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Instructor attire and student performance: Evidence from an undergraduate industrial organization experiment

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ABSTRACT

Four classes of the same Industrial Organization class were compared. The test group was taught by the instructor dressed in business attire, while the comparison group was taught by the instructor dressed casually. Results show that the attendance for test students was 8.50 percentage points higher than comparison students and this increase is associated with an improvement in their final exam score of 0.69 percentage points. Final exam scores for test students were 2.33 percentage points higher than comparison students. Together, the indirect and direct effects indicate that the total effect on learning from instructor attire is 3.02 percentage points.

1. Introduction

New faculty and other educational professionals are often advised to "dress for the job you want" or to "dress professionally". Moreover, most business schools and several Economics departments have implemented, or experimented with, professional dress codes for faculty. The literature on physical appearance in the classroom supports this advice to some extent by suggesting that students

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perceive faculty members dressed in formal attire to be better organized, better prepared and more knowledgeable than casually dressed faculty (Rollman, 1980; Leathers, 1992; Morris et al., 1996; Roach, 1997; Lavin et al., 2009a, 2009b). However, while it may provide a credibility signal from the faculty member, and improve their evaluations in student opinion surveys, the effects of instructor attire on actual student learning are largely unknown, particularly in the teaching of Economics. This study presents empirical findings from an ongoing research program examining the effects on student performance from the instructor dressing in Western business attire (''business attire'').

Four classes of an undergraduate Industrial Organization (IO) class at the University of Colorado, Boulder, one of the most business-orientated classes in the University's Economics program, were randomly assigned to comparison and test groups. The 158 students in these classes were taught by the same instructor but the students were not explicitly aware that they were participating in an evaluation. The sample students were observed to be representative and any differences in student characteristics between the comparison and test groups were accounted for in the empirical model of student performance. All other things being equal, there are three reasons why the test group may be expected to perform better than the comparison group in the evaluation. The first reason, which we call the ''indirect effect'', is that students perceive a more professional attitude regarding teaching from the instructor dressed in business attire and attend more classes. The second reason, which we call the ''direct effect'', is that instructor business attire positively influences student attention in the classroom through the perception that classroom concepts and activities are more important. Finally, because the instructor is knowingly participating in an experiment, the instructor may improve the quality of his teaching when dressed in business attire. We formally test for the indirect and direct effects with ordinary least squares (OLS) estimates from an empirical model with suitably specified control variables. The potential endogeneity of student attendance and experimenter bias, through a quality of teaching improvement, are ruled out with a robustness test and with an additional source of external evidence.

Model results show that the effect on student performance from instructor attire is both indirect and direct, and it is nontrivial. The attendance for students in the test group was 8.50 percentage points higher than comparison students and this increase is associated with an improvement in their cumulative final exam score of 0.69 percentage points. Controlling for attendance, final exam scores for test group students were about 2.33 percentage points higher than comparison students. Together, the indirect and direct effects indicate that the total effect on student learning from instructor attire is 3.02 percentage points, which, on average, is the difference between earning a *C*+ and a *B*− on the final exam. Although estimated from a relatively small subsample of female students, e.g., 26 out of 158 students, our results suggest that instructor attire does not significantly impact the attendance and/or final exam scores of female students and male students differently.

In the following section we review the recent literature and state the questions of interest. We then describe the data, outline the empirical model of student performance and present results.

2. Literature review and questions

Many perceptions of an individual are formed by observations of the clothing another is wearing. Whether accurate or not, these perceptions provide the observer with a foundation for relationship formation, communication and judgment making about the source's credibility (Morris, 1977; Rosenfeld and Plax, 1977; Bassett, 1979; Roach, 1997). Student–teacher interactions provide an interesting illustration of the importance of attire on perceptions. When a faculty member dressed in professional or business attire is perceived to be a more competent or credible instructor, students may rate that faculty member, and the course, more favorably. Such effects have heightened the evaluative importance in recent years of student opinion surveys, as universities move increasingly toward their use to evaluate the competence of faculty when determining salary, promotion, and tenure.

More generally, Haefner (2008) presents evidence that shows many employers believe that employees who dress more professionally were more deserving of being promoted. In related literature, Allan (1998), Coupland (2001) and Tan and See (2009) argued that television newscasters choose a formal business suit to signal authenticity and professionalism. This impression encourages

viewers to trust the content that is delivered by the newscaster. Gentile and Imberman (2012) examine empirically the effect of school uniforms on student achievement and behavior in a large urban school district in Southwest United States. They find that uniforms improve attendance in middle and high school and that the impact is stronger on girls. We focus on attire in college Economics departments because several departments, including Brigham Young University, Edith Cowan University, Oral Roberts University, The Citadel, Tristate University, University of New South Wales, and Virginia Military Institute, have introduced, or experimented with, professional dress codes for Economics faculty.

Several studies have examined the impact of faculty attire on college student perceptions of teaching competence. The most common research design, pioneered by Bassett (1979) and Rollman (1980), compared student responses to photographs of instructors dressed in different attire. Lavin et al. (2009a, 2009b) provide the most recent example when examining whether females are more responsive to clothing cues than males. They surveyed 506 students at a mid-sized Midwestern university during the Fall of 2008. Students were shown photographs of the same instructor in different outfits: professional, business casual, and casual attire. They were then asked how attire would influence their perceptions of the instructor's qualifications and ability, and the quality of the course.[1] Difference in mean tests show that students had more favorable opinions of the instructor dressed in professional attire versus casual attire, and that these effects were more pronounced for female students.

Because they do not involve actual student–teacher interactions in a classroom, Morris et al. (1996) downplay results from photographic experiments. They randomly assigned guest lecturers dressed in either formal professional dress (e.g., business suit and dress shoes), casual professional dress (e.g., slacks, collared sport shirt and casual shoes) or casual dress (e.g., faded jeans, T-shirt, flannel shirt and athletic shoes) across six sections of an introductory psychology course at West Virginia University. Their analysis of variance results from 401 students indicated that professional dress was only associated with a marked increase in female student ratings of female instructor competence. They conclude that the effects of attire on student perceptions of sociability, extroversion, and interesting lecture content may be overstated when using responses to photographs.[2]

Roach (1997) studied student perceptions and learning outcomes. He argued that professional attire conveyed a message that the class was an event with important concepts and activities and, as such, students were more open to learning. Moreover, because students perceive a more professional attitude from the instructor, they are also less likely to engage in misbehaviors such as tardiness and absenteeism. Using data from 355 students in a basic communications course at a large Southwestern university, Roach finds that professional attire is positively correlated with student learning and their ratings of teacher quality, and inversely correlated with student misbehaviors.

A limitation of Roach's (1997) study is that attire is not randomly assigned; each student determined their instructor to have professional attire when the instructor's dress was more formal than their own. Moreover, because they were obtained from self-reported student answers to end-of-year survey questions such as, "How much are you learning in this class?" and "How often did you attend class?", the learning and misbehavior variables are subject to relatively more measurement error. In contrast, Dowling (2008) used instructor-recorded data on students' attendance and final exam scores to measure learning outcomes. Two sections of Personal Finance and two sections of Business Finance were taught during the Fall of 2006 at Savannah State University. The same lectures were used in both sections of each course, and the only difference between the sections within each course was that one was taught by the faculty member in professional dress and the other was taught by the same faculty member dressed casually. Difference in mean tests showed that professional attire had no effect on attendance or final exam scores.[3]

[1] Professional, business casual and casual attire are not defined in the manuscript.

[2] In a similar vein, Hamermesh and Parker (2005) use data from 463 classes from The University of Texas from 2000 to 2002 to correlate the overall faculty instructional rating with faculty "beauty". Each instructor's photograph was subjectively rated from one to ten by six students, ex post, to measure faculty beauty. They find that faculty members with higher beauty have higher instructional ratings.

[3] Professional and casual attire are not defined in the manuscript. Retailer, Jos. A. Banks sponsored the research by providing and coordinating the faculty apparel using their best interpretation of the currently accepted definition of "professional dress" and "casual dress" based on their sales trends.

None of the reviewed studies model the specific mechanisms through which instructor attire affects the behavior of students in the classroom. Moreover, the academic works are not primarily concerned with differences between comparison and test groups and this may have confounded the analyses. As such, the effects of instructor attire on student learning are still largely unknown, particularly in the teaching of Economics. This study specifies an empirical model that controls for potential differences in student characteristics and measures the indirect and direct effects of instructor attire on student performance. The two questions of interest are:

a. Do Economics students exposed to the instructor dressed in business attire attend more classes than students who are not exposed to the instructor dressed in business attire; and
b. Conditional on attendance, do Economics students exposed to the instructor dressed in business attire perform better in their final exam than students who are not exposed to the instructor dressed in business attire.

In addition, we use the empirical model to investigate whether instructor business attire impacts the attendance and/or final exam scores of female and male students differently.

3. Data

The effects from the instructor dressing in business attire in the teaching of Economics were evaluated with data from an experiment with four undergraduate IO classes comprising a total of 158 students. The experimental design and sample characteristics are presented below.

3.1. Experimental design

During the Fall of 2008, 2009, 2011 and 2012, four classes of ECON 4697 Industrial Organization and Regulation at the University of Colorado, Boulder were randomly assigned to comparison and test groups. The 2009 and 2012 classes served as the test group and were taught with the instructor dressed in business attire. Business attire consisted of a dark business suit, a white or blue business shirt with a tie, and black dress shoes. The 2008 and 2011 classes served as the comparison and were taught with the instructor dressed in casual attire. Casual attire consisted of a pullover, collared shirt or T-shirt, jeans and brown boots.

It is important that the experimental design minimize any differences between the comparison and test classes caused by factors other than instruction with business attire. Students registered for each section through an online portal. They indicated their preferences and the system allocated a class on a first-come, first-served basis. Wait-list requests were prioritized by Economics major senior, Economics major junior and then everyone else. Students could be admitted directly with overriding permission from the instructor; however, there were no overriding admissions in the sections used in these experiments.

Students were not aware that they were being evaluated. No information was provided in the syllabus or to academic advisors prior to registration to inform students that the instructor would be wearing different attire in each class.[4] All classes were taught by the same instructor with the same syllabus, course content and work requirements. The 2008 class ran from 10:00 a.m. to 10:50 a.m. on Monday, Wednesday, and Friday, and the 2009 class ran from 12:00 p.m. to 12:50 p.m. on Monday, Wednesday, and Friday. The 2011 and 2012 classes ran from 2:00 p.m. to 3:15 p.m. on Tuesday and Thursday.

Because the classes were taught at different times it is possible that time of day alone could account for differences in student attendance. However, Devadoss and Foltz (1996) study the determinants of student absenteeism for a sample of over 400 students in agricultural and Economics classes at

[4] The instructor was a full-time faculty member with about six years of teaching experience at the Department of Economics, University of Colorado. The instructor primarily teaches graduate courses and has relatively low contact with undergraduate students outside of class. No faculty or graduate students were aware of the evaluation and the instructor wore the formal business attire all day, every day. Colleagues that inquired why the instructor was dressing in business attire were told that it was requested by the instructor's spouse.

University of Idaho, Washington State University, Purdue University, and The Ohio State University. They find that there is a "prime time" for classes taught, 10:00 a.m. to 3:00 p.m., in which attendance is higher than at other times of the day. Paisey and Paisey (2004) investigate factors that influence attendance, and how attendance improves academic performance for 68 third-year accounting students at an anonymous Scottish university. They find no significant difference in student attendance between lectures taught from 9:00 a.m. to 11:00 a.m. and lectures taught from 11:00 a.m. to 1:00 p.m. Given the classes in this experiment were taught between 10:00 a.m. and 3:15 p.m., both of these studies suggest that time of day should not be a confounding factor in our empirical analysis.

Attendance was taken by the instructor at the beginning of every class meeting and converted to a 100-point score for this evaluation, with "100" indicating zero absenteeism. An attractive feature of this measure is that the variation across students reflects true differences in attendance over the entire semester, and not measurement error from random or non-random sampling. Measurement error is also reduced by using instructor-recorded data instead of undergraduate answers to an end-of-year survey question that asks students to indicate how frequently they missed classes.

The comparison and the test groups had the same cumulative final exams, graded by the same instructor. This final exam score has also been converted to a 100-point score to measure student performance. Final exam score is chosen over total final grade (four homework assignments, plus two mid-term exams plus the final exam) as the key dependent variable in the empirical model because, unlike homework and midterm exam scores, it provides the cleanest measure of what each individual student learned at the end of the course. Moreover, because homework is completed outside the classroom environment, it is possible that each student's homework score and, ultimately their cumulative final grade, may not be entirely the result of individual efforts. In addition, because it is not curved, final exam score is also a measure of each student's absolute performance and learning.

3.2. Sample characteristics

Students' attendance and final exam scores, recorded by the instructor, were supplemented with demographic and education information from the University's Office of Planning, Budget, and Analysis. To check representativeness, we first compared our sample with other students who have taken ECON 4697 Industrial Organization and Regulation at University of Colorado and did not find large differences. We then compared characteristics between the comparison and test groups for the 158 students in our experiment. Table 1 shows that the comparison group (75 students) and the test group (83 students) are similar across final exam scores and almost all student characteristics. Test group students attended 78.7 percentage of classes, compared to 71.0 percentage for comparison students, and this difference is statistically significant ($t=2.61$; $P>|t|=0.01$). Test students also have weaker preferences for IO classes. On average, about four percentage of test students subsequently enrolled in the follow-up undergraduate IO class ECON 4999 Antitrust and Regulation, compared to about 13 percentage of comparison students, and this difference is statistically significant ($z=2.22$; $P>|z|=0.026$). These differences are controlled for in the empirical model of student performance.

4. Empirical model

To test the effects of instructor attire on student performance, the following empirical model is specified for student $i=1, \ldots, n$:

$$ATTEND_i = \alpha_0 + \alpha_1 TEST_i + \alpha_2 TREND_i + X_i'\beta + e_i \quad (1)$$

$$FINAL_i = \gamma_0 + \gamma_1 TEST_i + \gamma_2 TREND_i + \gamma_3 ATTEND_i + X_i'\delta + u_i \quad (2)$$

where *ATTEND* is the percentage of ECON 4697 Industrial Organization and Regulation classes attended, *TEST* equals one for students randomly assigned to the test group taught by the instructor in

Table 1
Student characteristics.

Variable	Description	Comparison group mean (s.e.)	Test group mean (s.e.)	Difference in groups (s.e.)
GPA	Cumulative grade point average prior to ECON 4697	2.877 (0.057)	2.773 (0.060)	0.103 (0.083)
PREREQ	Numerical grade for the prerequisite class ECON 3070	2.808 (0.093)	2.725 (0.101)	0.083 (0.138)
SAT	Score in the mathematics component of the scholastic aptitude test	616.7 (8.414)	602.7 (8.748)	14.02 (12.19)
ECON	1 if student was an economics major prior to ECON 4697	0.667 (0.055)	0.771 (0.046)	−0.104 (0.071)
IO_PREF	1 if student subsequently enrolled in ECON 4999 Antirust and Regulation	0.133 (0.040)	0.036 (0.021)	0.097** (0.044)
SOPHOMORE	1 if student was a sophomore	0.080 (0.031)	0.096 (0.032)	−0.016 (0.045)
JUNIOR	1 if student was a junior	0.347 (0.055)	0.349 (0.052)	−0.003 (0.076)
SENIOR	1 if student was a senior	0.547 (0.057)	0.554 (0.055)	−0.008 (0.079)
MALE	1 if student was male	0.840 (0.042)	0.831 (0.041)	0.009 (0.059)
WHITE	1 if student was white	0.733 (0.051)	0.735 (0.048)	−0.002 (0.070)
ATTEND	Percentage of ECON 4697 classes attended	70.97 (2.395)	78.67 (1.778)	−7.696*** (2.947)
FINAL_SCORE	Percentage score in the cumulative final exam	79.66 (1.161)	80.16 (1.062)	−0.498 (1.570)
Sample size		75	83	

Note: s.e., standard error.
** Significant at the 0.05 Type I error.
*** Significant at the 0.01 Type I error.
For the dummy variables, "Difference in groups" is a two sample z test for the equality of proportions. For the continuous variables, "Difference in groups" is a two sample t test for the equality of means.

business attire and zero for students in the comparison group taught by the instructor in casual attire, *TREND* equals one for 2008 students, two for 2009 students, four for 2011 students and five for 2012 students, X is a vector of control variables, *FINAL* is the student's score on the final exam, α_0, α_1, α_2, γ_0, γ_1, γ_2 and γ_3 are parameters to be estimated, β and δ are vectors of parameters to be estimated, and e and u are error terms.[5]

Eq. (1) tests the effect of instructor attire on student attendance. The parameter of interest is $\alpha_1 = \partial ATTEND/\partial TEST$. If the null hypothesis that $\alpha_1 = 0$ cannot be rejected, this would be taken as evidence that instructor attire has no affect on attendance. The finding that $\alpha_1 > 0$ indicates that students attend more classes when the lectures are presented by an instructor dressed in business attire. Eq. (2) controls for student attendance and tests the affect of instructor attire on the student's cumulative final exam score. Here, the parameter of interest is $\gamma_1 = \partial FINAL/\partial TEST$. If the null hypothesis that $\gamma_1 = 0$ cannot be rejected, this would be taken as evidence that, conditional on attendance, instructor attire has no direct affect on student performance. The finding that $\gamma_1 > 0$ indicates that students exposed to instructors in business attire perform better on the final exam than students who were not exposed.

[5] The linear trend is included in the model to control for unobserved time factors that may affect attendance and performance over the sample period from 2008 to 2012. We also estimated several alternative specifications without a trend (e.g., random noise across time), with a quadratic trend, and with a logarithmic trend. Model selection testing using Akaike's information criterion, indicated that the linear trend was appropriate.

Taken together, the parameters α_1, γ_1 and $\gamma_3 = \partial FINAL/\partial ATTEND$ provide information about the mechanisms through which instructor attire may affect student performance. From Eqs. (1) and (2), the total effect on student performance from instructor attire is:

$$\frac{\partial FINAL}{\partial ATTEND} \cdot \frac{\partial ATTEND}{\partial TEST} + \frac{\partial FINAL}{\partial TEST} \tag{3}$$

The parameters $\gamma_3 \cdot \alpha_1 = \frac{\partial FINAL}{\partial ATTEND} \cdot \frac{\partial ATTEND}{\partial TEST}$ measure the indirect effect and the parameter $\gamma_1 = \frac{\partial FINAL}{\partial TEST}$ measures the direct effect. Given $\alpha_1 > 0$, the finding that $\gamma_1 = 0$ and $\gamma_3 > 0$ indicates that the positive effect on student performance from instructor attire is indirect. Namely, because they perceive a more professional attitude toward teaching from the instructor dressed in business attire, students attend more classes, and their increase in attendance improves their cumulative final exam scores. The finding that $\gamma_1 > 0$ and $\gamma_3 = 0$ indicates that the positive effect on student performance from instructor attire is direct only. Restated, because instructor business attire positively influences student perceptions that classroom concepts and activities are important, students are more attentive to instructor delivery and perform better in the final exam. The finding that $\gamma_1 > 0$ and $\gamma_3 > 0$ indicates that the positive effect on student performance from instructor attire is both indirect, through increased attendance, and direct, through greater attention in the classroom.

Following similar studies of student attendance and performance, the vector X contains elements that control for student ability, knowledge and demographics, as reported in Table 1 (Becker et al., 1990; Romer, 1993; Durden and Ellis, 1995; Agarwal and Day, 1998; Brown and Liedholm, 2002; Sosin et al., 2004; Barrow and Rouse, 2005; Savage, 2009). The controls for student ability are *GPA* (pre-course cumulative grade point average), *SAT* (score in the mathematics component of the scholastic aptitude test) and *IO_PREF* (one if the student subsequently enrolled in the other IO class in the Economics program, ECON 4999 Antitrust and Regulation, and zero otherwise).[6] The controls for knowledge are *PREREQ* (numerical grade for the prerequisite class ECON 3070 Intermediate Microeconomic Theory), *SOPHOMORE* (one if the student was a sophomore and zero otherwise), *JUNIOR* (one if the student was a junior and zero otherwise) and *ECON* (one if the student was an Economics major and zero otherwise). The demographic controls are *MALE* (one if the student was male and zero otherwise) and *WHITE* (one if the student was white and zero otherwise).

5. Results

5.1. Effects of instructor attire on attendance and final exam score

We started by estimating the most general specification of the attendance Eq. (1) that included *GPA*, *SAT*, *IO_PREF*, *PREREQ*, *SOPHOMORE*, *JUNIOR*, *ECON*, *MALE* and *WHITE* as control variables. Following Kennedy (1998), we then used an *F*-test and Akaike's information criterion (AIC) to eliminate redundant variables and test down to a more parsimonious model. Estimates of this final model specification, which includes *GPA* as the control variable, are presented in column two of Table 2.[7] The model explains about 22 percentage of the variation in student attendance. The estimated coefficient on *TEST* of $\alpha_1 = 8.499$ is significant at the 0.01 Type I error and indicates that, all other things being equal, the attendance for students in the test group was about 8.50 percentage points higher than comparison students. The estimated coefficient on *GPA* of 15.53 is significant at the 0.01 Type I error.

Given the finding $\alpha_1 > 0$ from Eq. (1), we then estimated Eq. (2) to explore the direct effect of instructor attire on student performance. Again, we started by estimating the most general specification of the performance Eq. (2) that included *GPA*, *SAT*, *IO_PREF*, *PREREQ*, *SOPHOMORE*, *JUNIOR*,

[6] *GPA* also controls for some of the differences in motivation. For example, because they are more interested in the material and/or more focused on academic goals, motivated students are more likely to attend classes. Following Romer (1993), we approximated motivation by the number of assignments submitted by the student during the semester. The results from regressions using this additional control for motivation, not reported here, are very similar to those reported in Table 2 in the results section.

[7] See the authors for a detailed presentation and discussion of the OLS results from the general model and the econometric procedure used to test down to the parsimonious model.

Table 2
OLS Estimates of Empirical Model.

Independent variable	Attendance Eq. (1)	Performance Eq. (2)	Reduced-form performance Eq. (4)
TEST	8.499***	2.333**	3.045***
	(2.904)	(1.149)	(1.118)
ATTEND		0.081**	
		(0.035)	
TREND	1.193	−1.201***	−1.100***
	(0.886)	(0.366)	(0.375)
PREREQ		2.235***	2.297***
		(0.802)	(0.837)
SAT		0.031***	0.030***
		(0.009)	(0.009)
GPA	15.53***	6.576***	7.788***
	(2.440)	(1.506)	(1.494)
IO_PREF		3.622**	4.064***
		(1.495)	(1.522)
JUNIOR		−2.756**	−2.770**
		(1.135)	(1.163)
CONSTANT	23.24***	33.34***	35.71***
	(8.355)	(6.726)	(6.763)
Adjusted R^2	0.215	0.504	0.489
Chow test	1.360	0.764	
Observations	158	158	158

Note: Dependent variable in column two is *ATTEND* (e.g., percentage of classes attended). Dependent variable in columns three and four is *FINAL_EXAM* (e.g., cumulative final exam score).
** Significant at the 0.05 Type I error.
*** Significant at the 0.01 Type I error.
Robust standard errors in parentheses. Chow test tests whether the coefficients in the attendance and performance regressions on male and female students are equal.

ECON, *MALE* and *WHITE*. Estimates of the final parsimonious model specification, which includes *PREREQUISITE*, *SAT*, *GPA*, *IO_PREF* and *JUNIOR* as control variables, are presented in column three of Table 2. The model explains about 50 percentage of the variation in student performance. Similar to Romer (1993), Durden and Ellis (1995) and Savage (2009), we find that attendance is a positive predictor of student performance in the cumulative final exam, with the estimated coefficient on *ATTEND* of $\gamma_3 = 0.081$ statistically significant at the 0.05 Type I error. Conditional on attendance, the estimated coefficient on *TEST* is $\gamma_1 = 2.333$ and statistically significant at the 0.05 Type I error. This indicates that all other things being equal, the final exam scores for test group students were 2.33 percentage points higher than comparison students.

The point estimates of α_1, γ_1 and γ_3 can be used to construct the total effect on student learning from instructor attire from the separate indirect and direct effects. Substituting $\hat{\alpha}_1$, $\hat{\gamma}_1$ and $\hat{\gamma}_3$ into Eq. (3) shows that the positive indirect effect on the final exam score is 0.69 ($=0.081 \times 8.499$) percentage points and the positive direct effect is 2.33 percentage points. Together, the indirect and direct effects indicate that the total effect on student learning from instructor attire is 3.02 ($=0.69+2.33$) percentage points, and is statistically different from zero ($t=2.74$; $P>|t|=0.01$). Given the mean *FINAL_SCORE* for comparison students is 79.66, the total effect represents, on average, the difference between earning a *C*+ (i.e., 79.66) and a *B*− (i.e., $82.68 = 79.66 + 3.02$).

The estimates reported in columns two and three of Table 2 also reveal interesting results with respect to the control variables. Consistent with previous studies of economic education, college entrance exam score (*SAT*), grade in the prerequisite class (*PREREQ*) and cumulative grade point average (*GPA*) are important, positive determinants of student performance in undergraduate IO. Consistent with *a priori* expectations, students with a preference for IO, as indicated by their subsequent choice of the elective ECON 4999 Antitrust and Regulation (*IO_PREF*), also performed

better in ECON 4697 Industrial Organization and Regulation.[8] In contrast, the estimated negative coefficient on *JUNIOR* is somewhat counter intuitive as it indicates that, all other things being equal, third-year junior students performed worse in their final exam than both senior (the omitted category) *and* sophomore students. Given ECON 4697 Industrial Organization and Regulation is an upper-division class, one possible explanation is that the coefficient on *JUNIOR* is partially measuring the unobserved impact of a few highly motivated sophomore students, combined with the more prepared seniors.[9] The variable *TREND* controls for common exogenous factors that affect student performance over time and, as such, the interpretation of its effect is somewhat speculative. For example, the estimated negative coefficient on *TREND* may indicate declining university admission standards, increasing demands on students from outside activities, and/or declining quality of classroom instruction at the faculty level.

Previous studies suggest that females may be more responsive to clothing cues than males (Morris et al., 1996; Lavin et al., 2009a, 2009b). We used our data to explore the possibility that there are gender-related differences in the effects of instructor attire on student attendance and performance. Although estimated from a relatively small subsample of females, e.g., 26 out of 158 students, our results provide no evidence to support the specification of separate attendance and performance equations for female and male students, respectively. A Chow test ($F(4, 150) = 1.36$; Prob $> F = 0.36$), reported in column two of Table 2, did not reject the equality of coefficients between female and male students in the attendance equation. A Chow test ($F(9, 140) = 0.76$; Prob $> F = 0.92$), reported in column three of Table 2, did not reject the equality of coefficients between female and male students in the performance equation.

5.2. Robustness

Because it is randomly assigned, *TEST* is exogenous and the OLS estimates of α_1 and γ_1 are unbiased. However, because students choose to come to class, *ATTEND* is not exogenous. While we control for the potential endogeneity of *ATTEND* in Eq. (2) by using student characteristics as additional explanatory variables, one could argue that there are still unobserved factors that affect both *ATTEND* and *FINAL* and, as such, our OLS estimate of γ_3 in Eq. (2) may be biased. A Hausman test for the endogeneity of *ATTEND* is problematic due to the difficulty in finding suitable excluded variables as instruments. However, it is possible to indirectly test for the endogeneity of *ATTEND* by estimating a reduced-form specification of student performance. Substituting Eq. (1) into Eq. (2) gives:

$$FINAL_i = \lambda_0 + \lambda_1 TEST_i + \lambda_2 TREND_i + X_i'\eta + \upsilon_i \tag{4}$$

where $\lambda_0 = \gamma_3 \cdot \alpha_0 + \gamma_0$, $\lambda_1 = \gamma_3 \cdot \alpha_1 + \gamma_1$, $\lambda_2 = \gamma_3 \cdot \alpha_2 + \gamma_2$, $\eta = \gamma_3 \cdot \beta + \delta$ and $\upsilon = \gamma_3 \cdot e + u$. Because *TEST* is randomly assigned, the OLS estimate of the total effect on student learning from instructor attire, λ_1, is unbiased. Given α_1 and γ_1 are also unbiased, the OLS estimate of γ_3 in Eq. (2) should be unbiased when $\lambda_1 = \gamma_3 \cdot \alpha_1 + \gamma_1$. If $\lambda_1 < \gamma_3 \cdot \alpha_1 + \gamma_1$, then γ_3 is biased in a positive direction and if $\lambda_1 > \gamma_3 \cdot \alpha_1 + \gamma_1$, then γ_3 is biased in a negative direction.

Estimates of the parsimonious specification of (4) are presented in column four of Table 2. We regress *FINAL* on *TEST*, *PREREQ*, *SAT*, *GPA*, *IO_PREF*, *JUNIOR*, *TREND* and a constant. Similar to Eq. (2) in column three, the model specification of Eq. (4) explains about 49 percentage of the variation in student performance. The estimated coefficient on *TEST* is $\lambda_1 = 3.045$, statistically significant at the 0.01 Type I error, and strikingly close to our estimate of the total effect of 3.019 obtained from Eq. (2). This is reassuring as it suggests that with appropriately specified controls, the OLS estimate of γ_3 in (2) is likely unbiased and can be used to measure the total effect on student learning from instructor attire into separate indirect and direct effects.

Our experiment controls for environmental factors by observing the same instructor teaching in the same classrooms during the same time of the year. We also control for faculty-specific factors by

[8] Given it represents whether or not the student chose to pursue another IO class, it is possible that *IO_PREF* measures both an outcome and a preference prior to the course. For robustness, we estimated the performance Eq. (2) without *IO_PREF* as an explanatory variable. The results, not reported, are qualitatively similar to those reported in Table 2. The estimated coefficient on *TEST* is about two and statistically different from zero.

[9] While outside the scope of this study, the results regarding *JUNIOR* are interesting and could be the subject of future work.

observing the same instructor teaching the same classes during the course of the experiment, but dressed in different attire. Nevertheless, to be sure that our estimates of the indirect and direct effects of instructor business attire on student performance are not being driven by instructor quality, we present an additional source of external evidence from the faculty course questionnaire (FCQ). Specifically, we use FCQ data to estimate an empirical model that relates instructor quality to instructor business attire and several control variables (e.g., *TREND*, *ECON* and *MALE*). We can then see whether, conditional on control variables, there is a systematic relationship between quality and attire. These results, available on request, show no correlation between teaching quality and business attire. As such, experimenter bias is not driving the positive relationship between instructors' attire and student performance reported in Table 2.[10]

6. Conclusions

This study presented empirical findings from an ongoing research program that is examining the effects on student performance from the instructor dressing in business attire. We evaluated the effect on student performance of the instructor dressing in business attire in the teaching of college Economics. The empirical model was used to estimate the effect of instructor business attire on each student's attendance record and final exam score. OLS results show that the effect on student performance from instructor attire is both indirect and direct, and nontrivial. The attendance for students in the test group was 8.50 percentage points higher than comparison students and this increase is associated with an improvement in their cumulative final exam score of 0.69 percentage points. Controlling for attendance, final exam scores for test group students were 2.33 percentage points higher than comparison students. Together, the indirect and direct effects indicate that the total effect on student learning from instructor attire is 3.02 percentage points, which, on average, is the difference between earning a *C*+ and a *B*− on the cumulative final exam.

Although estimated from a relatively small subsample of females, e.g., 26 out of 158 students, our results suggest that instructor attire does not significantly impact the attendance and/or final exam scores of female and male students differently. Future work will consider a larger sample of female students to examine whether this result is by chance or due to female students being relatively more responsive to clothing cues and/or to the gender of the instructor. Furthermore, we will employ a larger sample size from several Economics classes, with random assignment of the treatment in order to directly control for instructor quality, instructor experience and classroom environment. Finally, because formal business attire might not fit in with students' perception of what an Economics faculty member should wear, we will compare business with casual dress as in the Morris et al. (1996) study.

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[10] Because four students had previously taken the prerequisite course with the instructor, it is possible that our results reflect a preference for the instructor's teaching style. To account for this, we included an additional control variable (equals one when the student completed the prerequisite course with the same instructor and zero otherwise) in both the attendance and performance equations. The results from these additional regressions, not reported here, are almost identical to those reported in Table 2.

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