Why do Economics Ph.D. graduates choose non-academic jobs?

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Abstract

Every January, over 700 Economics Ph.D. job market candidates will gather at the American Economic Association's Annual Meeting to be interviewed by potential employers. Most of them will find academic positions, typically as an assistant professor, post-doctoral researchers or lecturers. The others will opt for non-academic employment, such as in governments, NGOs, banks, Federal Reserve, and consulting firms. Since the purpose of receiving doctoral training is to prepare for academic positions, is it worthwhile for Ph.D. candidates to find jobs outside of academia? Why do they make such choice? This paper considers a binary choice decision model based on the placement data from 2010 to 2017 to simulate the decision-making process. The model suggests that the decisions are determined by pedigrees and graduates' preferences towards towards job characteristics, such as wages, job styles, expectations, etc. Thus, some graduates are more likely than others to find non-academic positions.

Introduction

Collecting placement data from 2010 to 2017 at 105 programs' websites, we identify the pedigrees, degree years and employers of 6187 graduates. Particularly, the placement in academia is a vital measure of program's training quality. The non-academic placements have been always neglected and regarded as relatively inferior, whether in the profession or research literature on doctoral education. However, such placement consists of 37% of the sample. In particular, the private sector attracts 11% more graduates in 7 years. Meanwhile, the aggregate number of Economics Ph.D.s far exceeds the academic job openings since 2010. Thus, it is inevitable that many Ph.D.s are employed outside the academia, either in private or public sectors. Graduate students in economics should better understand this phenomenon and fact to make the better career decision.

Graduates from larger programs are more likely to enter private and public sectors. However, when we assign the academic quality tiers to these programs, top programs and bottom programs have roughly same percentages of graduates in academia.

Programs have an impact on graduates' alternative possible academic career options ("opportunity cost"). Graduates from top programs generally land assistant professor positions at universities much better than other programs. The opportunity cost would be large if he/she has a high chance of landing a tenure-track job at top research universities. On the other hand, he/she may prefer working for consulting firm or banks if his/her possible academic position is a lecturer at the teaching college.

We also consider the effect of weights graduates put on different criteria, such as salaries, job satisfaction, opportunity cost, location, etc. As a result, when given graduates' weights of preferences and fixed variables from pedigrees, the model could provide a prediction for how likely they will finally find non-academic jobs.

Literature Review

There are many studies on economics graduate programs, such as rankings, determinants of placement quality and program characteristics. Siegfried and Stock (1999) surveyed Ph.D. graduates about their placement and satisfaction level to highlight the differences across sectors. Stock and Siegfried (2001) investigated the job types and salaries by surveying the 1996-1997 cohort. Athey et al. (2007), using a sample of 1029 graduate students in top five programs, found the quality of job placement would not be affected by demographic characteristics, GRE scores or master's degrees. Amir and Knauff (2008) rank economics department worldwide by calculating the total values of its Ph.D. graduates' current employing departments.

This paper builds upon the previous research by using the results in utility modeling. The contributions to the literature are in three aspects: First, the sample data spans across 105 programs and recent 8 years. Second, it provides a detailed discussion of the categories of non-academic jobs and opportunity cost. Third, a weighted utility function is proposed to model how some graduates' non-academic placement would be the optimal choice given preference parameters and pedigrees.

Data

The National Research Council's "A Data-Based Assessment of Research-Doctorate Programs" in 2010 examines the program characteristics of 110 Economics Ph.D. doctoral programs in the U.S. It provides the program-level data such as private or public universities, location, scholarship amount, size, providing office space or not, diversity, the number of publications per faculty member, student activities, the median time to degree, graduate student funding, citations per publication, number of grants per faculty member, diversity, student GRE scores, student health insurance, etc. This information is useful for identifying different programs' impact on graduates' placement and career decisions.

We also collected the initial job placement of these 110 Economics doctoral programs from 2010 to 2017. The range of 8 years allows us to analyze the underlying dynamics of the job market. Five programs (Auburn, Northern Illinois, Rensselaer Polytechnic Institute, SUNY Buffalo and Utah State) don't have available placement information, so we leave them out in the analysis.

Several graduates' placement information in 2017 had not been updated on websites. We tried to contact the placement coordinates at respective programs. We also manually confirmed the information by candidates' personal websites. Also, some placements didn't specify the type of positions that the graduates obtain. We updated this ambiguous information by searching the faculty rosters of their current employers.

Finally, there are 6187 observations specifying each student's pedigree, graduation year, initial employer and corresponding positions. The actual number should be slightly larger as there are several programs only provide part of the data in past 8 years. Some programs may only report the "best" or "example" placements. Although other information (such as fields, advisors, nationality, gender, publication, age, undergraduate institutes) would be relevant for the research, they are generally unavailable to collect for a large number of observations.

Who are they? (Exploratory Data Analysis)

The main group of interest is graduates who found jobs outside the academia. Siegfried and Stock (2014) described the primary sector of employment for economics doctoral graduates was academia, followed by government, international organizations, research organizations, and even smaller percentage in business and industry. Thus, I divide the positions categories into three groups by the keywords matching algorithm:

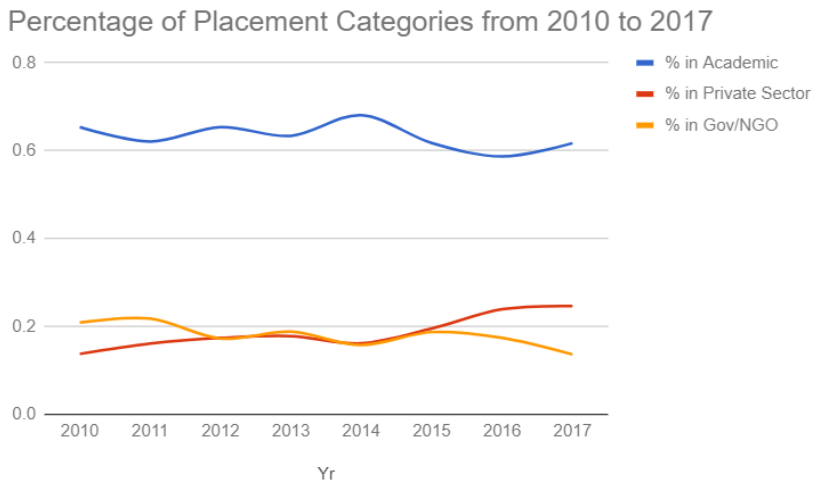
0: Academic Institutions (Universities, Liberal Arts College, Research Institutions...)
1: Private Sectors (Technology firms, Financial Services, Consulting Companies...)
2: Government, Non-Government Organization, Federal Reserve, World Bank, IMF, Thinktank, International Organizations

During 2010-2017, around 3910 students (63%) landed a position in academia. 1168 people (19%) got hired by companies, banks or firms as various roles, such as consultants, economists, econometricians, data scientists, associates, statisticians, analyst and so on. The remaining 1109 students (18%) work for government departments, policy-research institutes, and NGOs. This result confirms that academia is still the major destination. However, industry employment rises steadily, from 14% in 2010 to 25% in 2017. This number is no longer " smaller percentage" that previous literature suggests, and possibly is the trend in next decade as well.

Table: Percentages of Placement Categories, 2010-2017

Yr	0	1	2	Total	% in Academic	% in Private Sector	% in Gov/NGO
2010	404	85	129	618	65.37%	13.75%	20.87%
2011	439	114	154	707	62.09%	16.12%	21.78%
2012	493	131	130	754	65.38%	17.37%	17.24%
2013	516	145	153	814	63.39%	17.81%	18.80%
2014	548	130	127	805	68.07%	16.15%	15.78%
2015	544	172	165	881	61.75%	19.52%	18.73%
2016	513	209	152	874	58.70%	23.91%	17.39%
2017	453	181	100	734	61.72%	24.66%	13.62%
Total	3,910	1,167	1,110	6,187	63.20%	18.86%	17.94%

Graph: Dynamics of placement ratios, 2010-2017

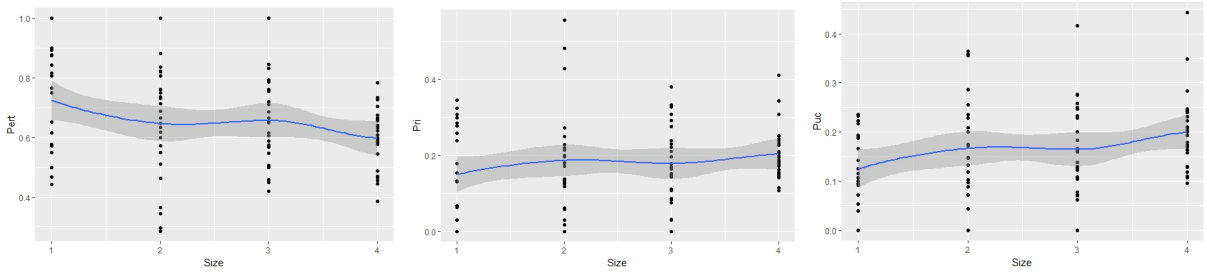


Where do they come from? (Pedigrees' sizes and quality)

Intuitively, graduates from smaller and top-ranked programs should be more likely to find academic jobs, since they would receive more attention and resources. To evaluate this hypothesis, we first control for the program size to validate its impact on programs' percentages of placement categories. I adopt the size quantiles provided by NRC. "1" (<5) is the smallest cohort size and "4" (>20) is the largest. Ceteris paribus, compared with a smaller program (1 quantile lower), graduates are 3% less likely to find academic jobs, 1.5% and 2.2% more likely to land positions in private and public sectors, respectively.

At larger programs, the percentages of three categories are closer to the aggregate mean values. The top 10 incubators of economics Ph.D.s are Harvard (219), Michigan (179), Wisconsin (160), Princeton (156), Berkeley (149), Stanford (147), UCSD (139), Yale (139), M.I.T (136), Northwestern (136).

Figure: Percentage of placement categories (0,1,2) with different size quantiles



Academia Private Sectors Public Sectors

This result verifies that graduates from a large program are less likely (-13%) to find jobs in academia. Meanwhile, more percentages of the large cohorts are employed by private and public sectors, compared with the small cohorts. The explanation could be that at larger programs,

students may have more resources and freedom to pursue different fields and interests, which prepare them for non-academic positions. Another situation is that larger programs allocate more resources to a fraction of top students who are likely to become academic stars in the market. Thus, the mediocre students and the rest know they have better to think more broadly about career options.

Secondly, we divide the programs into quality tiers to test whether better programs produce a higher ratio of academic professors. The rank is based on NRC's ranking scores (calculated by programs' overall quality and reputation).

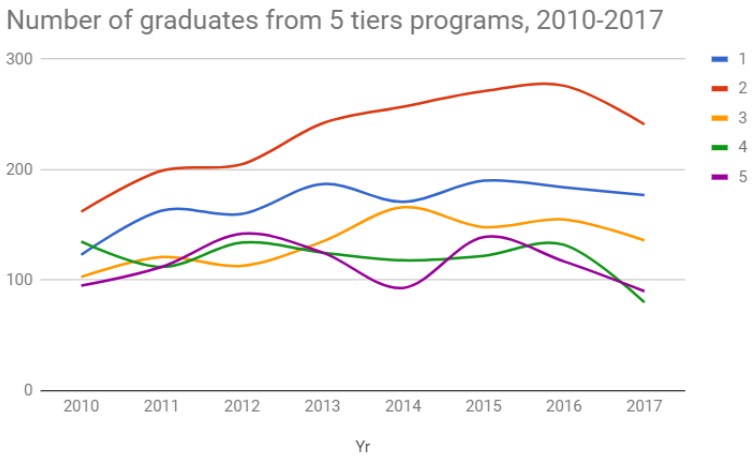
Tier	*Rank*
1	Top 1-10
2	Top 11-30
3	Top 31-50
4	Top 51-70
5	Top 71-105

From the following table, about 30% of the students obtained their Ph.D. degrees from Tier 2 programs. By comparison, Tier 1 has 22% graduates and Tier 5 has only 15% graduates. Even though Tier 1 consists of 10 programs and Tier 5 has 35 programs, the average cohort size of top-ranked programs is 7% larger than the bottom ranked programs. This is reasonable as they have more resources, faculty, and fundings to train more graduate students.

Table: Number of graduates from 5 tiers programs, 2010-2017

Yr	**1**		**2**		**3**		**4**		**5**		**Total**
2010	123	20%	162	26%	103	17%	135	22%	95	15%	618
2011	163	23%	199	28%	121	17%	112	16%	112	16%	707

2012	160	21%	205	27%	113	15%	134	18%	142	19%	754
2013	187	23%	242	30%	135	17%	125	15%	125	15%	814
2014	171	21%	257	32%	166	21%	118	15%	93	12%	805
2015	190	22%	271	31%	148	17%	122	14%	139	16%	870
2016	184	21%	276	32%	155	18%	132	15%	117	14%	864
2017	177	24%	241	33%	136	19%	80	11%	90	12%	724
Total	1,355	22%	1,853	30%	1,077	17%	958	16%	913	15%	6,156

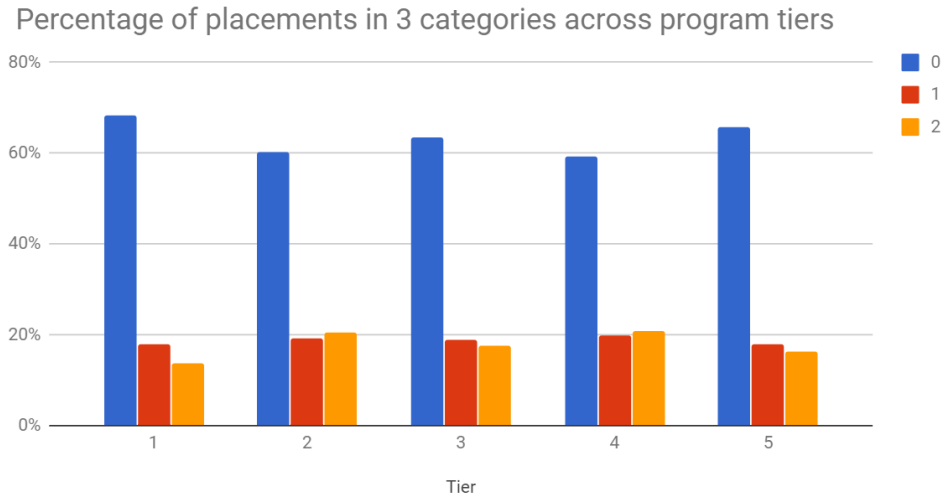


Athey et al. (2007) found that more than half of graduates at Top 5 programs accepted an academic job in the 1990s. Using this up-to-date dataset, we find the ratio at Top 10 (68%) is consistent with the previous findings. However, without controlling for the placement quality, this ratio doesn't decrease as the Tier number goes up. 66% of the Tier 5 programs graduates stay in academia as well. Their target employers are typically regional teaching universities and liberal arts colleges.

Moreover, there are no significant differences of industry placements ratio. This makes sense as the private sectors need graduates at various levels. For government/NGO type, the ratio at Tier 4 is 7% higher than the Tier 1's.

Table: Percentage of Placements in 3 categories across program tiers

Tier	**0**	(%)	**1**	(%)	**2**	(%)	**Total**
1	924	68%	243	18%	188	14%	1,355
2	1,115	60%	359	19%	379	20%	1,853
3	685	64%	204	19%	188	17%	1,077
4	567	59%	191	20%	200	21%	958
5	601	66%	163	18%	149	16%	913
Total	3,892	63%	1,160	19%	1,104	18%	6,156



This analysis shows that the programs' quality tier cannot be a strong predictor of whether the graduates are more/less likely to find jobs in private/public sectors. However, the analysis so far focuses on quantity instead of quality. A specific company may hire from the certain tier or certain program. In the Appendix, we provide the evidence that Amazon has hired primarily from large and top 20 programs.

What do they do? (Job functions)

Two traditional largest NGO employers are World Bank (61 hires) and IMF (88 hires). Their economists conduct more policy-relevant research and projects for politicians and clients. Banks have hired economists for risk management and analyzing financial time-series data. Consulting firms value Ph.D.s' expertise in their fields and abilities to apply statistical analysis and provide strategic reports.

Technology firms are the newcomers in this game. Professor Hal Varian joined Google to work on areas including advertising auctions and public policy in 2002 as a consultant and remains there as chief economist. Other technology giants (E.g., Uber, Facebook, Airbnb) also have their chief economist as well. At the Microeconomics Group of Microsoft Research in Seattle, WA, the researchers come from following top economics programs: Cornell (2017), Wharton (2017, 2011), Maryland (2016), UCSD (2015, 2010), Rochester (1990), Purdue (1980), Michigan (2007), Princeton (2008), M.I.T (2010) and others. They attract graduates interested in applying economic theories as well as causal inference to big data and business operation problems.

How does doctoral training help students acquire skills to qualify for these non-academic jobs? In order to understand this question, we should first know what are the job requirements at these places according to the AEA job listing.

1. Example of International Organization---World bank

*The Development Research Group of the World Bank is seeking to recruit research economists. The Development Research Group is the main department where **policy-relevant research** is conducted at the World Bank. Research economists are expected to maintain an outstanding **scholarly publication** record, as well as provide relevant policy advice and technical expertise to colleagues throughout the World Bank, and to policymakers in client countries…… We are considering new **Ph.D.s** as well as more experienced candidates with relevant post-doctoral academic or non-academic experience.*

2. Example of Technology Firm---Amazon

*Economists at Amazon will be expected to work directly with the chief economist and senior management on key business problems faced in retail, international retail, cloud computing, third party merchants, search, Kindle, streaming video, and operations. Amazon economists will apply the frontier of **economic thinking** to market design, pricing, forecasting, program evaluation, online advertising and other areas. You will build **econometric models**, using our world class data systems, and **apply economic theory** to solve business problems in a fast moving environment. Economists at Amazon will be expected to **develop new techniques** to process large data sets, **address quantitative problems**, and contribute to **design of automated systems** around the company."*

3. Example of Central Bank System---Federal Reserve Bank of St. Louis

The Research Division of the Federal Reserve Bank of St. Louis is seeking Junior Research Economists (those with less than 5 years of post-Ph.D. experience). The primary responsibilities include ***publishing in leading professional journals****, maintaining an active research agenda, and providing analysis on monetary and other policy issues. A* ***Ph.D.*** *in Economics is required by the end of 2018. Candidates must demonstrate a* ***potential for outstanding scholarly achievement****.*

4. Example of Consulting firms---Analysis Group

We seek ***Ph.D. candidates*** *who are passionate about solving the economic, financial, and business challenges our clients face. Candidates should have completed or be close to completing a graduate degree in economics with expertise in the areas listed above such as industrial organization, labor economics, health economics, econometrics or finance. We are especially interested in candidates with strong* ***communication and empirical skills*** *and the ability to work in a* ***team environment****.*

From these typical job posts by non-academic employers, it appears that a Ph.D. degree is a requirement for these non-academic positions. Some positions that emphasize more technical skills and experience claim applicants with Masters degrees are considered as well, such as econometrician/data scientist at Uber Technologies Inc. and transfer pricing analyst at Ernst & Young. However, these positions are mostly occupied by Ph.D.s in Economics and relevant subjects as well. Besides from conducting research, non-academic positions emphasize more on abilities such as communication, team collaboration, problem-solving, presentation, and programming.

Where else can they go? (Opportunity Cost)

If a graduates choose to work in private/public sectors, his/her opportunity cost is the advantages of working in academia instead. As a result, it is essential for graduates to know what kind of academic positions they will possibly obtain if they apply, given where the alumni are employed.

Among the academic placement data, many are international institutions, regional universities or liberal arts college. So rankings such as U.S news or NRC are not appropriate as they only compare the Top 100 U.S programs. Here, I adapted the ranking created by CentER for Research in Economics and Business at Tilburg University. It uses the database covers publications in 70 leading economics journals. Using its "sandbag" option, we selected the year period of 2010-2016 to get a ranking list of worldwide economics departments.

This ranking methodology is based on the sum of the selected journal publications numbers. As a result, larger programs with more prolific researchers are advantageous over smaller programs. Also, the selected 35 journals are assigned same weight, which is a biased assumption. Although these journals are regarded as prestigious and top-notch worldwide, there are potentially some other excellent journals published in foreign languages that are not counted in ranking.

The journal counts are treated as the scores (denote as α) to indicate the placement quality. This list consists of 1262 economics departments with their journal counts. There are 275 departments tied with rank 988 for score 1 (one publication). The top three departments are Harvard (783), Chicago (566), Stanford (509). 3003 out of 3915 placements (77%) are successfully paired with the departments in the Tilburg list. The remaining 912 entries are assigned 0.

Krueger and Wu (2000) suggested using the discount rate to recognize the quality differences of various academic positions. A typical and ideal academia placement is "tenure-track assistant professor". For some other positions, the rates are determined by three factors:

1. How related is the position compared to the tenure-track assistant professor?
2. Whether the position emphasizes on research?
3. How competitive is it to get such positions?

Table: Discount Rates for different academic positions

Position	**Rate(λ)**	**Freq.(%)**	**Comment**
Tenure-track assistant professor	1	3231 (83%)	most ideal academic placement
Postdocs	0.6	520 (13%)	Most postdocs will become assistant professors later.
Lecturer, Visiting/Practice/ Clinical assistant professor	0.4	130 (3%)	Non-tenure track positions, focusing on teaching.

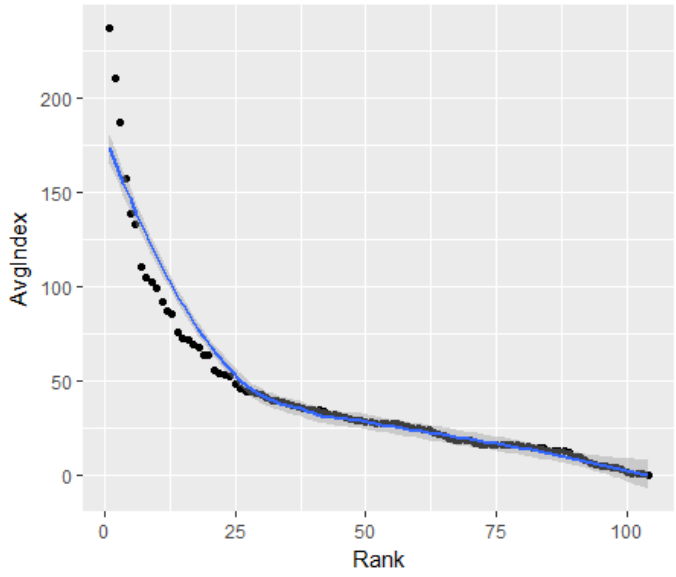
For individual k from program i, his/her placement score is the product of the scores ($\alpha(k)$) and corresponding discount rate ($\lambda(k)$). The whole program's placement score is the sum of all graduates' placement score and divided by the total number(n_i). The following formula gives an index for each program' placement quality:

$$y(i) = \frac{Aggregated\ discounted\ scores\ of\ graduates'\ employers}{Number\ of\ students\ graduated\ from\ the\ program} = \frac{\sum_{k=1}^{n(i)} \alpha(k)*\lambda(k)}{n(i)}, \text{ i=1,2,...105}$$

The full list of these 105 programs' score could be found in the Appendix. The score indicates the average level of their academic placements.

Quantiles	Index Values	Example Institutions
0%	0.0000	Gettysburg College
25%	15.4825	Miami University
50%	27.2950	Fordham University
75%	44.7375	University of Georgia
100%	236.9200	Cornell University

Graph: Relationship between Ranking and Actual Scores of Academic Placement



As the ranking goes up, the slope becomes steeper. This nonlinear relationship indicates that top programs graduates have placements significantly better than their peers. However, this doesn't apply to everyone. An index of 100 could have resulted from the average of 0 and 200. The variances are greater at large programs. As a result, the assumption is that the graduates from top programs will prefer private/public sectors if he/she is pessimistic of possible academic placements. If he/she is confident of being the job market star of the cohort, he/she would prefer academia.

How they choose their career? (Binary Response Model)

When applying for the graduate programs, it is common for applicants to express their ambitions of being an assistant professor. Some left the programs as they failed the qualification exams, some left half-way as they lost enthusiasm for research and academic career. For those successfully finishing around 6 years' rigorous study and research, they will have more realistic expectations of career choices with the updated understanding of themselves and the job market.

1.Wages (W)

Academia is not the place to become wealthy. The AEA website report that 10-month average salary for an assistant professor is $90,000, $128,600 for tenured associate professors and $204,800 for full professors.

Previous analysis has shown that many graduates end up at universities where the master is the terminal degree or liberal arts colleges. According to AEA report, the salaries for senior assistant professors, tenured associate professors, and full professors are on average $80,167, $82,333 and $97,500, respectively. Government economists are paid on the GS-12 grade range from $60,274 to $78,355 a year, according to the U.S. Office of Personnel Management's 2011 pay scale for federal employees.

Stock and Siegfried (2014) estimated that industry economists earned between 1.15 to 1.4 times of peers in academia. Although the industry job types and location vary the salaries, this is a reasonable ratio to assume for the graduates from 2010 to 2017. They also reported that government economists earn 20% more than academic economists.

2. Job Satisfaction (J)

Surprisingly, higher salaries do not generate greater job satisfaction. The questionnaire survey, conducted by Siegfried and Stock in 2004, reported that 31% of industry economists would rather not seek the doctoral degree as they regarded their current jobs as less commensurate with hard training in school. Also, there is no tenure system in private/public sectors, which means there could be more uncertainties and competitions.

On the contrary, assistant professors are more satisfied with their current jobs as the positions fulfill their expectations while they were still graduate students. They probably love doing research and teaching, believing that professor is a prestige profession, and value intellectual rigor.

3. Skills (S)

Stock and Hansen (2004) surveyed the cohorts from 1997 to 2002 to understand whether the skills necessary for success in graduate school and subsequent job differ. The graduates emphasized the importance of "application, communication, and instruction" towards success in jobs. Graduate economics programs are known as being math-intensive. However, the mathematical talents were reported as less important for jobs than mastering the first-year core courses.

The data revolution of the past decade is likely to have a profound effect on economic research (Levin and Einav, 2004). Besides from the demand in private/public sectors, there are also quite a few academic jobs in the current job openings for economists website that include "machine learning" or "big data".

4. Expectations (E)

Since the average length of the Ph.D. program is 5-6 years, a typical graduate will be at least 28 years old if he/she come directly from undergraduate institutions. Then after the job hunting in last year, he/she will become an assistant professor at one university. While continuing doing research, he/she will also have to teach three courses every year. After seven years, the department will evaluate his/her performance in publication, papers and teaching quality to decide whether to offer "tenure" or not. If he/she is prolific and shows great potentials, it is likely that he/she become a tenured associate professor. Being tenured means a wage increase and more job security. The promotion to professor requires more publications in top journals and professional services to the department.

However, this typical path is far more competitive than imagined. Conley and Onder (2014) showed that only a small percentage of economics Ph.D.s managed to produce a number of publications by their sixth year after graduation for tenure eligibility. In other words, most of them are not awarded tenure. They have to either move to other university or change job positions.

Binary Response Model

This model is estimated to simulate the decision of a graduate. The expected value of a dichotomous variable $Y_i \in \{0, 1\}$ is the probability that it takes the value 1 (choosing non-academic job):

$$E(Y_i) = 0 \cdot P(Y_i = 0) + 1 \cdot P(Y_i = 1) = P(Y_i = 1).$$

Graduates from program i entering academia expect to find similar jobs as their alumni. y is the academic placement index. $E[y|i]= y(i)$. They take wages, job satisfaction, expectations and opportunity cost into considerations when making career choices. However, they have different weights of these factors.

$$P(Y_i = 1)=F\ (W, S, E, y(i))+ \varepsilon$$

When $P(Y_i = 1) \geq 0.5$, non-academic positions are preferred. When $P(Y_i = 1)$ is close to 0, this graduate will almost surely find a job in academia. When $P(Y_i = 1)$ is close to 1, this graduate knows he/she will not become a professor.

One challenge for further analysis is that individuals' preferences are not observed. Surveys to graduates will provide data for better estimate the functional form. In this paper, we assume F (W, S, E, y(i)) is linear and simulate several scenarios of preferences:

$$P(Y_i = 1)=F\ (W, S, E, y(i))+ \varepsilon$$
$$= \alpha * Wi + \beta * Si - \gamma * Ei - \delta * y(i) + \varepsilon i$$

εi represents unobservable factors, such as families, visas, interests, etc.

$E(\varepsilon i \,|W, S, E, y(i)) = 0$

Suppose we get data from the survey to graduates and parameters for W, S, E, y(i) are rescaled, we consider three representative graduates:

1. Graduate from a top program who has prepared himself for academic careers

   $P(Y_i = 1)= 0.4 * 1.2 + 0.2 * 1 - 0.1 * 1 - 0.005 * 100 + \varepsilon i \approx 0.08$

2. Graduate from a mediocre program who is open to both career options

   $P(Y_i = 1)= 0.5 * 1.2 + 0.3 * 1 - 0.01 * 1 - 0.004 * 50 + \varepsilon i \approx 0.69$

3. Graduate from a mediocre program who prefers a more lucrative career

   $P(Y_i = 1)= 0.8 * 1.2 + 0.2 * 1 - 0.01 * 1 - 0.005 * 60 + \varepsilon i \approx 0.85$

Conclusion

Non-academic job positions are becoming the popular choice among economics Ph.D. graduates. Most of such jobs require a Ph.D. degree and research ability. As a result, although doctoral training is oriented toward academic positions, it is worthwhile for graduates to obtain the degree so as to qualify for these non-academic jobs. We suggest that both pedigrees and personal preference determine how likely graduates find jobs in private/public sectors. Graduates from large programs with poor performance in previous placement may opt for the non-academic job.

We also introduce the binary response model to simulate the graduate' decision-making process. However, individual-level preference data is needed to analyze these preferences' impact on the likelihood of ending up in private/public sectors. Survey data from graduates could also enable researchers to study how doctoral training help graduates prepare for different types of non-academic jobs.

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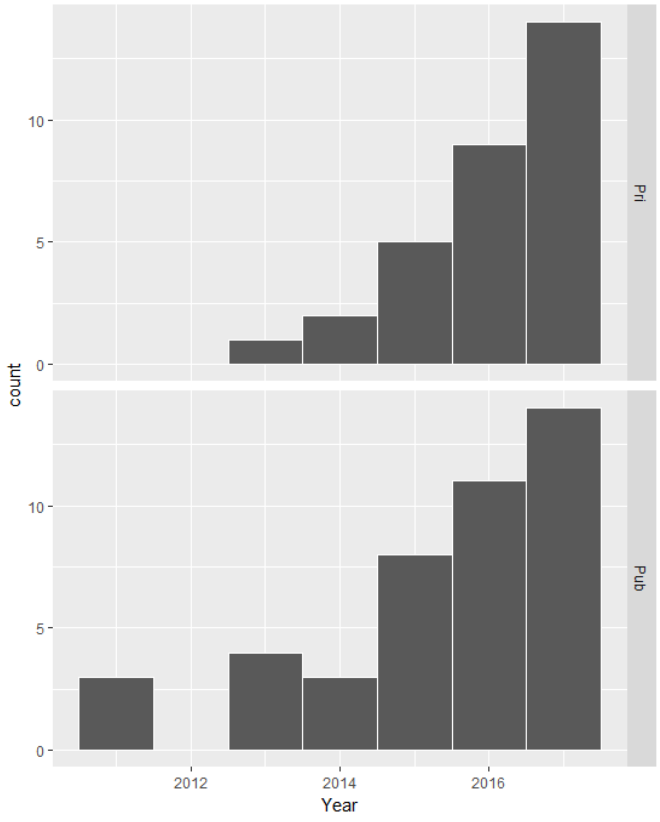
Appendices

A.Case Study of Amazon new economists' pedigrees

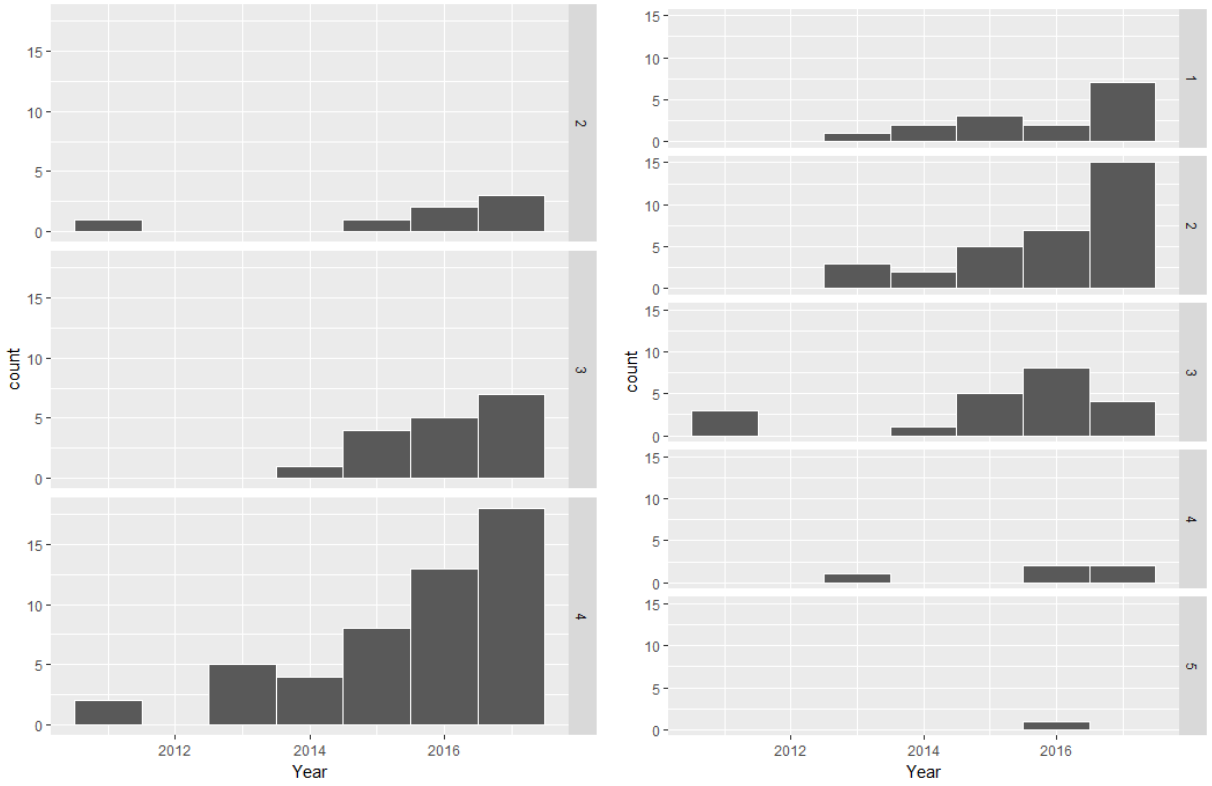
Let us take Amazon as an example to further understand whether one specific company prefer graduates from certain programs. The electronic commerce company has hired 74 newly-minted graduates from these 105 programs as economists or data scientists in the past 8 years. With the information of new employees' graduating programs' size, tier and characteristic (private v.s public), the following graph illustrate Amazon's hiring preferences.

Graph: Histograms of hires number across years at private and public institutions



There are more graduates from public institutions (43 counts) than private ones (31 counts). The graphs show the trend that the hiring numbers are soaring.

Graph (Left): Histograms of hires number across years and program sizes
Graph (Right): Histograms of hires number across years and program tiers



The graphs show that there are almost no new employees from the smallest (Size=1) and bottom-ranked (Tier =4,5) programs. Largest (Size=4) programs with Tier 2 are primary sources of new Amazon economists.

Table: Amazon new economists' pedigrees

Freq.	Counts	Percent	Size	Tier	Location
DUKE UNIVERSITY	5	6.76	3	2	NC
UNIVERSITY OF CALIFORNIA-SAN DIEGO	5	6.76	4	2	CA
BOSTON UNIVERSITY	4	5.41	4	2	MA
UNIVERSITY OF CALIFORNIA-LOS ANGELES	4	5.41	4	2	CA
CORNELL UNIVERSITY	3	4.05	4	2	NY
HARVARD UNIVERSITY	3	4.05	4	1	MA

MASSACHUSETTS INSTITUTE OF TECHNOLOGY	3	4.05	4	1	MA
MICHIGAN STATE UNIVERSITY	3	4.05	4	3	MI
STANFORD UNIVERSITY	3	4.05	4	1	CA
UNIVERSITY OF CALIFORNIA-BERKELEY	3	4.05	4	1	CA
UNIVERSITY OF CALIFORNIA-IRVINE	3	4.05	3	3	CA
UNIVERSITY OF MICHIGAN-ANN ARBOR	3	4.05	4	2	MI
UNIVERSITY OF TEXAS AT AUSTIN	3	4.05	4	3	TX
UNIVERSITY OF WASHINGTON	3	4.05	4	3	WA

30% (22 counts) of the new economists at Amazon got doctoral degrees from universities in California. 14% (10 counts) studied in Massachusetts and 8% (6 counts) in Michigan. Top four pedigrees of Amazon new economists are Duke, UCSD, Boston University, UCLA. Their placement quality indexes are 69, 71, 87 and 33, respectively. In the Tilburg ranking, University of Oregon has 70, University of Pittsburgh has 88 and City University of New York has 32. Assuming their job market papers are as good as their classmates in academia, they could predict that they are able to become assistant professors at similar places.

B. Ranking of programs based on academic placement index

Institution Name	Size	City	Space	FS	Citations	Faculty	Non Aca %	Num	AvgIndex	Tier
MASSACHUSETTS INSTITUTE OF TECHNOLOGY	4	1	1	0.96	3.25	46	0.26	136	236.92	1
HARVARD UNIVERSITY	4	1	0	1	4.21	66	0.33	219	210.40	1
CARNEGIE MELLON UNIVERSITY	2	1	1	1	1.88	30	0.00	11	186.67	2
STANFORD UNIVERSITY	4	1	0	0.83	2.81	73	0.37	147	156.71	1
YALE UNIVERSITY	4	1	0	1	1.68	43	0.22	139	138.14	1
UNIVERSITY OF CALIFORNIA-BERKELEY	4	1	0	0.5	2.83	60	0.30	149	132.43	1
UNIVERSITY OF CHICAGO	4	1	0	0.55	3.34	70	0.40	121	110.08	1
PRINCETON UNIVERSITY	4	0	0	1	3.04	47	0.38	156	104.83	1
NEW YORK UNIVERSITY	4	1	1	1	2.24	59	0.27	114	101.91	1
COLUMBIA UNIVERSITY	4	1	0	0.86	1.42	50	0.41	121	98.60	2

IN THE CITY OF NEW YORK										
BROWN UNIVERSITY	3	1	0	1	2.27	31	0.34	73	91.30	2
BOSTON UNIVERSITY	4	1	0	0.34	2.68	34	0.33	135	86.81	2
NORTHWESTERN UNIVERSITY	4	1	1	0.77	2.32	76	0.34	136	85.18	2
UNIVERSITY OF MICHIGAN-ANN ARBOR	4	1	0	0.74	1.86	88	0.39	179	75.34	2
CALIFORNIA INSTITUTE OF TECHNOLOGY	2	1	1	1	2.39	18	0.24	46	72.44	1
UNIVERSITY OF CALIFORNIA-SAN DIEGO	4	1	1	0.27	2.58	55	0.42	139	71.44	2
DUKE UNIVERSITY	3	1	0	1	2.07	63	0.39	109	68.77	2
RUTGERS THE STATE UNIVERSITY OF NEW JERSEY NEW BRUNSWICK CAMPUS	3	0	0	0.36	0.69	25	0.33	12	67.42	4

UNIVERSITY OF PENNSYLVANIA	4	1	1	0.23	2.21	46	0.34	128	63.58	1
PENN STATE UNIVERSITY	3	0	0	0.89	1.53	29	0.21	82	63.42	2
UNIVERSITY OF FLORIDA	2	0	1	0.77	0.89	18	0.25	3	59.20	5
WASHINGTON UNIVERSITY IN ST. LOUIS	2	1	1	0.91	1.9	23	0.19	57	55.26	2
UNIVERSITY OF IOWA	2	0	1	1	1.17	36	0.64	11	53.87	3
UNIVERSITY OF CALIFORNIA-SANTA BARBARA	3	0	1	0.77	1.02	39	0.24	71	52.59	3
UNIVERSITY OF ROCHESTER	3	1	0	0.47	1.44	16	0.35	40	52.53	2
UNIVERSITY OF ARIZONA	2	1	1	0.36	1.14	23	0.18	50	48.23	3
UNIVERSITY OF TEXAS AT AUSTIN	4	1	0	0.79	1.16	39	0.41	81	45.75	3
UNIVERSITY OF SOUTHERN CALIFORNIA	3	0	0	1	1.23	38	0.38	26	43.94	3

UNIVERSITY OF MINNESOTA-TWIN CITIES	4	1	0	1	1.41	30	0.42	85	43.20	2
UNIVERSITY OF NEW HAMPSHIRE	1	0	0	0.72	0.37	17	0.00	11	42.27	5
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN	3	0	0	0.93	0.93	51	0.39	61	40.47	3
UNIVERSITY OF WISCONSIN-MADISON	4	1	1	0.45	2.07	28	0.40	160	39.43	2
CLAREMONT GRADUATE UNIVERSITY	3	0	0	0	0.68	18	0.17	6	38.90	5
UNIVERSITY OF CONNECTICUT	3	0	0	0	0.66	34	0.31	35	38.54	5
UNIVERSITY OF PITTSBURGH PITTSBURGH CAMPUS	3	1	1	1	1.33	34	0.31	51	37.41	2
FORDHAM UNIVERSITY	3	1	1	0.29	0.27	15	0.54	24	36.57	5
GEORGETOWN UNIVERSITY	3	1	0	0.59	0.92	30	0.50	12	36.25	4

RICE UNIVERSITY	2	1	0	1	1.18	16	0.70	27	35.19	5
UNIVERSITY OF CALIFORNIA-DAVIS	4	0	0	0.55	1.19	34	0.36	96	34.64	3
GEORGIA STATE UNIVERSITY	3	1	1	0.86	0.79	32	0.25	65	34.59	4
UNIVERSITY OF WYOMING	1	0	1	1	0.96	16	0.12	33	34.30	3
JOHNS HOPKINS UNIVERSITY	3	1	1	0.56	1.1	15	0.43	61	33.70	3
CORNELL UNIVERSITY	4	0	1	0.82	1.63	54	0.53	51	32.23	2
UNIVERSITY OF CALIFORNIA-LOS ANGELES	4	1	0	0.35	1.66	59	0.54	127	31.58	2
EMORY UNIVERSITY	1	1	1	1	0.69	25	0.25	28	30.82	5
UNIVERSITY OF VIRGINIA	4	0	0	0.44	1.23	25	0.56	81	30.55	4
UNIVERSITY OF MASSACHUSETTS AMHERST	3	0	0	0.91	0.53	47	0.15	65	29.29	4
OHIO STATE UNIVERSITY	4	1	0	0.83	1.13	43	0.39	97	28.94	3

MAIN CAMPUS										
INDIANA UNIVERSITY AT BLOOMINGTON	3	0	0	0.67	1.02	33	0.29	66	28.42	4
VANDERBILT UNIVERSITY	2	1	0	1	0.66	40	0.29	42	28.30	4
UNIVERSITY OF NEBRASKA - LINCOLN	1	1	1	0.67	0.26	23	0.16	32	27.94	5
FLORIDA INTERNATIONAL UNIVERSITY	1	1	0	1	0.63	13	0.23	30	27.47	5
UNIVERSITY OF COLORADO AT BOULDER	3	1	0	0.64	1.15	30	0.28	79	27.12	3
UNIVERSITY OF CALIFORNIA-RIVERSIDE	2	1	0	0.71	0.66	28	0.26	53	27.08	4
UNIVERSITY OF MARYLAND COLLEGE PARK	4	0	1	0.95	1.95	52	0.61	122	26.98	2
OKLAHOMA STATE UNIVERSITY	1	0	0	0	0.47	16	0.13	16	26.88	5

MAIN CAMPUS										
DREXEL UNIVERSITY	1	1	1	1	0.86	38	0.10	10	26.62	4
LEHIGH UNIVERSITY	1	0	0	1	0.41	24	0.50	18	25.76	5
ARIZONA STATE UNIVERSITY	2	1	0	1	1.68	18	0.43	35	24.86	2
SYRACUSE UNIVERSITY MAIN CAMPUS	2	1	1	1	1.02	17	0.38	47	24.31	3
STATE UNIVERSITY OF NEW YORK AT STONY BROOK	2	0	1	0.88	0.97	13	0.37	41	24.13	3
BOSTON COLLEGE	3	1	1	1	1.28	25	0.41	73	24.11	2
UNIVERSITY OF CALIFORNIA-IRVINE	3	1	1	0.67	1.25	39	0.49	69	22.52	3
MICHIGAN STATE UNIVERSITY	4	0	0	0.27	1.39	83	0.42	31	21.34	3
UNIVERSITY OF GEORGIA	1	0	1	0.88	0.62	16	0.43	21	20.62	3
BRANDEIS UNIVERSITY	1	0	0	0.56	3	21	0.56	34	19.26	3

UNIVERSITY OF HOUSTON	3	1	1	0.71	1.21	22	0.35	46	18.16	5
UNIVERSITY OF MISSOURI - COLUMBIA	2	0	0	0.31	0.56	17	0.66	29	18.06	5
TEXAS A & M UNIVERSITY	4	0	1	0.44	0.71	29	0.36	75	17.93	3
IOWA STATE UNIVERSITY	3	0	0	1	0.87	38	0.43	67	17.86	2
UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL	3	0	1	0.93	1.05	35	0.45	86	16.35	4
PURDUE UNIVERSITY MAIN CAMPUS	2	0	0	0.9	0.92	30	0.12	34	16.15	3
LOUISIANA STATE UNIVERSITY AND AGRICULTURAL AND MECHANICAL COLLEGE	1	1	0	1	0.34	17	0.19	26	15.98	5
STATE UNIVERSITY OF NEW YORK AT BINGHAMTON	3	0	0	0.35	0.86	19	0.21	42	15.88	5
UNIVERSITY OF MISSOURI	2	1	0	0.57	0.15	13	0.31	29	15.72	5

- KANSAS CITY										
FLORIDA STATE UNIVERSITY	2	1	0	0.82	0.76	28	0.40	35	15.61	4
UNIVERSITY OF WASHINGTON	4	1	0	0.48	1.45	58	0.46	90	15.49	3
WASHINGTON STATE UNIVERSITY	2	0	1	0.56	0.46	36	0.45	80	15.49	4
UNIVERSITY OF DELAWARE	2	0	0	0.77	0.61	24	0.71	35	15.46	5
UNIVERSITY OF HAWAII AT MANOA	2	0	0	0.44	0.3	26	0.33	24	15.27	5
SOUTHERN ILLINOIS UNIVERSITY CARBONDALE	2	0	0	0.17	0.39	13	0.18	34	15.24	5
UNIVERSITY OF KENTUCKY	2	0	0	0.33	0.93	34	0.16	49	14.58	5
UNIVERSITY OF CALIFORNIA-SANTA CRUZ	2	0	1	1	0.87	22	0.54	67	14.54	4
GEORGE WASHINGTO	4	1	0	0.22	0.7	28	0.51	43	14.25	5

N UNIVERSITY										
UNIVERSITY OF UTAH	3	1	0	0.33	0.3	21	0.24	54	12.99	5
UNIVERSITY OF ILLINOIS AT CHICAGO	3	1	0	0.75	1.26	21	0.55	29	12.89	4
UNIVERSITY OF WISCONSIN-MILWAUKEE	2	1	0	0.46	0.32	22	0.27	41	12.56	5
CITY UNIVERSITY OF NEW YORK GRAD. CENTER	4	1	0	0.14	1.17	40	0.54	70	12.47	4
NORTH CAROLINA STATE UNIVERSITY	3	1	0	0.44	0.9	39	0.58	50	11.68	4
UNIVERSITY OF OREGON	2	1	0	0.58	0.65	22	0.35	51	9.71	4
SOUTHERN METHODIST UNIVERSITY	1	1	1	0.5	0.69	17	0.45	31	9.15	4
KANSAS STATE UNIVERSITY	1	0	0	0.8	0.52	18	0.11	28	7.66	5
UNIVERSITY OF TENNESSEE	1	1	1	0.75	0.38	25	0.18	38	5.78	5

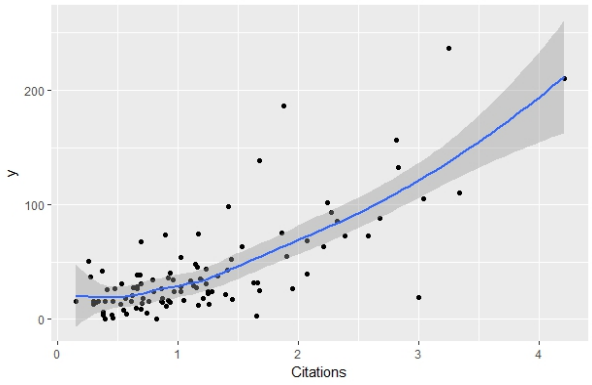
WAYNE STATE UNIVERSITY	2	0	1	0.78	0.74	10	0.00	2	5.00	5
UNIVERSITY OF OKLAHOMA NORMAN CAMPUS	1	0	1	1	0.57	14	0.25	16	4.81	5
OREGON STATE UNIVERSITY	1	0	0	0.6	1.25	16	0.53	30	4.64	4
STATE UNIVERSITY OF NEW YORK AT ALBANY	3	0	0	0.68	0.38	22	0.00	3	3.47	5
UNIVERSITY OF MISSISSIPPI	1	0	0	1	0.45	12	0.38	26	3.38	5
CLARK UNIVERSITY	2	1	0	0.67	1.65	10	0.64	22	2.59	5
UNIVERSITY OF KANSAS	2	0	0	0.8	0.55	33	0.49	45	0.96	5
TEMPLE UNIVERSITY	1	1	0	0.5	0.46	22	0.43	14	0.80	5
UNIVERSITY OF NEW MEXICO MAIN CAMPUS	1	1	1	0.64	0.8	14	0.35	23	0.77	4
WESTERN MICHIGAN UNIVERSITY	1	0	0	0.88	0.39	18	0.42	26	0.12	5

UNIVERSITY OF SOUTH CAROLINA COLUMBIA	1	1	1	1	0.82	11	0.00	1	0.00	5

C. Placements and program characteristics

Faculty: size of economics professors
Citation: measure of faculty quality
FS: percentage of students with financial supports
Int: percentage of international students within the program
Size: size quantile of the program
Tier: program tier
Pri: dummy variable, equals 1 if the university is private, 0 if public
GradNum: number of graduates for each program in the sample data, 2010-2017
AcaPert: Percentage of placements in academia
Space: dummy variable, equals 1 if graduate students have own office space
City: dummy variable, equals 1 if the campus is located in a city with a population of more than 100,000 people.
Time: Time to graduation

Graphs: Scatter Plots with Fit Lines
Ordering from left to right, top to bottom: $y(i)$ with Faculty Citations, Faculty Size, Financial Supports, International Percentage, Size, Tier, Private or Public, Graduate Number, Academic placement percentage, Office Space ,City location and Graduation time.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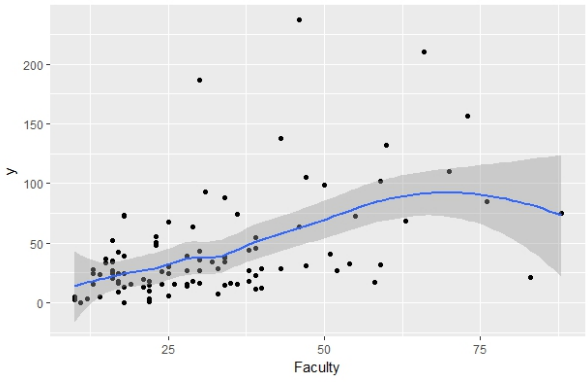
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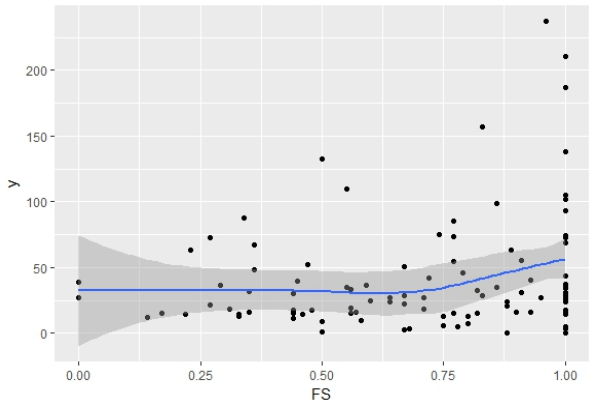
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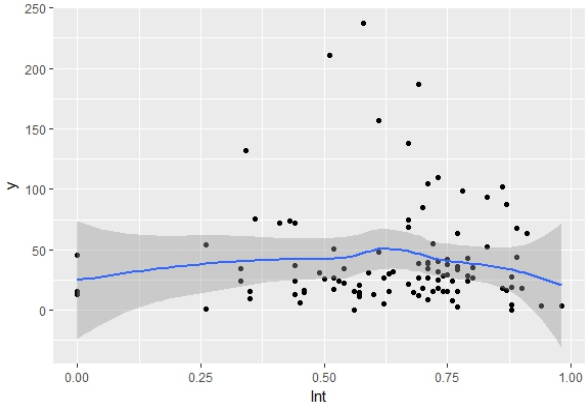
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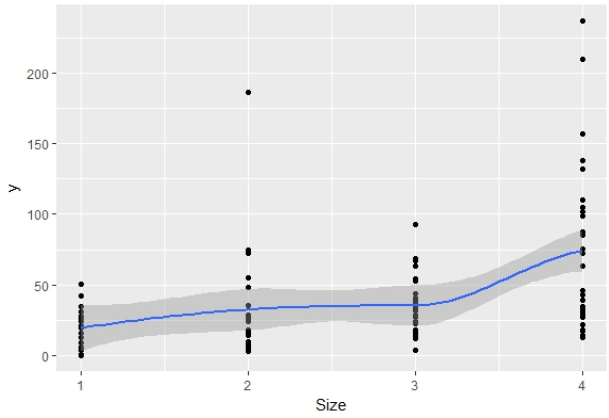
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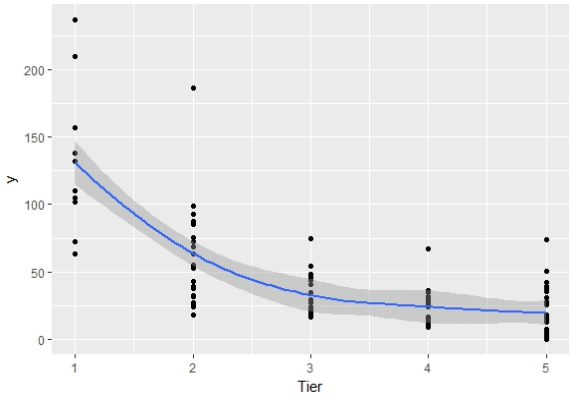
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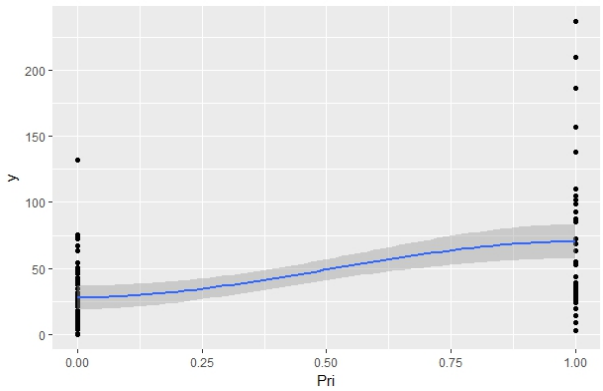
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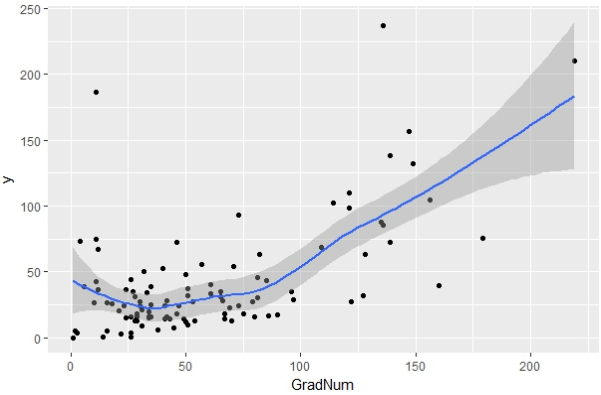
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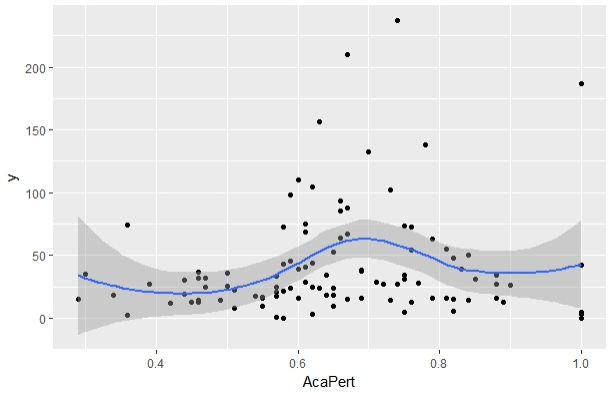
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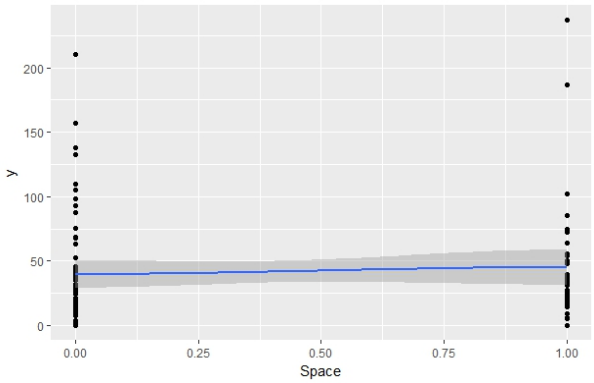
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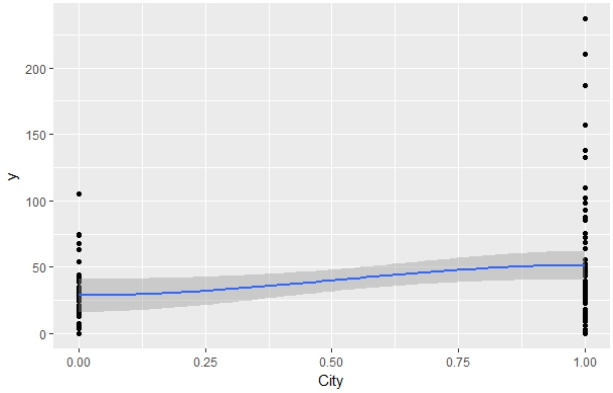
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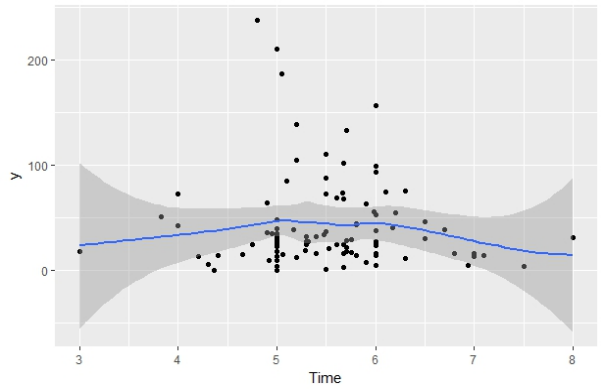
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