The Shaw Prize in Mathematical Sciences	29
Rolf Nevanlinna Prize	11
The Mirzakhani Prize—formerly the NAS Award in Mathematics	9
Bocher Memorial Prize	37
George David Birkhoff Prize in Applied Mathematics	19
Norbert Wiener Prize in Applied Mathematics	20
Oswald Veblen Prize in Geometry	37
Leroy P. Steele Prize for Lifetime Achievement	33
Rolf Schock Prize in Mathematics	14
Breakthrough Prize in Mathematics	14
Physics	
Nobel Prize in Physics	222
Wolf Prize in Physics	68
Isaac Newton Medal	15
Max Planck Medal	86
Breakthrough Prize in Fundamental Physics	38
Special Breakthrough Prize in Fundamental Physics	16
Physics Frontiers Prize	10
Lorentz Medal	24
Henri Poincare Prize	30
Benjamin Franklin Medal in Physics	39
UNESCO Niels Bohr Medal	10
Life sciences	

Continued on next page

Table O1: Awards (continued)

Award name and website	# recipients
Nobel Prize in Physiology or Medicine	225
Albert Lasker Basic Medical Research Award	167
Lasker-DeBakey Clinical Medical Research Award	156
Lasker-Koshland Special Achievement Award in Medical Science	17
The Canada Gairdner International Award	367
Canada Gairdner Global Health Award	17
The Shaw Prize in Life Science and Medicine	37
Wolf Prize in Medicine	64
Crafoord Prize in Biosciences	17
The Kavli Prize in Neuroscience	24
Breakthrough Prize in Life Sciences	58
Benjamin Franklin Medal in Life Science	28
Heineken Prize for Medicine	18
Heineken Prize for Biochemistry and Biophysics	27
Chemistry	
Nobel Prize in Chemistry	191
Wolf Prize in Chemistry	61
Priestley Medal	88
Welch Award in Chemistry	56
NAS Award in Chemical Science	43
Benjamin Franklin Medal in Chemistry	26
Faraday Lectureship Prize	37
The Davy Medal	146
Peter Debye Award for Physical Chemistry	56
Roger Adams Award in Organic Chemistry	33
Earth sciences	
Crafoord Prize in Geosciences	17
Wollaston Medal	195
Penrose Medal	97
Vetlesen Prize	33
Benjamin Franklin Medal in Earth and Environmental Science	25
Arthur L. Day Prize and Lectureship	18

Continued on next page

Table O1: Awards (continued)

Award name and website	# recipients
Arthur L. Day Medal	76
Carl-Gustaf Rossby Research Medal in Atmospheric Science	68
Alexander Agassize Medal in Oceanography	48
A.G. Huntsman Award for Excellence in Marine Sciences	47
G. K. Warren Prize for Fluviatile Geology	13
International Meteorological Organization Prize	67
Astronomy	
Crafoord Prize in Astronomy	13
The Kavli Prize in Astrophysics	19
The Shaw Prize in Astronomy	36
The Gold Medal from the Royal Astronomical Society	257
The Bruce Medal	114
Dannie Heineman Prize for Astrophysics	48
James Craig Watson Medal	48
Henry Draper Medal	56
Electrical & Informational Engineering	
Turing Award	76
IEEE Medal of Honor	103
IEEE Edison Medal	110
IEEE John von Neumann Medal	34
Benjamin Franklin Medal in Electrical Engineering	25
Benjamin Franklin Medal in Computer and Cognitive Science	27
The Okawa Prize	58
Knuth Prize	22
Royal Society Milner Award	11
W. Wallace McDowell Award	32
BBVA Foundation Frontiers of Knowledge Award in Information and Communication Technologies	21
Civil engineering	
Freyssinet Medal	13
IABSE Medal of Merit	45
IABSE Honorary Membership	67

Continued on next page

Table O1: Awards (continued)

Award name and website	# recipients
Theodore von Karman Medal	61
FIB Medal of Merit	30
Energy engineering	
Eni Award	98
Enrico Fermi Award	65
The Global Energy Award	47
Environmental engineering	
Tyler Prize for Environmental Achievements	79
Volvo Environmental Prize	51
Stockholm Water Prize	34
BBVA Foundation Frontiers of Knowledge Award in Ecology and Conservation Biology	27
BBVA Foundation Frontiers of Knowledge Award in Climate Change	22
Heineken Prize in Environmental Sciences	17
The Zayed International Prize for the Environment	9
Materials engineering	
MRS Von Hippel Award	47
MRS Medal	55
David Turnbull Lectureship	32
Outstanding Early Career Investigator Award	36
Armourers and Braisiers Company Prize	20
Mechanical engineering	
ASME Medal	91
Timoshenko Medal	70
Benjamin Franklin Medal in Mechanical Engineering	13
Gibbs Brothers Medal	18
Economics	
The Sveriges Riksbank Prize in Economic Sciences	93
John Bates Clark Medal	45
The Frisch Medal Award	44
The John von Neumann Award	29
The IZA Prize in Labor Economics	21

Continued on next page

Table O1: Awards (continued)

Award name and website	# recipients
The Jacob Mincer Award	22
The Deutsche Bank Prize in Financial Economics	6
Stephen A. Ross Award	16
Leontief Prize for Advancing the Frontiers of Economic Thought	34
The Erwin Plein Nemmers prize in Economics	14
The Fischer Black Prize	10
BBVA Foundation Frontiers of Knowledge Award in Economics, Finance and Management	25
Political Science & International Affairs	
The Johan Skytte Prize in Political Science	29
ECPR Lifetime Achievement Award	10
Karl Deutsch Award of the International Political Science Association	10
Karl Deutsch Award of the International Studies Association	39
ISA Foreign Policy Analysis Section Distinguished Scholar Award	32
ISA International Political Economy Section Distinguished Scholar Award	33
ISA THEORY Distinguished Scholar Award	7
ISA Book of the Decade Award	7
IPSA Foundation Mattei Dogan Award	7
Juan Linz Prize	4
Sir Isaiah Berlin Prize	23
Sociology	
ISA Award for Excellence in Research and Practice	3
European Amalfi Prize for Sociology and Social Sciences	21
British Journal of Sociology Prize	4
Adam Podgorecki Prize	20
The Balzan Prize	4
Roger V. Gould Prize	34
William F. Ogburn Career Achievement Award	22
Viviana Zelizer Best Book Award	33
W.E.B. Du Bois Career of Distinguished Scholarship Award	44
Linton C. Freeman Award	13
Law	

Continued on next page

Table O1: Awards (continued)

Award name and website	# recipients
The Stockholm Prize in Criminology	32
Law and Society Association International Prize	18
Harry J. Kalven, Jr. Prize	46
Peter Birks Prize	10
Francis Deak Prize	52
Canada Prize of the International Academy of Comparative Law	7
Hessel Yntema Prize	31
Manley O'Hudson Medal	44
European Association of Law and Economics Award	12
Edwin H. Sutherland Award	62
Tang Prize in the Rule of Law	5
Education	
AERA Distinguished Contributions to Research in Education Award	62
E. F. Lindquist Award	52
E. L. Thorndike Career Achievement Award	60
AERA Outstanding Book Award	58
Oeuvre Award for Outstanding Contributions to the Science of Learning and Instruction	16
John Nisbet Award	18
Yidan Prize	15
LRA Distinguished Scholar Lifetime Achievement Award	21
Grawemeyer Award in Education	41
NCME Career Contribution Award to Educational Measurement	11
SSSR Distinguished Scientific Contributions Award	11
CIES Honorary Fellows Award	38
Psychology	
APA Award for Distinguished Scientific Contributions	217
APA Award for Outstanding Lifetime Contributions to Psychology	35
APA Award for Distinguished Contributions to the International Advancement of Psychology	38
APA Award for Distinguished Professional Contributions to Applied Research	48

Continued on next page

Table O1: Awards (continued)

Award name and website	# recipients
APA Distinguished Scientific Award for the Applications of Psychology	56
APA Distinguished Scientific Award for an Early Career Contribution to Psychology	185
APS James McKeen Cattell Fellow Award	104
APS William James Fellow Award	187
APS James S. Jackson Lifetime Achievement Award for Transformative Scholarship	7
Atkinson Prize in Psychological and Cognitive Sciences	12

Table O2: Top 10 affiliations for each subject ranked by the number of recipients

Institute name	# of recipients	% of recipients
Mathematics		
Number of Awards: 14		
Number of Recipients: 261		
Number of Institutions: 233		
Princeton University	87	33.33
Institute for Advanced Study	57	21.84
Harvard University	57	21.84
Massachusetts Institute of Technology	56	21.46
University of California, Berkeley	47	18.01
New York University	43	16.48
University of Chicago	40	15.33
Stanford University	39	14.94
École normale supérieure	23	8.81
University of Cambridge	22	8.43
Physics		
Number of Awards: 11		
Number of Recipients: 427		
Number of Institutions: 390		
Princeton University	67	15.69
Harvard University	59	13.82
University of Cambridge	54	12.65
University of California, Berkeley	51	11.94
Massachusetts Institute of Technology	50	11.71
University of Chicago	38	8.90
California Insitute of Technology	38	8.90
Stanford University	37	8.67
CERN	37	8.67
Columbia University	35	8.20
Chemistry		
Number of Awards: 10		
Number of Recipients: 496		
Number of Institutions: 490		

Continued on next page

Table O2: Top 10 affiliations (continued)

Institute name	# of recipients	% of recipients
Harvard University	94	18.95
University of Cambridge	66	13.31
University of California, Berkeley	64	12.90
University of Oxford	55	11.09
Massachusetts Institute of Technology	52	10.48
Columbia University	46	9.27
California Institute of Technology	41	8.27
Imperial College London	38	7.67
University of Chicago	37	7.46
Stanford University	34	6.86
Life Science		
Number of Awards: 14		
Number of Recipients: 762		
Number of Institutions: 682		
Harvard University	140	18.37
National Institutes of Health	86	11.29
University of Cambridge	79	10.37
Johns Hopkins University	67	8.79
Rockefeller University	64	8.40
Columbia University	63	8.27
Yale University	54	7.09
University of California, Berkeley	50	6.56
University of Oxford	47	6.17
Stanford University	45	5.91
Astronomy		
Number of Awards: 8		
Number of Recipients: 320		
Number of Institutions: 257		
University of Cambridge	66	20.63
California Institute of Technology	55	17.19
Harvard University	41	12.81
Princeton University	40	12.50

Continued on next page

Table O2: Top 10 affiliations (continued)

Institute name	# of recipients	% of recipients
University of California, Berkeley	35	10.94
University of Chicago	30	9.38
Massachusetts Institute of Technology	25	7.81
University of Oxford	22	6.88
Carnegie Institution for Science	21	6.56
Cornell University	18	5.63
Earth Sciences		
Number of Awards: 12		
Number of Recipients: 453		
Number of Institutions: 389		
Massachusetts Institute of Technology	63	13.91
University of Cambridge	57	11.04
Harvard University	50	11.04
University of Chicago	41	9.05
Columbia University	33	7.28
United States Geological Survey	32	7.06
California Institute of Technology	29	6.40
University of California, San Diego	29	6.40
Yale University	29	6.40
Princeton University		5.74
Electrical Engineering		
Number of Awards: 11		
Number of Recipients: 444		
Number of Institutions: 338		
Massachusetts Institute of Technology	105	23.65
Bell Laboratories	73	16.44
Stanford University	67	15.09
University of California, Berkeley	60	13.51
Harvard University	49	11.04
IBM Laboratories	38	8.56
Carnegie Mellon University	33	7.43
Princeton University	32	7.21

Continued on next page

Table O2: Top 10 affiliations (continued)

Institute name	# of recipients	% of recipients
Columbia University	31	6.98
University of Illinois-Urbana Champaign	26	5.86
Civil Engineering		
Number of Awards: 5		
Number of Recipients: 171		
Number of Institutions: 177		
University of California, Berkeley	17	9.94
Columbia University	13	7.60
ETH Zurich	12	7.02
California Institute of Technology	12	7.02
Brown University	12	7.02
Massachusetts Institute of Technology	11	6.43
Lehigh University	10	5.85
University of Cambridge	9	5.26
University of Illinois-Urbana Champaign	9	5.26
Northwestern	8	4.68
Energy Engineering		
Number of Awards: 3		
Number of Recipients: 196		
Number of Institutions: 281		
University of California, Berkeley	28	14.29
Massachusetts Institute of Technology	19	9.69
Stanford University	18	9.18
University of Chicago	18	9.18
California Institute of Technology	15	7.65
Harvard University	13	6.63
University of Cambridge	13	6.63
Cornell University	12	6.12
Russian Academy of Sciences	12	6.12
Princeton University	12	6.12
Environmental Engineering		
Number of Awards: 7		

Continued on next page

Table O2: Top 10 affiliations (continued)

Institute name	# of recipients	% of recipients
Number of Recipients: 186		
Number of Institutions: 301		
University of California, Berkeley	24	12.90
Harvard University	23	12.37
Stanford University	16	8.60
Massachusetts Institute of Technology	14	7.53
Yale University	12	6.45
Princeton University	12	6.45
University of Cambridge	12	6.45
University of California, San Diego	11	5.91
Cornell University	11	5.91
University of Oxford	11	5.91
Materials Engineering		
Number of Awards: 5		
Number of Recipients: 166		
Number of Institutions: 162		
Massachusetts Institute of Technology	33	19.88
University of Cambridge	28	16.87
University of California, Berkeley	21	12.65
Harvard University	21	12.65
University of Illinois-Urbana Champaign	18	10.84
Stanford University	18	10.84
Northwestern University	16	9.64
Princeton University	11	6.63
California Institute of Technology	10	6.02
Cornell University	10	6.02
Mechanical Engineering		
Number of Awards: 4		
Number of Recipients: 165		
Number of Institutions: 169		
Massachusetts Institute of Technology	31	18.79
Brown University	22	13.33

Continued on next page

Table O2: Top 10 affiliations (continued)

Institute name	# of recipients	% of recipients
University of California, Berkeley	16	9.70
University of Cambridge	15	9.09
Stanford University	15	9.09
California Institute of Technology	15	9.09
Cornell University	15	9.09
Columbia University	11	6.67
Harvard University	11	6.67
University of Illinois-Urbana Champaign	9	5.45
Economics		
Number of Awards: 12		
Number of Recipients: 259		
Number of Institutions: 249		
Harvard University	96	37.07
Massachusetts Institute of Technology	80	30.89
University of Chicago	65	25.10
Yale University	59	22.78
Princeton University	58	22.39
Stanford University	55	21.24
University of California, Berkeley	46	17.76
Columbia University	36	13.90
London School of Economics	32	12.36
University of Oxford	27	10.42
Political Sciences and International Affairs		
Number of Awards: 11		
Number of Recipients: 158		
Number of Institutions: 227		
Harvard University	38	24.05
Stanford University	30	18.99
Columbia University	26	16.46
Yale University	24	15.19
University of Chicago	20	12.66
Princeton University	19	12.03

Continued on next page

Table O2: Top 10 affiliations (continued)

Institute name	# of recipients	% of recipients
University of Oxford	17	10.76
University of Michigan	17	10.76
University of California, Berkeley	16	10.13
Ohio State University	13	8.23
Sociology		
Number of Awards: 10		
Number of Recipients: 185		
Number of Institutions: 264		
Columbia University	33	17.84
Harvard University	33	17.84
University of Chicago	31	16.76
University of California, Berkeley	30	16.22
Stanford University	19	10.27
University of Michigan	18	9.73
Princeton University	17	9.19
Northwestern University	14	7.57
University of Wisconsin-Madison	13	7.03
New York University	13	7.03
Law		
Number of Awards: 11		
Number of Recipients: 252		
Number of Institutions: 252		
Harvard University	44	17.46
Yale University	40	15.87
University of London	29	11.51
University of Chicago	28	11.11
Columbia University	27	10.71
University of Cambridge	23	9.13
University of Oxford	22	8.73
University of Wisconsin-Madison	19	7.54
University of California, Berkeley	17	6.75
New York University	17	6.75

Continued on next page

Table O2: Top 10 affiliations (continued)

Institute name	# of recipients	% of recipients
Education		
Number of Awards: 12		
Number of Recipients: 294		
Number of Institutions: 335		
Harvard University	58	19.73
Stanford University	52	17.69
University of Chicago	43	14.63
Columbia University	32	10.88
University of California, Berkeley	28	9.52
University of Michigan	28	9.52
University of Illinois-Urbana Champaign	25	8.50
University of California, Los Angeles	24	8.16
University of Wisconsin-Madison	21	7.14
University of Pennsylvania	20	6.80
Psychology		
Number of Awards: 10		
Number of Recipients: 589		
Number of Institutions: 360		
Harvard University	133	22.58
Yale University	94	15.96
University of Michigan	75	12.73
Stanford University	74	12.56
University of Pennsylvania	62	10.53
University of California, Berkeley	52	8.83
Columbia University	47	7.98
University of Illinois-Urbana Champaign	44	7.47
University of California, Los Angeles	44	7.47
University of Minnesota	43	7.30

Table O3: Ranking of economics affiliations by time share

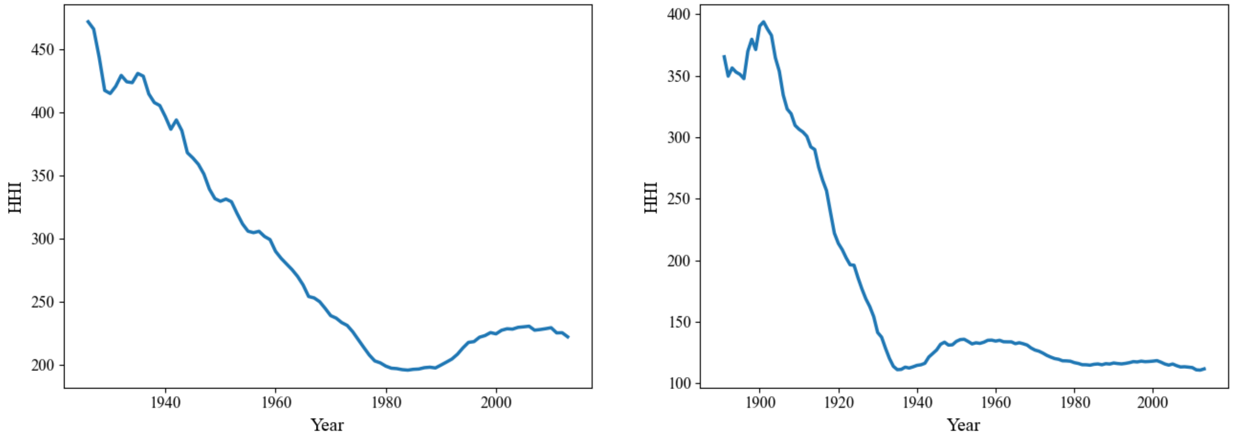
Institute name	% time	Ranking
Harvard University	10.94	1
University of Chicago	8.03	2
Massachusetts Institute of Technology	7.63	3
Stanford University	6.40	4
Princeton University	4.88	5
Yale University	4.25	6
University of California, Berkeley	4.02	7
Columbia University	3.34	8
London School of Economics and Political Science	3.03	9
University of Oxford	2.32	10
University of Pennsylvania	2.17	11
University of Cambridge	2.16	12
Cornell University	1.73	13
Carnegie Mellon University	1.58	14
Northwestern University	1.53	15
New York University	1.35	16
Hebrew University of Jerusalem	1.31	17
University of Minnesota	1.25	18
University of Massachusetts Amherst	1.14	19
Tel Aviv University	1.08	20
University College London	0.95	21
University of Oslo	0.91	22
University of Michigan	0.87	23
University of California, Los Angeles	0.87	23
University of Manchester	0.77	25
Stockholm University	0.69	26
University of Sussex	0.68	27
University of Maryland-College Park	0.67	28
Boston University	0.62	29
University of California, San Diego	0.59	30
The New School	0.54	31
University of Texas at Austin	0.54	32

Continued on next page

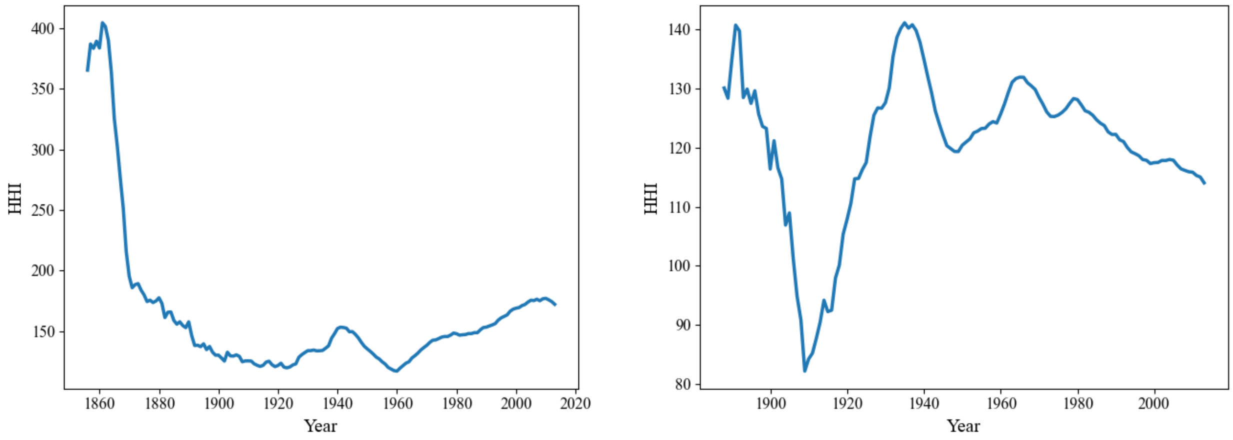
Table O3: Ranking of economics affiliations by time share (continued)

Institute name	% time	Ranking
University of California,Santa Barbara	0.53	33
University of Wisconsin-Madison	0.52	34
Brown University	0.51	35
École Nationale Supérieure des Mines de Nancy	0.48	36
Washington University in St.Louis	0.47	37
Erasmus University Rotterdam	0.47	38
University of Washington	0.41	39
University of Delhi	0.38	40
California Institute of Technology	0.37	41
Indiana University	0.37	41
University of Southern California	0.37	43
Autonomous University of Barcelona	0.37	43
Stockholm School of Economics	0.36	45
Jawaharlal Nehru University	0.35	46
City College of New York	0.35	46
RAND Corporation	0.32	48
Institute for Advanced Study	0.29	49
Duke University	0.29	49

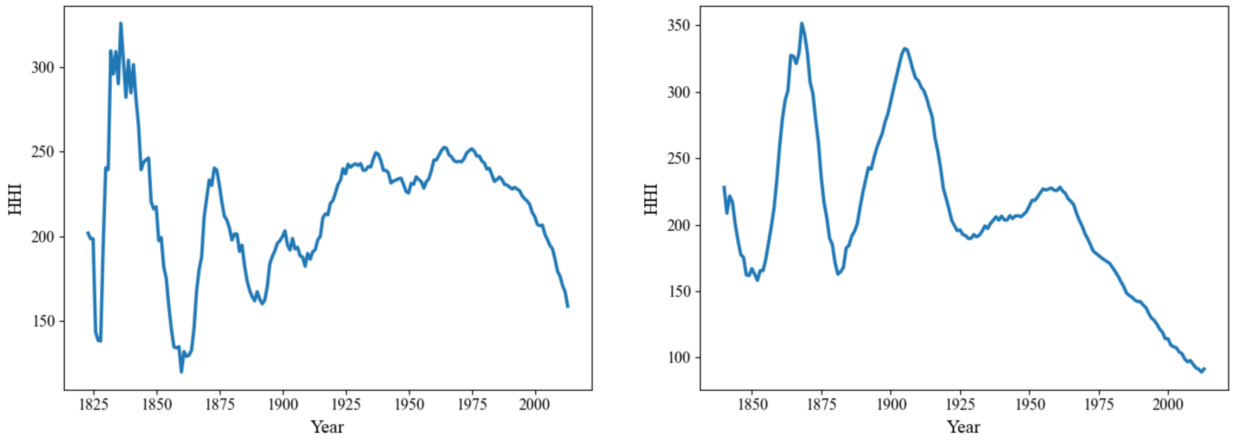
Figure O1: Normalized HHI: Natural Sciences


(1) Mathematics

(2) Physics


(3) Chemistry

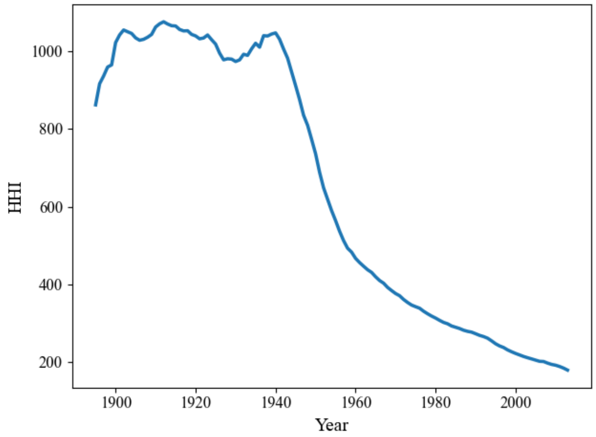
(4) Life Sciences


(5) Astronomy

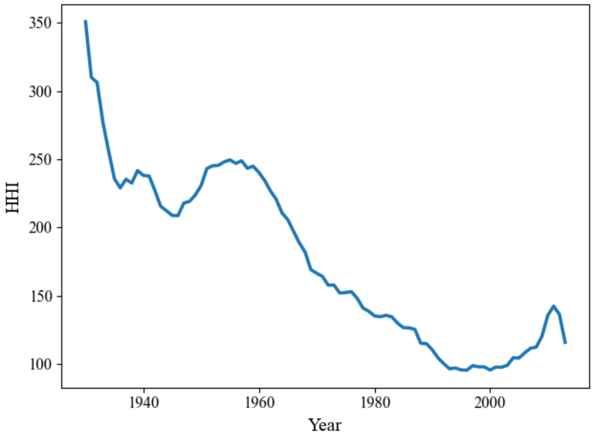
(6) Earth Sciences

Figure O1: Normalized HHI (continued): Engineering

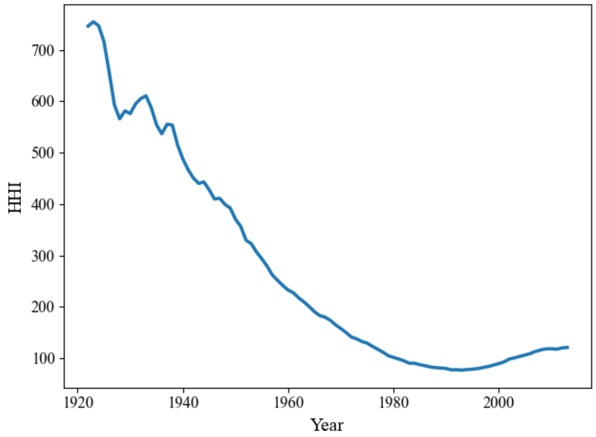
(7) Electrical & Informational Engineering



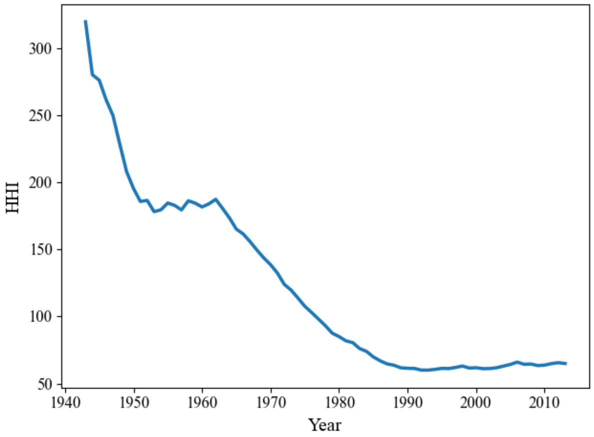
(8) Civil Engineering



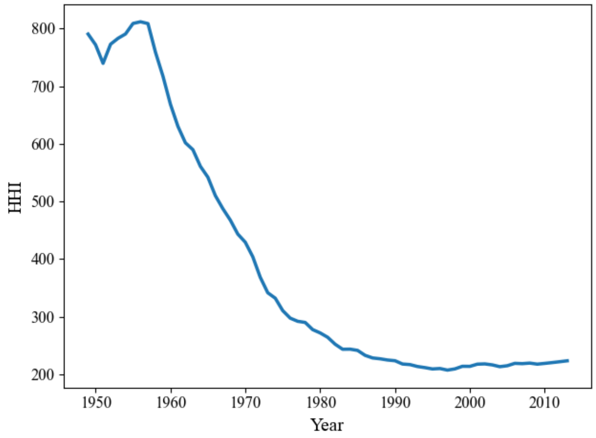
(9) Energy Engineering



(10) Environmental Engineering



(11) Materials Engineering



(12) Mechanical Engineering

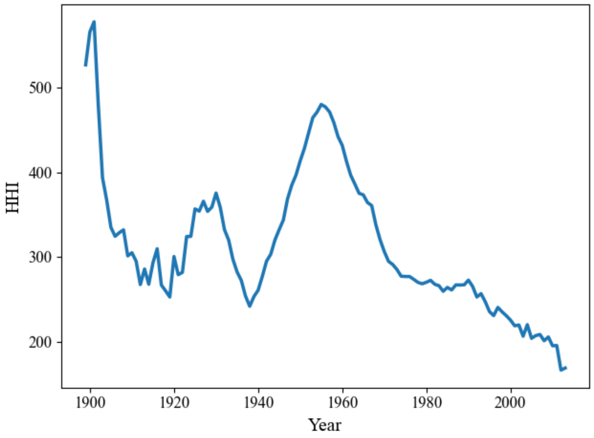
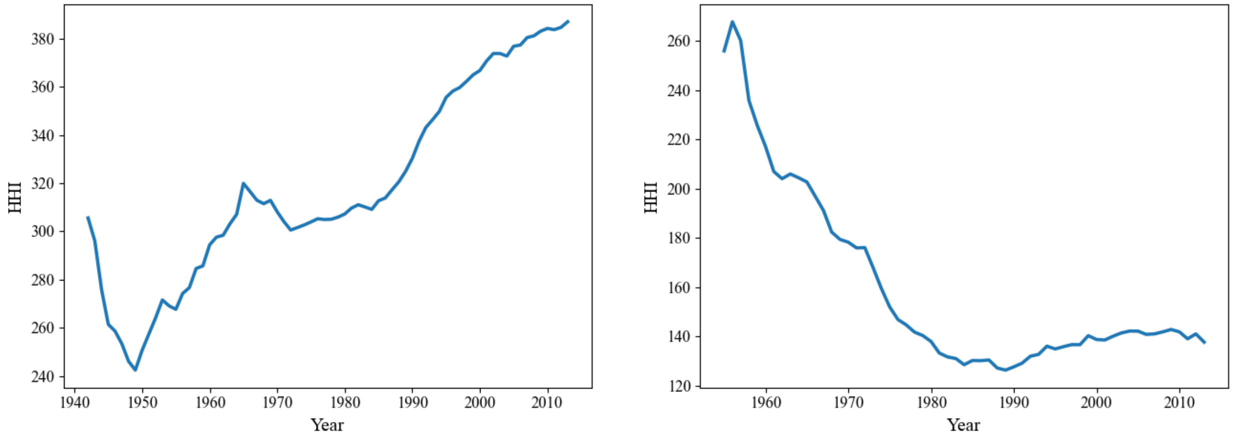
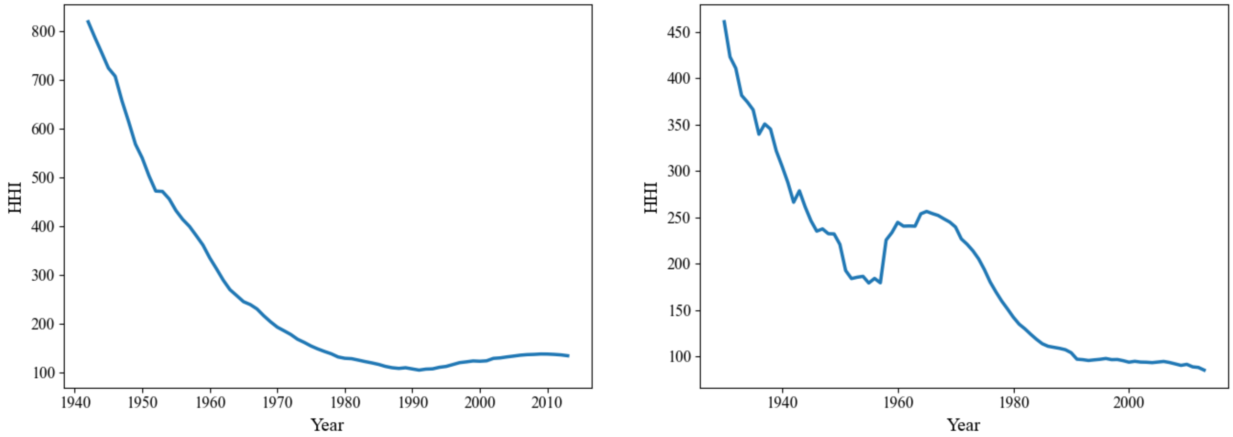


Figure O1: Normalized HHI (continued): Social Sciences

(13) Economics (14) Political Science & International Affairs



(15) Sociology (16) Law



(17) Education (18) Psychology

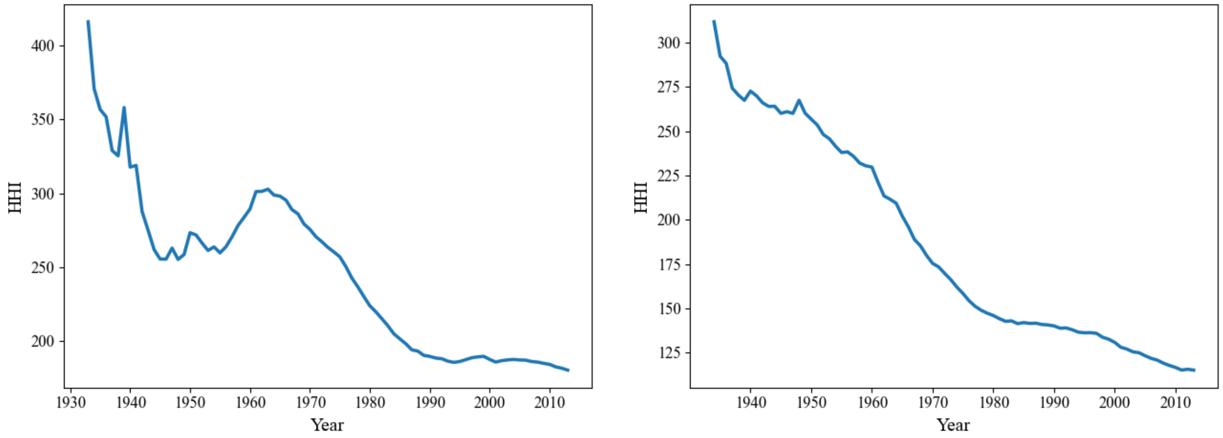
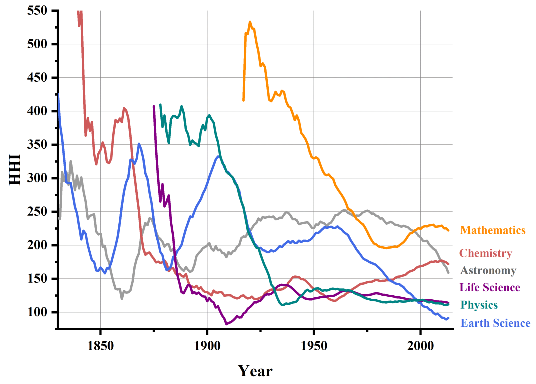
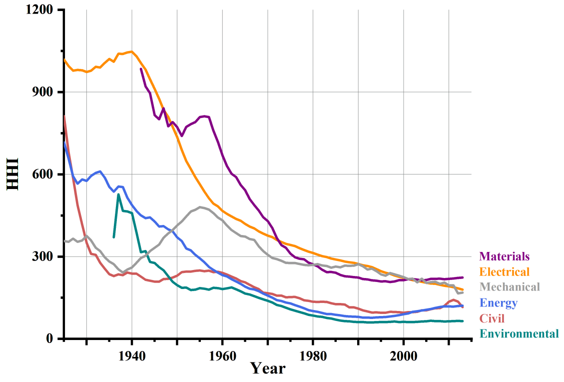


Figure O2: Employment HHI

Natural Sciences



Engineering



Social Sciences

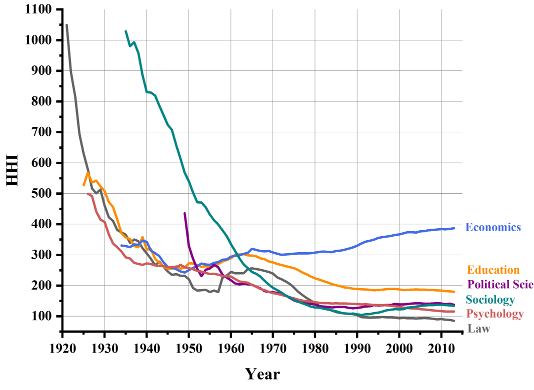
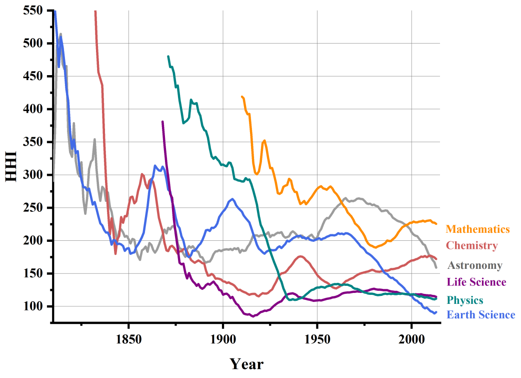
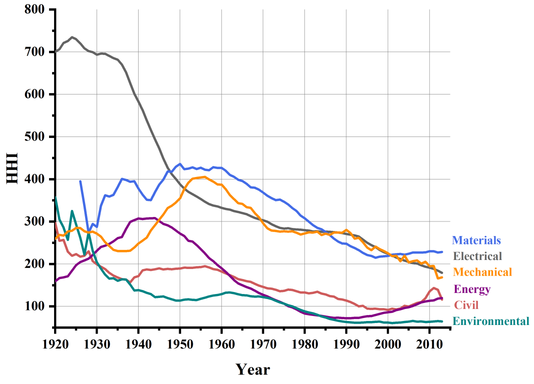


Figure O3: Employment and education HHI

Natural Sciences



Engineering



Social Sciences

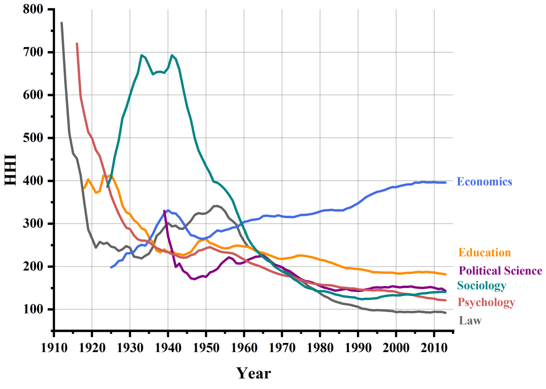
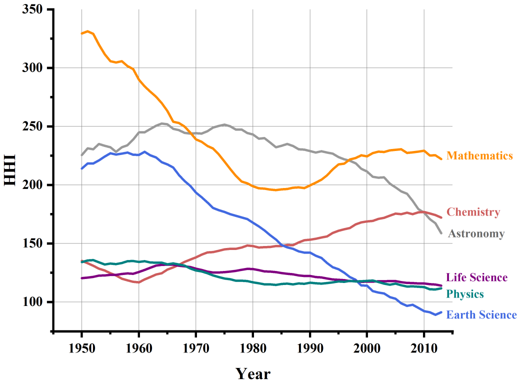
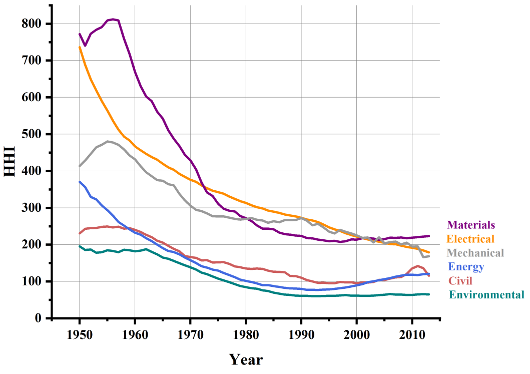


Figure O4: HHI after 1950

Natural Sciences



Engineering



Social Sciences

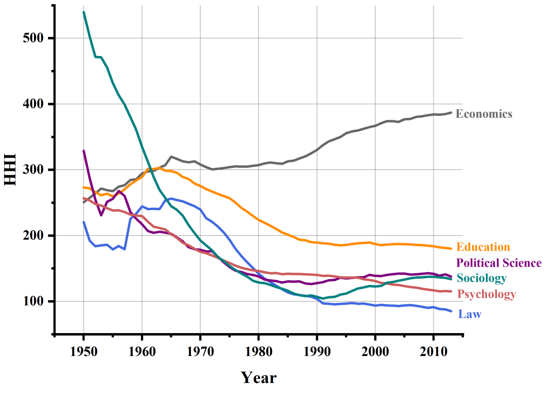
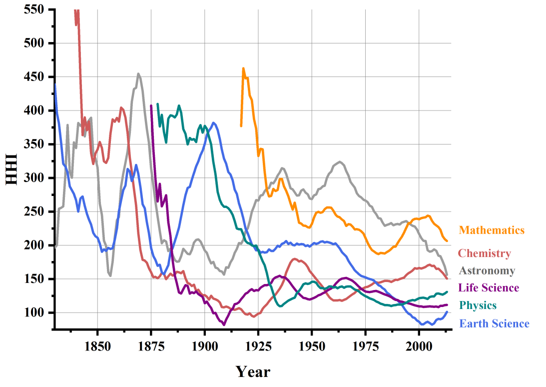
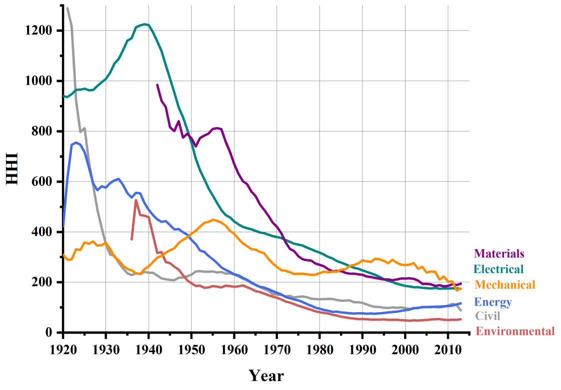


Figure O5: HHI until laureate year

Natural Sciences



Engineering



Social Sciences

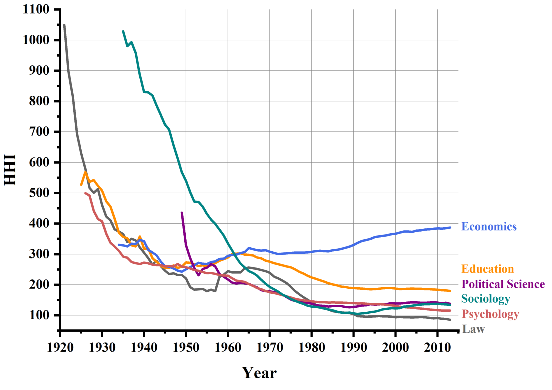
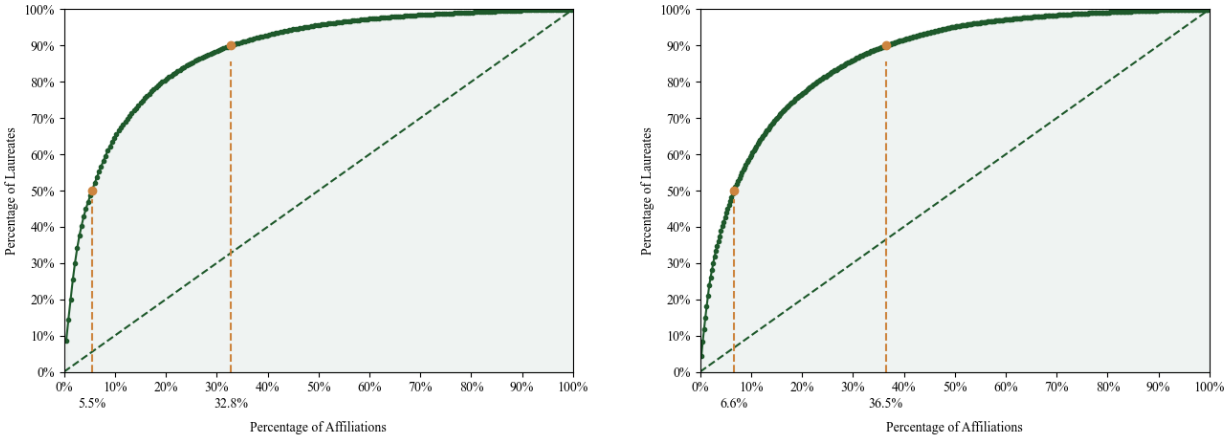
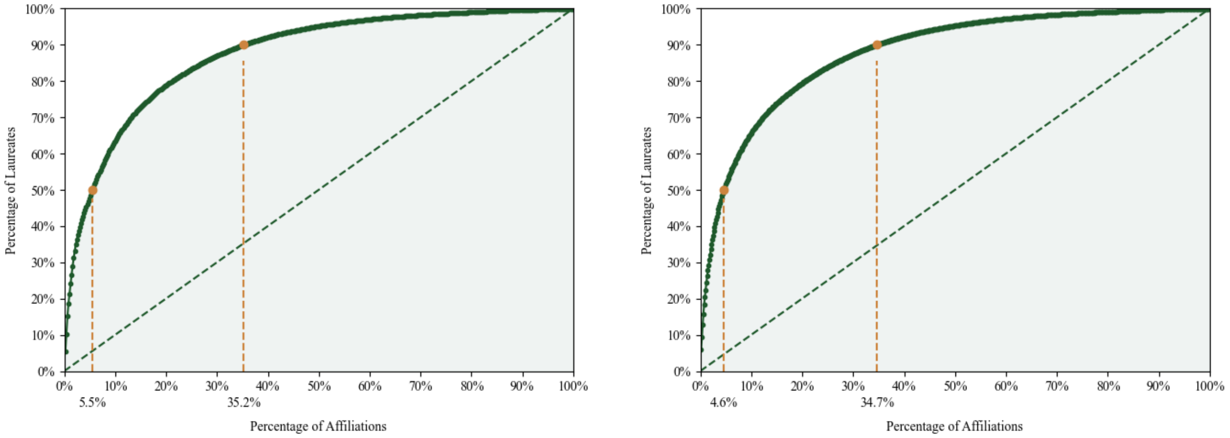


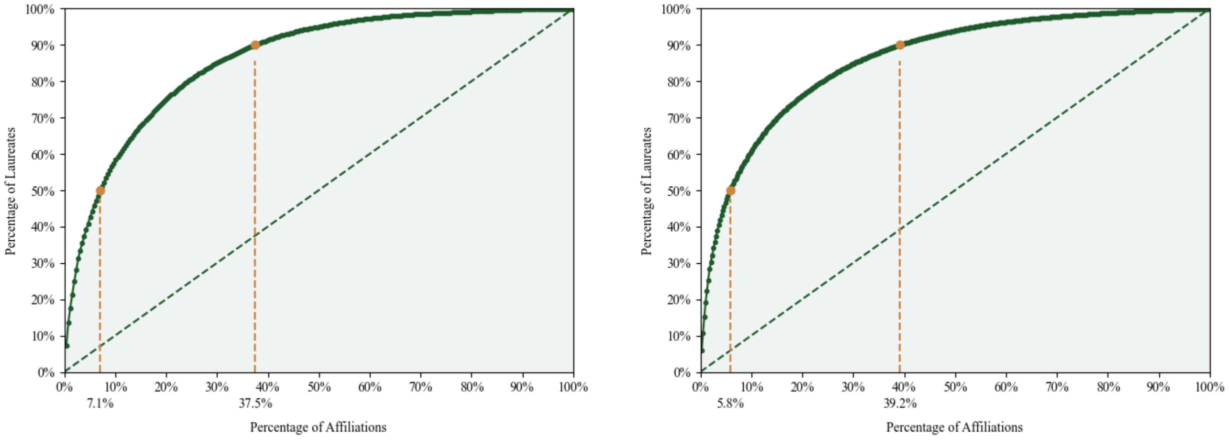
Figure O6: Lorenz curve: Natural Sciences


(1) Mathematics

(2) Physics

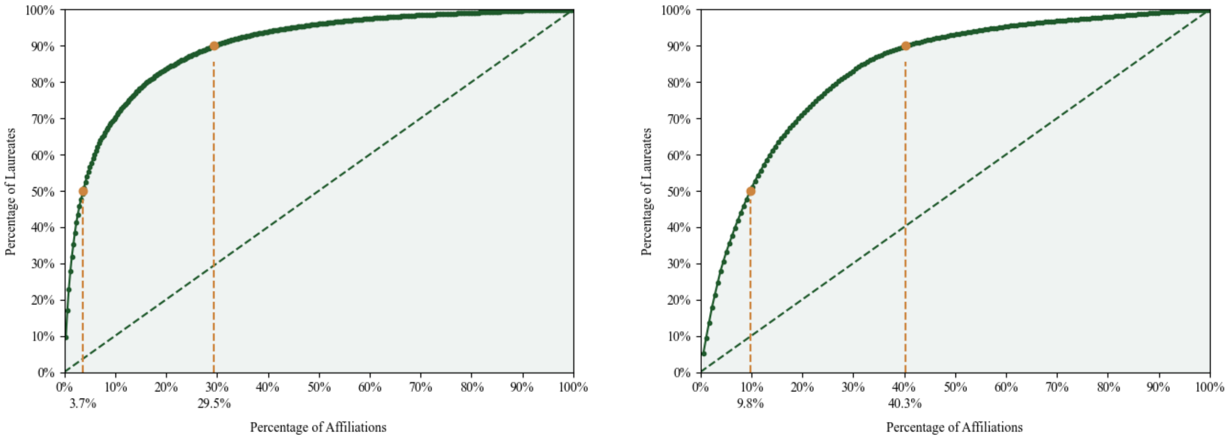

(3) Chemistry

(4) Medicine

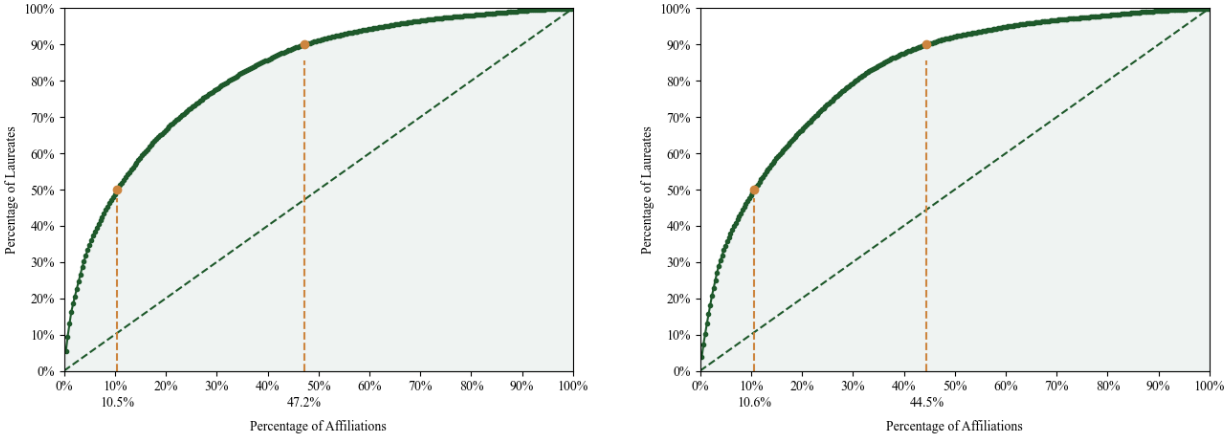

(5) Astronomy

(6) Earth Sciences

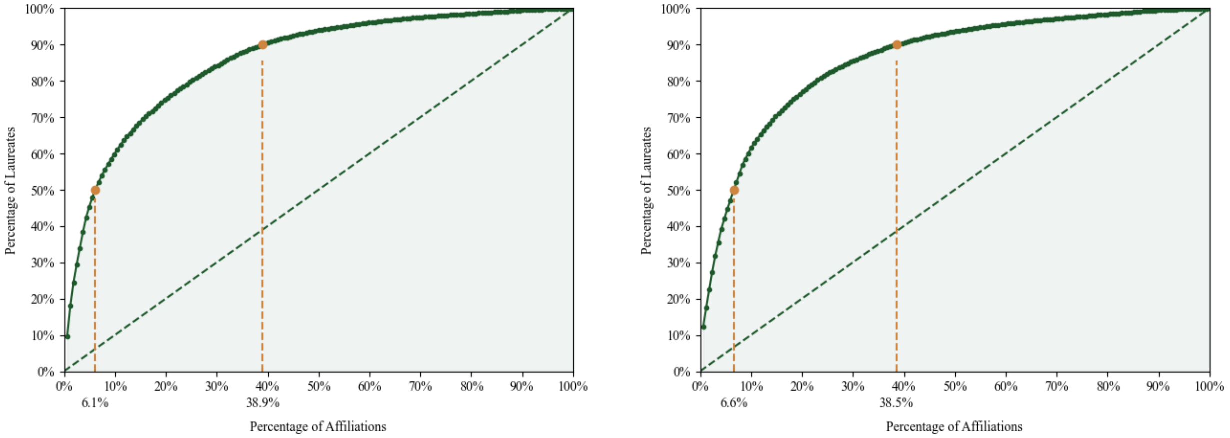
Figure O6: Lorenz curve: Engineering


(7) Electrical & Informational Engineering

(8) Civil Engineering

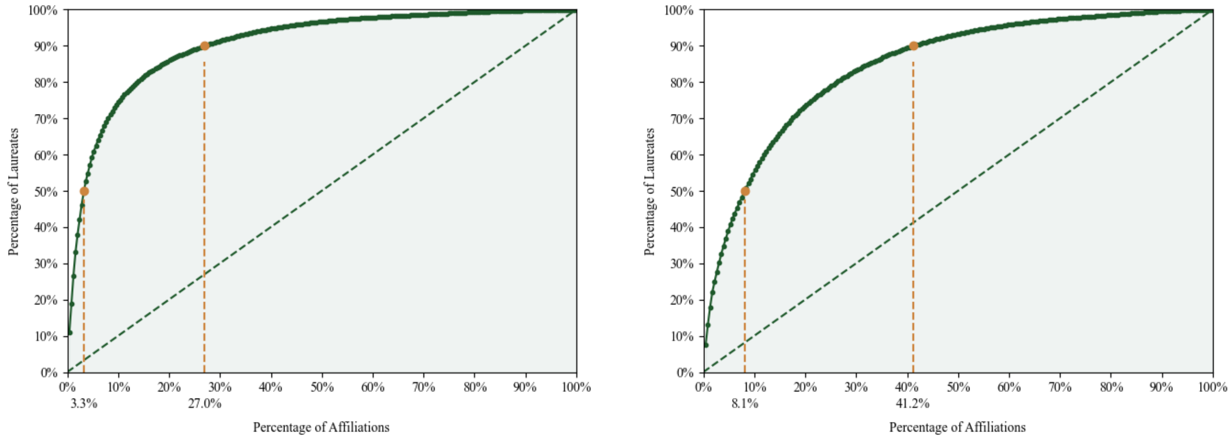

(9) Energy Engineering

(10) Environmental Engineering

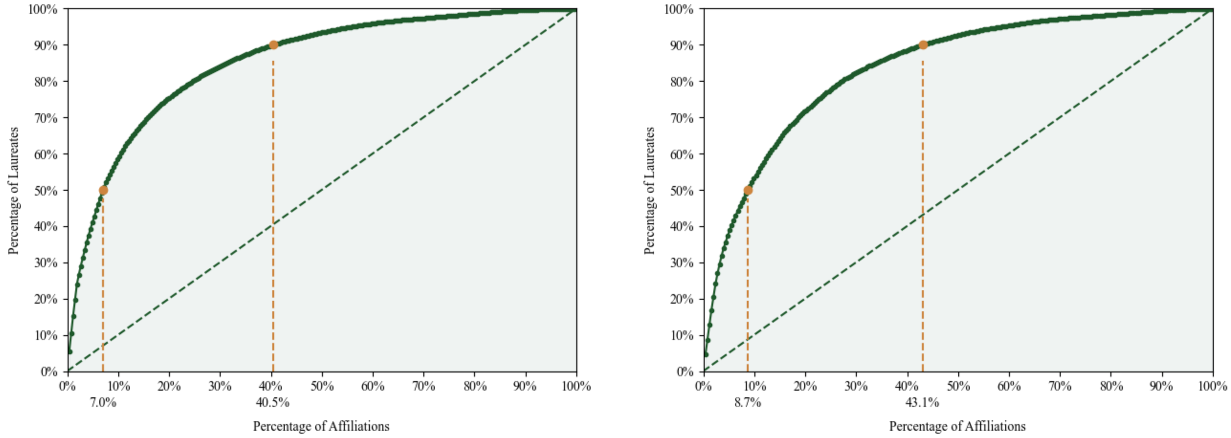

(11) Materials Engineering

(12) Mechanical Engineering

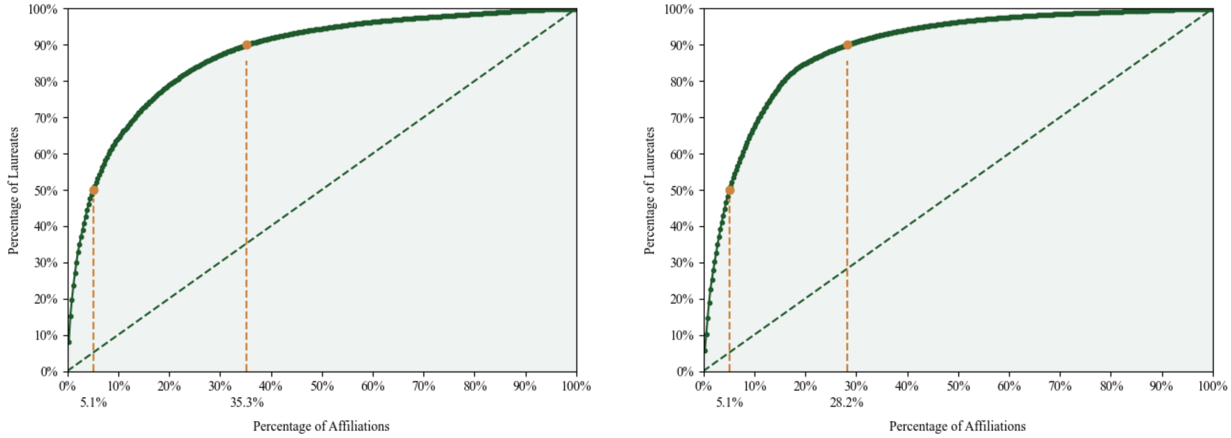
Figure O6: Lorenz curve: Social Sciences


(13) Economics

(14) Political Science & International Affairs


(15) Sociology

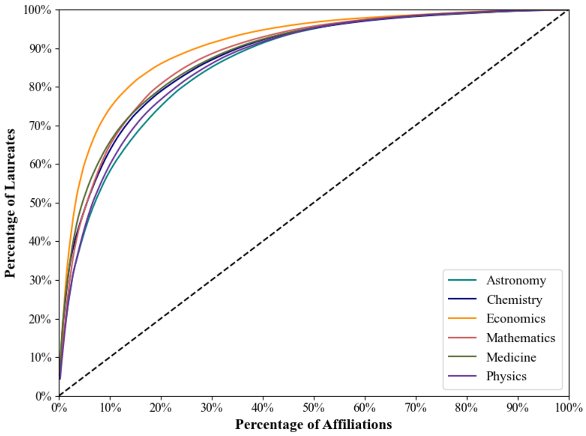
(16) Law


(17) Education

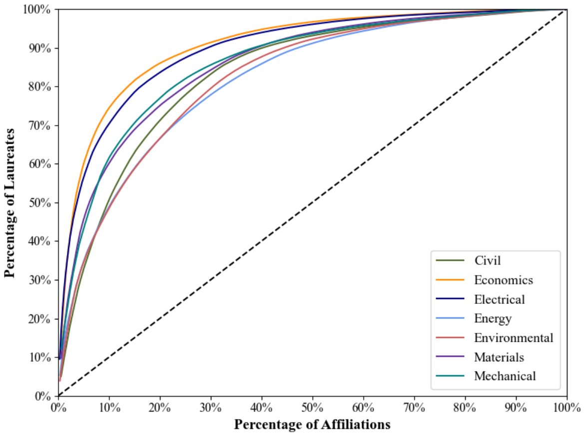
(18) Psychology

Figure O7: Lorenz curves: Comparisons with economics

Natural Sciences



Engineering



Social Sciences

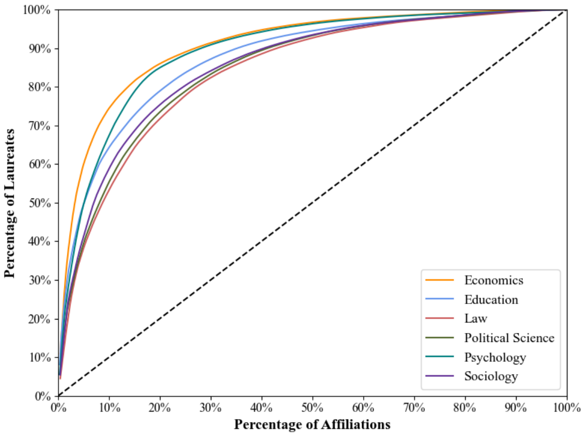


Table O4: Move Probability Regression

	Dependent variable: Move probability			
	(1)	(2)	(3)	(4)
Astronomy	-0.0339***	-0.0476***	-0.0331***	-0.0406***
	(0.00362)	(0.00370)	(0.00362)	(0.00371)
Chemistry	-0.0236***	-0.0450***	-0.0223***	-0.0317***
	(0.00312)	(0.00317)	(0.00309)	(0.00317)
Civil engineering	-0.0541***	-0.0680***	-0.0529***	-0.0555***
	(0.00438)	(0.00447)	(0.00437)	(0.00448)
Earth science	-0.0388***	-0.0558***	-0.0376***	-0.0439***
	(0.00336)	(0.00342)	(0.00334)	(0.00343)
Education	-0.0312***	-0.0336***	-0.0311***	-0.0324***
	(0.00339)	(0.00346)	(0.00339)	(0.00348)
Electrical engineering	-0.0329***	-0.0438***	-0.0322***	-0.0364***
	(0.00318)	(0.00325)	(0.00318)	(0.00326)
Energy engineering	-0.0352***	-0.0403***	-0.0348***	-0.0365***
	(0.00389)	(0.00397)	(0.00389)	(0.00399)
Environmental engineering	-0.0373***	-0.0414***	-0.0371***	-0.0397***
	(0.00378)	(0.00386)	(0.00378)	(0.00387)
Law	-0.0306***	-0.0291***	-0.0307***	-0.0303***
	(0.00385)	(0.00394)	(0.00385)	(0.00395)
Materials engineering	-0.0523***	-0.0463***	-0.0527***	-0.0502***
	(0.00403)	(0.00412)	(0.00403)	(0.00413)
Mathematics	-0.00879**	-0.0111**	-0.00853*	-0.00806*
	(0.00336)	(0.00343)	(0.00336)	(0.00344)
Mechanical engineering	-0.0397***	-0.0600***	-0.0382***	-0.0442***
	(0.00472)	(0.00481)	(0.00470)	(0.00482)
Life science	-0.0306***	-0.0486***	-0.0295***	-0.0372***
	(0.00280)	(0.00285)	(0.00277)	(0.00285)
Physics	-0.0192***	-0.0348***	-0.0183***	-0.0253***
	(0.00308)	(0.00314)	(0.00306)	(0.00314)
Political science	-0.0214***	-0.0169***	-0.0217***	-0.0192***
	(0.00382)	(0.00390)	(0.00382)	(0.00392)
Psychology	-0.0357***	-0.0360***	-0.0356***	-0.0350***
	(0.00291)	(0.00298)	(0.00291)	(0.00299)
Sociology	-0.0191***	-0.0114**	-0.0193***	-0.0127**
	(0.00396)	(0.00405)	(0.00396)	(0.00406)
years_since_phd	-0.00423***		-0.00429***	
	(0.0000503)		(0.0000462)	
year	-0.000112**	-0.00124***		
	(0.0000339)	(0.0000318)		
R-Squared	0.053	0.012	0.053	0.003
N	164581	164581	164581	164581

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table O5: Homophily regression

VARIABLES	(1) Count	(2) Count	(3) Count	(4) Count	(5) Count	(6) Count	(7) Count
Gender	0.03***		0.04***	0.03***	0.03***	0.03***	0.06***
	(0.00)		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Discipline	1.04***	1.04***		1.04***	1.05***	1.04***	1.18***
	(0.00)	(0.00)		(0.00)	(0.00)	(0.00)	(0.00)
Ethnicity	-0.06***	-0.06***	-0.04***		0.01	-0.06***	0.13***
	(0.00)	(0.00)	(0.00)		(0.33)	(0.00)	(0.00)
PhD	2.36***	2.36***	2.38***	2.35***		2.36***	3.61***
	(0.00)	(0.00)	(0.00)	(0.00)		(0.00)	(0.00)
Age difference	0.00***	0.00***	0.00	0.00***	0.00*		-0.00***
	(0.00)	(0.00)	(0.14)	(0.00)	(0.05)		(0.00)
Colleague years	0.46***	0.46***	0.47***	0.46***	0.48***	0.46***	
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	
Observations	28,869,129	28,869,129	28,869,129	28,869,129	28,869,129	29,452,329	28,869,129
R-squared	0.0072	0.0072	0.0069	0.0072	0.0068	0.0072	0.0014

pval in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table O6: Different effect of homophily variables by subject

VARIABLES	(1) Unified count	(2) Unified count	(3) Unified count	(4) Unified count
Gender	0.13		-0.37	-0.23
	(0.68)		(0.19)	(0.47)
Ethnicity	-2.13***	-2.49***		-2.87***
	(0.00)	(0.00)		(0.00)
PhD	4.82***	4.60***	4.34***	
	(0.00)	(0.00)	(0.00)	
Age difference	0.00	0.00	0.00	0.00
	(0.14)	(0.14)	(0.14)	(0.14)
Colleague years	3.01***	3.01***	3.01***	3.26***
	(0.00)	(0.00)	(0.00)	(0.00)
Gender - Mathematics	-1.12***		-0.63*	-0.90**
	(0.00)		(0.08)	(0.02)
Gender - Physics	0.18		0.35	0.14
	(0.58)		(0.24)	(0.68)
Gender - Political	1.01*		2.05***	1.63***
	(0.10)		(0.00)	(0.01)
Gender - Sociology	1.50**		3.56***	3.59***
	(0.01)		(0.00)	(0.00)
Gender - Chemistry	0.56*		0.74**	0.68**
	(0.09)		(0.01)	(0.04)
Gender - Energy	0.65		0.86*	0.77
	(0.18)		(0.05)	(0.11)
Gender - Electrical	-0.46		0.04	-0.08
	(0.19)		(0.90)	(0.82)

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VARIABLES	(1) Unified count	(2) Unified count	(3) Unified count	(4) Unified count
Gender - Education	0.77*		0.87**	1.30***
	(0.10)		(0.03)	(0.00)
Gender - Psychology	1.22***		1.78***	1.63***
	(0.00)		(0.00)	(0.00)
Gender - Law	0.68		0.97**	0.65
	(0.17)		(0.03)	(0.19)
Gender - Civil	0.34		1.28***	0.92*
	(0.49)		(0.01)	(0.06)
Gender - Medicine	0.45		0.80***	0.71**
	(0.15)		(0.00)	(0.02)
Gender - Earth	0.79**		1.20***	0.98***
	(0.02)		(0.00)	(0.00)
Gender - Astronomy	1.33***		1.86***	1.73***
	(0.00)		(0.00)	(0.00)
Gender - Materials	2.12***		3.50***	4.35***
	(0.00)		(0.00)	(0.00)
Gender - Environmental	1.05**		2.41***	2.64***
	(0.05)		(0.00)	(0.00)
Gender - Mechanical	-0.45		0.94**	0.48
	(0.42)		(0.04)	(0.39)
Ethnicity - Mathematics	1.53*	0.55		3.24***
	(0.08)	(0.49)		(0.00)
Ethnicity - Physics	-1.32*	-1.15*		-1.94***
	(0.05)	(0.07)		(0.00)
Ethnicity - Political	3.67***	4.32***		4.93***
	(0.00)	(0.00)		(0.00)
Ethnicity - Sociology	6.67***	7.59***		11.65***
	(0.00)	(0.00)		(0.00)
Ethnicity - Chemistry	0.47	0.96*		1.26**
	(0.42)	(0.07)		(0.03)
Ethnicity - Energy	-0.30	0.22		0.96
	(0.77)	(0.82)		(0.35)
Ethnicity - Electrical	1.94***	1.52***		3.16***
	(0.00)	(0.00)		(0.00)
Ethnicity - Education	1.27**	1.68***		2.52***
	(0.04)	(0.00)		(0.00)
Ethnicity - Psychology	2.14***	2.81***		3.26***
	(0.00)	(0.00)		(0.00)
Ethnicity - Law	1.24	1.65**		1.38*
	(0.11)	(0.02)		(0.07)
Ethnicity - Civil	8.28***	8.62***		17.30***
	(0.00)	(0.00)		(0.00)
Ethnicity - Medicine	1.20**	1.56***		2.96***
	(0.03)	(0.00)		(0.00)
Ethnicity - Earth	1.43**	2.12***		2.42***
	(0.02)	(0.00)		(0.00)
Ethnicity - Astronomy	2.00***	3.16***		4.48***
	(0.00)	(0.00)		(0.00)
Ethnicity - Materials	5.22***	6.75***		20.05***
	(0.00)	(0.00)		(0.00)
Ethnicity - Environmental	6.01***	6.67***		11.31***

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VARIABLES	(1) Unified count	(2) Unified count	(3) Unified count	(4) Unified count
	(0.00)	(0.00)		(0.00)
Ethnicity - Mechanical	4.46***	4.02***		6.66***
	(0.00)	(0.00)		(0.00)
PhD - Mathematics	11.80***	11.26***	12.10***	
	(0.00)	(0.00)	(0.00)	
PhD - Physics	-11.92***	-11.78***	-13.21***	
	(0.00)	(0.00)	(0.00)	
PhD - Political	18.20***	18.67***	19.21***	
	(0.00)	(0.00)	(0.00)	
PhD - Sociology	82.48***	83.05***	84.80***	
	(0.00)	(0.00)	(0.00)	
PhD - Chemistry	1.15	1.42	0.79	
	(0.34)	(0.24)	(0.51)	
PhD - Energy	7.16***	7.46***	6.13**	
	(0.01)	(0.01)	(0.02)	
PhD - Electrical	23.23***	23.12***	23.71***	
	(0.00)	(0.00)	(0.00)	
PhD - Education	19.87***	20.21***	20.05***	
	(0.00)	(0.00)	(0.00)	
PhD - Psychology	20.63***	20.93***	21.16***	
	(0.00)	(0.00)	(0.00)	
PhD - Law	-8.83***	-8.55***	-8.62***	
	(0.00)	(0.00)	(0.00)	
PhD - Civil	71.08***	71.30***	74.95***	
	(0.00)	(0.00)	(0.00)	
PhD - Medicine	23.73***	23.97***	23.80***	
	(0.00)	(0.00)	(0.00)	
PhD - Earth	7.84***	8.19***	8.08***	
	(0.00)	(0.00)	(0.00)	
PhD - Astronomy	34.37***	34.87***	34.85***	
	(0.00)	(0.00)	(0.00)	
PhD - Materials	131.53***	132.19***	133.88***	
	(0.00)	(0.00)	(0.00)	
PhD - Environmental	113.68***	114.16***	115.90***	
	(0.00)	(0.00)	(0.00)	
PhD - Mechanical	92.46***	92.36***	93.72***	
	(0.00)	(0.00)	(0.00)	
Constant	-1.21***	-0.72***	-1.27***	-0.96***
	(0.00)	(0.00)	(0.00)	(0.00)
Observations	2,209,939	2,209,939	2,209,939	2,209,939
R-squared	0.0558	0.0557	0.0557	0.0488

P-value in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure O8: Cumulative institutions versus cumulative laureates: Nobel subjects

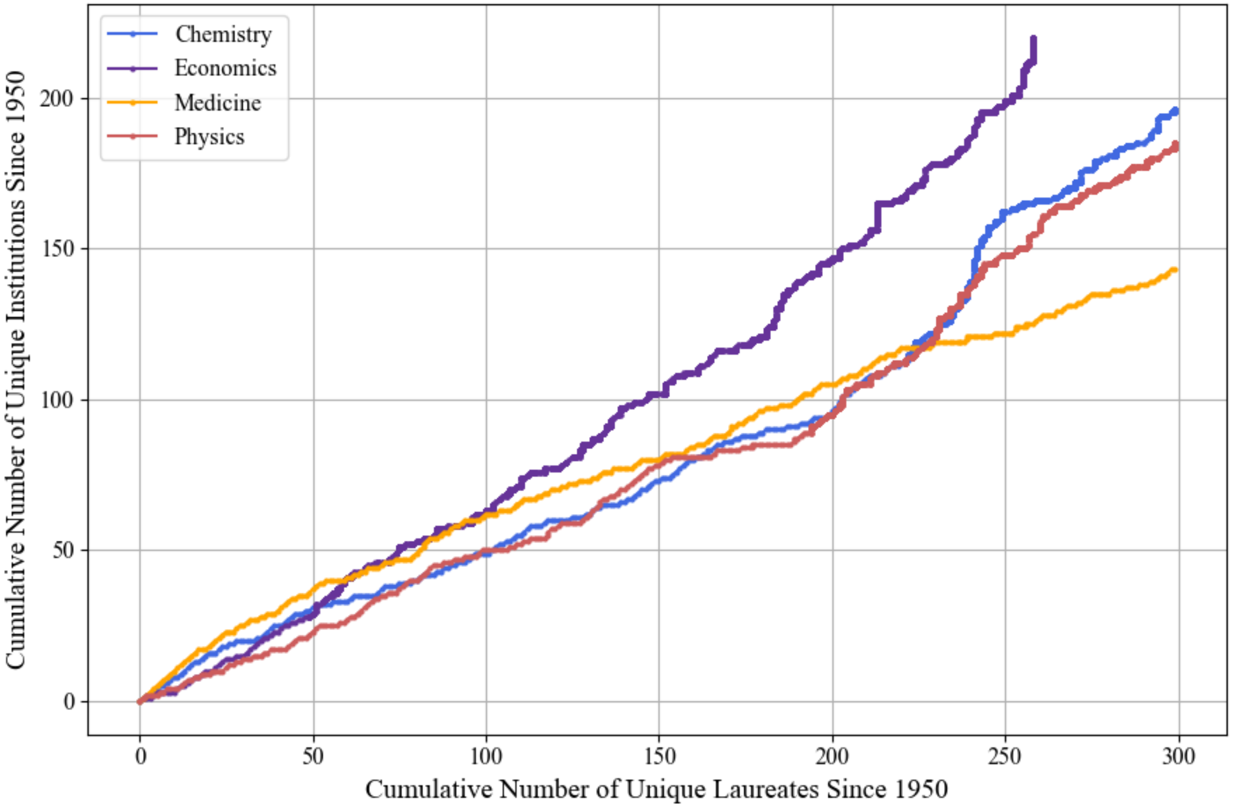


Figure O9: Cumulative institutions versus cumulative laureates: All subjects

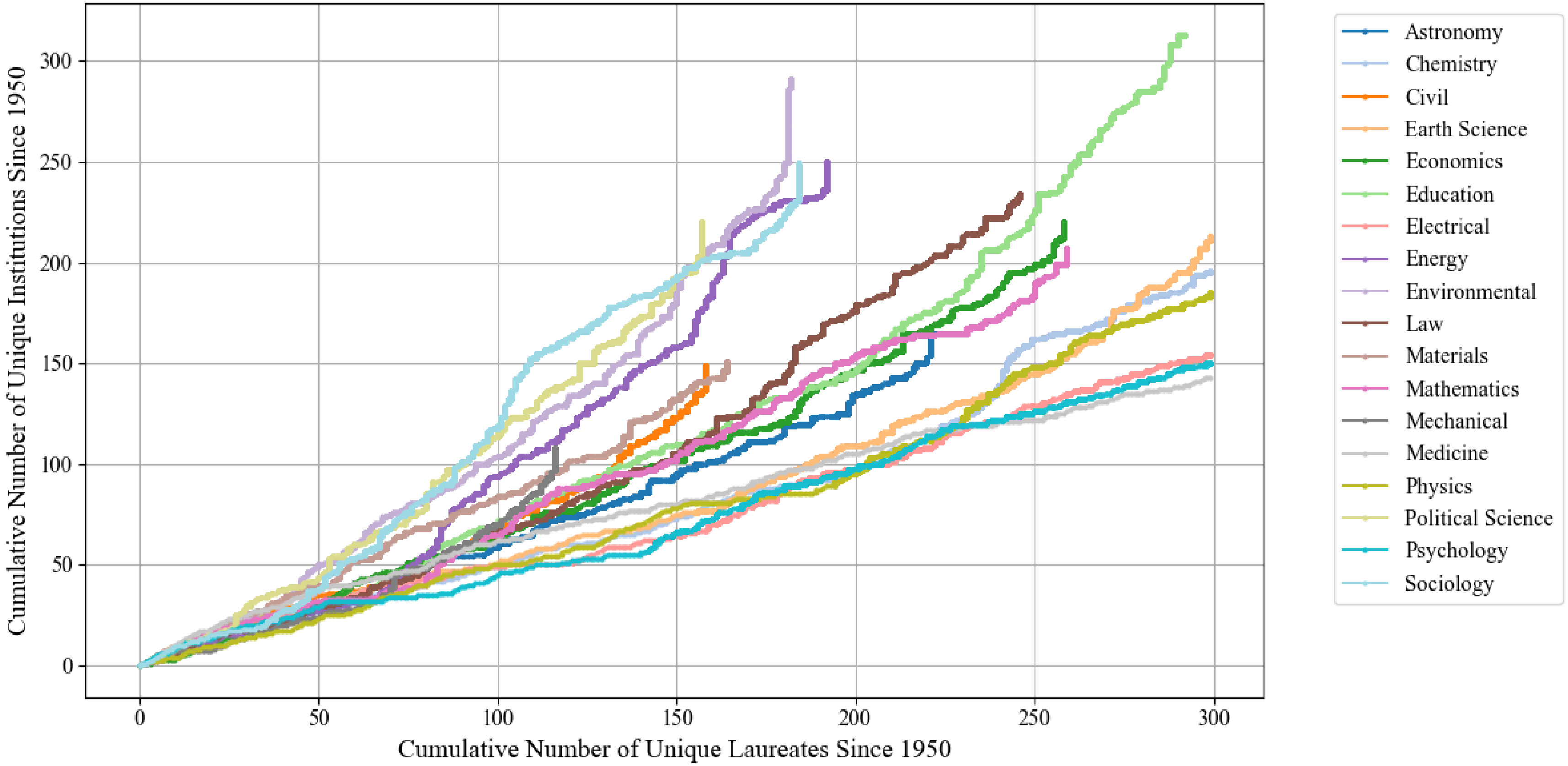


Figure O10: Average university rankings for social sciences

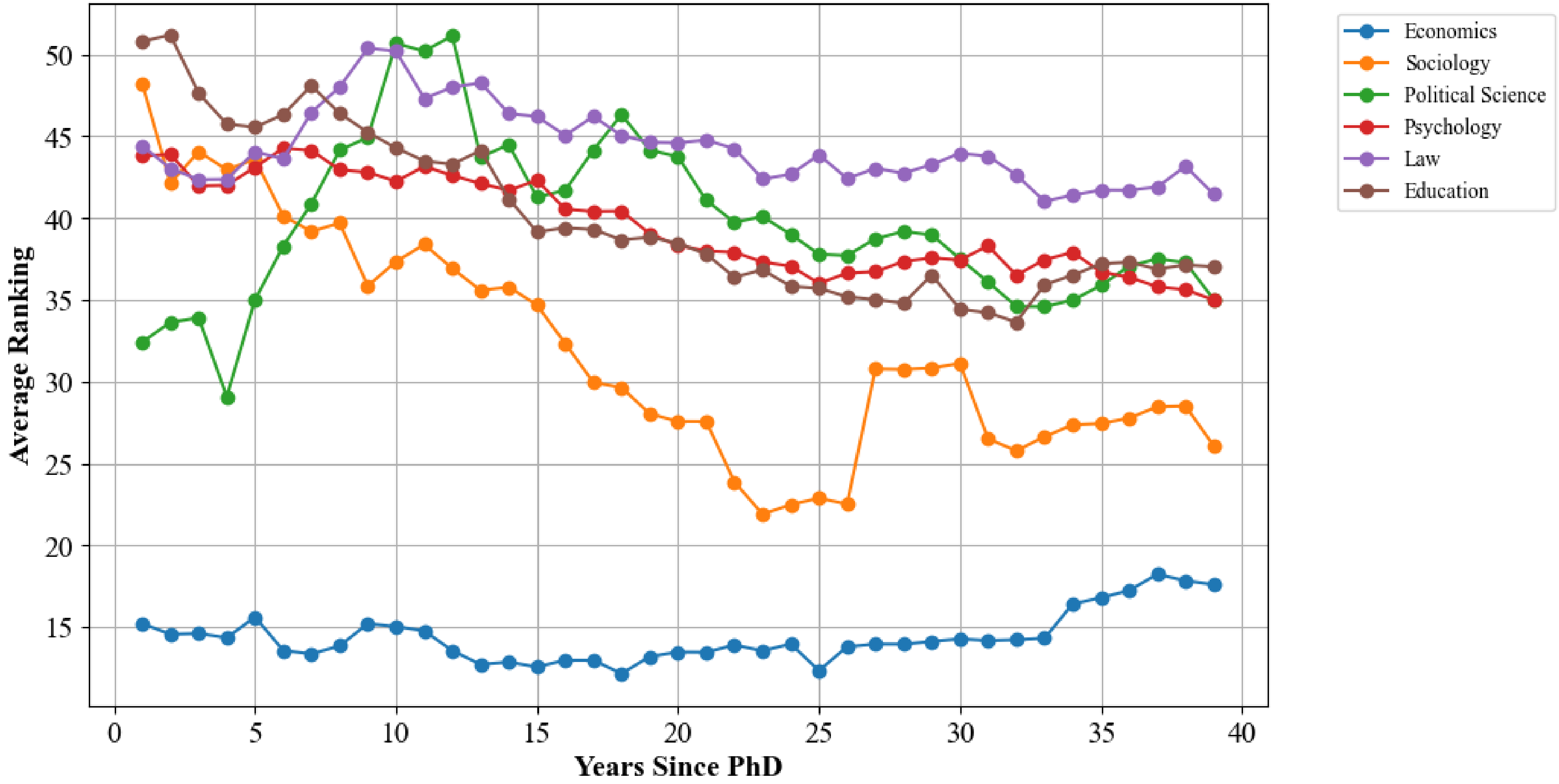
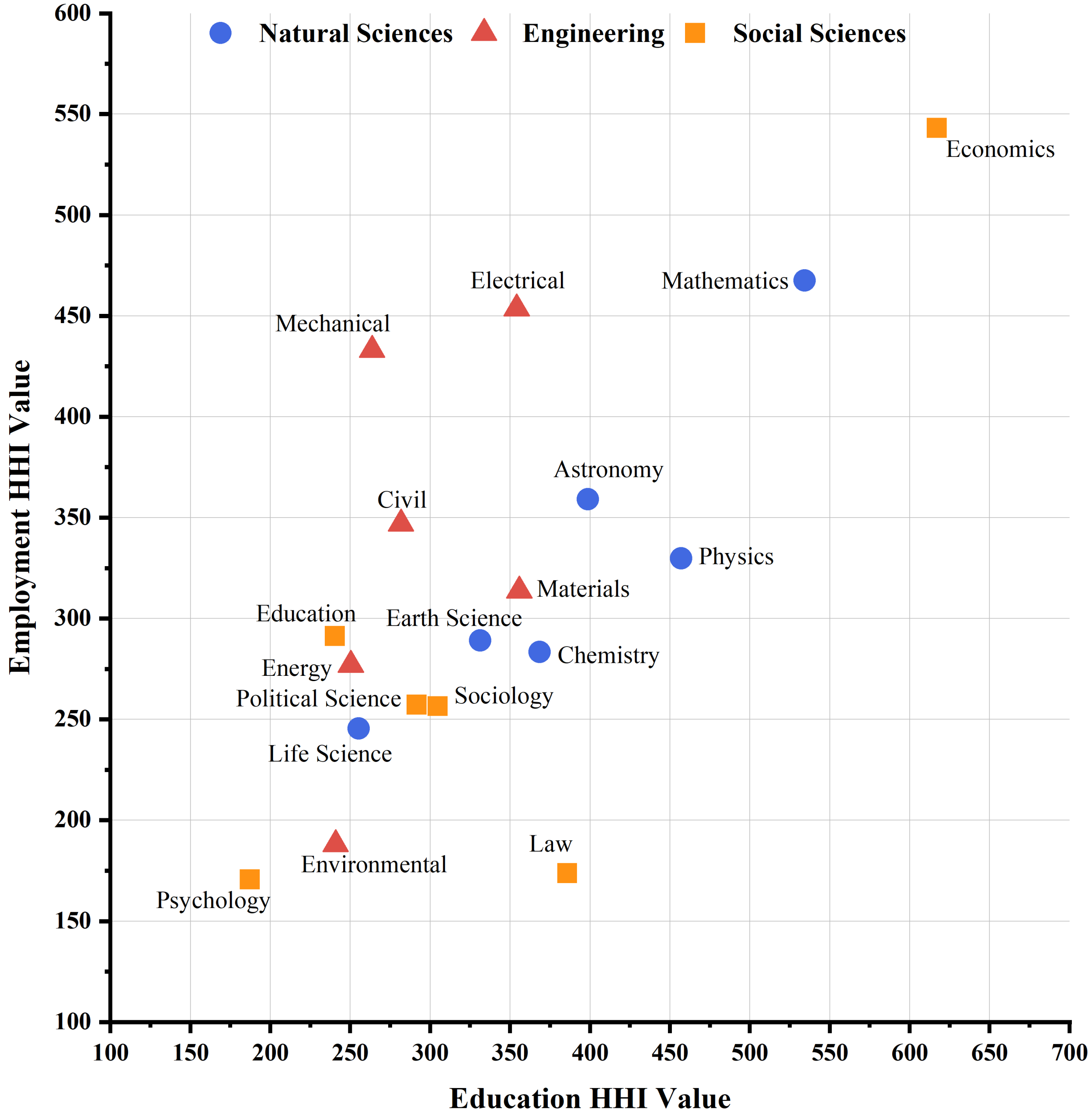


Figure O11: Education and employment institutional concentration across different fields; U.S. institutions only



Note: The x-axis is the overall HHI of educational affiliations of all award recipients. The y-axis is the overall HHI of the professional affiliations of all award receipts.