

## ISSUE BRIEF

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The United States is at a critical juncture in its ability to remain internationally competitive in STEM. At present, too few people from diverse populations, including women, participate in the STEM academic and workforce communities. This issue brief is the first in a series produced by the American Institutes for Research (AIR) to promote research, policy, and practice related to broadening the participation of traditionally underrepresented groups in STEM doctoral education and the workforce.

The Center for STEM Education and Innovation at AIR supports the national effort to prepare more students for educational and career success in science, technology, engineering, and mathematics by improving teaching and providing all students with 21st century skills needed to thrive in the global economy; meeting the diverse needs of all students—especially those from underrepresented groups; and using technology, evidence, and innovative practice to support continuous improvement and accountability.

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# How Long Does It Take? STEM PhD Completion for Underrepresented Minorities

## Overview

Obtaining a PhD in a science, technology, engineering, or math (STEM) field requires many years of education. Yet societal, personal, financial, and familial needs pressure students to reduce the time they take to earn a PhD. At a societal level, there is a call for more STEM professionals, and due to a variety of demographic and political factors,<sup>1</sup> there has been an increasing demand for STEM doctorate holders (Stine and Matthews 2009). However, of concern to both society and the student is the expense of education in terms of costs and forgone income. Each year of graduate school can come at great public expense, as approximately three-quarters of graduate students are funded through teaching assistantships, research assistantships, and fellowships that are often paid for, either directly or indirectly, with federal grant money (Goldman and Massy 2001; Fiegenger 2009). Moreover, researchers estimate that between 22 and 25 percent of STEM PhD recipients take out loans to finance their graduate education, with borrowers reporting between \$28,800 and \$31,000 of debt on average (depending on field of study) for their graduate education alone (Kim and Otts 2010). Additionally, extended time spent in graduate school may delay starting a family, especially for female students (Ecklund and Lincoln 2011; Mason and Goulden 2004). Due to factors such as those discussed above related to family responsibilities and financial issues, which are often coupled with inadequate academic and social support systems, feelings of hopelessness and depression are common among graduate students (Kajitani and Bryant 2005; Berkeley 2004; Brazziel and Brazziel 2001). All of these factors could influence students to minimize the amount of time they spend pursuing a PhD.

Although previous research has shown that median time to completion (TTC) among PhD recipients in STEM fields has decreased in the past 20 years, other research has also shown that the time it takes to complete a PhD varies across subpopulations; differences in TTC by race/ethnicity in particular have persisted over time (Fiegenger 2009; Espenshade and Rodriguez 1997). These findings are troublesome because they result in minority students in graduate STEM programs experiencing more of the financial and personal burdens of a graduate education relative to non-minority students.

Given this backdrop, we examine the relationships between a number of social and institutional factors and students' time to STEM PhD completion. We also look within racial/ethnic groups to investigate if certain educational experiences during graduate school or life circumstances (such as parents' education, family status, and debt accrued during undergraduate and graduate education) relate to racial/ethnic differences in time to completion of a PhD in a STEM field.

<sup>1</sup> These demographic factors include the aging population, increased restrictions on the employment of foreign nationals both within and outside of the federal government, and the underrepresentation of minority students in STEM fields despite the overall increase in their proportions in the population.

Specifically, this issue brief addresses three distinct but related research questions:

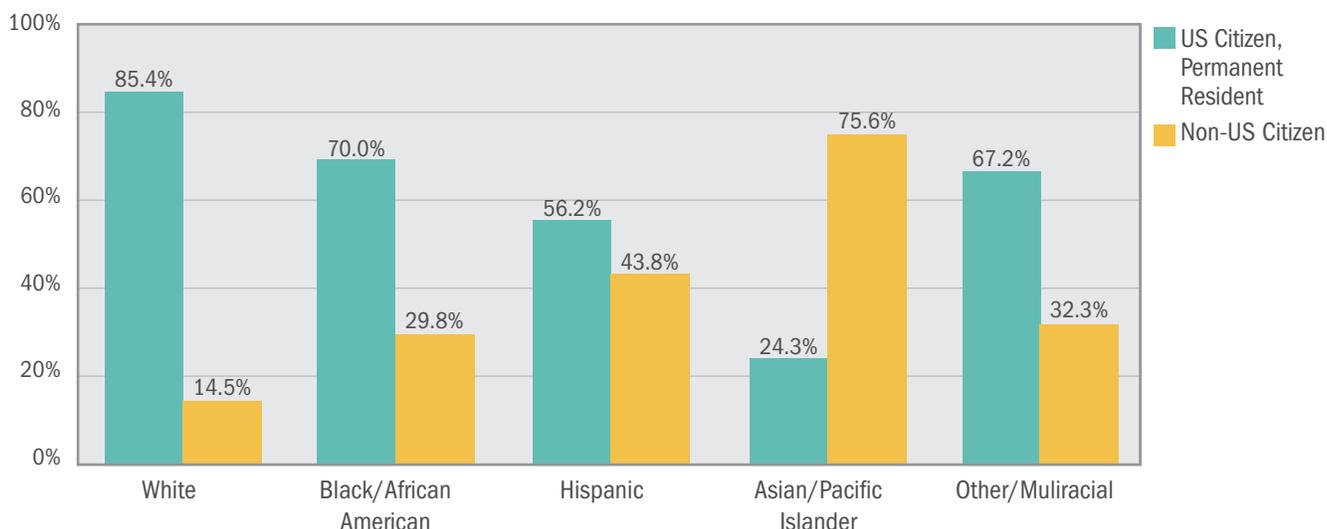
- What characteristics, including demographic characteristics and educational experiences, are related to time to completion of a STEM PhD?
- Do racial/ethnic differences in TTC exist among PhD recipients with similar background characteristics and college experiences?
- Do significant racial/ethnic differences in TTC remain after controlling for other background characteristics and college experiences?

## Methodology

*Data Source:* This brief uses data from the National Science Foundation’s (NSF) Survey of Earned Doctorates (SED) from the 1989–1990 school year to the 2008–2009 school year. Due to the nature of the questions in the SED, educational experiences in this study are limited to measures of students’ field of study, whether students earned a master’s degree, levels of student debt, and primary source of funding.

*Study Sample:* This study is limited to respondents who received a PhD<sup>2</sup> in one of the following broad STEM fields: engineering, mathematics, computer and information sciences, biological/biomedical sciences, physical sciences, and agricultural sciences/natural resources (see NSF 2009 for a list of subfields). We also limit our sample to respondents who reported that they were a U.S. citizen or a U.S. permanent resident. Figure 1 shows the percentage of students from each racial/ethnic subpopulation who are classified as non-U.S. citizens or non-U.S. permanent residents and have thus been removed from the sample. Overall, 38.5 percent of the PhD recipients in STEM fields in the SED data were classified as a non-U.S. citizen or non-U.S. permanent resident, with foreign-born Asian respondents making up the largest proportion of this group. Of Asian/Pacific Islander STEM PhD recipients between 1990 and 2009, 75.6 percent were classified as a non-U.S. citizen or non-U.S. permanent resident.

**Figure 1: Citizenship Status by Race/Ethnicity**



<sup>2</sup> Over 99 percent of doctoral recipients in STEM fields in the Survey of Earned Doctorates received a PhD; the remaining respondents received another doctoral degree such as a doctor of science or a doctor of engineering. In this brief, the term “PhD” includes all types of doctoral degrees.

*Analysis:* For this brief, TTC is measured by the number of years between entry into graduate school for the first time and PhD completion.<sup>3</sup> This measure of time to completion is consistent with the definition used in previous NSF reports (Fiegener 2009). However, because students may take time off during graduate school (for example, between receiving their master’s degree and starting a PhD program), this measure of time to completion is right-skewed. To account for this phenomenon, the extreme outliers (students whose TTC falls below the 0.5th percentile or above the 99.5th percentile within each school year) were removed from the data. With these outliers removed, TTC has a maximum of 32.3 years and a minimum of 3.0 years. The mean TTC is 7.9 years, but the median is 6.7 years. All analyses are based on the median TTC. Our final analytic sample includes 198,572 PhD recipients from 1990 to 2009 who received their PhD in a STEM field.<sup>4</sup>

This brief begins by looking at overall trends in TTC, as well as trends in racial/ethnic differences in TTC, among PhD recipients in STEM fields from 1990 to 2009. Next, we examine the relationships between TTC and various student background characteristics and college experiences. For each of these characteristics, we look at the most recent data (from 2009) to investigate whether racial/ethnic differences in TTC exist among students who are otherwise similar in background characteristics and college experiences. To provide a point of reference, we provide median TTCs for the total sample, which includes all respondents who remain after imposing the sample restrictions described above. Our brief specifically highlights disparities in TTC between traditionally underrepresented minority students (URMs), who are defined by NSF as African American, Hispanic, and Native American students; and students who are not underrepresented in PhD programs in STEM fields (non-URMs), including native-born whites, Asians, and respondents who reported “other” or “multiracial” categories. When we examine the intersection of race/ethnicity and other student characteristics in 2009, we exclude Native American students due to the small number of respondents. Finally, we conclude with ordinary least squares (OLS) regressions to examine whether significant racial/ethnic disparities in TTC in 2009 remain after statistically controlling for differences in other background characteristics and college experiences.

<sup>3</sup> TTC is calculated based on the month and year of graduate school entrance and the month and year of PhD completion. In instances when the month of entering graduate school was missing, a value of “September” was assumed; within the analytic sample, among respondents who reported a specific month of entering graduate school, over 77 percent reported either August or September.

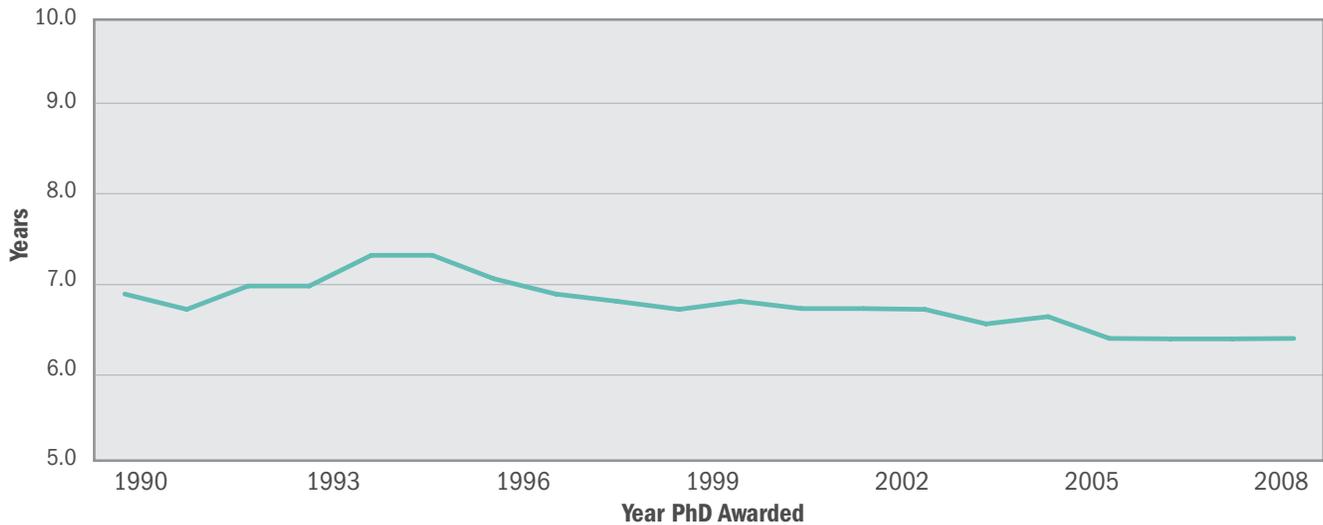
<sup>4</sup> Any respondents who were missing data for the year in which they entered graduate school (N=19,310, 8.8 percent of STEM PhDs, 4 percent in 2009) were removed from the sample. Students who were missing data for this variable also tended to have missing data on several other background characteristics, thereby making it impossible to impute the year in which respondents entered graduate school. However, students who were missing data on this variable did not differ substantially from the total sample in terms of race/ethnicity, gender, first generation status, or primary source of funding. Students who were missing the year of entry into graduate school were slightly more likely to major in biology/biomedical sciences and less likely to major in engineering.

# Findings

## OVERALL TRENDS AND RACIAL/ETHNIC DIFFERENCES IN TIME TO COMPLETION

As noted in other research (Fiegener 2009), the median TTC in STEM fields overall has been declining over time (see Figure 2). After a period of increasing TTC between 1990 and 1994, where TTCs increased from 6.8 years to 7.3 years, median TTC declined by almost a full year (0.9 years) between 1994 and 2009.

**Figure 2: Median Time to Completion in STEM Fields: 1990 to 2009**



Also consistent with previous research (Fiegener 2009), African American PhD recipients generally took longer to complete a STEM PhD relative to Hispanic PhD recipients who, in turn, tended to take longer than non-URM PhD recipients in most years (see Table 1). Native American PhD recipients experienced the largest decline in median TTC, with a decline of 2.0 years between 1990 and 2009. African Americans experienced a decline of 0.9 years in median TTC, while non-URMs experienced a decline of 0.5 years. Hispanics experienced an overall decline in median TTC of 0.2 years—the smallest decline of all racial/ethnic groups.

**Table 1: Median Time to Completion in STEM Fields by Race/Ethnicity: Change between 1990 and 2009**

	1990	2009	Change
Total Sample	6.8	6.3	-0.5
African American	7.7	6.8	-0.9
Hispanic	6.9	6.7	-0.2
Native American	8.3	6.3	-2.0
Non-URM	6.8	6.3	-0.5

Although racial/ethnic differences narrowed over time, in 2009, African American and Hispanic PhD recipients still had median TTCs that exceeded the median TTC among non-URM PhD recipients by 0.5 and 0.4 years, respectively. In the next section, we examine different student characteristics that may contribute to these persisting racial/ethnic differences in TTC to examine whether disparities in TTC are exaggerated or diminished among different subpopulations

of PhD recipients. For the remainder of this brief, figures that illustrate racial/ethnic disparities in TTC focus exclusively on African American, Hispanic, and non-URM recipients due to the relatively small number of Native American PhD recipients. In each year between 1990 and 2009, fewer than 50 Native Americans received a PhD, and so, for confidentiality purposes, we cannot further disaggregate this group of PhD recipients.

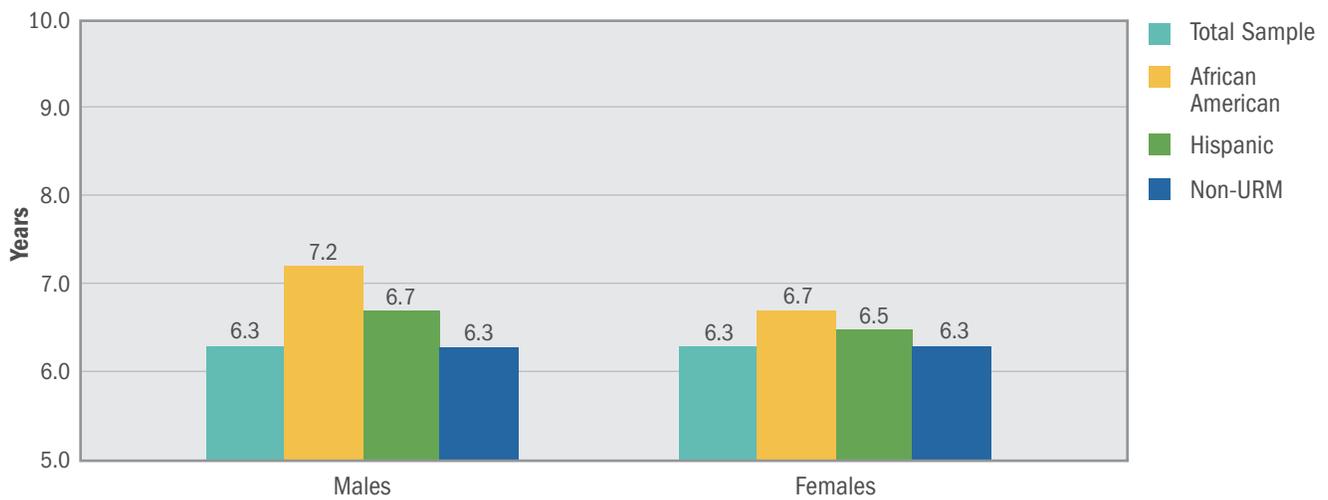
Median TTC in STEM fields has been declining over time; yet URMs continue to take longer to complete their degrees, on average, than non-URMs.

## TIME TO COMPLETION BY RACE/ETHNICITY AND GENDER

Although non-URM students consistently had shorter TTCs relative to African American and Hispanic PhD recipients, racial/ethnic differences in TTC were more pronounced among male PhD recipients.

In 2009, male and female PhD recipients in STEM fields had almost equivalent median TTC (see Figure 3). With a difference of less than 0.1 years, these results are generally consistent with an earlier NSF report, which found that gender differences in TTC were relatively small in STEM fields (Fiegenger 2009). Although non-URM students consistently had shorter TTCs relative to African American and Hispanic PhD recipients, racial/ethnic differences in TTC were more pronounced among male PhD recipients. For instance, in 2009, the median TTC among non-URM males was 0.9 years shorter than the median TTC for African American male PhD recipients and 0.4 years shorter than the median TTC for Hispanic male PhD recipients (see Figure 3). Meanwhile, in 2009, the median TTC for non-URM female PhD recipients was 0.4 and 0.2 years shorter than the median TTCs for African American and Hispanic female PhD recipients, respectively.

Figure 3: Median Time to Completion in STEM Fields in 2009 by Race/Ethnicity and Gender



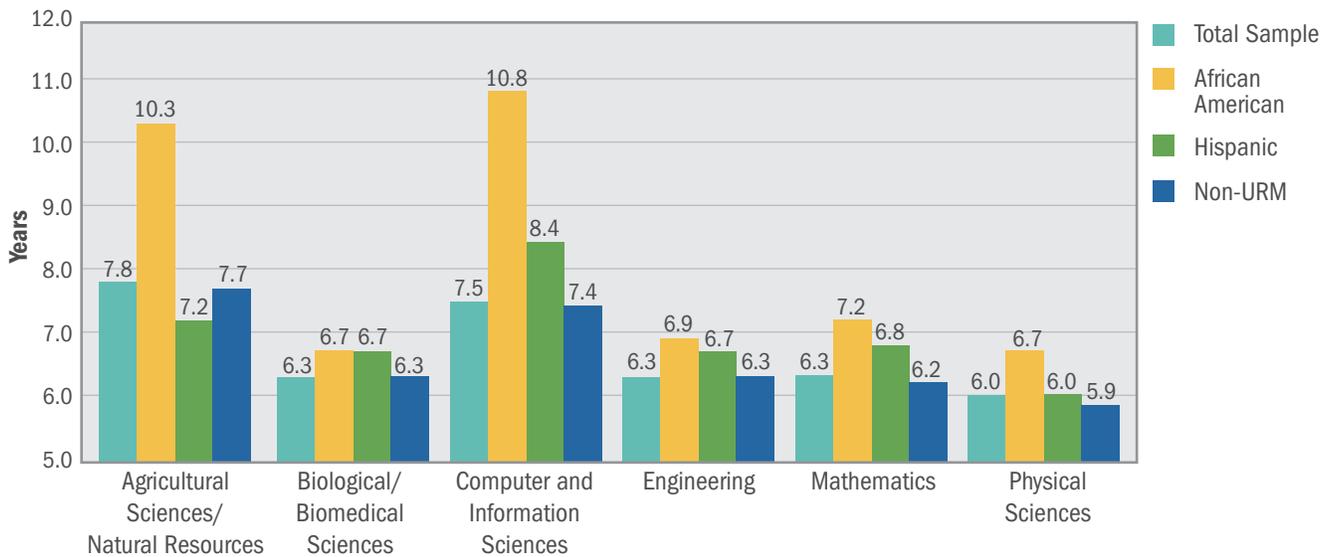
## TIME TO COMPLETION BY STEM FIELD

In most fields, African American PhD recipients took longer to obtain their PhDs than Hispanic recipients who, in turn, took longer than non-URM recipients.

Median TTC also varied by field of study (Figure 4): students in the physical sciences had the shortest median TTC and students in the agricultural and computer sciences had the longest TTCs. Although the overall median TTC in 2009 was close to 6.3 years, this was driven by the larger fields, such as the physical sciences, which had shorter median TTCs. The story is dramatically different for PhD recipients in other fields. In 2009, at least half of the recipients of PhDs in computer and informational sciences and agricultural sciences spent more than 7.5 years pursuing their degree.

The fields in which certain groups are more likely to obtain their PhDs could possibly contribute to the racial/ethnic differences in median TTC. However, Figure 4 illustrates a pattern within each field that is consistent with the overall pattern for STEM doctoral recipients: in all fields other than agricultural sciences, African American PhD recipients took longer to obtain their PhDs than Hispanic recipients who, in turn, took longer than non-URM recipients. When comparing African American and non-URM PhD recipients, differences in median TTC were largest within the agricultural sciences (2.6 years) and computer sciences (3.4 years), though in the other fields, differences ranged from 0.4 to 1.0 years. Differences in median TTC were smaller between Hispanic and non-URM PhD recipients, exceeding 1 year in computer sciences and ranging from 0.4 to 0.6 years in the other fields.

**Figure 4: Median Time to Completion in STEM Fields in 2009 by Field of Study and Race/Ethnicity**



## MASTER'S DEGREE PRIOR TO PHD

Approximately 80 percent of the PhD recipients in STEM fields received a master's degree before completing their PhD program. Some of these students completed a master's degree in the process of earning their PhD, while others entered their PhD program having earlier earned a master's degree from a different program. The remaining 20 percent of students did not receive a master's degree prior to completing a PhD. As discussed earlier, TTC is calculated based on the month and year when recipients entered graduate school *for the first time*: therefore, TTC includes the amount of time students spent obtaining their master's in addition to the time spent working toward their PhD, as well as the time students may have spent pursuing work or other activities outside of school in between their master's and doctoral degree programs. Not surprisingly, PhD recipients who received a master's degree had a longer median TTC in 2009 (by approximately 1 year) relative to PhD recipients who did not receive a master's degree along the way. Moreover, those fields with the shortest median TTCs (biological/biomedical sciences and physical sciences) also had the smallest percentage of students who received a master's degree,

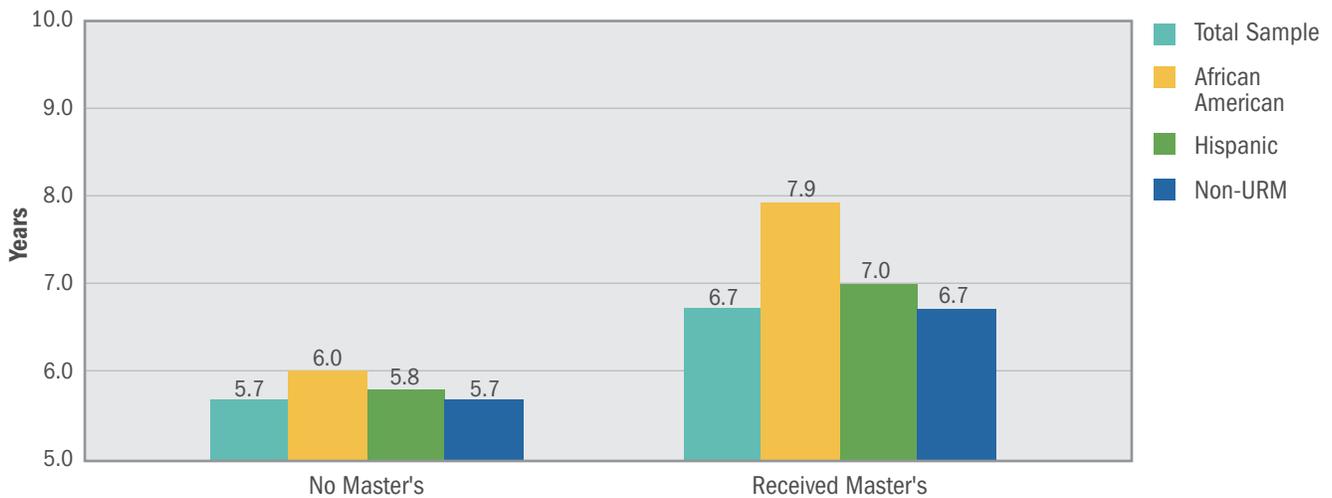
with fewer than 80 percent of PhD recipients in these fields obtaining a master's degree. On the other hand, over 90 percent of students in agricultural sciences and computer and information sciences obtained a master's degree, corresponding with the fact that students in these fields had the longest median TTCs.

Regardless of master's degree attainment, racial/ethnic differences in TTC persisted. However, disparities were three to four times larger among PhD recipients who received a master's degree prior to earning a PhD.

When one looks separately at PhD recipients who did and did not receive a master's degree, the same racial/ethnic differences emerge for both groups of students: African American PhD recipients tended to have longer median TTCs relative to Hispanic PhD recipients and Hispanic PhD recipients tended to have longer median TTCs relative to non-URM PhD recipients (Figure 5). However, these differences were smaller among PhD recipients who did not receive a master's degree along the way. In fact, in 2009,

among PhD recipients who did not receive a master's degree, median TTC ranged from 5.7 years (among non-URMs) to 6 years (among African Americans). On the other hand, among PhD recipients in 2009 who received a master's degree, the median TTC ranged from 6.7 years among non-URM PhD recipients to 7.9 years among African American PhD recipients. Therefore, although racial/ethnic differences persisted among PhD recipients who did and did not receive a master's degree, much larger disparities in TTC were observed among PhD recipients who received a master's degree.

**Figure 5: Median Time to Completion in STEM Fields in 2009 by Master's Degree Attainment and Race/Ethnicity**



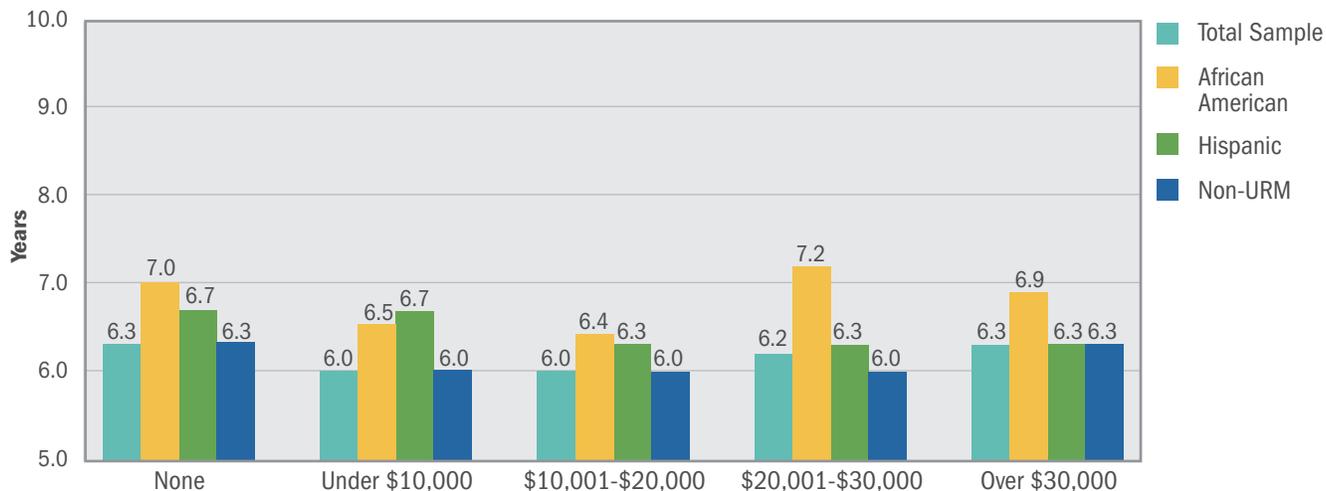
## TIME TO COMPLETION BY LEVELS OF STUDENT DEBT

Within the STEM fields, it also appears that median TTC differed depending on students' levels of undergraduate debt. Students with no undergraduate debt and students with more than \$30,000 in undergraduate debt had the longest median TTCs (see Figure 6). As noted in the introduction, long periods of graduate study can lead to large financial burdens for students. Not surprisingly, Figure 7 demonstrates that PhD recipients in STEM fields who accrued more than \$30,000 in debt during graduate school had the longest median TTCs, indicating that students who stayed in graduate school longer tended to accrue a larger amount of debt. However, it is not possible to determine whether these PhD recipients accrued more than \$30,000 in graduate school debt because they stayed longer or they stayed longer because of a lack of financial (and potentially institutional) support that caused them to accrue a large amount of debt. Differences in median TTC among PhD recipients with other levels of graduate school debt were relatively small (differing by less than 0.2 years in 2009) compared to the difference observed between PhD recipients with no graduate school debt and recipients with over \$30,000 in graduate school debt, which was 0.7 years in 2009.

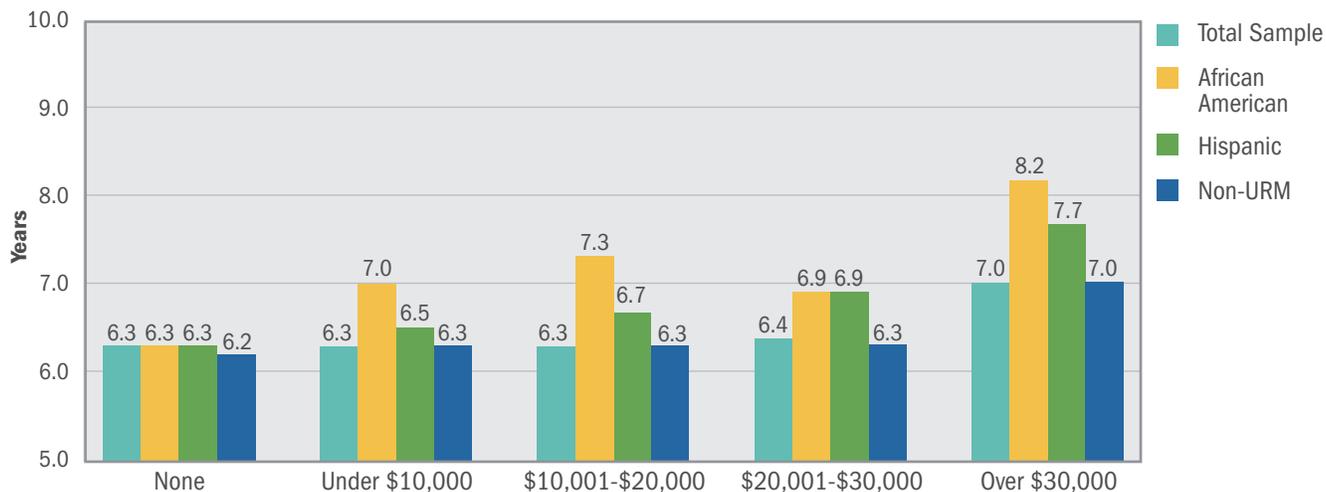
Racial/ethnic differences persisted among PhD recipients with similar levels of undergraduate and graduate debt (Figures 6 and 7). In 2009, among respondents with \$20,000–\$30,000 or over \$30,000 of undergraduate debt, African American PhD recipients tended to have longer median TTCs (by 1.2 and 0.6 years respectively)

than non-URM PhD recipients. While differences in median TTC between Hispanic and non-URM recipients were smaller in magnitude, the median TTCs of Hispanic PhD recipients also exceeded the median TTCs of non-URM PhD recipients at every level of undergraduate debt. Moreover, within each level of graduate school debt, African American PhD recipients tended to have longer median TTCs relative to non-URM PhD recipients by at least 0.5 years, with the largest difference of 1.2 years existing between African American and non-URM PhD recipients who accrued over \$30,000 in graduate school debt. Though the differences are smaller in magnitude, Hispanic PhD recipients also had median TTCs that exceeded those of non-URM PhD recipients at every level of graduate school debt, with the largest difference of 0.7 years between Hispanic and non-URM PhD recipients with over \$30,000 in graduate school debt. In contrast, in 2009, the difference in median TTC was only 0.1 years between URM students and non-URM students who did not accrue debt during graduate school.

**Figure 6: Median Time to Completion in STEM Fields in 2009 by Level of Undergraduate Debt and Race/Ethnicity**



**Figure 7: Median Time to Completion in STEM Fields in 2009 by Level of Graduate Debt and Race/Ethnicity**



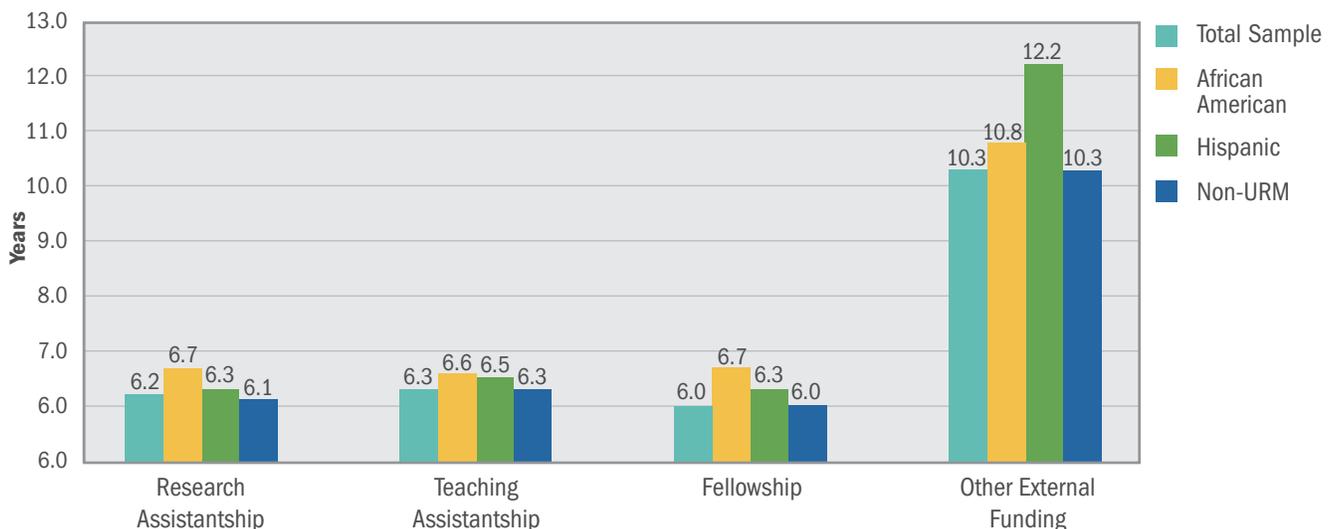
## TIME TO COMPLETION BY PRIMARY SOURCE OF FUNDING

Within every racial/ethnic group, recipients whose primary funding came from external or personal sources took at least 4 years longer on average to complete their PhDs than recipients of the same race/ethnicity who received institutional funding.

Primary source of funding during graduate school was also correlated with time to completion. Figure 8 illustrates that students who obtained fellowships had the shortest median TTCs in 2009, followed by students with research assistantships and students with teaching assistantships. Students whose funding came from external or personal sources such as loans, savings, earnings, or family support had longer median TTCs. Though previous research has focused on differences among students with research assistantships, teaching assistantships, and fellowships (Kim and Otts 2010), it is evident that all students who received institutional financial support had shorter median TTCs by at least 4 years relative to students who were not being financially supported by their institutions in 2009. While the category “Other External Funding” contains a fair amount of variation, with students obtaining loans having a shorter median TTC (of 7.9 years) and students relying on earnings having a longer median TTC (of 12.3 years), it is not possible to report median TTCs for many of these smaller funding source categories by race/ethnicity due to small sample sizes. Within all three racial/ethnic groups, over 80 percent of PhD recipients in STEM fields in 2009 primarily received funding from research assistantships, teaching assistantships, or fellowships.

Figure 8 illustrates that, regardless of the primary source of funding, African American PhD recipients had longer median TTCs compared to Hispanic PhD recipients, who, in turn, had longer median TTCs relative to non-URM PhD recipients, with one exception: Hispanic recipients who received their funding from other external sources had the longest median TTC (of 12.2 years). In 2009, among students who primarily received their funding through fellowships, non-URM students had a median TTC of 6 years, while African American and Hispanic PhD recipients had median TTCs of 6.7 and 6.3 years, respectively. Racial/ethnic differences in median TTC among PhD recipients who received funding through research or teaching assistantships were similar, but differences were much smaller in magnitude among PhD recipients who received their funding through teaching assistantships. However, within every racial/ethnic group, students who did not receive institutional funding through an assistantship or a fellowship took at least 4 years longer on average to complete their PhDs than recipients of the same race/ethnicity who received institutional funding. These findings corroborate prior research that found that minority STEM PhD students perceived that funding supports helped them to remain in their PhD programs and complete their PhDs in a timely manner (American Institutes for Research 2010).

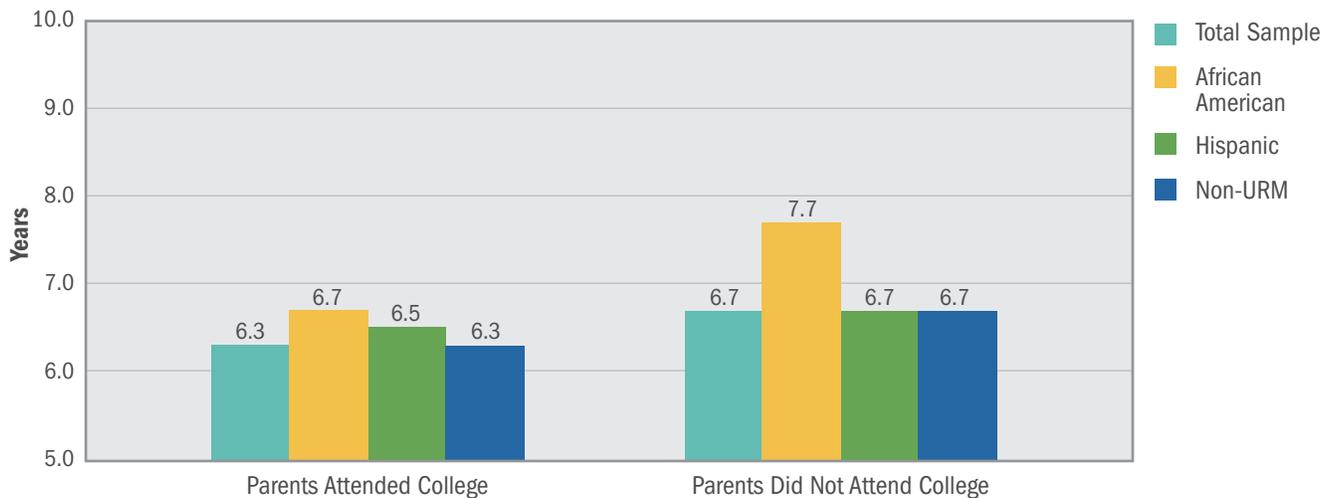
**Figure 8: Median Time to Completion in STEM Fields in 2009 by Primary Source of Funding and Race/Ethnicity**



## TIME TO COMPLETION BY LEVEL OF PARENTAL EDUCATION

The results presented in Figure 9 illustrate that PhD recipients in 2009 whose parents did not attend college had longer median TTCs, by 0.4 years, than PhD recipients whose parents attended college. Racial/ethnic differences in TTC among students whose parents attended college were relatively small; however, Figure 9 illustrates that racial/ethnic differences in TTC were larger among recipients whose parents did not attend college. In 2009, the difference in median TTC between African American and non-URM PhD recipients was twice as large among PhD recipients whose parents did not attend college when compared to PhD recipients whose parents attended college (1 year vs. 0.4 years). Additionally, while median TTCs were identical among non-URM and Hispanic PhD recipients whose parents did not attend college (6.7 years), among PhD recipients whose parents attended college, Hispanic recipients experienced a longer median TTC than non-URM recipients by 0.2 years.

**Figure 9: Median Time to Completion in STEM Fields in 2009 by Race/Ethnicity and Parental Education Status**



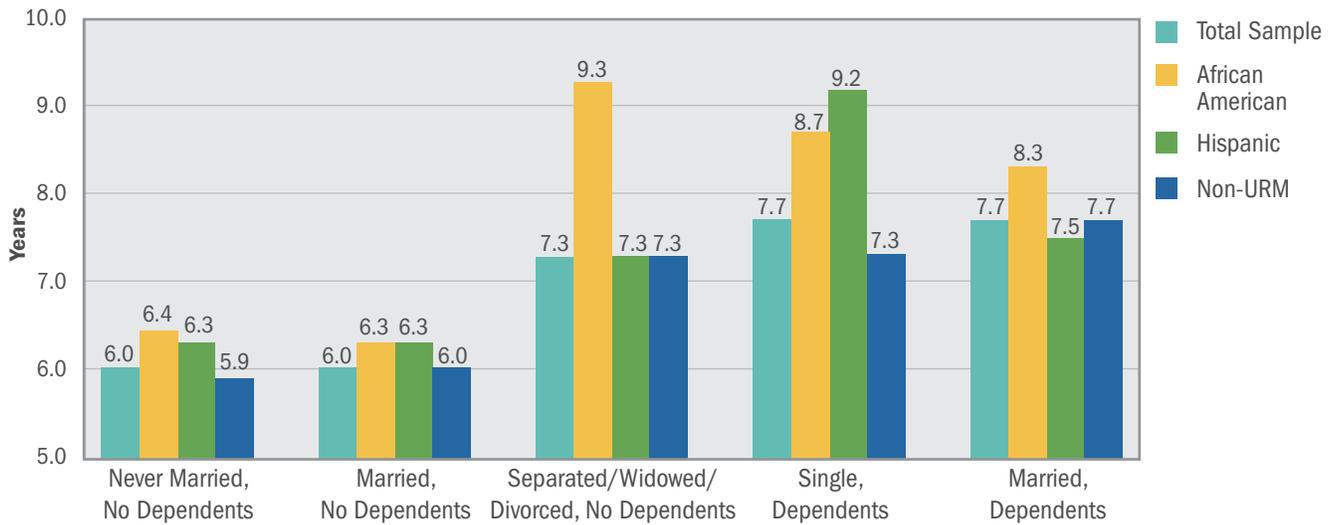
## TIME TO COMPLETION BY FAMILY STATUS

Another characteristic that is related to median TTC is family status. Figure 10 illustrates that, among PhD recipients in STEM fields, those who did not have dependents and were either never married or married at the time of PhD completion had the shortest TTCs, with a median TTC of 6 years in 2009. The median TTCs of all respondents who reported having at least one dependent exceeded the median TTCs of both married and never-married respondents who did not have dependents by 1.7 years in 2009. PhD recipients who were separated, widowed, or divorced without dependents also had a median TTC that exceeded the median TTC of married or never-married PhD recipients without dependents by 1.3 years in 2009. These results suggest that all PhD recipients who did not have dependents, particularly if they were either married at the time they completed their PhD or never married before they received their PhD, had the shortest median TTCs.

Figure 10 also demonstrates that racial/ethnic disparities in median TTC persisted in 2009 among PhD recipients with the same family status. In fact, within every family structure category excluding “married without dependents,” the median TTC of African American PhD recipients exceeded the median TTC of non-URM PhD recipients by at least 0.5 years. The smallest differences in median TTC between African Americans and non-URMs were observed among PhD recipients who were never married and did not have dependents (with a difference of 0.5 years) and PhD recipients who were married with no dependents (with a difference of 0.3 years). Although differences in median TTC between Hispanic and non-URM PhD recipients with the same family status were smaller in size, within each family status excluding “separated, widowed, or divorced” and “married with dependents,” the median TTCs of Hispanic PhD recipients exceeded the median TTCs of non-URM PhD recipients by at least 0.3 years (among

respondents who were married without dependents), and by as much as 1.9 years (among respondents who were single with dependents). Among respondents who were married with dependents at the time of completing their PhD, Hispanic PhD recipients had slightly shorter median TTCs relative to non-URM recipients.

**Figure 10: Median Time to Completion in STEM Fields in 2009 by Family Status and Race/Ethnicity**

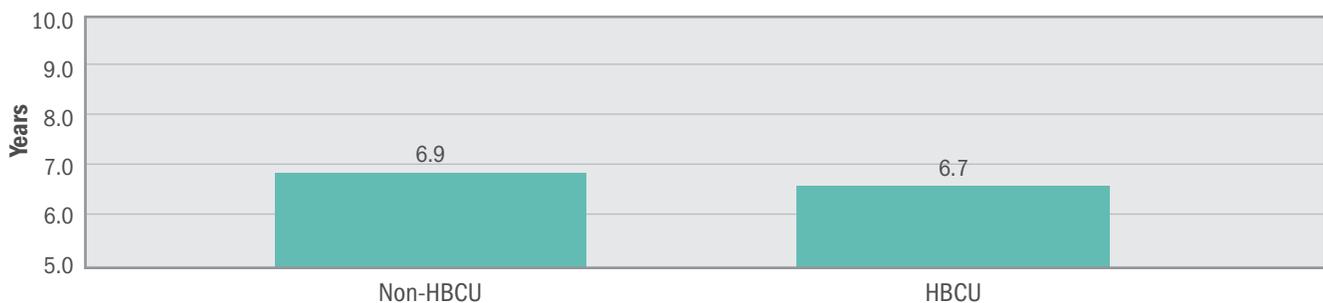


NOTE: There were too few separated, widowed, or divorced PhD recipients with dependents to report as a separate category. These recipients are included in the single with dependents category.

## TIME TO COMPLETION BY HBCU BACCALUAREATE ORIGINS

Finally, we consider the role of Historically Black Colleges and Universities (HBCUs) in preparing African American students academically for further study in graduate school. Prior research has shown that HBCUs are responsible for a disproportionate share of African American STEM PhD recipients, with approximately one-third of African American PhD recipients in 2006 receiving their bachelor’s degrees from an HBCU (Burrelli and Rapoport 2008). However, in 2009, African American PhD recipients who received their bachelor’s degrees from an HBCU had a median TTC that was only 0.2 years shorter than the median TTC of African Americans who did not receive their bachelor’s degrees from an HBCU (see Figure 11 below). Therefore, it appears from these data that attending an HBCU as an undergraduate is only weakly associated with shorter TTCs.

**Figure 11: Median Time to Completion in STEM Fields among African Americans in 2009, by Bachelor Degree-Granting Institution**



NOTE: Results for other racial/ethnic groups are not presented due to the small number of non-URM and Hispanic PhD recipients who received their bachelor’s degrees from an HBCU.

## PUTTING IT ALL TOGETHER!

After controlling for all of the background characteristics and college experiences considered in this brief, African American PhD recipients still had longer TTCs relative to non-URMs by approximately 0.7 years on average. These results indicate that a majority of the racial/ethnic gap in TTC between African Americans and non-URMs cannot be explained by these background and institutional characteristics.

What happens when all of the factors that individually relate to TTC are considered together? To address this question, we performed ordinary least squares (OLS) regressions to predict TTC. We limited our sample to non-URM, African American, and Hispanic PhD recipients to reveal whether racial/ethnic differences in TTC remain after statistically controlling for various background characteristics. Table 2 below reveals that, before controlling for other student background characteristics, African American PhD recipients in 2009 tended to have TTCs that were on average 1.1 years longer than the TTCs of non-URM PhD recipients (the reference group, see Model 1). On the other hand, the TTCs of Hispanics and non-URMs were not significantly different in 2009. After controlling for all of the background characteristics and college experiences considered in this brief (see Model 2 below), which jointly explain

approximately 27 percent of the variation in TTC, African American PhD recipients still had longer TTCs relative to non-URMs by approximately 0.7 years on average. These results indicate that the background characteristics considered in this brief only explain approximately 36 percent of the difference in TTC between African Americans and non-URMs in 2009, and a majority of the racial/ethnic gap in TTC between African Americans and non-URMs cannot be explained by these personal and educational background characteristics.

**Table 2: Predicting Time to Completion in STEM Fields in the 2009 SED (the reference group, see Model 1)**

	Model 1		Model 2	
	Coefficient	Std. Error	Coefficient	Std. Error
African American	1.10***	(0.18)	0.70***	(0.19)
Hispanic	0.19	(0.16)	0.04	(0.14)
Intercept	7.35***	(0.04)	7.16***	(0.09)
R <sup>2</sup>	0.33%		26.95%	

N = 11420

\*\*\* p < 0.001

Model 2 controls for gender, field of study, master's degree attainment, HBCU baccalaureate origins, parents' education, family status, source of funding, undergraduate debt, and graduate debt.

## Summary

Racial and ethnic disparities in median time to PhD completion in a STEM field continue to exist such that African Americans have longer median TTCs relative to Hispanics who, in turn, have longer median TTCs relative to non-URM students. In this brief, we examined different student characteristics and college experiences that may be related to TTC, and which may help to understand these disparities. In general, our findings confirm the conclusions of past research (Fiegener 2009; Espenshade and Rodriguez 1997). Factors that are related to longer TTCs include:

- field of study (with students in agricultural, computer, and information sciences having longer TTCs),
- completion of a master's degree,
- having over \$30,000 in graduate school debt,
- receiving funding for graduate school from external or personal sources, and
- having dependents at the time of PhD completion.

Although many of these factors mitigated the racial/ethnic disparities in TTC, the disparities remained. In other words, even among recipients who were otherwise similar in their background characteristics and college experiences, African American students took longer to complete their PhDs than non-URM students. After statistically controlling for various student background characteristics and college experiences, African Americans tended to have longer TTCs by approximately 0.7 years relative to non-URMs. Differences in TTC were smaller between non-URM and Hispanic recipients, and significant differences were not observed after statistically controlling for all of the various factors considered in this brief.

These findings, however, are not definitive. We were unable to statistically control for many factors that are likely to be related to TTC, such as academic preparation prior to graduate school, mentoring and peer relationships during graduate school, and characteristics of graduate programs. Future research with more in-depth examinations of some of these factors may be able to further clarify how differences in educational experiences are associated with TTC. Despite these limitations, the findings presented in this brief highlight the pervasiveness and persistence of racial/ethnic disparities in time to completion of a PhD in a STEM field.

## Implications

It is important to note that this brief focused on the racial/ethnic disparities in TTC; this represents only a fraction of the larger racial/ethnic inequalities within STEM education and careers. For instance, past studies have revealed that URM students are more likely to drop out of graduate school for a variety of reasons, including negative mentoring relationships and lack of funding (Milner 2004; Barnhill and Stanzione 2004). Moreover, prior research has also shown that URM students are less likely to pursue a degree in a STEM field relative to non-URM students at both the undergraduate and at the graduate level (Malcom and Dowd 2011; *Hearing Charter* 2010). Therefore, this brief demonstrates that racial/ethnic disparities exist even among Americans who have achieved the highest level of education—who not only entered a graduate program in a STEM field, but also completed a PhD. More research is necessary to fully understand factors that may contribute to disparities in TTC as well as PhD completion itself, such as obstacles that may lead URM students in STEM fields to drop out of college and graduate school.

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