

Journal of Graduate Education Research

Volume 3

2022

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Osasohan Agbonlahor
University of Colorado Colorado Springs

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Agbonlahor, Osasohan (2022) "Multilevel Analysis of Factors Predicting International Doctoral Students' Time-to-Degree Completion," *Journal of Graduate Education Research*: Vol. 3 , Article 7.

Available at: <https://scholarworks.harding.edu/jger/vol3/iss1/7>

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Multilevel Analysis of Factors Predicting International Doctoral Students' Time-To-Degree Completion

Osasohan Agbonlahor

University of Colorado - Colorado Springs

How to cite this article:

Agbonlahor, O. (2022). Multilevel analysis of factors predicting international doctoral students' time-to-degree completion. *Journal of Graduate Education Research*, 3, 20-34.

ABSTRACT

Time-to-doctoral degree has consistently increased in American universities since the 1960s. The elongated time-to-degree has cost implications, not only for the degree granting institutions, but for doctoral recipients, particularly their international counterparts. This paper examined the effect of various factors, including financial aid, demographic characteristics, and home country economic conditions on international doctoral students' time-to-degree completion. The Push-Pull Model and human capital theory formed the conceptual framework for this study. Utilizing multiple regression and multilevel analysis on a set of student demographic characteristics, country-level economic factors, financial aid packages, and institutional level variables, the study finds that that foreign government aid is the most significant financial support for international doctoral students. Foreign government funding significantly reduced time-to-degree across regions and economies. Economic conditions in the home country are also an important factor affecting international doctoral student outcomes. Students from poorer countries took significantly less time to complete their degrees compared with their counterparts from richer countries. Higher U.S. assistant professor salaries also impacted on international doctoral student outcomes by increasing time to doctoral degree completion. The study provides recommendations for foreign governments, U.S. state governments and policy makers, as well as institutions of higher education.

INTRODUCTION

The Institute of International Education (2017) reports that there were over a million international students enrolled in U.S. higher education institutions in the 2016–2017 academic year, which represents an 85 percent increase in international students in the United States from a decade ago. Of this number, 391,124 were graduate students, with 124,705 being doctoral students (IIE, 2016). International students now account for about five percent of the more than 20 million students enrolled in U.S. higher education. Although the demand for the U.S. doctoral degree by international students is growing, research on international student retention has been limited in the literature. Research has particularly shown that international students often encounter a unique set of challenges related to academic and social integration, in addition to experiencing a mismatch between pre-arrival expectations and the realities of the American educational system (Ehrenberg & Marvos, 1995). International students have been found to have a shorter time to degree completion than their domestic counterparts (Nettles & Millet, 2006; Gillingham, Seneca, & Taussig, 1991). The Council of Graduate Schools' Ph.D. Completion Project findings show that international students finished the degree in a shorter time period, but not necessarily at a higher rate overall (CGS, 2009). The literature on international students notes that the immigration requirement places greater pressure on them to

complete their education faster than domestic students. Since international students are generally treated as a monolith in research studies, the differences by student characteristics are unknown. Student characteristics, including field of study, gender, and race, are shown in the literature to be a factor in doctoral time-to-degree. For doctoral students studying in a country different from their home, these characteristics may play a crucial role.

While multiple studies have explored the influence of financial factors and employment outlook on U.S. doctoral students, international doctoral students have not been the focus of any available studies. Empirical studies have investigated the role of finance in higher education based on Tinto's (1975) persistence model (Ampaw, 2010; St. John & Paulsen, 2002). There is a consensus that a lack of financial support significantly reduces the probability of completing the graduate degree, particularly in a short time (Abedi & Benkin, 1987; Gillingham, Seneca, & Taussig, 1991). These studies that have focused at the individual student level do not consider the divergent economic factors that work to impact international doctoral student outcomes. These factors may cause students from lower-income economies to experience challenges in the doctoral process that are different for their counterparts from high-income countries. This research study examines the impact of divergent macroeconomic home country factors and financial resources on international student's time to degree completion.

RATIONALE OF STUDY

This research study examines the impact of divergent home country economic factors and financial resources on international student's time to degree completion. From the international student perspective, the decision to pursue a doctoral degree outside of their home country cannot be taken lightly. In addition to the academic responsibilities, pursuing a doctoral degree abroad often implies a lengthy break from the workforce as well as a long period away from their family and support groups in their home countries. Financing their doctoral degree can also be challenging for most international students even after receiving institutional support since they are unable to receive other US-based financial aid and fellowships because of immigration rules, which limit on-campus employment and prohibit off-campus employment (Hazen & Alberts, 2006).

Thus, I used data from the Survey of Earned Doctorates (SED) and World Bank country economic data to understand (1) the effect of demographic characteristics, financial aid packages, country-level economic factors, and institutional level variables on international doctoral students' time-to-degree completion and (2) whether any differential effects on time to degree completion exist by the student's home country's region and income classification.

BACKGROUND LITERATURE ON DOCTORAL TIME-TO-DEGREE

Over the last three decades, researchers and policymakers have demonstrated a sustained interest in different aspects of doctoral education (Bowen & Rudenstine, 1992; Council of Graduate Studies 2008; Agbonlahor, Mendez & Bingham, 2021). These studies have discussed several critical issues

related to doctoral education including socialization (Austin, 2002); disciplinary/departmental culture (Lovitts, 2011); attrition (Lovitts, 2001); financial aid (Ampaw & Jaeger, 2012; Bowen & Rudenstine 1992); labor market outcomes (Agbonlahor& Ampaw, 2021; Ampaw& Jaeger, 2012); and supervisor relations (Baird, 1993). Time to the doctoral degree for all students has been the focus of multiple studies, and I discuss the literature by the various factors examined.

Previous research studies on graduate students and time to degree completion have focused on student characteristics and program factors that impact on the timely completion of the doctoral degree. Men have been found to have a shorter time to degree completion than women (Abedi & Benkin, 1987). Seagram, Gould, and Pyke (1998) also found that more women negatively experienced delays toward degree progress than their male counterparts. Marital status and family responsibilities increased the time it took to earn a doctorate (Wilson, 1965). This result was confirmed by Siegfried and Stock (2000), who found that childbearing lengthened the time to degree considerably for women. Similarly, Abedi and Benkin (1987) found that the number of dependents supported by the doctoral student had an even greater impact on time to degree than gender.

Student's age has also been included in most studies on time to degree completion. However, the effect of age on degree completion is not clear. Nettles and Millett (2006) found that older students in their sample exhibited faster time to degree completion, which is contrary to the study by Tuckman et al. (1990), which found that younger students experienced faster time to degree. Pressey (1962) found that students who complete the degree at a younger age and with faster time to degree completion were more likely to reap better professional rewards.

Researchers have examined the effect of race and ethnicity on doctoral program success, degree completion, and time to degree completion. Nettles (1990) found that the interaction of ethnic background, financial support and mentoring affected the doctoral experience of the students (Nettles, 1990). Similarly, Ellis (2001) found that race was a salient factor impacting on mentoring, program environment, and research and teaching. Rapoport (1999) study found that minority students were more likely to have greater levels of loan debt compared to their White and Asian counterparts. Nettles and Millett (2006) found that the tendency for underrepresented minorities to have lower GRE scores and undergraduate GPAs makes them less competitive for the best research assistantships and mentoring assignments in doctoral programs.

Program environment and disciplinary socialization also impact on time to degree completion. Time to degree completion differs greatly both within and across institutions by broad field or discipline (Bowen & Rudenstine, 1992; NSF, 2009). Research demonstrates that integration into the culture and norms of the department are critical components for retention, persistence, completion, and time to degree completion of doctoral students (Ferrer de Valero, 2001; Gardner, 2009; Girves & Wemmerus, 1988; Golde, 2000). Golde (2005) found that the effects of discipline and department are inextricably linked together in how the doctoral student interprets his or her

“fit” with the graduate program, which could impact time-to-degree.

Academic performance and labor market outlook are also related to the time of doctoral degree completion (Tuckman et al. 1990). Siegfried and Stock (2000) found that when starting salaries were higher, students in economics doctoral programs completed degrees in less time. Also, students who planned to pursue post-doctoral research appointments were likely to complete their degrees in a shorter time compared with students who planned for non-academic positions (Abedi & Benkin, 1987; Agbonlahor et.al, 2021). This is likely because students who planned to work outside of academia were more likely to work outside the department during their studies while those who planned for academic positions were more likely to work as research or teaching assistants in the department, thus, shortening their time-to-degree completion (Abedi & Benkin, 1987; Agbonlahor et.al, 2021).

Financial support, and particularly the research assistantship, have been found to impact doctoral degree completion and time to degree completion (Abedi & Benkin, 1987; Girves & Wemmerus, 1988; Zhang 2019; Zhou & Okahana, 2016). Abedi and Benkin (1987) showed that the source of financial support during graduate school was important in predicting the time to the doctorate. Girves and Wemmerus (1988) found students employed as teaching assistants were likely to become involved in their graduate programs and earn their degrees in less time than those who were self-supporting but in more time than research assistants. Similarly, Bowen and Rudenstine (1992) found that students who funded their doctoral program had lower completion rates and longer time-to-degree than their institutional supported peers. The authors hypothesized that students with full institutional support could devote more time to their doctoral degrees compared to self-supporting students who may have had to work part-time.

Ehrenberg and Marvos (1995) also observed completion rates and mean time to degree completion were affected by different types of student financial support. They also found that financial support has a high degree of impact on doctoral degree completion. They note that that having financial support was more important than the type or form of financial support and that for students using their own resources, were prone to attrition and a longer time to degree completion than their supported peers. Similarly, Siegfried and Stock (2000) found that doctoral students who were supported by a combination of fellowships and assistantships completed their programs in a shorter time period than their peers who were supported by only fellowships. It is crucial to understand how the type of financial support received will impact on the time to the doctoral degree from the international student context. Dongbin and Otts (2010) investigated whether student loan amounts influenced time to the doctoral degree and showed that except for the social sciences, borrowing over \$50,000 for study was a common predictor of higher time to degree completion.

The literature on doctoral education has clearly shown the effect of individual characteristics on time to a doctoral degree; however all these research studies have used a sample made up of mainly domestic students in their analyses. Little is known as whether these factors affect international students in the same way. It is especially important in terms of funding the degree to

understand how different sources of financial support can impact students coming from countries with varying economic conditions (Agbonlahor & Ampaw, 2021). Using a census sample of international students who graduated with research doctorates from United States higher education institutions, I examined the effects of financial aid and home-country economic indicators on international student's time-to-degree completion. I used multiple regression analysis and hierarchical linear modeling to disaggregate the results based on the students' home countries' geographical regions and income classifications as designated by the World Bank.

THEORETICAL BACKGROUND

Human capital serves as the theoretical basis for our study. Economists and higher education researchers have used the theory to explain how and why individuals decide to invest in higher education (Becker, 1964). I constructed a conceptual framework that assumes opportunity costs affect student decisions, which in turn impacts time to degree completion, broadly speaking, an individual chooses to invest more in higher education when the expected future benefits exceed the expected cost (Becker, 1964).

From an economic perspective, a student's decision to pursue a doctoral degree involves present costs in the form of opportunities foregone while the student pursues the doctorate. International doctoral students choose to pursue foreign higher education in anticipation of the intrinsic and extrinsic benefits they expect from the investment. Extrinsic benefits from education, are the future earnings individuals expect to receive as they use their education in economic activity (Becker, 1962). Expected future earnings are the sum of earnings over a lifetime, with future years discounted to reflect present-day values. In the case of international students, expected earnings include higher median earnings of doctoral recipients' in the United States through the possible transition into the U.S. labor market after graduation and earnings of doctorate holders in the home country.

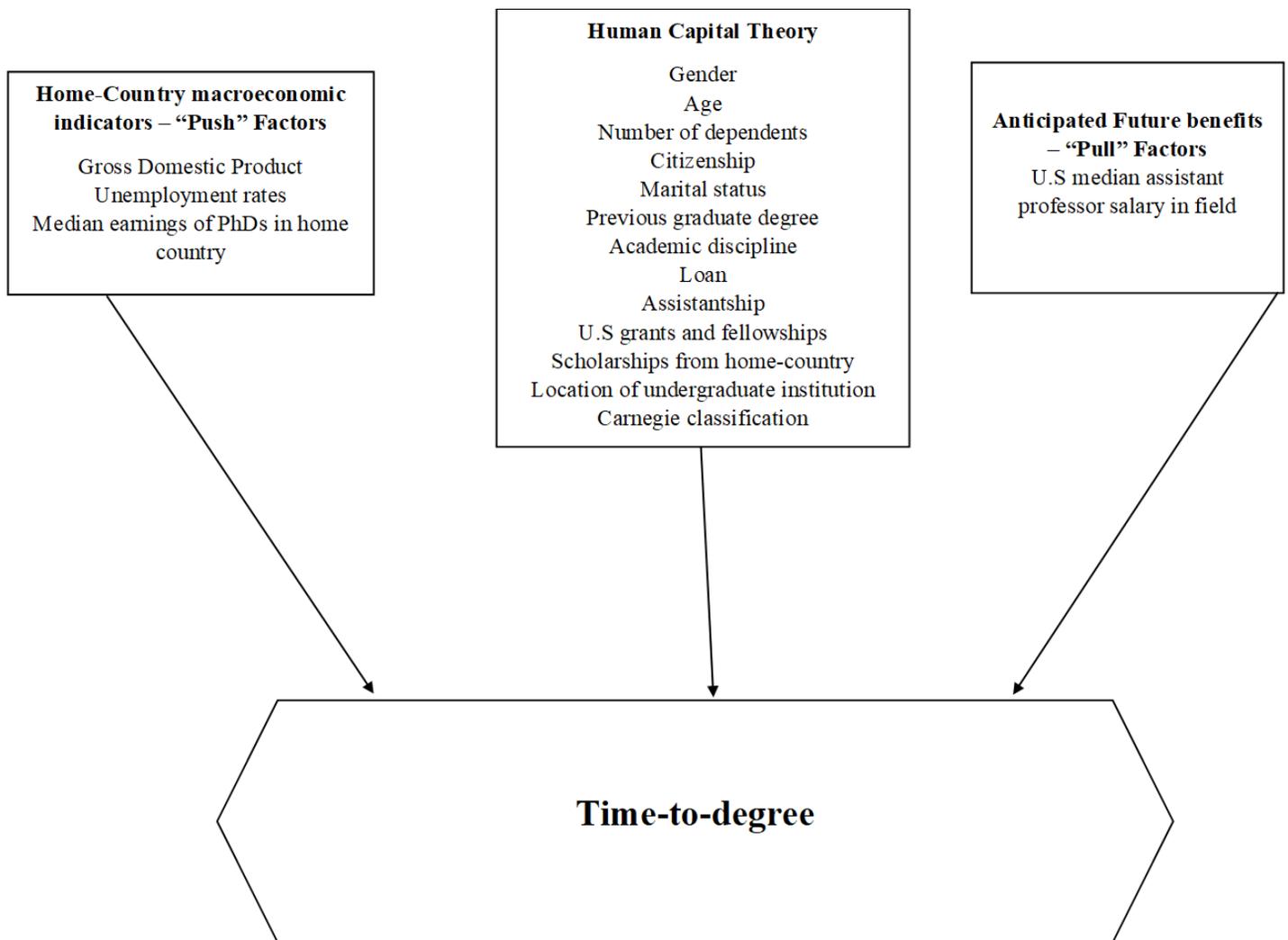
The extrinsic costs of foreign doctoral education include the tuition and fees paid to attain the education, plus the opportunity costs, which are the earnings the student forfeited upon undertaking full-time education (Ampaw, 2010). Financial aid subsidizes extrinsic costs, but depending on the type and nature of the funding, the time to degree could be negatively or positively affected. For example, students holding teaching assistantships spend less time on degree-related activities and may have a longer time-to-degree than those with research assistantships (Girves & Wemmerus, 1988). As financial cost increases, incentives are created to complete the program as quickly as possible, and time to degree decreases (Tuckman et.al, 1990). Because they offset some of the income lost from non-participation in the formal labor market, financial aid in the form of fellowships, grants, and assistantships may reduce the opportunity costs of pursuing the doctorate (National Research Council, 1990).

Similarly, each variable in the conceptual model can be examined within the opportunity-cost framework. Societal norms place primary care responsibility on women, and thus, married women with dependents may have a longer time to degree completion. For example, as the number of dependents

increases, the amount of time the student may spend with their family also increases, causing time to degree completion to rise. The effect of the type of undergraduate education on time to degree completion is not as straightforward. International students who studied in the United States may be better prepared for graduate school, reducing adjustment time and the cost of pursuing the doctorate and resulting in faster progress to the degree. In addition, the quality of the doctoral institution may impact on time to degree. Academic discipline is included in the model because their fields have peculiar research norms and standards that impact time to degree. Similarly, the economic factors can be examined from the opportunity cost framework. Higher U.S. faculty salaries may

lead students to work faster on their dissertations to get these positions. On the other hand, if the market is competitive while salaries are high, students may spend more time working to publish high-quality positions to compete for these positions. Wages of advanced degree holders in the home country are included in the model as wages forgone during the time the student completes the degree in the United States. Higher wages will imply a higher opportunity cost and students will experience a shorter time to degree completion. Higher unemployment rates in the home country may lead to increased time to degree for students as they may stay longer in the programs with hopes of obtaining a U.S. position before graduating.

Figure 1
Conceptual Framework



RESEARCH METHODS

DATA SOURCES

For international students, time-to-degree completion is the result of individual characteristics, and the interaction between the doctoral recipient, the academic discipline, and the economic conditions of their countries. Hence, time-to-degree completion ought to be studied within the multi-level context in which it exists. Four data sets – Survey of Earned Doctorates from NSF, the Integrated Postsecondary Education Data System (IPEDS) from NCES, World Bank data, and the National Faculty Salary Survey, are incorporated to clarify the relationship between financial aid factors and home country macroeconomic conditions on time to doctorate degree completion of international students.

The primary data for the research is obtained from the Survey of Earned Doctorates (SED). The SED is a nationally prepared, institutionally administered survey of all doctorate recipients in the United States. This study will include every non-US citizen on a student visa who received a first research doctorate from U.S. academic institutions between July 1, 2011, and June 30, 2016. Given that the SED offers census data, it is not necessary to conduct any statistical techniques to adjust for sampling error or design effect.

The second data source is the Integrated Postsecondary Education Data System (IPEDS) developed and maintained by the U.S. Department of Education's National Center for Education Statistics (NCES) in 1980. Institutional level variables are derived from the Integrated Postsecondary Education Data System database which offers institutional structural characteristics (institutional size or Carnegie classification) and racial/ethnic composition of the field of study.

This study also uses World Bank data which provides the home country macroeconomic variables such as GDP and unemployment rates. The World Bank uses aggregation rules that are intended to yield estimates for a consistent set of economies from one period to the next and for all indicators. Aggregates are based on the World Bank's regional and income classification of countries (The World Bank, 2018). Data from the World Bank is for the period 2010 through 2015, which represents the median time to degree completion for the students and the covers the period when they were enrolled in their degrees. This will capture how macroeconomic conditions in their home countries impacted on their time to degree completion and their subsequent labor market choices.

Finally, this study used data from the National Faculty Salary Survey, which provides information on the median U.S. assistant professor salary in the different fields as a proxy for expected earnings. The country of origin in the SED was used to match the world bank data while the field of study also contained in the SED was used to match the NFS data.

ANALYTICAL METHOD

The analysis began with multiple regression analysis to examine the relationship between time to degree and student characteristics, institutional variables, and economic conditions of the home country. Since international doctoral students are nested within the field of study and also within countries, this

study uses Hierarchical linear models (HLM) to assess the estimates of the effects of level-3 variables (home country) on level-2 variables (field) on the student level outcome of time to degree (Thomas, 2000). The dependent variable, time to doctorate degree, measures the elapsed time from entry into the doctoral program through completion of the doctorate. The independent variables are categorized into five groups: demographic, academic, financial, external responsibilities, and economic conditions.

These variables include gender, age, and first-generation status (neither parent attained a bachelor's degree). Doctoral students vary in the amount of family responsibilities they hold during their pursuit of the degree so marital status, dependents in home country and dependents in the U.S. were included in the analysis. Financial aid variables include loans, assistantships, U.S. awarded grants and fellowships and scholarships from home country. Loans for graduate education were combined and grouped into three categories based on frequency distribution – No loans, Debt less than \$20,000 and Debt more than \$20,000.

Institutional level variables include the Carnegie classification (research intensive or extensive) and institutional size (small, medium, and large institutions). Carnegie classification is a dichotomous variable that refers to whether the institution is research extensive or research intensive. To control for any unobserved effects of the field of study time-to-degree, the analysis will include the department the student graduated from. The departments will be coded into seven categories – Biological Sciences, Engineering, Physical Sciences, Social sciences, Humanities, Education, and Business. The salary of US assistant professor was the main field level variable and served as a proxy for expected earnings in the US after degree completion.

Home country region classification will follow the World Bank (2017) categorization, which falls into six broad categories – Europe and Central Asia, East Asia and the Pacific, Latin America and the Caribbean, Middle East and North America, North America, South Asia and Sub-saharan Africa. The analysis was conducted by region and income classification. Country-level variables used included the per capita GDP, unemployment rates, and monthly earnings of advanced degree holders.

RESEARCH FINDINGS

DESCRIPTIVE RESULTS

Table 1 and 2 presents the descriptive statistics for the variables in the model. The initial sample consisted of 63% men and 37% women. The average age at which international doctoral students completed their degree over the study period was 32 years old. The average time to degree completion was 5.658 years, with the maximum being 11 years. Average GNI per capita of the home countries was \$17,867, with the wealthiest country having \$121,016. The mean wages of individuals with advanced degrees (professionals) from the home country was \$15,247 which is sharply lower than the mean of U.S. faculty salaries, \$67,099.

Table 1
Descriptive Statistics for Categorical Variables

Variable	Percent	
Gender	Male	62.7
	Female	37.2
Parents Education	First generation	38.2
	Bachelor's degree	30.9
	Graduate School	30.9
Region	Europe and Central Asia	12.9
	East Asia and Pacific	46.7
	Latin America & the Caribbean	7.2
	Middle East & North Africa	8.79
	North America	3.14
	South Asia	17.9
	Sub-Saharan Africa	3.3
	Economy	24.7
Economy	High Income	24.7
	Upper-Middle-Income	50.8
	Lower-Middle-Income	22.1
	Low-Income	2.5
Prior Academic Experience		
U.S. Bachelors	No	91.2
	Yes	8.8
U.S. Masters	No	40.2
	Yes	59.0
Academic Disciplines	Biological Sciences	18.3
	Engineering	29.3
	Physical Sciences	25.2
	Social Sciences	11.3
	Humanities	4.6
	Education	3.5
	Business Management	3.7
	Non-classified	4.1
Family/External Responsibilities		
Single	No	56.7
	Yes	43.4
Dependents	No	72.1
	Yes	27.9
Program Characteristics		
Prerequisite Master's degree for doctoral Program	No	77.3
	Yes	22.7
Financial Resources		
Primary Support	Fellowship/grants/scholarships	20.8
	Research Assistantship	46.9
	Teaching Assistantship	22.8
	Foreign Government	4.3
	Others (savings, loans)	5.2
Full tuition remission	No	31.1
	Yes	68.9
Graduate level debt	No loans	31.1
	Loans less than \$20,000	68.9
	Loans more than \$20,000	9.7
Secondary support	No	16.1
	Yes	83.9
Institutional Variables		
Carnegie classification	Research Intensive	4.5
	Research Extensive	95.5
Institutional size	Small	5.1
	Medium	12.6
	Large	82.3

Table 3 presents the results of the average time-to-degree completion by across home country classifications. Students from high-income countries took the longest to complete their degrees (5.82 years), followed by students from lower-middle-income countries (5.62 years), and low-income countries (5.49 years). Students from Upper middle-income countries took the least amount of time to complete their degrees (5.43). It is noteworthy that there is not much variation amongst mean time-to-degree completion for international students compared with studies on domestic students which show wide variations because of visa and duration of stay limitations placed on international students. As expected, students in the humanities took the longest to complete their degrees (6.75 years) across all economies. Of all the students in the humanities, those from lower-middle-income countries took the longest time to complete their degrees (6.82 years) while those from low-income countries took the shortest time (6.17 years). Students in Engineering took the shortest time to complete their degrees (5.25 years) across all economies.

In terms of financial support, those who were supported by a foreign government/entity took the least time to complete their degree across all economies (5.27 years), with students from lower-middle-income countries have the shortest time-to-degree completion (5.06 years) and those from low-income countries taking the longest time to complete their degree. Those who were self-supporting through a mixture of personal savings, spouse/family income, and internships took the longest time to complete their degrees (6.14 years), with students from high-income countries taking the longest time (6.29 years) in this category.

MULTIPLE REGRESSION MODELS

Table 4 presents the results of the multiple regression analysis of time-to-degree completion with three separate models. The first being a general model of TTD, the second model adds institutional controls of tuition, institutional size, and Carnegie classification (research extensive/research intensive), and the final model including the economic conditions in the home countries (wages of professionals, GNI per capita, and unemployment rates) and U.S. faculty salaries. In the initial model, women, older students, married women and first-

generation college going students took significantly more time to complete their degrees than their counterparts. Married Compared with students from Europe and Central Asia, students from Latin America and the Caribbean and Sub-Saharan took significantly less time to complete their degrees. Students who obtained their bachelor's or Master's in the United States took significantly more time to complete their degrees than their counterparts who obtained foreign degrees. Compared with students in the Social Sciences, students in the Biological Sciences, Engineering and Education took significantly less time to complete their degrees. Those who received secondary support and those who were supported by teaching assistantships took significantly more time to complete their degrees. Whereas those supported by a foreign government, those who received full tuition remission, and those who financed their graduate education with debt of more than \$20,000) took significantly less time to complete their degrees.

After adding the institutional controls, all the variables maintain their significance and direction of effect except for teaching assistantships and physical sciences. After controlling for institutional factors, teaching assistantships loses its significance, implying that those who received teaching assistantships were not significantly different from those who were self-supporting in terms of time-to-degree completion. Similarly, students in the Physical sciences are not significantly different from those in the social sciences, implying that obtaining a doctoral degree in the physical sciences did not necessarily shorten or lengthen the time to degree completion compared with their counterparts in the social sciences. Two of the institutional controls are positive significant predictors of time-to-degree completion. Higher tuition and attending a research extensive institution are related to longer time to degree completion. It is noteworthy that after adding the economic variables, the regional significance disappears, because of the relationship between the economic variables and the regions, which makes it necessary to utilize a hierarchical linear model to control for the within-region effects, that are not captured in the multiple regression. The HLM model provides the between field and within-region (country effects) and their relationship on the individual variables.

Table 2
Descriptive Statistics of Continuous Variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Time-to-degree completion	5.581	1.420	1	11
Age	32.22	4.66	18	70
Out-of-state graduate tuition	\$24,838.18	\$9,374.19	0.00	\$46,000.00
GNI per capita	\$17,867.15	\$13,764.00	\$700.00	\$121,016.00
Wages	\$15,247.53	\$13,514.34	\$1,377.168	\$81,307.53
Unemployment	7.82	6.29	1.50	47.52
US Faculty Salary	\$67,099.18	\$9,455.80	\$54,671.00	\$107,066.00

Table 3
Average Time-to-Degree Completion by Individual, Institutional, and Field Variables Across Home Country Classifications

		High Income	Upper-Middle-Income	Lower-Middle-Income	Low-Income	Total
Gender	Male	5.734	5.361	5.580	5.470	5.513
	Female	5.958	5.538	5.690	5.580	5.695
Region	Europe and Central Asia	5.805	5.742	5.580	5.545	5.776
	East Asia and Pacific	5.859	5.396	5.699	-	5.513
	Latin America and the Caribbean	5.808	5.825	5.781	5.659	5.820
	Middle East and North Africa	5.427	4.987	5.071	5.871	5.099
	North America	5.985	-	-	-	5.985
	South Asia	-	-	5.670	5.459	5.655
	Sub-Saharan Africa	-	5.875	5.370	5.505	5.449
Parents Education	First generation	5.818	5.364	5.461	5.439	5.494
	Continuing generation	5.825	5.49	5.670	5.58	5.64
US bachelor degree	No	5.806	5.415	5.607	5.471	5.558
	Yes	6.036	5.751	5.821	5.591	5.877
US master's degree	No	5.537	5.134	5.359	5.175	5.309
	Yes	6.069	5.644	5.821	5.675	5.807
Secondary support	No	5.500	5.222	5.407	5.266	5.337
	Yes	5.876	5.470	5.667	5.557	5.627
Carnegie classification	Research Intensive	5.804	5.525	5.509	5.176	5.586
	Research Extensive	5.823	5.426	5.628	5.529	5.580
Discipline	Biological Sciences	5.692	5.502	5.584	5.428	5.578
	Engineering	5.437	5.086	5.457	5.187	5.248
	Physical Sciences	5.652	5.525	5.758	5.633	5.609
	Social Sciences	6.081	5.950	5.970	5.669	6.009
	Humanities	6.765	6.717	6.821	6.170	6.750
	Education	5.726	5.728	5.476	5.650	5.698
	Business Management	5.364	5.296	5.396	5.325	5.347
	Non-classified	5.598	5.310	5.412	5.187	5.439
	Financial Support	Fellowship/grants/scholarships	5.888	5.557	5.556	5.354
	Research Assistantship	5.578	5.305	5.560	5.369	5.422
	Teaching Assistantship	6.024	5.604	5.777	5.708	5.753
	Foreign Government	5.414	5.171	5.064	5.516	5.267
	Other Sources	6.286	6.060	5.933	5.693	6.143
	Total	5.823	5.430	5.621	5.498	5.581

Table 4
Multiple Regression Results of Time-To-Degree Completion

Model	Initial Model		Model with institutional controls		Model including economic conditions	
Variable	β	SE	β	SE	β	SE
Student Characteristics						
Single women	0.000	0.029	0.046	0.060	0.058	0.146
Age	0.106***	0.002	0.105***	0.005	0.108***	0.011
Married men	-0.098***	0.025	-0.138***	0.038	-0.152	0.129
Married women	0.178***	0.037	0.112	0.077	0.015	0.184
Dependents	-0.007	0.023	0.103**	0.048	0.020	0.128
First generation	0.102***	0.011	0.099***	0.023	0.054	0.054
East Asia and Pacific	-0.053	0.029	-0.119**	0.057	-0.027	0.218
Latin America & the Caribbean	-0.188***	0.042	-0.196**	0.083	-0.111	0.145
Middle East & North Africa	-0.449***	0.039	-0.491***	0.078	0.824	0.508
North America	0.018	0.056	-0.077	0.105	-0.092	0.135
South Asia	0.083**	0.034	0.130	0.067	0.174	0.364
Sub-Saharan Africa	-0.627***	0.056	-0.348***	0.118	-0.061	0.375
Prior Educational Experience						
U.S. Bachelor's degree	0.189***	0.035	0.179***	0.071	0.064	0.131
U.S. master's degree	0.511***	0.019	0.337***	0.038	0.430***	0.100
Masters Prerequisite	-0.159***	0.021	-0.140***	0.045	-0.249	0.110
<i>Academic Discipline</i>						
Biological Sciences	-0.101***	0.033	-0.090	0.065	-0.116	0.155
Engineering	-0.196***	0.030	-0.221***	0.064	-0.306	0.173
Physical Sciences	0.073***	0.030	0.002	0.060	-0.006	0.142
Humanities	0.638***	0.045	0.751***	0.087	0.673***	0.179
Education	-0.210***	0.049	0.005	0.109	-0.759***	0.285
Business Management	0.510***	0.049	-0.441***	0.080	-1.042**	0.466
Financial Support						
Secondary support	0.258***	0.025	0.200***	0.055	0.236	0.166
Fellowship/grants/scholarships	0.019	0.044	-0.183	0.111	0.053	0.231
Research Assistantship	0.046	0.044	-0.092	0.109	-0.018	0.236
Teaching Assistantship	0.111**	0.044	-0.122	0.110	-0.191	0.230
Foreign Government	-0.246***	0.056	-0.390***	0.157	-0.478	0.370
Full tuition remission	-0.168***	0.021	-0.129***	0.044	-0.339***	0.105
Graduate debt less than \$20,000	0.087***	0.027	0.061	0.058	0.131	0.135
Graduate debt more than \$20,000	-0.107***	0.031	-0.146***	0.067	0.085	0.167
Institutional Characteristics						
Logged Tuition			0.142***	0.040	0.025	0.096
Research extensive			0.269**	0.121	0.417	0.274
Size			-0.057	0.050	-0.154	0.111
Economic Factors						
Logged GNI per capita					0.182**	0.114
Logged wages in home country					0.022	0.143
logged U.S. salary in the field					0.170	0.822
Unemployment rates in the home country					-0.033	0.017

HLM ANALYSIS

To examine whether significant results exist in the time-to-degree completion by country, field, and individual level, the HLM modeling was further conducted. The HLM technique requires the dataset to be balanced, wages and unemployment rates in the home country are not included because the World Bank did not provide estimates for low-income countries and a number of lower middle-income countries. After controlling for the country-level and field level, the HLM results presented in Table 5 shows that compared with single men, married men took significantly shorter times to complete their degrees while married women had significantly longer time to doctorate degree completion. Older students took significantly longer than younger students to complete their degrees. The same is true of first-generation college-going students ($B=0.101$, $p<0.001$). Those who obtained their Bachelors or Masters degree in the United States took about half a year longer than their counterparts who obtained those degrees abroad. However, recipients who graduated from programs requiring a

master's degree as a prerequisite for admission took significantly less time to complete their degree.

Regarding financial support, doctoral recipients who had secondary support also took significantly longer to complete their degrees compared with their peers with only one source of funding. Recipients with foreign government funding and those who had full tuition remissions took significantly less time to complete their degrees. Compared with recipients with no loans, a debt of less than \$20,000 significantly increased the time to degree completion while debt of more than \$20,000 significantly reduced time to degree completion. Doctoral recipients who graduated from research extensive institutions ($B=0.279$, $p<0.001$) took significantly more time than their counterparts who graduated from research-intensive institutions.

Separate analyses were also run for the various country income classifications to determine whether there were any unique differences for international students originating from those regions.

Table 5
HLM Results of International Doctoral Students Time-To-Degree Completion

Variable	β	SE
<i>Student level variables</i>		
Single women	0.024	0.029
Married men	-0.072***	0.025
Married women	0.153***	0.037
Dependents	-0.016	0.023
Age	0.111***	0.002
U.S. Bachelor's degree	0.219***	0.036
U.S. Master's degree	0.500***	0.019
Masters Prerequisite	-0.133***	0.021
Secondary support	0.246***	0.025
Fellowship/grants/scholarships	-0.011	0.044
Research Assistantship	0.030	0.043
Teaching Assistantship	0.070	0.044
Foreign Government	-0.301***	0.057
Full tuition remission	-0.170***	0.021
Graduate debt less than \$20,000	0.085***	0.027
Graduate debt more than \$20,000	-0.100***	0.031
Research Extensive	0.279***	0.046
Intercept	1.025**	0.163
<i>Field level variables</i>		
Logged U.S. Faculty salaries	0.001**	0.001
<i>Country-level variables</i>		
Logged GNI per capita	0.080**	0.000
Intra-class correlation	3.5%	
Reliability	0.32	

Table 6
Multiple Regression Results of Time-To-Degree Completion by Home Country Classifications

Model	High-Income		Upper Middle-Income		Lower Middle-Income		Low-Income	
Variable	β	SE	β	SE	β	SE	β	SE
Student Characteristics								
Single women	0.087	0.120	-0.033	0.138	0.033	0.138	-0.079	0.272
Age	0.125***	0.010	0.085***	0.013	0.085**	0.013	0.075**	0.013
Married men	-0.029	0.107	0.089	0.109	-0.089	0.109	-0.098	0.172
Married women	0.079	0.152	0.091	0.178	0.091	0.178	0.250	0.327
Dependents	-0.041	0.099	-0.064	0.115	-0.064	0.115	-0.040	0.147
First generation	0.119***	0.043	0.187***	0.055	0.187***	0.055	0.165**	0.082
Prior Educational Experience								
U.S. Bachelor's degree	0.238**	0.118	0.229	0.168	0.229	0.168	0.354	0.193
U.S. Master's degree	0.349***	0.078	0.305***	0.090	0.305***	0.090	0.475**	0.142
Masters prerequisite	-0.167	0.090	0.061	0.094	0.061	0.094	-0.089	0.126
Academic Discipline								
Biological Sciences	0.054	0.128	-0.352***	0.155	0.352**	0.150	-0.165	0.200
Engineering	-0.084	0.130	-0.060	0.153	0.060	0.155	-0.215	0.212
Physical Sciences	0.091	0.118	0.463***	0.312	0.463***	0.152	0.228	0.191
Humanities	0.813***	0.118	0.445***	0.320	1.004***	0.312	0.273	0.342
Education	-0.454***	0.194	0.097	0.215	0.210	0.320	-0.079	0.284
Business Management	-0.559***	0.152	-0.318***	0.116	-0.318	0.214	0.197	0.440
Financial Support								
Secondary support	0.047	0.126	0.129***	0.253	0.129	0.116	0.338**	0.144
Fellowship/grants/scholarships	-0.262	0.179	-0.412	0.244	-0.412	0.253	-0.334	0.291
Research Assistantship	-0.367**	0.182	0.123	0.245	-0.123	0.243	-0.031	0.287
Teaching Assistantship	-0.265	0.178	-0.228	0.390	-0.228	0.244	0.126	0.282
Foreign Government	-0.547**	0.267	-0.796**	0.104	-0.796***	0.389	0.332	0.047
Full tuition remission	-0.278***	0.085	-0.068	0.118	-0.068	0.103	-0.080	0.131
Graduate debt less than \$20,000	0.074	0.114	0.164	0.171	0.164	0.118	0.070	0.145
Graduate debt more than \$20,000	-0.466***	0.124	0.522***	0.103	0.522***	0.171	0.538**	0.216
Institutional Characteristics								
Logged tuition	0.024	0.086	0.243***	0.208	0.243**	0.103	-	-
Research extensive	0.809***	0.290	-0.067	0.123	-0.067	0.208	-0.750**	0.236
Large institution	-0.005	0.094	-0.261**	0.069	-0.261**	0.123	-	-

ANALYSIS BY HOME COUNTRY INCOME CLASSIFICATION

Analyses for the four home country classifications (high, upper middle, lower middle and low) show that the increased time to degree effects persist for older and first generation students. For high-income countries, students receiving funding via research assistantships, foreign governments, full tuition remissions and debt over \$20,000 took significantly less time to complete their degree. Students from Upper-middle income and low income countries who received secondary support in addition to their primary sources took significantly longer times to complete their degree than their counterparts who only had one source of funding.

LIMITATIONS

The methodology employed for this study has several limitations. First, this research was limited by the self-report nature of the SED dataset. Secondly, the study excluded several other components that impact on time to doctoral degree, including peer socialization and student-advisor relationship. The literature has shown that socialization and relationship with faculty are crucial variables impacting doctoral students. This study however does not incorporate faculty or administrative perceptions about the policies and procedures of the academic program or the institution or any other departmental variables that define the unique characteristics of the faculty who provide doctoral education and mentor students. It also does not include cultural factors that could impede the progress of the doctorate

for international students such as language barriers and social capital. Finally, this study conducted statistical analysis on a national dataset and the results will reveal national trends and implications and not factors that may impact on institution-specific or program-specific time-to-degree completion. While the analysis will include many institutional factors that are similar across the US, results may still differ across institutions.

DISCUSSION AND CONCLUSION

The purpose of this study was to examine the effects of financial aid and home-country macroeconomic indicators on international doctoral student's time-to-degree completion. By conducting multiple regression analysis across economies and Hierarchical Linear Modelling (HLM) analysis, it was possible to compare the unique and common factors impacting international doctoral recipients in the United States.

The results of the multivariate analysis and the HLM showed that females took longer to complete their degree than their male counterparts. This is consistent with studies over the last two decades that have shown time differences between domestic male and female doctoral recipients (Abedi & Benkin, 1987; Berg & Ferber, 1983; Maher, Ford, & Thompson, 2004). Siegfried and Stock (2000) found that having children was the cause of lengthened time to degree for domestic women. However, this study on international doctoral recipients found that marital status, and having dependents had no significant impact on time to degree completion. According to the Nettles (1990) study, the difference lies more in the nature of financial assistance they received during graduate school, with women being less likely to receive fellowships, fellowships or more time-saving forms of financial support. The difference may also be as a result of women graduating from programs that have longer time-to-degree completion rates. However, when divided by income classifications of the home country, the results show that except for high-income countries, all other women took significantly longer than their male counterparts.

I found that older international students took longer to complete their degrees. This is consistent with the Tuckman, Coyle, and Bae (1990) study and the Dongbin and Otts (2010) study which also found that younger domestic students exhibit faster time-to-degree completion but contrary to the Nettles and Millet (2006) study which found that older students finished faster. In this study, I found age to be a positive significant predictor of time to degree completion for recipients from high-income and upper-middle-income countries. That is, older students from high and upper-middle-income countries took longer to complete their degrees. On the other hand, age is a non-significant predictor of time to degree completion for doctoral recipients from lower middle-income and low-income countries.

Amongst the regions, the results of the multivariate analysis found no significant difference between doctoral recipients from East Asia and the Pacific and Europe and Central Asia. However, compared to European and Central Asian recipients, students from Latin America and the Caribbean, the Middle East and North Africa and Sub-Saharan Africa took significantly less time to complete their degrees. While there are significant wealth differences within regions, the HLM results and the results by home country classification show that

international doctoral student performance could be affected by conditions of their country of origin. Most of the countries in Sub-Saharan Africa as well as in the MENA region fall in the Lower middle and low-income category, with only a few in the upper-middle-income category. Students from less privileged countries might feel the need to complete their degrees in a shorter period, so as to quickly join the labor force. Unlike their counterparts from wealthier countries, the cost (opportunity cost and actual financial cost) might be too high for them to spend the same length of time completing their degrees.

Finally, I found that first-generation college-going students took a significantly longer time in completing their degrees. Other studies using domestic students (Dongbin & Otts, 2010) have found a similar result. The academic and social struggles of first-generation students at both the undergraduate and graduate level are well documented in the literature, and they have often been found to underperform compared with their peers from continuing generations. It is thus not surprising to find the same results to be true for the international population. However, in the sub-analysis, I found this to be true for only first-generation college-going students from high-income and lower-middle-income countries. That is, first generation recipients from high-income countries took significantly longer to complete their degrees than continuing generation recipients from high-income countries. Doctoral recipients from upper-middle-income and low-income did not differ from their peers with college-educated parents.

A limitation of this study is that the SED did not provide GRE/GMAT or TOEFL scores. However, it did contain academic information relevant to their success in the United States. In this study, I found that international students who obtained their bachelor's or master's degrees in the United States took significantly longer than their peers who obtained a foreign degree. However, in the sub-analysis, having a U.S. bachelor's degree only increased time to degree for high-income countries. For all other countries, having a U.S. bachelor's did not significantly impact on time to degree completion. Obtaining a U.S. master's degree was the only variable significant across all classifications of home countries – obtaining a master's degree in the United States increased the time to degree completion in high-income, upper-middle-income, lower-middle-income, and low-income countries.

With respect to academic disciplines, the HLM results show that there are significant differences by field. The logged of faculty salaries by field is a positive predictor of time to degree, implying that higher salaries increase the time to degree completion. It could be that higher salaries, may make the market more competitive and doctoral students may take longer to publish more articles and write higher quality dissertations to obtain these positions. From the multiple regression results, I found that compared to recipients of social science doctorate degrees, recipients in the Biological Sciences, Engineering, and Education took a significantly shorter time to complete their degree. On the other hand, the physical sciences, humanities, and business management fields increased the time to degree completion. These results differ by home country classification. For example, for upper-middle-income countries, recipients in the STEM fields (Biological Sciences, Engineering, and Physical sciences) from upper-middle-income countries took

significantly shorter time while recipients in the humanities took significantly longer time compared with the counterparts in the social sciences. For low-income countries, none of the fields were significantly different from the social sciences, in terms of completion time. That is, low-income recipients did not differ in time to degree regardless of the fields they graduated from.

Financial resources have consistently been shown to be an important factor affecting doctoral time to degree completion (Ampaw & Jaeger, 2010; Dongbin & Otts, 2010). Ehrenberg and Marvos (1995) found that mean time to degree completion were affected by different types of student financial support and that students using their own resources, took a longer time to complete their degrees than their supported peers. The literature has demonstrated that a research assistantship will reduce time to degree completion while a teaching assistantship prolongs time to degree completion (Abedi & Benkin, 1987; Ehrenberg & Marvos, 1995; Girves & Wemmerus, 1988).

The results of this study on international doctoral students are contrary to these findings. Although the results from the initial multivariate analysis show that teaching assistantships significantly increased the time to degree completion, when I control for institutional characteristics, and economic variables, I find that neither the teaching assistantship nor research assistantship significantly impacts on time to degree completion. What matters for international doctoral student time to degree completion is foreign government assistance and full tuition remissions. For international doctoral recipients, foreign aid and full tuition remissions significantly reduce time to degree completion. Foreign aid is the only financial variable to reduce time to degree in all economies. In the sub-analysis, full tuition remission reduces time to degree completion only amongst high-income country recipients. That is, students who received full tuition remissions in upper-middle-income countries, for example, did not necessarily experience significantly shorter time than their peers from other upper-middle-income countries but experienced a significantly shorter time to completion than their peers from other economies.

It is interesting that research assistantships do not significantly reduce time to degree completion for international doctoral recipients. Most of the research on time to degree have found research assistantship to reduce time to degree primarily through its effect on socialization within the department (Girves & Wemmerus, 1988). Generally, doctoral students may not always be effectively socialized into their academic and professional careers (Austin, 2009; Bieber & Worley, 2006). However, international doctoral students may even be less socialized than their domestic counterparts. Some studies (Eley, Wellington, Pitts, & Biggs, 2012; Weidman et al., 2001) have stated that many faculty members find it difficult to deal with the cultural differences that arise in interactions with international students and rather focus on academic matters instead of professional socialization. As a result, some international students rely more exclusively on their peers for assistance with problems of adapting to US academic life and culture (Eley, Wellington, Pitts, & Biggs, 2012; Ku, Lahman, Yeh, & Cheng, 2008; Weidman et al., 2001).

The difference in the results for the different types of funding compared to domestic students show that from the international

students' point of view, even a "fully-funded" Ph.D. can still be very expensive, especially due to the hidden costs that most U.S. doctoral programs entail. Foreign government aid is usually "free money" given to their citizens, covering and exceeding most of their expenses with no responsibility for teaching or research. Students receiving full tuition remissions and foreign aid (that likely cover all their expenses) differ in time to degree from those who are self-supporting likely because these forms of funding are more supportive of the needs of the international doctoral students. On the other hand, research assistantships that do not cover all the students' expenses may still leave the student struggling financially, given that international doctoral students are limited in their work options in the U.S. due to visa constraints. In addition, I find that graduate debt of less than \$20,000 to significantly increase the time to degree completion but debt of more than \$20,000 significantly reduced time to degree completion. This is consistent with the results from Dongbin & Otts (2010) study, which found that loans between \$20,001-\$50,000 and greater than \$50,000 were negatively associated with time to degree completion.

Siegfried and Stock (2000) found that economics doctoral students who were supported by combination of fellowships and assistantships completed their programs in a shorter time period than students who were supported by only fellowships. This is contrary to the findings of this study. I found that international doctoral students who had secondary support in addition to their primary source of funding took significantly longer than their counterparts with single sources of funding. For international doctoral recipients, the responsibilities of two different source of funding increased time to degree completion.

This study showed that economic factors in the host country do affect time to degree completion. Because the World Bank only provides wages and unemployment rates for high-income and very few upper middle and lower-income countries, the results of the multiple regression do not include low-income countries. From the multiple regression, the economic factors do not appear significant for time to degree completion for high-income and upper-middle-income recipients. However, in the HLM results, including GNI per capita, which has complete data for all countries in the study, and U.S. faculty salaries by field, I found both to be positive significant predictors of time to degree completion. That is, recipients from wealthier countries took significantly more time to complete their degrees. This is in line with the Human Capital Theory. Recipients with lower financial costs and opportunity costs can afford to take longer to complete their degrees than their counterparts from poorer economies with higher opportunity cost and financial implications due to more costly exchange rate differences. Recipients in fields with higher salaries also took significantly longer to complete their degree. That is, higher expected benefits, may motivate students to increase their research productivity, and remain longer in their doctoral programs to obtain better job opportunities after graduation.

The results presented a comprehensive look at financial aid sources and their effects on time to doctoral degree completion for international recipients. Although the importance of research assistantships has been identified in previous studies

on domestic students (Abedi & Benkin, 1987; Ehrenberg & Marvos, 1995; Girves & Wemmerus, 1988), the results of the study have highlighted the role of foreign aid in reducing time to degree for international doctoral recipients. Data for the study shows that while 47% of the students were supported by research assistantships, only about 5% received foreign aid. Foreign aid reduces time to degree compared to other sources because it usually does not come with any responsibilities for teaching and research. While teaching and research are invaluable components of graduate school training and are used by most institutions and doctoral programs to balance the training needs of the students with the instructional needs of the department, international students may still struggle because even a fully funded assistantship may still be very expensive due to uncovered additional and sometimes intrinsic costs. Tuition remissions were also found to significantly reduce time to degree completion while fellowships and assistantships had non-significant effects on time to degree completion.

IMPLICATIONS FOR FUTURE RESEARCH

This investigation provides several important implications and directions for future research. The major limitation of the study was the exclusion of several important variables that were not contained in the SED dataset. The study is missing important variables such as TOEFL/GRE/GMAT and GPA scores and Language barriers, which often pose difficulties to those with a foreign first language, especially at the dissertation writing stage. In addition, this study only includes completers. Future research should employ the study's theoretical framework in examining how these issues impact on retention across the three stages of doctoral education: transition, development, and research. Future research should also examine how race and ethnicity and other interaction terms within the regions and economies examined in this study impact on time to degree completion. For example, the analysis should consider if White students from high-income countries like Canada differ from Black students from Canada. Finally, longitudinal data that tracks a sample of international doctoral recipients both in the United States and when they return home should be developed. This will provide a richer and deeper analysis of their transitions, career development, and life outcomes.

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- ABOUT THE AUTHOR**
Osasohan Agbonlahor is a Postdoctoral Research Associate at the University of Colorado - Colorado Springs. Her intellectual interests are in the fields of the economics of education, international education, and higher education policy. Her research focuses on labor market outcomes of higher education, the career trajectories of international doctoral recipients and the participation of underrepresented minorities in STEM fields.