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Research Paper

Optional Practical Training (OPT) and International Students After Graduation

Human Capital, Innovation, and the Labor Market

Jeremy L. Neufeld[1]
Immigration Policy Analyst
Niskanen Center

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Executive Summary

Since the 1950s, international students studying in the United States have had the opportunity to stay in the country on their student visas after their graduation for a limited time in a program called Optional Practical Training (OPT), gaining valuable on-the-job experience and the chance to transition onto longer-term work visas.

Since that time, the OPT program has grown into the largest recruitment program for new high-skilled workers in the country, bringing 200,000 of them into the labor force each year. This report looks at the skill levels and human capital of OPT participants, finding they are highly educated and work increasingly in Science, Technology, Engineering, and Mathematics (STEM) fields.

This report also investigates the economic effects of the OPT program, using geographic variation, as well as the promulgation of a rule that offered a 24-month extension to OPT participants with STEM degrees as a natural experiment. The report finds higher levels of OPT participants in a region lead to increased innovation in that region, as measured by the number of patents, higher average earnings, especially among the higher-skilled, and no evidence of adverse effects on unemployment or labor force participation.

The report closes with some policy recommendations to better retain OPT participants, including a new exemption for OPT participants from the H-1B numerical limitations.

Introduction

Over 800,000 international students are enrolled in institutions of higher learning in the United States.[2] These students overwhelmingly hold F-1 student visas. F-1 visas do not generally authorize visa holders to work off-campus, but they do offer participation in the Optional Practical Training (OPT) program that authorizes eligible students and—as is more often the case—recent graduates to work for up to one year in jobs relevant to their field of study. As of 2016, students who have graduated with a degree in a Science, Technology, Engineering, and Mathematics (STEM) field may get a 24-month extension of their OPT status, meaning they can generally work in the United States for a total of three years after they graduate. The 24-month extension is the second STEM extension, supplanting a 17-month STEM extension that was established in 2008.

The OPT program provides valuable experience to graduates seeking on-the-job training as a capstone to their educational experience, but it also provides valuable human capital to the U.S. labor force. Indeed, the OPT program serves as the most important connection between the F-1 visa program and the H-1B visa program, the high-skilled guest worker program. The relationship between the two programs was described well by the U.S. District Court for the District of Columbia: "F-1 and H-1B are integrally related...F-1 and H-1B perform the interlocking task of recruiting students to pursue a course of study in the United States and retaining at least a portion of those individuals to work in the American economy."[3]

Operating as it does at the intersection of F-1 and H-1B, the OPT program can accurately be described as the largest high-skilled worker *recruitment* program in the country, bringing in well over 200,000 *new* high-skilled foreign workers each year, compared to only about 180,000 new H-1B visas issued each year.[4] However, because OPT is nonrenewable and lasts for less time, the H-1B program still contributes more high-skilled workers at any one time. And however successful OPT is at recruitment, retention is ultimately reliant on the H-1B.

The relative scarcity of H-1B visas—only 85,000 can be awarded per year to those not employed by universities and other cap-exempt employers—and the relatively short duration of OPT makes retention more difficult. Many OPT participants would like to remain in the United States to work after they graduate, but because of the difficulty of obtaining a scarce H-1B visa, the OPT program must serve as veritable "waiting room" for F-1 students waiting to get an H-1B.

Indeed, the Department of Homeland Security (DHS) justified the original STEM extension on the grounds that it better coordinates the recruitment and retention functions of both programs:

> Many employers who hire F-1 students under the OPT program eventually file a petition on the students' behalf for classification as an H-1B worker...Because the H-1B category is greatly oversubscribed, however, OPT employees often are unable to obtain H-1B status within their authorized period of stay in F-1 status, including the 12-month OPT period, and thus are forced to leave the country. The inability of U.S. employers, in particular in the fields of science, technology, engineering and mathematics, to obtain H-1B status for highly skilled foreign students and foreign nonimmigrant workers has adversely affected the ability of U.S. employers to recruit and retain skilled workers and creates a competitive disadvantage for U.S. companies.[5]

Despite its important role connecting the F-1 and H-1B visas and in recruiting high-skilled workers, little research has investigated the economic effects of the OPT program. This report begins to fill that gap, using data on OPT participants obtained through the Freedom of Information Act (FOIA), along with economic and demographic data. Ultimately, the data suggests that the program

increases innovation, benefits high-skilled workers, and does not adversely affect natives.

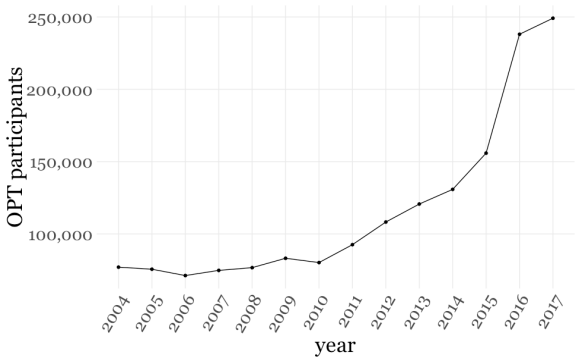
Data on OPT Participants

A. Scale and growth

U.S. Citizenship and Immigration Services (USCIS) tracks international students in the United States through the Student and Exchange Visitor Information System (SEVIS). Data from SEVIS on over 1.7 million OPT participants, including information on their degrees and employers was obtained through a FOIA request. Data was obtained as far back as 2003, when the use of SEVIS became mandatory, but unfortunately the data before 2004 and after 2017 appears fragmentary.

The data shows the remarkable growth in the program since first STEM extension was established in 2008, plotted below in Figure 1. Since 2004, the number of OPT participants working in the United States has grown more than three-fold, from over 77,000 to nearly 250,000. The largest yearly increase is evident between 2015 and 2016, coinciding with the launch of the 24-month STEM extension.

Figure 1: OPT participants working in U.S., 2004-2017

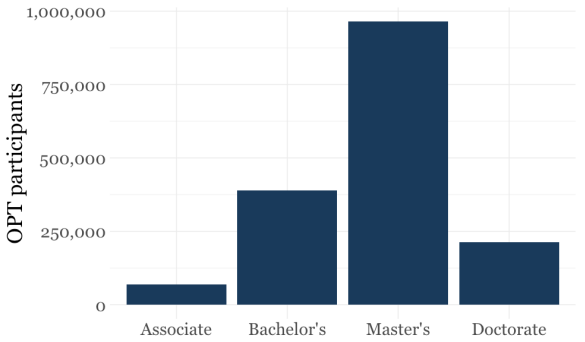


Note: An OPT participant is considered employed in a given year if she was employed through most of that year.

B. Educational attainment

The data also shows the breakdown of degrees earned by OPT participants, revealing that well over half—59 percent—of OPT participants between 2004 and 2017 have received master's degrees from U.S. institutions. Bachelor's degrees and doctorate degrees made up 24 percent and 13 percent respectively over the same period. The breakdown can be seen below in Figure 2.

Figure 2: Degrees earned by OPT participants, 2004-2017



While the majority of OPT participants have always been graduates with master's degrees, the proportion of OPT participants who graduated with a master's degree grew from about 53 percent in 2004 to over 70 percent in 2017. Meanwhile, the proportion of those with doctorates has hovered fairly consistently around 10 percent while the proportion of those with bachelors' degrees has shrunk dramatically, from over 30 percent in 2004 to about 18 percent in 2017. In short, as the number of OPT participants has grown, the average educational attainment among OPT participants has increased as well.

C. Fields of study

The data reveals the concentration of OPT participants in STEM fields and business. The 20 most common fields of study among OPT participants from 2004 to 2017 are shown below in Table 1. The most common fields of study among OPT participants from 2004-2017 were computer science, business administration, and electrical engineering.

However, trends indicate a shift away from business and toward STEM fields. To give an illustrative example, in 2004, 12 percent of OPT

participants had degrees in business administration and management and only 8 percent had degrees in computer science. However, in 2017, 14 percent had degrees in computer science and only 5 percent had degrees in business administration and management. In 2004, business administration and management was the single most common field of study, but it had fallen to fourth place by 2017.

Table 1: Most common fields of study among OPT participants, 2004-2017

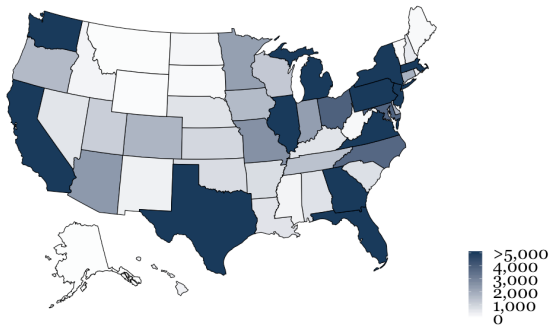
Field of study	Share
Computer Science	8.6%
Business Administration and Management	8.6%
Electrical and Electronics Engineering	5.5%
Computer and Information Sciences	3.4%
Mechanical Engineering	3.2%
Electrical and Communications Engineering	2.6%
Accounting	2.6%
Finance	2.0%
Economics	1.8%
Civil Engineering	1.7%
Computer Engineering	1.6%
Chemistry	1.5%
Information Science	1.4%
Information Technology	1.3%
Biology	1.1%
Industrial Engineering	1.1%
Chemical Engineering	1.0%
Mathematics	1.0%
Business	1.0%
International Business	1.0%

Note: Field of study denotes major subjects of undergraduates and equivalents for other degrees. For individuals with multiple majors, only the first is counted.

D. Geography

The geographic distribution of employed OPT participants can be seen in Figure 3. California, New York, and Texas lead with the greatest numbers of OPT participants. However, smaller states like Delaware, New Jersey, and Massachusetts (as well as Washington, D.C.), where about one in 300 workers is an active OPT participant, have the most OPT participants as a proportion of their respective populations. Meanwhile, Michigan, Washington, Georgia, Arkansas, and Iowa have seen the most growth in their levels of OPT participants.

Figure 3: OPT participants employed by state, 2017



Note: The true number of OPT participants in a given state is higher than indicated in the figure, because the employment locations were missing from 14 percent of the total number of OPT participants working in 2017. See also Appendix 2 for the numbers of OPT participants in states above 5,000.

In any case, the distribution across states may obscure the way OPT participants are employed around various urban and economic centers. Luckily, the data shows the geographic distribution at a higher-resolution than the state level, identifying cities of employment. Aggregating to the level of core-based statistical areas (CBSAs), Table 2, below, shows the top OPT destinations.

Table 2: Most common CBSA destinations among OPT participants, 2008-2017

Core-based statistical area	Share
New York-Newark-Jersey City	16.3%
Los Angeles-Long Beach-Anaheim	6.5%
San Francisco-Oakland-Hayward	5.9%
San Jose-Sunnyvale-Santa Clara	5.1%
Dallas-Fort Worth-Arlington	5.0%
Washington-Arlington-Alexandria	4.8%
Boston-Cambridge-Newton	4.6%
Chicago-Naperville-Elgin	4.1%
Seattle-Tacoma-Bellevue	2.7%
Houston-The Woodlands-Sugar Land	2.6%
Atlanta-Sandy Springs-Roswell	2.4%
Detroit-Warren-Dearborn	2.3%
Philadelphia-Camden-Wilmington	2.1%
San Diego-Carlsbad	1.5%
Miami-Fort Lauderdale-West Palm Beach	1.5%
Minneapolis-St. Paul-Bloomington	1.0%
Phoenix-Mesa-Scottsdale	1.0%
Austin-Round Rock	1.0%
Baltimore-Columbia-Towson	0.9%
Columbus	0.8%

The specific schools graduating OPT participants are mainly state schools and prestigious private schools. The most common degree-awarding institutions since 2003 have been the University of Southern California, Columbia University, and New York University. See Appendix 1 for a longer list of the most common schools.

Economic Effects

This section estimates and describes the effects of OPT employment on a variety of economic outcomes, using geographic variation in the employment locations of OPT participants. It finds that greater numbers of OPT participants lead to higher levels of innovation, measured by the number of patents, as well as higher average earnings, especially among the higher-skilled.

Determining the causal effect of the level of OPT participation presents a challenge because some causation is expected to run in both directions; economic conditions in a region are expected to respond to the level of OPT participation but it is also to be expected that economic conditions will affect where OPT participants locate in the first place.

However, this challenge is not insurmountable. First, the rule establishing the 24-month STEM extension, which dramatically increased the total number of active OPT participants can be exploited as a natural experiment. Second, existing networks formed by previous OPT participants, colleges, and employers have an effect on where OPT participants work that is independent from the given economic conditions in a given year. Both of these are used to isolate variation in the levels of OPT participation unrelated to economic conditions.

Estimates are shown below in Tables 3 and 4. See Appendix 3 for econometric details on the fixed-effects instrumental variable (FE-IV) approach described above, as well as the simpler fixed-effects (FE) models estimated for comparison.

As indicated in Table 3 below, the data show statistically significant positive effects of OPT participation on the number of patents and on average earnings. All else equal, the data suggests 10 additional OPT participants working in a CBSA leads to about five additional patents originating in that CBSA. It is unlikely that this is entirely a direct effect (i.e., that OPT participants themselves own or are responsible for these patents), but rather represents some combination of direct innovation by OPT participants and indirect spillover effects caused by a larger supply of highly educated workers. The effect of greater numbers of OPT participants on average earnings is also positive and statistically significant in the preferred model specification, and shows larger effects for residents with higher educational attainment, though unlike the effect on patenting, is not robust to the alternative model specification.

Table 3: Economic effects of OPT participants

Outcome variable	FE-IV	FE
Patents	.499***	.391**
	(.059)	(.167)
Average earnings ($)	.201*	-.003
	(.118)	(.112)
Bachelor's	.332***	.066
	(.103)	(.116)
Graduate	.680***	.282
	(.178)	(.183)

Note: * p<.1, ** p<.05, *** p<.01. All errors are cluster-robust standard errors. Estimating patents in the FE-IV model used only the network instrument, because patent data was available through 2015, precluding the use of the STEM extension instrument used in all other FE-IV estimations. Controls were included for total CBSA population size and that of various degrees of educational attainment, the age distribution, and a time trend.

Table 4 below shows estimates of the marginal effects of one hundred OPT participants in a CBSA on labor force participation, the fraction of the population employed, and the unemployment rate. None of the estimated effects is statistically different from zero, suggesting that OPT participants do not have adverse effects on aggregate labor market outcomes.

Table 4: More economic effects of OPT participants

Outcome variable	FE-IV	FE
Labor force participation (%)	.013	-.006
	(.008)	(.011)
Employment as % of population	.014	-.008
	(.010)	(.012)
Unemployment rate (%)	-.003	.002
	(.007)	(.005)

Note: No estimate is statistically significant at the 0.1 significance level. Magnitudes represent estimated effects per hundred OPT participants. All errors are cluster-robust standard errors. Labor force participation is among those over 25, as is employment over population, due to data limitations. Controls were included for total CBSA population size and that of various degrees of educational attainment, the age distribution, and a time trend.

Taken together, the results in this section suggest that regional economies benefit from employing greater numbers of OPT participants, seeing higher levels of innovation and higher earnings for residents, without discernable negative effects.

Policy Considerations

The results in this report indicate that OPT participants are quite highly-skilled (with a significant majority having attained advanced degrees), have positive effects on innovation and the marginal productivity of high-skilled workers, and little to no effect on other economic outcomes.

Yet, much of the program rests on the preservation of the status quo in the administrative rules by which it is governed. The STEM and Cap-Gap extensions are regulatory provisions, and are susceptible to revision or repeal under an unfriendly administration. Indeed, at the time of writing, the Unified Agenda indicates that a notice of proposed rulemaking is expected in September 2019 that would increase requirements and costs associated with participation in the OPT program.[6] Codification of various regulatory components of the program, including extensions and the use of duration of status, would not *expand* the scope of the benefits derived from the program, but would protect the benefits that are generated under the existing regulatory structure.

Beyond codification, new policies could help retain such high-skilled workers. Greater retention would allow the United States to continue to benefit from individual OPT participants when their OPT status expires instead of forcing them to leave their jobs and take their talents elsewhere if they are not lucky enough in the H-1B lottery.

Smaller-scale reforms to expand retention include proposals such as authorizing international students to declare dual intent on F-1 visas if they participate in OPT—that is, intent to transition from their temporary non-immigrant visas to immigrant visas.[7] However, dual intent is, on its own, insufficient to ensure that a given OPT participant can transition onto a non-student visa. Allowing OPT renewals for H-1B lottery losers and/or increasing the cap on advanced-degree exemptions under the H-1B would have larger effects, though still smaller than exempting all OPT participants who meet basic requirements from the H-1B numerical limitation, just as the employees of universities and similar institutions are exempted now. In addition, the results in this report lend support to the proposal of some lawmakers to authorize permanent residence for all those who graduated from a U.S. institution of higher education subject to degree or subject requirements.[8]

Making it easier for talented and highly educated workers and innovators to continue to pursue their careers in the United States can be an inexpensive part of any strategy to increase productivity growth.

Appendix

A1: Most common schools among OPT participants, 2003-2017

Degree-awarding institution	OPT participants
University of Southern California	30,720
Columbia University	29,438
New York University	25,537
City University of New York	20,730
Carnegie Mellon University	17,109
Arizona State University	16,797
University of Texas at Dallas	16,109
University of Michigan	15,848
University of Illinois	15,811
Northwestern Polytechnic University	15,463
Northeastern University	15,382
University of Texas at Arlington	15,129
Purdue University	14,675
Illinois Institute of Technology	14,630
State University of New York at Buffalo	14,228
University of Florida	13,717
University of Pennsylvania	13,142
Boston University	13,102
San Jose State University	12,464
Indiana University	12,374
Texas A&M University	12,300
Ohio State University	12,050
Harvard University	12,026
University of California, Los Angeles	12,014
Cornell University	11,808

A2: OPT participants employed by state in states with more than 5,000, 2017

State	OPT participants	Share
California	44,536	20.8%
New York	24,611	11.5%
Texas	22,870	10.7%
New Jersey	15,396	7.2%
Massachusetts	10,604	4.9%
Illinois	9,334	4.4%
Michigan	7,840	3.7%
Washington	7,585	3.5%
Virginia	7,086	3.3%
Georgia	7,035	3.3%
Florida	6,997	3.3%
Pennsylvania	5,265	2.5%

Note: As indicated above, the true number of OPT participants in a given state is higher than indicated here, because the employment locations were missing from 14% of the total number of OPT participants working in 2017

A3: Data and econometric considerations

The data set provided by USCIS on OPT participants was transformed into a data set containing the yearly numbers of estimated OPT participants in each CBSA in the United States. The interval was restricted from 2008-2017, because data on locations of employment was widely missing in the data USCIS provided before 2008. To prevent overestimating the magnitudes of economic effects, it was assumed that missing geographic data within the interval from 2008-2017 was random, meaning that the number of OPT participants in a given CBSA in a given year could be estimated by scaling the number of OPT participants observed in that CBSA in that year by the ratio of the total number of OPT participants to the number of observations that included geographic data (which turned out to be about 1.4).

CBSA-level geographic data on economic and demographic variables was obtained from the Local Area Unemployment Statistics Program,[9] the American Community Survey,[10] and the U.S. Patent and Trademark Office patent breakouts.[11]

The FE-IV model was estimated with Balestra and Varadharajan-Krishnakumar's generalized two-stage least squares (2SLS).[12] The endogenous variable, x_{it}, the estimated number of OPT participants in CBSA i and year t, was instrumented with a binary variable that indicated whether the 24-month STEM extension had gone into effect and a network instrument,[13] $z_{it} = \frac{x_{it-1}}{\sum_i x_{it-1}} \sum_i x_{it}$. Fixed effects in all models are CBSA-fixed effects, and all models were estimated with controls or covariates for total CBSA population size and that of various degrees of educational attainment, the age distribution, and a time trend.

Endnotes

[1] I gratefully thank Kristen de Peña and David Dagan for valuable comments on this paper. I'd also like to give special thanks to Matthew La Corte, Sam Peak, and Bryce Farabaugh for helping me clean up thousands of faulty observations in the data. Remaining errors are my own.

[2] Institute of International Education, "Open Doors Report on International Educational Exchange," 2018.

[3] *Washington Alliance of Technology Workers v. U.S. Department of Homeland Security*, No. 14-529 (D.C. Cir. 2018).

[4] U.S. Department of State, "Report of the Visa Office 2018."

[5] USCIS, DHS, "Extending Period of Optional Practical Training by 17 Months for F-1 Nonimmigrant Students with STEM Degrees and Expanding Cap-Gap Relief for All F-1 Students With Pending H-1B Petitions," 73 *Federal Register* 18944 (04/08/2008).

[6] DHS, "Establishing a Maximum Period of Authorized Stay for F-1 and Other Immigrants," 8 CFR 214 (Fall 2018).

[7] This provision was proposed in S. 2344, the Immigration Innovation Act of 2018, and similar legislation.

[8] A version of this proposal formed the basis of H.R. 2717, the "Stopping Trained in America Ph.D.s From Leaving the Economy (STAPLE) Act," introduced in 2017.

[9] U.S. Department of Labor, Bureau of Labor Statistics, Local Area Unemployment Statistics, "Labor Force Data by County, 2003-2017."

[10] U.S. Census Bureau, American Fact Finder, American Community Survey, "S1501, Educational Attainment."

[11] U.S. Patent and Trademark Office, "U.S. State Patenting Breakout by Regional Component Count of 2000-2015, Utility Patent Grants, As Distributed By Calendar Year of Grant."

[12] The models were estimated using the plm package of R: Y. Croissant and G. Millo, "Panel Data Econometrics in R: The plm Package," *Journal of Statistical Software*, 27:2 (2008), 1–43. However, the underlying technique comes from Pietro Balestra and Jayalakshmi Varadharajan-Krishnakumar, "Full Information Estimations of a System of Simultaneous Equations with Error Component Structure," *Econometric Theory*, 3:2 (1987), 223-246.

[13] This instrument is based on the instrument in Joseph G. Altonji and David Card, "The Effects of Immigration on the Labor Market Outcomes of Less-skilled Natives," in *Immigration, Trade, and the Labor Market*, eds. John M. Abowd and Richard B. Freeman (Chicago: University of Chicago Press 1991), 201-234 and David Card, "Immigrant Inflows, Native Outflows, and the Local Market Impacts of Higher Immigration," *Journal of Labor Economics*, 19:1 (2001), 22-64.