The Influence of Labor Market Changes on First-Time Medical School Applicant Pools

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Abstract

Purpose
To explore whether the number and composition of first-time applicants to U.S. MD-granting medical schools, which have fluctuated over the past 30 years, are related to changes in labor market strength, specifically the unemployment rate and wages.

Method
The authors merged time series data from 1980 through 2010 (inclusive) from five sources and used multivariate time series models to determine whether changes in labor market strength (and several other macro-level factors) were related to the number of the medical school applicants as reported by the American Medical College Application Service. Analyses were replicated across specific sex and race/ethnicity applicant pools.

Results
Two results surfaced in the analyses. First, the strength of the labor market was not influential in explaining changes in applicant pool sizes for all applicants, but was strongly influential in explaining changes for black and Hispanic males. Increases of $1,000 in prevailing median wages produced a 1.6% decrease in the white male applicant pool, while 1% increases in the unemployment rate were associated with 4.5% and 3.1% increases in, respectively, the black and Hispanic male applicant pools. Second, labor market strength was a more important determinant in applications from males than in applications from females.

Conclusions
Although stakeholders cannot directly influence the overall economic market, they can plan and prepare for fewer applications from males, especially those who are black and Hispanic, when the labor market is strong.

While a wide literature examines the relationship between prevailing labor market conditions and individual decisions to complete high school and enroll in college,[1–3] a smaller but growing literature sheds light on enrollment in graduate and professional school.[4,5] Collectively, this scholarship concludes that when labor market conditions are favorable or strong (i.e., when unemployment rates are low or when wages are high), people decide to postpone or forego higher education and participate in the labor market; however, when market conditions are weak, people invest in education and enroll in higher education programs. That being said, few investigators have used time series data to examine specifically how changes in labor market strength impact trends in the medical school applicant pool.

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The two studies that have taken up this issue do not apply formal statistical tests, present only bivariate results, and lack statistical controls. Moreover, the findings are mixed. One study concludes that the economy is an important factor in explaining trends in the size of medical schools' applicant pools,[6] while the other concludes the opposite.[7] Finally, these two studies fail to examine the trend in medical school applicant pools separately by sex and by race. This final omission is noteworthy because trends in the numbers of applicants vary both by sex and race/ethnicity.[8] In the analyses that follow, we begin to fill these gaps and reexamine the temporal relationship between labor market conditions and the size of the pool of first-time applicants to U.S. MD-granting medical schools separately by sex and by race/ethnicity using time series data between 1980 and 2010 (inclusive).

A reexamination of this relationship is important for three reasons. First, the academic medical community knows that the medical school applicant pool fluctuates over time. Yet, explanations of these changes have not been informed by a coherent theoretical framework, and they cannot account for seemingly disparate findings. Revisiting this question through the use of a long-standing theoretical framework will provide the medical education community with important tools to understand seemingly contradictory results. Second, in 2006, the Association of American Medical Colleges (AAMC) issued a statement calling for a 30% increase in first-year enrollment over the 2002 baseline of 16,488 students in U.S. MD-granting schools. Knowing whether the share of medical school applicants to fill these new positions is partly determined by prevailing labor market conditions would be extremely useful for stakeholders. This determination may help medical school administrators anticipate the yearly volume of applications and more adequately allocate scarce resources. Third, administrators increasingly focus on ensuring that entering and matriculating cohorts are diverse. Exploring whether the strength of the labor market differentially affects application volume by sex, race, and ethnicity will help those who are interested in diverse medical school cohorts to understand some of the macro-level factors that influence the number and diversity of the applicants they will ultimately have.

Given both the heretofore lack of rigorous analyses that have been applied to this issue and its importance for multiple

stakeholders, we ask and answer two questions. First, what is the multivariate relationship between changes in labor market conditions and changes in the number of first-time applicants to U.S. MD-granting medical schools? Second, does this relationship vary by sex and by race/ethnicity?

Background and Hypotheses

Hall and colleagues[6] have found that the trend in medical school applicants is nonlinear. Indeed, from 1974 to 1998, the number of applicants to U.S. MD-granting medical schools fell, rose until and peaked in 1996, and declined thereafter until 1998, when their study ended. The literature offers several explanations for this pattern. Colquit and Killian[9] suggest that declines in the number of applicants occur because students with significant debt decide against applying to medical school. Kassebaum and Szenas[7] argue that changes in the applicant pool are related to the share of majors available for undergraduates to choose among and the employment conditions that they will likely face upon graduation. We believe that economic theories of pursuing education can frame conversations about period changes in first-time medical school applicants and help to build an understanding of factors that influence the size and composition of the medical school applicant pool.

Economists[10,11] theorize that rational individuals evaluate the expected returns associated with various wage-generating paths and choose the pathway that brings the greatest returns, consistent with their interests or financial means. This reasoning is based partly on human capital investment theory. Pioneered by Gary Becker,[12] the theory suggests that rational individuals choose to pursue education when they perceive that the benefits they would derive from education outweigh the benefits that they would derive from alternative uses of their time and resources (e.g., entering the labor market). In an attractive labor market, individuals may decide against attaining more education because they perceive greater benefits from alternatives to education than they would in a less attractive labor market. Because temporary, proximate, or current, labor market conditions (e.g., the unemployment rate and prevailing wage rates) influence the evaluations of those selecting a career or education move, they can produce period effects on labor market volumes. This framework suggests, on the one hand, that when labor market conditions are strong, individuals will likely postpone enrollment in medical school in favor of entering the labor market. On the other hand, when market conditions are weak, individuals will instead choose higher education over competing in the labor market.[13] We use this logic to propose the following hypothesis concerning long-term changes in the medical school applicant pool size:

Hypothesis 1: Over time, the number of first-time applicants to medical school will rise when labor market conditions are poor and fall when conditions are strong.

Diprete and Buchmann[14] have established that males receive lower returns to education than females do. These lower returns are realized in particular with regard to household standard of living. Thus, changes in labor market opportunities for individuals who forego additional education should have a stronger effect on the size of the pool of male applicants than on the pool of female applicants. This logic suggests the following hypothesis:

Hypothesis 2: Over time, the number of first-time applicants to medical school will rise when the labor market is poor and fall when the labor market is strong, but the pattern will be less pronounced for female applicants than for male applicants.

The literature also suggests that groups from traditionally more advantaged (i.e., white or high socioeconomic status) backgrounds are confident of receiving very high returns from education and are *un*likely to be swayed in their decisions about pursuing higher education by changes in the job prospects that they would face if they were to forego additional training.[15–18] Thus, the less confident an individual is of receiving substantial returns from additional education, the more likely that individual is to be influenced by changes in the labor market and seek further education rather than employment when the market is poor. The literature is also clear that, in the aggregate, minorities underrepresented in medicine have experienced nontrivial structural disadvantages, have lower returns on education, and feel more uncertain regarding educational returns than their white counterparts.[19,20] As such, changes in labor market opportunities for individuals who forego additional education should have a stronger effect on the medical school applicant pool size for disadvantaged minorities than whites. We use this logic to propose the following hypothesis:

Hypothesis 3: Over time, the number of first-time applicants to medical school will rise when the labor market is poor and fall when the labor market is strong, but the pattern will be more pronounced for minority applicants than white applicants.

Finally, skeptics may argue that medical school applicants tend to commit to pathways toward medical school years before the timing of submission of applications and have invested heavily on that pathway. The thinking is that because applicants' decisions are likely made early in the life course, proximate labor market conditions do not affect these decisions. However, we have recently shown that 10 times more aspirants report (while in high school) a decision to become a doctor than the number who actually apply to medical school.[21] Thus, the pipeline into medical school leaks copiously for reasons that are not entirely clear. This research, therefore, tests the proposition that labor market conditions proximate to timing of application could influence the rate and extent of the leakage by sex and race/ethnicity.

Method

To answer the research questions, we merged together 30 years of trend or time series data from five data sources: the American Medical College Application Service, the Tuition and Fees Questionnaire (fielded by the AAMC), the Current Population Survey (managed by the U.S. Census Bureau), the U.S. Census, and the Integrated Postsecondary Education Data System (coordinated by the National Center for Education Statistics). Because our interest is in explaining changes in first-time applicant pools, we used multivariate time series methods to estimate all statistical models.

Importantly, these data were not at the individual level (i.e., one record per person) but were structured as an annual time series with one record for each of the 30 years between 1980 and 2010 (inclusive). To discuss percent changes in

applicant pools, we used as the dependent variable the logged number of first-time applications among applicants aged 20 to 24 in each year, disaggregated by sex and by race/ethnicity, producing eight dependent variables (for all male and female applicants, black male and female applicants, Hispanic male and female applicants, white male and female applicants). We limited our observations to applicants within a narrow age bracket because hypotheses about the influence of labor market conditions on outcomes tend to be age specific. Moreover, we needed to control for the population of potential applicants (which varies by cohort), and constraining our observations to a narrow age bracket enabled this control.

The main human capital investment independent variables of interest were the unemployment rate and the median wages of college-educated 20- to 24-year-olds in each year. These two variables also served as measures of labor market strength. The remaining independent variables were other factors salient to human capital investment theory or more general controls. Remaining human capital investment factors included the median earnings for physicians, median public in-state tuition, and the national average medical school acceptance rate. General control variables included the size of the graduating cohort, the number of graduates who earned a bachelor of science (BS), and a dummy variable that measured the years in which a recession occurred (i.e., 1981, 1982, 1990, 1991, 2000, 2001, 2007, 2008, 2009). We obtained the data on these general control variables from the Bureau of Labor Statistics. We controlled for recession years to ensure that associations with labor market conditions were consistent with theoretical predictions and not spurious. With the exception of the unemployment rate, the medical school acceptance rate, and the dummy variable for recession period, all independent variables were scaled in thousands. Finally, we measured all independent variables using a one-year lag and have included a one-year lagged dependent variable as a control. We included the lagged dependent variable because it is required to properly specify the time series model and to help control for serial autocorrelation. Because all variables, except tuition and physician salaries, were sex and race/ethnicity group-specific, we interpreted the effects of these independent variables as representative of the macro-level conditions *prior* to the year in which schools received applications for each group. Table 1 provides descriptions of all variables, their source, and the hypothesized associations with the dependent variables.

We estimated several time series models using ordinary least square (OLS) multivariate methods embedded in the STATA 12 software package (College Station, Texas) specifically designed for time series data. Because the main independent variables of interest (the unemployment rate and median wages) were not logged (i.e., were not mathematically transformed to the log scale, which minimizes extremes in the distribution of interval/ratio variables), we interpreted the estimated coefficients for these variables as representative of how yearly percent increases in the unemployment rate or $1,000 increases in median wages produced yearly *percent* increases or decreases in the size of the applicant pool. For example, we will discuss below how $1,000 increases in median wages are associated with percent increases or decreases in the size of the applicant pool. The interpretation of "percent increases or decreases" is appropriate here because the variable "applicant pools" is logged, while median wages is not.

Results

Our first task was to describe the trend in applicant pools over the 30-year period. We did so using graphical techniques, as displayed in Figure 1. The graphs first illustrate what we already know: Trends in applicant pools have not monotonically increased or decreased over time. Indeed, trends in applicant pools can be best characterized as containing several increases and decreases over the past 30 years. Despite this fact, we found that overall applicant pools have rebounded from the decrease Hall et al[6] described at the end of the 1990s (Figure 1A). Second, a nontrivial proportion of that overall

Table 1

Description of Variables and Hypothesized Relationship to Dependent Variable in a Study Examining Medical School Applicant Pool Trends and Market Strength, 1980–2010

Variable	Data source[a]	Demographic specificity	Hypothesized association with dependent variable
Dependent variable (logged first-time applications)	AMCAS	Age 20–24	—
Human capital investment variables			
Unemployment rate	CPS	Age 20–24	Positive
Median wages of college graduates	CPS	Age 20–24	Negative
Median physician salary	CPS	—	Positive
Public in-state tuition	Tuition and student fees questionnaire	—	Negative
Medical school acceptance rate	AMCAS	Age 20–24	Positive
Control variables			
Cohort size	U.S. Census	Age 20–24	Negative
Bachelor of science degrees earned	IPEDS	Age 20–24	Positive

Abbreviations: AMCAS indicates American Medical College Application Service; CPS, Current Population Survey; IPEDS, Integrated Postsecondary Education Data System.

[a]AMCAS data are collected and maintained by the Association of American Medical Colleges (AAMC). CPS data are collected and maintained in a joint effort by the Bureau of Labor Statistics, U.S. Department of Labor, and U.S. Census Bureau. Tuition and student fees data are collected and maintained by the AAMC. Census data are produced and maintained by the U.S. Census Bureau. IPEDS data are collected and maintained by the National Center for Education Statistics, U.S. Department of Education.

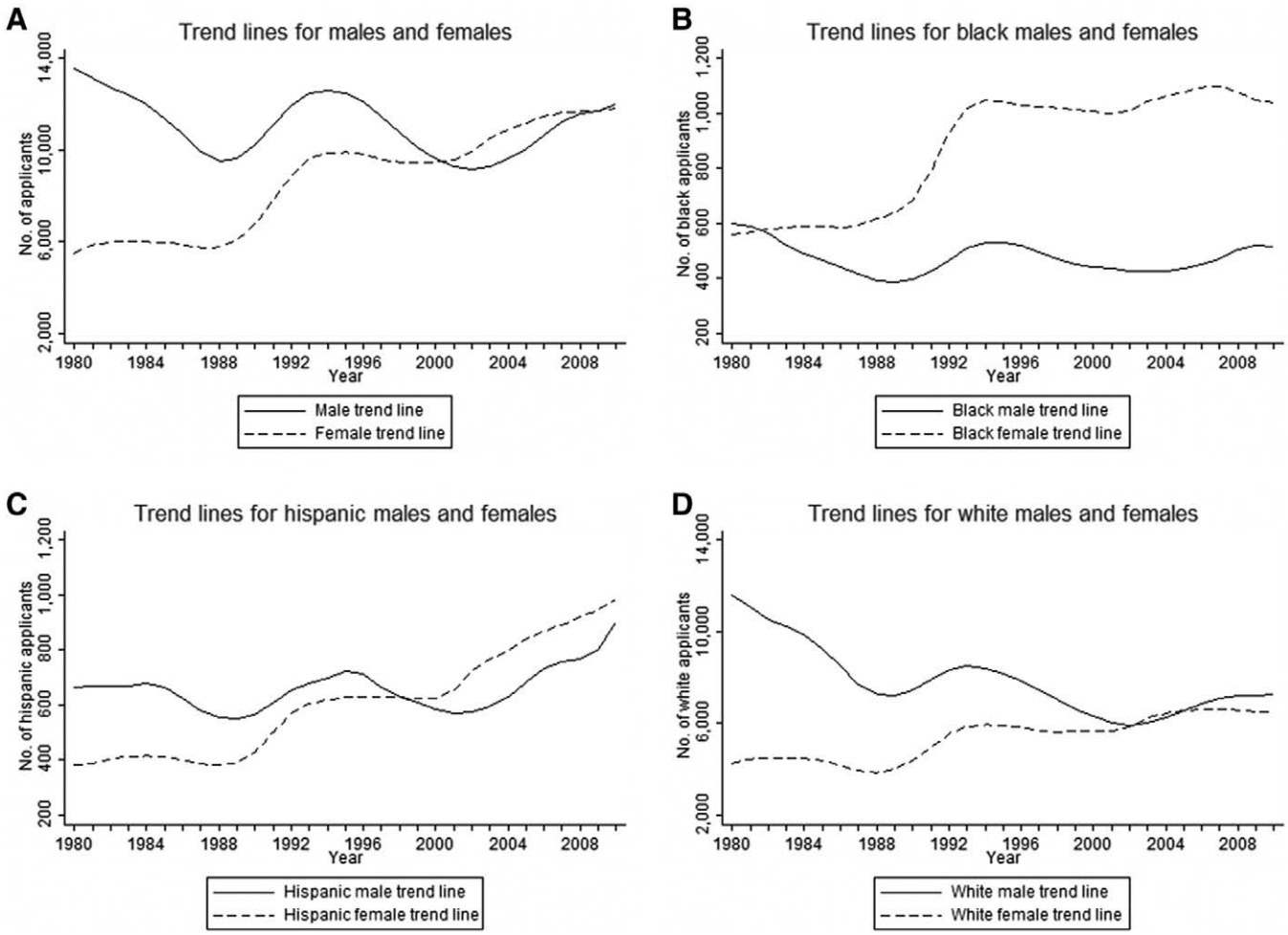

Figure 1 Trends of the observed numbers of all (A), black (B), Hispanic (C), and white (D) applicants, by gender, to U.S. medical schools, 1980–2010. Data come from the American College Application Service maintained by the Association of American Medical Colleges.

increase was driven by applications from three minority groups: black females (Figure 1B), Hispanic males (Figure 1C), and Hispanic females (Figure 1C). These groups of applicants experienced a systematic rise, while the pool declined or remained stagnant for whites (Figure 1D).

To determine the extent to which factors salient to human capital investment theory explain changes in the applicant pool for males, females, whites, and minorities, we estimated a series of time series models that captured the multivariate relationship between these and other factors and the logged number of first-time applications. Table 2 summarizes the findings with respect to our three hypotheses.

Discussion

Hypotheses

Our first hypothesis was that labor market conditions were associated with applicant pool size. In a preliminary test of this hypothesis, Hall and colleagues[6] reported no relationship between these two factors between 1974 and 1998. In the time period we examined, we were able to replicate that finding, but only when the applicant pool was *not* separated by race and ethnicity. Specifically, coefficients in the first three columns of Table 2 suggested that neither of our two measures of labor market strength (the unemployment rate and wages) reached statistical significance, while other variables did. Thus, when the focus was on everyone—or on all males or on all females regardless of racial or ethnic background—factors *other than* changes in the labor market were responsible for explaining changes in applicant pool sizes over the last 30 years.

We next hypothesized that associations between labor market conditions and applicant pool size would be stronger for males than females. Strong support surfaced for this hypothesis. When we examined the effects of labor market factors across sex groups, we found consistent evidence that these factors were influential for males but not for females. By and large, the evidence indicated that labor market conditions matter much *less* for woman than they do for males, a finding that is intriguing but consistent with previous human capital investment theory literature.

Our third hypothesis was that labor market conditions matter more for minorities from historically disadvantaged groups than they matter for whites. Evidence in Table 2 strongly supported this hypothesis. We found that variables measuring changes in the strength of the labor market *were* significantly related to changes in applicant pool sizes in three of the six racial, ethnic, and sex groups we examined. Specifically, we found that increases of $1,000 in

Table 2

Regression Coefficients From a Study Examining the Relationship Between Changes in Independent Variables and Changes in Logged Applicant Pools (With *t* Statistics in Parentheses), 1980–2010

Independent variables	Everyone	Everyone		Whites		Blacks		Hispanics	
		Males	Females	Males	Females	Males	Females	Males	Females
Human capital investment									
Unemployment rate[a]	0.011	0.009	0.018	0.003	0.011	0.0446[b]	0.0189	0.0309[b]	–0.003
	(1.69)	(1.32)	(2.01)	(0.49)	(0.92)	(3.43)	(1.40)	(4.05)	(–0.17)
Median wages of college graduates[c]	–0.009	–0.011	–0.013	–0.016[b]	–0.001	–0.00208	0.00730	–0.00891	–0.001
	(–1.27)	(–1.73)	(–1.49)	(–2.85)	(–0.13)	(–0.35)	(1.04)	(–1.79)	(–0.08)
Median physician salary[c]	0.0007	0.0003	0.0005	0.00001	0.001	0.00239	–0.00143	0.00304	0.0001
	(0.60)	(0.24)	(0.40)	(0.01)	(0.58)	(0.90)	(–0.73)	(1.77)	(0.03)
Public in-state tuition[c]	–0.050[b]	–0.034	–0.068[b]	–0.049[b]	–0.072[b]	–0.0308	–0.0151	0.0543	–0.029
	(–3.20)	(–1.65)	(–3.84)	(–3.35)	(–3.67)	(–1.14)	(–0.84)	(1.84)	(–0.85)
Medical school acceptance rate[a]	0.007[b]	0.004[b]	0.007[b]	–0.001	–0.005	–0.0186[d]	0.00781	–0.00214	0.005
	(3.86)	(2.70)	(3.24)	(–0.54)	(–0.90)	(–2.51)	(1.49)	(–0.47)	(0.82)
Control variables									
Cohort size[c]	–0.00002[b]	–0.00005[b]	–0.00005[d]	–0.00002	–0.00001	–0.001[d]	–0.0005	–0.00006	–0.0001
	(–2.59)	(–3.09)	(–2.07)	(–1.01)	(–0.27)	(–2.26)	(–1.60)	(–0.70)	(–0.28)
Bachelor of science degrees[c]	0.0007[b]	0.002[d]	0.001[b]	0.003[b]	0.003[b]	0.00776	0.00472	–0.00557	0.006
	(3.45)	(2.43)	(3.31)	(3.89)	(3.38)	(1.04)	(1.37)	(–0.90)	(1.00)
Recession year[e]	0.018	0.014	0.036	–0.008	0.012	0.120[b]	0.0302	0.0266	0.006
	(0.93)	(0.58)	(1.62)	(–0.38)	(0.41)	(2.91)	(0.86)	(0.90)	(0.12)
Lagged dependent[f] variable	1.013[b]	0.769[b]	0.960[b]	0.554[b]	0.568[d]	–0.0367	0.824[b]	0.424[d]	0.826[b]
	(7.20)	(5.16)	(7.87)	(3.90)	(2.06)	(–0.17)	(4.49)	(2.15)	(3.69)
Intercept[g]	–0.259	2.199	0.394	3.880[b]	2.691	7.687[b]	1.126	3.475[d]	0.930
	(–0.17)	(1.32)	(0.34)	(2.69)	(1.19)	(4.45)	(0.70)	(2.41)	(0.61)
Model fit									
Observations	30	30	30	30	30	30	30	30	30
R^2	0.926	0.897	0.976	0.958	0.929	0.591	0.944	0.814	0.936
Durbin alternative chi	0.715	0.343	0.462	1.031	0.076	0.352	0.688	0.013	0.060

[a]Variables measured in percentages.
[b]$P < .01$.
[c]Variables measured in thousands.
[d]$P < .05$.
[e]The recession year is a dummy variable: 1 for a recession year; 0 for a nonrecession year.
[f]Lag of dependent variable is the prior-year value of the dependent variable, which is needed to properly parameterize the time series model.
[g]The intercept is the predicted value of the dependent variable when all independent variables are set to zero.

the median wages of college-educated white males were associated with 1.6% decreases in the applicant pool size of the same population. Similarly, 1% increases in the unemployment rate were also associated with 4.5% and 3.1% increases in the applicant pool sizes of, respectively, black and Hispanic males. We speculate that the reason *median wages* affected the number of white male applicants and *unemployment* affected the number of black and Hispanic male applicants (but neither vice versa—nor both) is that median wage for whites tends to be higher, and its variance can change the balance of incentives (above and beyond the availability of jobs) with regard to further education, whereas median wage for disadvantaged minorities is lower, and its variance is unlikely to tip the balance.

One notable finding is that in all but one year, the number of BS degrees conferred correlated with applicant pools (not shown). To ensure that the number of degrees conferred did not drive the size of the applicant pool, we reestimated our models omitting a control for BS degrees. Our findings with respect to labor market conditions remained unchanged, so endogeneity does not appear to be an issue.

Collectively, this evidence suggested that changes in labor market conditions were indeed influential in explaining changes in applicant pool sizes for selected groups. More important, the evidence also provided clear support for human capital investment theory, suggesting that this theoretical paradigm can provide an important tool for stakeholders in explaining seemingly contradictory results.

Implications

Although medical school administrators and application specialists have been aware that the applicant pool size has fluctuated over time, explanations of these changes have been elusive at best and mixed at worse, producing only confusion among stakeholders who

seek clarity about changing patterns. We argue that confusion is indeed present and has been reflected in the medical education research literature because, heretofore, investigators have not used long-standing theoretical paradigms to inform their understanding of temporal patterns in applicant pool sizes. This gap in the literature has persisted despite the fact that such theories have been present in the economics literature for many decades. Through our analyses, we have begun to close that gap by applying human capital investment theory to explaining temporal changes in applicant pool sizes. We argue that this exercise is a first step toward using existing theoretical tools to help make sense of inconsistent findings in the medical education literature. Indeed, we believe that because the human capital perspective has such a historically strong standing, its use lends significant credence to our findings. Moreover, the theory provides the academic medicine community with a clearer understanding of patterns pertaining to changes in the volume and composition of the applicant pool.

These results also have some important practical implications for stakeholders. Many readers are aware of the Project 3000 by 2000[22] campaign, which sought to enroll 3,000 students from underrepresented minority groups annually in U.S. medical schools by the year 2000. Indeed, this campaign is analogous to the AAMC's more general call for a substantial increase in enrollment of first-year students at U.S. MD-granting institutions. Medical school administrators and admissions officers, thus, seek not only to increase enrollment more generally but also to enhance the number of students from underrepresented groups. We believe our findings imply that when the labor market is performing well, males, especially those who are from minority groups, may be less inclined to apply to medical school and could therefore benefit from incentives to apply. Put differently, although medical school administrators cannot do much about the overall state of the labor market, our results may help them to think creatively about such challenging situations. They can benefit from understanding and appreciating that the behavior of certain applicants depends in part on the labor market. As such, certain groups could benefit from extra attention and incentives, especially when the labor market appears to be especially strong.

Methodologically, this work omits several important factors that, if included in future work, could improve scholars' ability to generalize findings to broader patterns. First, physician assistant (PA) and nurse practitioner (NP) programs have expanded rapidly since 1980. Quite possibly, during the years the medical school applicant pool declines, a non-trivial proportion of these "lost" applicants may have chosen to enroll in PA or NP programs. Including a control for the numbers of applicants to these programs could improve the medical education community's understanding of the role these growing professions play in changing the applicant pool. Second, although we have found some support for the human capital investment model, previous scholars have shown that students' preferences and ability are also important considerations in human capital investments.[12] Including these individual factors may reduce any bias in the relationships we have described. Third, we were unable to control specifically for the share of graduates earning BS degrees who majored in natural and physical science fields. We believe that future work should take these factors into account. Additionally, expanding the analytical time period would be beneficial. Specifically, if investigators could explain trends from the 1960s onward, then much more could be said about how changes in the diversity climate contribute to observed trends.

Finally, two events in the legal and policy community were occurring during our examination period—both of which could partially account for some of our findings. Immediately before our time series, in 1977, the Supreme Court rendered a ground-breaking decision on affirmative action and diversity in higher education. Following the court's ruling, administrators began to put into place special programs that provided incentives for members of certain underrepresented groups to apply to medical schools. Moreover, Project 3000 by 2000 was already in place during the time period we analyzed. The fact that both programs were ongoing during our time series could have had a positive influence on the decisions of first-time minority applicants to apply to medical school, thereby explaining part of the applicant pool trend.

Conclusions

To summarize, our analyses imply qualified support for human capital investment theory as it relates to personal investment in medical education. We describe the evidence as qualified because the degree of support depends on the group under analysis. On the one hand, when the focus is on the *overall* trend in applications for males and females, the results suggest no temporal relationship between labor market conditions and the applicant pool. On the other hand, when we examine the applicant pool pattern separately by sex and by race/ethnicity, we find support for the argument that human capital investment factors generally, and labor market conditions more specifically, are important determinants of male applicant pool sizes. As such, the strength of the labor market appears to be a factor that male applicants, especially those who are black or Hispanic, consider in evaluating their choices when it comes to applying to medical schools. Medical school administrators and admissions officers may be able to apply these findings—and, at least as important, this framework—to predicting and preparing for changes in the number and composition of applicants.

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