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The Finance and Economics Women's Network (FEW): Encouraging and Engaging Women in Undergraduate Programs

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ABSTRACT

We describe a novel intercollegiate resource for engaging more undergraduate women in finance and economics programs. In response to the gender gap in undergraduate studies, we developed the Finance and Economics Women's Network (FEW) to support women majoring in finance and economics through FEW clubs. These clubs provide professional skill development and visibility for women in these professions through speaker events. Students run FEW clubs, and faculty advisors and community professionals support them. We also conducted a descriptive survey of students and report the responses. Finally, we provide a constitution template to facilitate the creation of FEW clubs.

Introduction

Although both the Committee on the Status of Women in the Economics Profession (CSWEP) and the American Economic Association (AEA) currently support women in economics at the doctoral level, there is no parallel support network for women in economics at the undergraduate level in the United States. We have developed a model for such a resource to connect female economics students and facilitate extracurricular education through professional skills workshops and speaker events, including presentations by women in economics. The Finance and Economics Women's Network (FEW) aligns with the CSWEP and AEA goals of increasing the representation of women in economics. The FEW club model encourages women to major in finance and economics through peer support, professional skill development, increased visibility of female role models, and increased opportunities to connect with them. Although the FEW clubs focus on female student networking and support, which distinguishes them from standard economics clubs, the clubs are inclusive to all genders. Two universities currently have FEW clubs. We hope to see the FEW Network grow to include more student clubs over time. Our goal in this paper is to describe how our clubs work so that other faculty and students can replicate our model at other schools.

Although more than 50% of undergraduate students in the United States are women, only about 30% of bachelor degrees in economics are awarded to women. Historically, women represent about 30% to 35% of economics majors, or about 1 woman for every 2.5 to 3 men (Siegfried 2019; Emerson and McGoldrick 2019; Ahlstrom and Asarta 2019). Women are also less likely to persist in economics courses and degree programs (Avilova and Goldin 2018; Ahlstrom and Asarta 2019; Emerson and McGoldrick 2019), and the low share of women from historically underrepresented ethnic groups is even more pronounced (Bayer and Wilcox 2019; Emerson et al. 2012).

The gender gap among economics and finance majors has persisted even though more women than men now enroll in college (Goldin et al. 2006; Hawash and Stephen 2019). However, this disparity does not primarily stem from a gap in technical skills. It is, to some extent, perpetuated by attitudes toward women and by institutional practices (Bayer and Rouse 2016; Chari and Goldsmith-Pinkham 2017; Flaherty 2018; Stoet and Geary 2018). Programs that address the gender gap at the undergraduate level may increase the number of professional female economists in the long run.

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Academic networks for women and minorities in economics have a long precedent at the doctoral level. A core aim of CSWEP is to encourage the representation of women among professional economists. The Committee on the Status of Minority Groups in the Economics Profession (CSMGEP) and the Committee on the Status of LGBTQ+ Individuals in the Economics Profession (CSQIEP) support parallel goals. In addition to training, these committees serve as networks. Fellow economists can meet each other at conferences, learn about research related to the committee, and connect with both peers and mentors. Issues related to the representation of women in economics were also considered in the American Economic Association (2019) Professional Climate Survey. However, encouraging women to pursue careers in economics often begins at the undergraduate level. An intercollegiate undergraduate institutional resource such as FEW could support the retention of women in economics majors and, by extension, work toward closing the gender gap in the economics profession.

FEW, founded in 2018, is an official campus organization run primarily by student officers with support from a faculty advisor. The club meets about once per month during the school semester for networking and professional development. Events often involve an outside speaker from industry or academia.

In the next section, we provide a literature review. In the third section, we outline the aims and model of FEW and provide institutional context. In the fourth section, we report the responses to a descriptive pedagogical survey of students in these programs, including FEW club members. The concluding section gives recommendations for further developing the network and provides guidance for faculty interested in starting a FEW chapter as a high-value, low-cost service activity. Finally, in Appendix A, we provide a club constitution template for general use to support this effort, and Appendix B reports the survey results.

Literature Review

There have been several efforts to increase the share of women in undergraduate economics programs and to understand why women are less likely to persist in economics classes after an introductory course. Potential explanations for the gender gap among undergraduate economics majors include the lack of female role models in the classroom, course performance and sensitivity to grades, general interest in the subject, and career interests (Lundberg 2020). Some of these factors, such as career interests, represent more difficult obstacles to increasing the representation of women in economics. However, some factors could be influenced by FEW clubs that provide peer support, skill development, and network development.

There can be positive spillover peer effects for the advancement of female students, both within classrooms and by cohorts (Huntington-Klein and Rose 2018), and research has shown that having more peers in the classroom can improve the grades of underrepresented minority students (Griffith and Main 2019). However, random assignment by groups has also indicated a neutral effect (Feld and Zölitz 2017), suggesting that the effect of peer groups may be non-random. Both low-achieving and high-achieving students also have a strong effect on their peers within the classroom. High-achieving students can improve the achievements of their peers across the distribution, although low-achieving peers may be negatively affected and may negatively affect other low-achieving students (Griffith and Main 2019; Feld and Zölitz 2017). Peer effects also account for a third of the gender gap among STEM majors (Calkins et al. 2020), but the presence of peers and the instructor's gender can increase the persistence of female students in these programs (Griffith and Main 2019). Buchanan (2022) found that young female students are more likely than males to expect that they would experience discrimination or harassment in the future workforce if they enter the technology sector. Exposure to female mentors and enhanced networking may help with this by assuring females students that there will be support when they enter the workforce in a male-dominated field.

Seeing women who have pursued careers in finance and economics has the potential to inspire women to choose these majors, but some economics departments do not have any tenured or tenure-track female economists (AEA 2019). When Porter and Serra (2020) exposed students in introductory classes to successful and charismatic professional women who had majored in economics at the same university, female student enrollment in further economics classes significantly increased, and their likelihood of majoring in economics went up by 8 percentage points.

The presence of female professors also improves female student performance in introductory math and science classes, with strong effects on graduating with a STEM degree; however, the effect is limited for humanities classes (Carrell et al. 2009). Having a female instructor for a principles of economics course may increase the likelihood of students taking additional courses in economics, but Fournier and Sass (2000)

found the effect to be gender invariant while Jensen and Owen (2001) found weaker evidence supporting the role model hypothesis.

Other research finds an indirect link between female instructors and female students' decision to major (Rask and Bailey 2002; Griffith 2014). In contrast, many studies have found a null effect from female faculty on the decision to major in economics (Dynan and Rouse 1997; Robb and Robb 1999; Canes and Rosen 1995; Emerson et al. 2018). The gap between taking additional courses and majoring in economics may rather be explained by a lack of sustained support over time, as mentoring and other encouragement for female students has been shown to increase their probability of majoring in economics by about 6 percentage points (Li 2018).

Developing FEW and Its Clubs

The FEW club model encourages female student participation in finance and economics through peer support, professional skill development, increased visibility of female role models, and increased opportunities to connect with them. In addition, FEW aims to connect FEW clubs across universities and identify alumni who can connect women with finance and economics job opportunities. We formally identify FEW's goals and FEW club features in Table 1.

Table 1: FEW Goals and Features

#	FEW Goals	FEW Club Features
1	Connect women in undergraduate economics and finance programs with each other	Supported by faculty advisors, club officers manage and promote the club to economics and finance students
2	Promote skill development for women in undergraduate economics and finance programs	Organizes career training events for club members to develop relevant skills
3	Promote visibility of women working in economics and finance to current students	Organizes speaker and panel events to promote visibility of women in economics and finance
4	Connect club members with alumni and women in fields related to economics and finance	Organizes student-alumni networking events and directories
5	Connect chapters of FEW clubs (and similar clubs) at different institutions	Connects members with peers and faculty in similar clubs at other institutions

There are currently two member institutions that have developed FEW clubs: Samford University and San José State University. We promote FEW clubs in our classrooms and advertise them through our departments, which increases student engagement. Although the FEW clubs focus on female student networking and support, which distinguishes them from standard economics clubs, the clubs are inclusive to all genders; membership and events are not limited to students who identify as female. We provide a club constitution template in Appendix A to support students and instructors who want to form a FEW club at their institution.

To our knowledge, FEW is the first project designed to support and connect undergraduate women in both economics and finance programs across universities, but other recent endeavours warrant discussion. In particular, the Undergraduate Women in Economics (UWE) initiative in the United States shares goals with FEW, but it does not formally connect clubs across universities. Although FEW shares UWE's aim of connecting undergraduate women in economics, FEW includes finance as well given the common interests and courses that students share across these majors (Avilova and Goldin 2018). The Women in Economics Network (WEN) in Australia also shares similar goals with FEW but is organized around Australian universities.

Next, we describe our university institutions and FEW clubs. Both clubs have had motivated student leaders and have successfully identified future club leaders. Capable student leaders reduce the time commitment from a faculty mentor. Although faculty administer the clubs, there is no special emphasis on pursuing jobs in academia. The Samford University club includes mentors from both economics and finance departments, while the San José State University club has one faculty mentor from the economics department. Either model may be applied to new universities, depending on whether the economics and finance departments are housed in the same college of not. Below we describe first a private university in which

economics and finance are both housed in a business school, and secondly a large state school. FEW has worked well in both settings and therefore we argue can be successful at many colleges and universities.

Samford University

Samford University is a mid-sized private university in Birmingham, Alabama. Its undergraduate enrolment was 3,591 in 2019. The economics program is housed within the Brock School of Business, in the same department as the finance program. Thus, FEW faculty leadership is contained within one department. Not all FEW student members are declared economics or finance majors, and FEW events can draw a wide variety of students interested in the event's topic.

From 2017 to 2019, Samford's economics major grew from 31 students to 42. Including both BA and BABS degrees, there were 10 female economics majors in 2017, 12 in 2018, and 9 in 2019. During the same period, the finance major grew from 80 students to 93. Female students are in the minority in upper-level courses for both majors, even though, like most universities, Samford has more female than male students. In 2021, after several years of FEW operations, multiple female Samford graduates went on to pursue graduate-level studies in economics, which rarely happened before FEW.

Samford's FEW club started in 2018 after several students and faculty advisors attended a conference that year hosted by the Federal Reserve that addressed the issue of female representation in economics. After the idea for FEW emerged, students worked to create an official university student organization. Three female faculty mentors (two in economics and one in finance) support the club. The FEW club consists of three student officers (president, vice president, and treasurer) and about 35 members who are current students. FEW consists of alumni and members of the local business community.

FEW events usually involve hosting a female member of the local business community. Local business leaders have been supportive of the club. FEW Club events at Samford have included the following:

- local bank executives speaking to and meeting with students
- a panel discussion on salary negotiation
- a panel discussion with a local organization that mentors women in the commercial real estate industry
- conversations about HR directors and leave after childbirth
- end-of-semester networking dinners for current members and all affiliates

When university activities became remote due to COVID-19, club members held virtual meetings to stay connected and advise each other.

San José State University (SJSU)

SJSU is a public university of 28,490 full-time equivalent students in San José, California. The economics department is housed in the College of Social Sciences, and the accounting & finance department is housed in the Lucas College and Graduate School of Business. The FEW club at SJSU is both interdisciplinary and intercollegiate but is currently housed in the economics department.

From 2017 to 2019, SJSU's economics major fell from 464 students to 446, and rose from 84 female students to 95. From 2017 to 2019, the finance major fell from 709 students to 606, and from 228 female students to 206. In economics courses, female students often make up less than an eighth of the class.

FEW has helped connect women in these majors through an extracurricular setting. At a commuter university like SJSU, it may otherwise be difficult for women in economics classes to identify each other. The FEW club consists of three student offices (president, vice president, and treasurer) and about 55 student members. Student officers have handled almost all of the club organization and activities independently, with the faculty advisor providing university authorization for the club and general guidance.

The FEW club at SJSU has focused on skill development for female students entering the competitive labor market of Silicon Valley. Beginning in Spring 2018, the FEW club began organizing training in basic coding skills, and these training sessions (including training on Excel, Stata, R, Python, and SQL) have evolved into an annual coding workshop hosted by the club. The FEW club also organized an instructional event on business etiquette and has organized speaking events with women in business.

Survey

We conducted a survey of students at both universities with 114 responses. We do not attempt to infer a causal effect of exposure to FEW clubs. We report a summary of responses here and present our tabulated responses to survey questions in Appendix B. Responses support the idea that female students are sensitive to role models and the advice of mentors when choosing their major.

Factors Positively Influencing Choice of Major

We asked students to report the factors, including role models, that positively influenced their choice of major. For most of the possible answers, the women's responses were statistically indistinguishable from the other students' responses (women were 43% of respondents). However, women were significantly more likely to select three of the options as positive influences. "Interest in the subject" was selected by 92% of female respondents, while only 77% of others chose it. Women were also more likely to select "Interest in current events." Most relevant to this paper, female students were nearly twice as likely as other students (39% vs. 20%) to say that a role model in their chosen profession influenced their choice of major.[2] Porter and Serra (2020) demonstrated a causal effect of exposure to dynamic female role models on the decision to take additional economics classes. We do not conduct a similar test of the causal impact of our guest speakers or clubs. However, the survey suggests that FEW clubs may impact choices at the margin.

We also asked students who the positive influences were on choosing their major. Female respondents again largely responded in the same way as the other respondents. For two of the response options, we found significant gender differences. The influence of parents was selected by 61% of female respondents, compared to only 35% of others. Female respondents in our sample were almost twice as likely to state that parents helped them determine their college major, which is consistent with a Google survey indicating that encouragement from parents was the most influential factor for women who choose to study computer science ("Women Who Choose Computer Science— What Really Matters" 2014). High school teachers and past guidance counselors have less influence than parents, friends, and college faculty. The outcome for the option "Role models in my chosen profession" confirmed the previous responses. Role models were important to 41% of female respondents compared to only 23% of other students.

Responses to Survey Questions on the Impact of FEW

We also asked students to answer questions regarding whether FEW activities impacted their choice of major and found a significant difference in how female respondents answered the questions.[3] After answering 17 multiple-choice questions, we asked respondents who were FEW members to provide written accounts of how FEW affected them. We quote responses below from FEW members to the question, "If you are a member of the FEW (Finance and Economics Women) club, please describe the impact that FEW has on your choice of major." Responses included: "It's not changed my major, but I've certainly enjoyed my involvement enabling me to have important conversations"; "Allowed me to see different career options and has empowered and inspired me to see other women succeed in the business world"; "No impact on my major just interested"; "It's been positive"; "It further increased my interest in my major and helped me get more information/opportunities that were previously unavailable to me through the university (ex: Coding classes)"; "The women in FEW are confident and smart. They inspire me to do well in my courses and to challenge the stereotypical. This organization has helped me feel more confident in my chosen major because it has helped me make connections within and outside our university"; and "So far it has made me more interested in economics as a major or minor."

We next report a sample of responses from FEW members to the question: "If you are a member of the FEW (Finance and Economics Women) club, please describe the impact that FEW has on your perception of women in finance and economics." Responses included: "An opportunity to network and meet people"; "It's been encouraging to see initiative promoting the increase of women pursuing business-related professions"; "Encouraged me"; "Hard workers, diligent, determined, and confident"; "Respect for the women whom are

[2] This is a significant difference using a two-tailed difference in proportions test (p-value = 0.02).

[3] We conducted a chi-squared test for statistical significance among the gender groups: female, male, and other (p = 0.001).

in the finance and economics department and their dedication for it."; "It has encouraged me to meet more women in this field. It helps me to recognize that there are positions out there for women and if I'm interested in them, I am empowered and supported to pursue it"; "It gives me a sense of solidarity to know that there are other women in economics and finance"; and "Honestly, it was nice to see more women in my field in general. Most of my economics classes only have/had a handful of women—really, I could/can count them on one hand. FEW just made it clear that there were more of us women out there."

Some FEW members replied that they had already selected their major by the time the club formed. It is clear that some female students would have selected economics or finance majors without the FEW club. Responses indicated that female students appreciated the club and were influenced by the role models they found through the organization.

Conclusion and Recommendations

The gender gap among undergraduate economics students has persisted over time despite previous efforts and interventions. We have described a novel resource to address this issue by starting and maintaining an intercollegiate student-run club network. These clubs are devoted to connecting and training female majors in finance and economics. We were motivated to start FEW because women are underrepresented in these fields, and we observe these issues at our institutions. We expect that extra help and encouragement at the undergraduate level may support the future growth of female professionals in finance and economics and support female students pursuing careers in these fields.

We have seen significant benefits to our female students from engaging with the FEW clubs. Further, the development of a FEW club represents a high-value but low-cost service activity for faculty members while also increasing student engagement with faculty. We have found that club members get excited about pursuing finance and economics academically and professionally, and club officers in particular develop important professional skills. We provide a club constitution template in Appendix A to support faculty interested in developing a FEW club at their institution, and we hope that the example of the first two FEW clubs will inspire students and faculty at other schools. FEW and FEW clubs provide a practical organizational form to enhance professional development for students and to potentially support the long-term retention of women in both the finance and economics disciplines.

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Appendix A: Club Constitution Template

Finance and Economics Women's Club Constitution

Article I: Name

The name of this organization shall be Finance and Economics Women's Club, also known as FEW.

Article II: Purpose

The purpose of this organization shall be to support and inform college students, especially women, about careers in finance and economics, as such support has been shown to increase the number of women who go on to higher level finance and economics classes. We exist to encourage diversity by showing young women that it is possible to pursue a technical field and to be bold in their choice of career path.

Article III: Membership

Section 1: Membership shall be open to all [*UNIVERSITY NAME*] students.
Section 2: No member may be removed from membership without having an open hearing and then by no less than a majority vote at a regular meeting.
Section 3: FEW complies with [*UNIVERSITY NAME*] policies prohibiting discrimination against protected classes.

Article IV: Officers

Section 1: The officers of this organization shall be president, vice president, and treasurer.
Section 2: All officers will be elected by the third meeting in the fall semester and will serve an academic year-long term. Officers will be elected by majority of those present at said meeting.
Section 3. No officer may be removed from office without first having an open hearing and then by no less than a majority vote at a regular meeting.
Section 4. Office vacancies will be filled by special election at the meeting after the vacancy occurs.

Article V: Officer Responsibilities

Section 1: President

- Promote FEW and engage with potential members
- Welcome the guests and speakers and serve as their student contact
- Serve as a liaison between the advisor and other members of FEW
- Establish meeting days and times, agendas, and presentations
- Manage social media and marketing
- Set up events and meetings

Section 2: Vice President

- Assist the president in any responsibilities stated above
- Fill in for the president if needed
- Assist in organizing meetings and presentations
- Ensure meeting places are reserved
- Ensure communications are sent out after every monthly meeting
- Assist president with social media and marketing
- Assist president with event and meeting setup

Section 3: Treasurer

- Handle finances
- Submit documentation needed for associated students when funding is needed
- Understand funding limitations through school organizations
- Fill in for president and vice president when needed
- Assist with social media and marketing
- Events and meetings set up

Article VI: Meetings

FEW will meet each semester to prepare for upcoming events. Additional meetings will be called if necessary and will be communicated to members via email. These meetings will be called by the majority agreement of the members at the first meeting each month based on available times and then officially set by the president. Meetings throughout the semester will include outside speakers, workshops and team-bonding events.

Article VII: Quorum

Section 1. Proposed amendments to this constitution or its bylaws shall be presented at a regular meeting at least one meeting prior to being discussed and voted upon.
Section 2. Having been properly presented, amendments may be adopted by a majority vote of the members present at a regular meeting.
Section 3. Amendments shall go into effect immediately upon adoption.

Article VIII: Financial Operations

Section 1. There shall be no cost for membership in this organization.

Section 2. Should FEW go dormant or inactive, any remaining funding associated with the organization should be controlled by the president, vice president, and treasurer to be distributed to sister organizations.

Appendix B: Survey Methodology and Responses

Methodology

To assess students' perception of a FEW club, we distributed a voluntary survey to them at our respective universities. We based our design on previous surveys concerning gender differences in economics (Dynan and Rouse 1997; Calkins and Welki 2006; Jensen and Owen 2000, 2001; Bansak and Starr 2010). We distributed the descriptive survey using Qualtrics. We asked 19 questions, including two specifically related to the FEW club. The tables in Appendix B report the full list of questions. We have actively promoted the FEW clubs to all of our students and therefore do not include a randomized control trial or attempt to estimate any causal effects of FEW club activities on students. All respondents attend a university at which FEW operates.

The survey was advertised in the authors' classrooms, with 106 students, and through emails to the FEW clubs, with membership estimated at 90 members across Samford University and SJSU. The survey received 114 responses, with 71% from Samford University and 29% from San José State University. Overall, the response rate is estimated at 58% of the population surveyed. Advertising for the survey was done through the classroom and emails. We do not claim that these responses are representative of all undergraduate students because most responses came from students who are connected to the authors through business or economics classes. We then analyzed the survey responses using tests for differences of proportions and chi-squared tests.

Demographic and Academic Factors (Questions 1–11)

We first asked students some baseline demographic and academic questions. Table B1 presents summary statistics for demographic factors. We have a nearly equal number of female and male respondents; in addition, one respondent identified their gender as other. Overall, female students are demographically similar to the other gender groups in this sample. Most students are seniors or above, and most have not transferred in from another university. About half of students are economics or finance majors. Table B2 presents summary statistics for academic factors.

Additional Survey Questions (Questions 12–19)

Table B3 presents the responses to question 12, "What factors positively influenced your choice of major? Check all that apply." Table B3 also presents the responses to question 13, "Who were the positive influences on choosing your major? Check all that apply." We also report additional academic demographic factors and FEW club membership from respondents. Table B4 presents the responses to question 14, "To what degree does the availability of extracurricular activities for women in finance and economics (the FEW club) impact your interest in finance and economics majors?" Table B1 presents the responses to questions 17-19. Question 15 and question 16 were the fields for free responses that we reported in Section 4.2.

Survey Tables

Table B1: Survey Questions on Demographic Information

Question	Response Choice	Frequency	Percent
Q1: Your Gender:	Female	49	43%
	Male	64	56%
	Other	1	1%
Q2: What academic year are you in?	Freshman	5	4%
	Sophomore	3	3%
	Junior	8	7%
	Senior or above	91	78%
	Alumni	7	6%
Q3: Your transfer status:	I did not transfer in from another university	93	82%
	I transferred in from another university	21	18%
Q4: What is your major?	Economics	35	31%
	Finance	26	23%
	Accounting	10	9%
	Another major within the business school	38	33%
	Math	0	
	Computer Science	1	1%
	Another major	4	4%
	Undeclared	0	
Q5: Is your major type a:	BA	51	45%
	BS or BSBA	63	55%
Q18: My college is located in	Alabama	81	71%
	California	33	29%
Q19: My first economics class was	Smaller than 45 students	102	89%
	Larger than 45 students	12	11%
Q17: Are you a member of the FEW (Finance and Economics Women) club?	Yes	19	17%
	No	95	83%

Notes: Frequency is the total count from all respondents. Percent reflects the percent of overall respondents who selected each option.

Table B2: Survey Questions on Academic Factors

Question	Response Choice	Full Sample		Female Finance & Economics Majors	
		Frequency	*Percent*	*Frequency*	*Percent*
Q6: What was your grade in your first economics class?	A (A-, A, or A+)	49	43%	11	48%
	B (B-, B, or B+)	49	43%	10	43%
	C (C-, C, or C+)	14	12%	2	9%
	D or F	2	2%	0	0%
Q7: Did you expect the grade you got in your first economics class? Was that grade better or worse than your performance in other courses?	Better	20	18%	5	22%
	About the same	72	63%	16	70%
	Worse	20	18%	1	4%
	I have not taken an economics class in college yet	2	2%	1	4%
Q8: What is the highest level math class you took prior to taking your first economics class?	Pre-calculus	50	44%	10	43%
	Calculus I	46	40%	8	35%
	Calculus II	8	7%	2	9%
	Linear algebra or higher	9	8%	3	13%
	I have not taken an economics class in college yet	1	1%	0	0%
Q9: Were you considering majoring in your declared major when you took your first economics class?	Yes	65	57%	11	48%
	No	48	42%	12	52%
	I have not taken an economics class in college yet, or I have not yet declared a major	1	1%	0	0%
Q10: Was the number of women in your economics classes:	More than you expected	9	8%	2	9%
	About what you expected	81	71%	15	65%
	Less than you expected	22	19%	5	22%
	I have not taken an economics class in college yet	2	2%	1	4%
Q11: Are you considering graduate school in economics or finance?	Yes	38	33%	10	43%
	No	76	67%	13	57%
N		114		23	

Notes: Full Sample reflects the full sample of all respondents. Female Finance and Economics Majors reflects the sample of respondents who identify as female and major in either finance or economics. Frequency reflects the number of respondents to each question, by sample. Percent reflects the percent of respondents who selected each option, by sample.

Table B3: Survey Questions on Factors that Positively Influence Choice of Major

Q12: What factors positively influenced your choice of major? Check all that apply:	Frequency	Percent of Female Respondents
Interest in the subject	96	92%**
Expected job marketability after graduation	72	59%
I have always done well in my major classes	43	29%
The approachability or friendliness of the faculty	29	29%
The teaching reputation of faculty in the department	20	14%
Representation of women in the faculty	8	10%
Expected income after graduation	56	45%
Interest in current events	37	45%**
Preparation for graduate school	15	14%
The availability of internships	32	35%
Previous high school courses	17	14%
Role models in my chosen profession	32	39%**

Table B4: Survey Questions on People that Positively Influence Choice of Major

Q13: Who were the positive influences on choosing your major? Check all that apply:	Frequency	Percent of Female Respondents
Faculty in the major	58	55%
Peers'/friends' recommendation	57	53%
High school teachers	20	16%
Parent/guardian	53	61%**
Guidance counselor	14	10%
Role models in my chosen profession	35	41%**

*Notes: ** indicates that female respondents were more likely to choose this option (p-value < 0.05 in a two-tailed test of difference of proportions). Frequency is the total count from all respondents. Percent of Female Respondents reflects the percent of female respondents who selected this option, using total female respondents as the base.*

Table B5: FEW Influence on Choice of Major, Frequency by Gender

Q14: To what degree does the availability of extracurricular activities for women in finance and economics (the FEW club) impact your interest in finance and economics majors?	**Female**	**Male and Other**
It increases my interest	21	8
It's about the same	25	51
It decreases my interest	2	3

The Interaction of Gender and Incentives in Active Learning: An Experimental Investigation

***Caleb Lewis*[1]**

ABSTRACT

The economics and finance education literature includes a growing collection of active learning exercises that are an increasingly important part of the educator's toolkit. At the core of many exercises are incentives that either encourage competition or foster cooperation. Significant research in the educational psychology literature demonstrates that female students are more receptive to a collaborative learning environment. This paper presents results from an experiment investigating the learning implications of cooperative and competitive active learning exercises in the economics classroom. Findings suggest a gendered performance response to incentives in classroom activities and encourage further study on the topic.

Introduction

The under-representation of women in economics is a well-documented and persistent phenomenon. Indeed, even as the number of economics majors has grown in recent years the percentage of women earning degrees has declined (Siegfried 2016). Researchers have investigated several factors related to female persistence in the study of economics, and among them are performance, grades, and confidence (Dynan and Rouse 1997; Emerson et al. 2012; Rask and Bailey 2002). Many of these factors are outside of the control of individual educators. One important area for advancement relates to pedagogy and incentives and their impact on student performance and continued study in economics.

This paper details results from an experiment designed to test the impact of activity incentive structures on student learning. Particular focus is given to gender differences in performance associated with classroom games with cooperative and competitive incentives. Often the relationship between learning and incentives is considered in the context of an entire course or even year of study. However, it is possible that there are outcome implications for the incentives of particular delivery methods, assessments, and other pedagogical tools. In this study, four sections of students were randomly assigned to treatment and control groups in each of four separate units in the course. Students were pre- and post-tested to assess learning. The results provide evidence that female students respond positively to cooperative learning environments and negatively to competitive learning environments. The opposite result is found for male students. Though limited in scale and scope, this study encourages future research and motivates careful consideration of incentives on the part of educators. Further, instructors should carefully design an appropriate mix of delivery and pedagogy that takes into consideration a classroom's composition and contemporaneous performance and the implications for student persistence into further study of economics and similar disciplines. The results presented show that further research on this topic is warranted.

Literature Review

This section reviews relevant literature which provides a foundation for this study, establishing a link between pedagogy, incentives, and performance. Pedagogical practices and incentives have implications, not only for performance in the current class, but also for persistence into continued study in a discipline. If these tools impact groups differently, then some students may be disadvantaged in the classroom.

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Given this paper's focus on gender, some discussion of female students is warranted. Historically, female students are under-represented in the economics classroom despite being over-represented in the overall undergraduate population. As a result, as the number of economics majors has increased, the share of female economics majors has declined (Seigfried 2016). The under-representation of women in economics programs has many causes. For example, researchers have shown that female students are less likely to have a predisposition to economics (Calkins and Welki 2003). Women tend to perform better on standardized English exams than math, where such results are a predictor of major choice for both genders (Davison et al. 2014). Further, educators choose tools that impact student confidence, performance, and persistence. Students who are less confident in their performance in economics are less likely to persist in the major, and women report less confidence in their performance in economics classes (Jensen and Owen 2001). This is despite the well-established gender advantage in performance female students exhibit (Conger and Long 2010). Women have been shown to be more sensitive than their male counterparts to the grade earned in a course (Owen 2010). Given the link between confidence, performance, and perseverance, the pedagogical methods utilized in the classroom have implications for the number and composition of economics majors and graduates.

Modern education and pedagogy often rely on an especially important tool: active learning exercises. Active learning exercises take students out of the passive role associated with traditional lecture and engage them directly in the learning process. Bonwell and Eison (1991), in a seminal work laying out a shared definition of active learning, define active learning as "instructional activities involving students in doing things and thinking of what they are doing." They extend the definition to include activities where students are expected to reflect or produce evidence of learning that is ungraded or low-stakes. This broad definition includes a significant range of activities. Such tools have been demonstrated to be powerful methods of encouraging engagement, critical thinking, and other key objectives of teachers. There is a significant body of work demonstrating the importance of active learning in many quantitative fields including engineering (Prince 2004), science and mathematics (Freeman 2014), and the social sciences (McCarthy 2000). Anderson et al. (1992) found that active learning has benefits for a diverse student body and can be used to better serve under-represented populations. Active learning exercises are particularly common in economics, and are often termed classroom experiments or games. This is not surprising, as the ideas inherent in an economic theory often involve incentives that lend themselves to modeling in a classroom exercise.

Many of these games share an essential feature in that students are placed in a position to interact with each other, or the professor, in the context of incentives designed to reflect those of a real world environment. Indeed, this literature is filled with many examples of cleverly designed incentive structures. These incentives create learning environments that reflect the inherent dynamic of the game itself (see Delemeester 1995 for a significant collection of these activities). From the participant's perspective the incentive structure of a particular game may be individualistic, competitive, or cooperative. Much of the work on cooperation, competition, and individualized classrooms relates to the entirety of the course, not the salient incentives in a particular session. One novel feature of this study is that the inherent competitive or cooperative incentives in active learning tools are assessed. Bartlett (2006) covers many possible implementations of cooperation in an economics course. While there is discussion of cooperation in the classroom, there is little work done to assess its value in economics. The intention of this experiment is to investigate how students, depending on gender, respond to active learning exercises that are inherently cooperative or competitive

Women are often purported to prefer collaborative learning environments, avoid quantitative reasoning, and seek to avoid competitive and confrontational topics and classrooms. Wehrwein et al. (2007) find clear evidence of gender differences in self-reported learning preferences among physiology students. Lau et al. (2010) find evidence for gendered learning styles and suggest pedagogical methods to address to these differences. Kulturel-Konak et al. (2011) find evidence of gendered learning styles in STEM fields. Tanner and Lindquist (1998) find that female accounting students prefer cooperative environments and report increased perceived performance. These fields are similar to economics in their quantitative nature and one might expect these results to extend to economics.

The literature surrounding incentives and gender in economics education is not settled. In one of the first studies linking learning styles to outcomes in the economics classroom, Charkins et al. (1985) find significant evidence for learning styles and suggests teaching styles should be coordinated with student learning styles. Ziegert (2000) finds that personality traits are important predictors of student learning in economics and that these attributes are heavily gendered. She finds that women tend to be "feelers" rather than "thinkers." Boatman et al. (2008) find evidence of learning styles in economics students but find that gender and ethnicity are not strong predictors of performance after controlling for learning styles. Lage and Treglia (1998) write

about the underrepresentation of women in economics and suggest that appropriate active learning exercises could help encourage women to enter the economics profession. They argue that active learning exercises are particularly powerful pedagogical tools for reaching out to female students in economics classroom and that educators who fail to do so are contributing to the pattern that resulted in such under-representation in the first place. However, Dickie (2006) finds that point incentives reduce performance, with female students experiencing a larger magnitude negative effect, though the gender difference was not statistically significant.

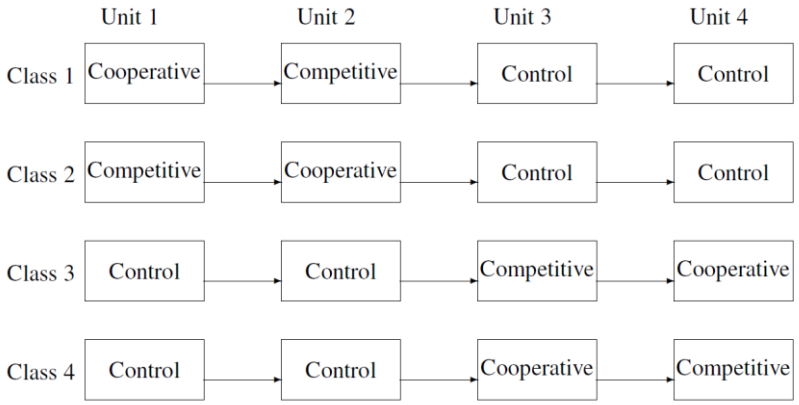
The intention of this experiment is to investigate the extent to which gender and active learning incentives interact to effect performance. The remaining sections of the paper will outline the details of the experiment design and empirical methodology, present the results, and conclude with a discussion of the implications and limitations of those results.

Methodology

At a small, private Liberal Arts university in the Midwest, four sections of Principles of Microeconomics participated in this experiment over the course of a semester. Students were exposed to interventions in each unit of the course where, if not in a control group, performance would be jointly determined with either a positive or negative relationship. Performance on exam questions was used as post-test scores.

On one day in each of the four units of the course, the sections were exposed to treatment or controls. On a particular day of the experiment there were two classes, one assigned to competitive and another to cooperative active learning exercises, and two classes assigned to control groups which received traditional lecture and individualized assessments. The sections were randomly assigned to treatment groups with two constraints: each section would be observed in each experiment group by the end of the semester and that on each day of observation there must be one of each type of experiment group. As such, by the last course unit the assignment of treatments was no longer random but rather dependent on the pattern of previous treatments. This pattern can be seen in Figure 1.

Figure 1: Representation of the Progression of Classes Through Treatment Groups



It bears noting that this experimental design is focused on capturing the impact of an individual activity and not the cumulative impact of a semester long intervention. Activities were determined to be either competitive or cooperative depending on the nature of the points awarded to students. If the points were zero-sum or otherwise inversely related, the activity was determined to be competitive. If the points were jointly-determined and positively correlated, the activity was considered cooperative. However, in all cases, including the control groups, students had a deliverable giving them an active role in the determination of their grade and incentivizing performance.

Students were pretested with 20 questions designed to assess the particular concepts covered in the experimental sessions. Five questions were selected to cover material from each of the four units of the course. The majority of questions came from the Test for Understanding of Collegiate Economics (TUCE)[2]

[2] Some questions were added to more closely fit the learning outcomes of the content covered in experimental sessions. The survey is available upon request.

(Walstad 2007). The TUCE is a nationally normed assessment of student learning in economics. The intent of using this standardized material is to provide for reproducibility and continuity with other works. The questions were selected to fit with the content from the course units and the active learning exercises.

Student achievement data that include pre- and post-testing is commonly used to measure student learning. The difference between pretest and post-test scores, referred to as the gainscore, is often used as an indicator of the value-added associated with a particular program, teacher, or pedagogical tool. However, recent work by Walstad and Wagner (2016) shows that achievement data can be decomposed into constituent parts that reflect different possible patterns of correct and incorrect answers spanning the pre- and post-test. These patterns allow for more focused analysis of performance and better understanding of the learning process. Questions answered incorrectly in the pretest but correctly in the post-test are referred to as positive learning (PL), reflecting reflects increased economic understanding. Questions answered incorrectly in the pretest that remains incorrect in the post-test are known as zero learning (ZL). Finally, questions initially answered correctly either remain correct in an example of retained learning (RL) or become incorrect as example of negative learning (NL). These components provide information about the nuance of performance across assessments.

Commonly used measures of student performance, such as post-test scores and gainscores, are not unadulterated measures learning. The gainscore can be thought of as the net outcome of PL, demonstrating improvement, and NL, reflecting a loss of understanding. This can be formalized as $gainscore = PL - NL$. As a result, an intervention shown to improve gainscore may reflect acquisition of new knowledge (PL) or that NL was low. The post-test performance is made up of correct answers that in the pretest where either correct (RL) or incorrect (PL) which can be formalized as $post-test = PL+RL$. An intervention in that improves performance on the post-test may only reflect that it helped students maintain their existing knowledge (RL) not necessarily gain new knowledge (PL). Given the experiment design focused on the impact of a single intervention, PL will measure new knowledge obtained that day. Of course, there remains value in observing if students retain their knowledge, lose their grasp on information, or fail to correct a misconception. However, so long as the varied patterns of questions from pre- to post-test are unclear, PL is a more direct reflection of the learning students experience than the post-test or gainscore.

Course Units

The Principles of Microeconomics sections were identically structured. Each section covered the same material and used the same text, received the same instruction (outside of the experimental interventions), and had the largely the same assessments. Throughout the semester students were given four exams covering material from the preceding unit in the class. A portion of these unit exams included five multiple-choice questions repeated from the pretest that corresponded to the material covered in the course unit.

The first section of the course included, among other things, traditional material on supply, demand, and market equilibrium. On the observation day, sections were randomly selected to participate in one of three activities. Students in the competitive active learning treatment group participated in the classic "Pit Market" classroom experiment developed by Holt (1996). This game puts students in direct interaction attempting to negotiate an exchange with reservation prices assigned to them by the experimenter. On the day of the experiment, points were awarded to students according to their returns. As such, in a price negotiation between parties in the pit students were determining their shares of a fix amount of net benefit. In the cooperative active learning exercise students were provided similar information on reservation prices and asked to determine in a group the equilibrium market price and quantity and produce a brief statement on the returns in the market. Points depended on the performance of the group. To work against any incentive to free-ride, students were informed that a randomly selected student from each group would have to describe the results to the entire class. Finally, the control groups observed a lecture including examples of the process of price determination with the same data and given a short, low-stakes quiz on the material.

The second unit in the course included market and government failure. Students in the competitive active learning treatment group participated in a classroom experiment that simulates the incentives of a fishing boat in the context of overfishing (Lewis 2018). Students can choose to fish aggressively, which is the sub-game perfect equilibrium, and earn high returns from a large catch, or to fish conservatively (resulting in a sustainable fish stock) and earn lower returns in that round but increase the total return for the group. Points depended on each student's total catch in the experiment. The strong incentive to maximize individual profits at the cost of others' results in a competitive environment. Students in the cooperative active learning project read a short article and discussed it in a group and prepared a short report on how the article displayed

concepts of market failure. Again, to circumvent the incentive to free-ride students were informed that a randomly selected student from each group would be asked to describe the results to the entire class. The control groups observed a lecture including examples of market failure, read individually the short article from the cooperative treatment, and wrote a short response to the material.

The third unit included material on production and firm costs. Students in the competitive and cooperative active learning treatment groups participated in a similar activity where they were put in small groups and given typical disposable cups and a small table which represent variable and fixed resources respectively. In the first round one student is asked to create as many pyramids of three stacked cups as possible in a limited amount of time. In the second round two students stacked cups and in subsequent rounds the number of students increased in the same manner. Eventually, the capital constraint (table size) results in diminishing marginal returns. The key difference here is in the incentives of each student. In the cooperative treatment the groups were described as teams and they were expected to collect data on total, marginal, and average product, which they then graphed together and turned in with all names listed. In the competitive section students returned to their desks to graph the data and were also awarded points according to their number of 'units' they produced. The control sections observed a lecture on these production ideas including sample calculations and graphs and were given a short, low-stakes quiz.

The final unit included material on imperfect competition and monopoly. In the competitive active learning treatment students participated in a game theoretic interaction with an anonymous classmate. The limit pricing game has jointly determined outcomes which are inversely related, and points were awarded accordingly. The cooperative active learning treatment section was broken up into groups who were provided the payoff matrix from the limit pricing game and asked to solve it as a group. Again, with the proviso that a random student would be asked to present the results to the class. Finally, the control group observed a lecture over the relevant theory and the solution to the game, and were given a short, low-stakes quiz over the content.

This experiment was designed to generate data on the response of students to different incentives in a variety of pedagogical applications. Data were collected on each experimental session, student performance on exams, and student level demographics. The pre- and post-test data has been decomposed into the parts that make up the usual value-added measures of performance. As such, these data can be organized as panel data with repeated observations on students spanning treatment groups.

Data

Data was collected on a variety of student and class characteristics. Descriptive statistics for the 69 students in the sample are presented in Table 1.

Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Female	0.261	0.442	0	1	69
Black	0.13	0.339	0	1	69
Age	20.897	3.634	18.2	39.93	69
Related Major	0.536	0.502	0	1	69
Attended	0.841	0.369	0	1	69
Previous Econ	0.116	0.323	0	1	69
Pretest Score	6.58	2.219	0	11	69
Athlete	0.681	0.469	0	1	69
Conditional Admit or Remedial	0.319	0.467	0	1	69
Median HH Income	57151.06	14511.97	30546	97251	69
Freshmen	0.706	0.456	0	1	69
Male PL	1.009	.9363	0	4	51
Female PL	1.4167	1.1227	0	5	18

In congruence with other studies, the majority (72.9%) of the sample is male and a minority is black (13%). A significant share is in a related major (53.6% business, economics, and accounting). Data was also collected on a proxy for income, the median income in students' home zip codes. Slightly more than half of the students are freshmen and approximately 32% are conditionally admitted to the institution or enrolled in remedial courses. For the majority of students (88.4%), this was the first economics course at the college level. The average pre-test score is less than 6.58 out of twenty questions. Selection into courses resulted in significant disparities between sections. However, in this experimental design, each section is observed in both treatments and control groups, thus the sample is well-balanced across treatments.

Empirical Analysis

The underlying model of this estimation is one in which pedagogical tools are only one of several inputs in a learning production function. One key factor of this production function is the interaction between gender and active learning incentives. As such, the estimation strategy must include controls for the most essential confounding factors and a series of interactions terms. Due to data limitations typical individual fixed effects cannot be employed here. However, recent evaluations of these estimations (sometimes termed value-added) such as Chetty et al. (2014) and Koedel et al. (2015) find there is little support in the literature for the necessity of individual fixed effects in this context. The absence of individual fixed effects does require the use of particular individual level variables. Fortunately, the data include robust measures of individual characteristics. Course section (which equates to time of day) and time (which equates to content unit) effects are essential to control for variation among class sections and course units.

There are observations on student performance Y_{ict} for individual i in classroom c and in course unit t. The dependent variable Y_{ict} represents different performance measures including *posttest*, *gainscore*, and *PL*.[3] Included demographic variables are dummies for race (a dummy for black), economics or related major, previous economics coursework, conditional admit status, and athlete status. There is also a measure of relative socioeconomic status: a quintile of household income by home zip code. Also included is a dummy for attending the day of the treatment.

The first analysis makes no distinction between the incentive structures of the active learning exercises. As such, the observations from these treatments share an indicator representing group-dependent incentives in active learning. The estimation equation is as follows:

$$Y_{ict} = \beta_0 + \beta_1 F * Control_{ict} + \beta_2 F * AL_{ict} + \beta_3 M * AL_{ict} + X_{ict}\beta + \theta_c + \eta_t + \varepsilon_{ict} \quad (1)$$

X is a vector of individual characteristics, including age and a quadratic of age, race, and dummies for student status (i.e., athlete, freshman, etc.). $F * AL_{ict}$ is an interaction term including female and treated status. This term picks up the *female specific* effect of the AL treatment. Similarly, $M * AL_{ict}$ captures the impact of active learning on male students. $F * Control_{ict}$ is a term of interacting female and control groups status. As such, in this fully-interacted model, the comparison group is male and in a control group. Finally, θ_c is a vector of section fixed effects and η_t is a vector of time effects.

The second specification decomposes active learning into categories by incentives is as follows:

$$Y_{ict} = \beta_0 + \beta_1 F * Control_{ict} + \beta_2 F * Comp_{ict} + \beta_3 M * Comp_{ict} + \beta_4 F * Coop_{ict} + \beta_5 M * Coop_{ict} + X_{ict}\beta + \theta_c + \eta_t + \varepsilon_{ict} \quad (2)$$

As before, this interacted model has a benchmark comparison group of male students in a control group.

Results

This section presents the results from a series of panel regressions under varying specifications. There are a few central pieces necessary to the interpretation of the results. First, in each case the omitted comparison group is male and in a control group. As such, the results represent differences in performance from this benchmark. Second, the control groups received generally interactive lecture and were aware that a quiz, or other deliverable, would follow. Thus, any significant results derive from differences in incentive structures themselves and not the presence of an activity. Third, results are presented from commonly used measures

[3] Estimates of the effect on RL, NL, and ZL produced no significant results.

of performance, post-test and gainscore, and from the PL measure discussed above. The results, limited by the sample size, provide preliminary evidence of a gender specific effect for certain incentives.

Table 2 reports estimates of the gender specific effects of treatment including any form of non-individualized incentives in active learning exercises. Estimations include course-section and unit fixed effects, as well as an age-squared measure that are suppressed for brevity. No significant results are found for post-test and gainscore measures of performance related to the focus of the study. Previous economics course work and attending the session are statistically significant at the 1% level in these estimations. Attending the day of the exercise improves performance, this is perhaps just measuring the impact of good attendance habits as attendance is measured for treatment and control groups. In the PL specification, some interacted variables gain significance. It is clear that group dependent incentives in active learning have little impact on male students. However, there is a modestly significant effect for female students. In continuity with other works, the results indicate that female students tend to outperform their male peers, independent of the treatment effect. A female student attending an active learning exercise will see her positive learning improved by 0.320 of a question (significant to the 10% level) over the male control group on average. However, the same student in a control group will see her score improved by 0.408 (significant to the 5% level) questions on average. That is to say that group incentives in active learning seem to result in *lower* female performance by the amount of 6.21% of the average female PL. Thus, the marginal effect is higher in the control, however the difference between the estimates is not statistically significant.

Table 2: Effect of Active Learning Exercises

	(1)	(2)	(3)
	posttest	gainscore	PL
Female*Control	0.279	-0.0935	0.408**
	(0.259)	(0.265)	(0.228)
Female*Active Learning	0.267	-0.0989	0.320*
	(0.345)	(0.233)	(0.281)
Male*Active Learning	-0.119	-0.0142	-0.0636
	(0.174)	(0.168)	(0.146)
Related Major	-0.193	-0.198	-0.127
	(0.188)	(0.163)	(0.129)
Previous Econ	0.664**	0.595**	0.357
	(0.272)	(0.249)	(0.259)
Quantiles of Median HH Income	-0.0307	-0.0825	-0.0142
	(0.0665)	(0.0646)	(0.0456)
Cond. Admit or Remedial	-0.199	-0.0341	-0.204*
	(0.176)	(0.172)	(0.116)
Black	0.107	-0.138	0.283
	(0.264)	(0.202)	(0.192)
Attended	0.686***	0.438**	0.402***
	(0.213)	(0.192)	(0.153)
Athlete	0.194	-0.315	0.326*
	(0.233)	(0.250)	(0.169)
Freshman	-0.0503	0.0144	-0.130
	(0.241)	(0.259)	(0.196)
Age	-0.224	-0.121	-0.142
	(0.164)	(0.170)	(0.123)
Observations	256	256	256

Note: Clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3 details results focused on the gender specific effect of different group-dependent incentives in active learning. For male students, the impact of group dependent, competitive incentives result in a statistically significant positive change in performance of 0.124 questions (significant at the 10% level) over

the control group in the PL specification. For female students, cooperative incentives result in a larger marginal effect over the control group in the PL specification (0.635 significant at 5% compared to 0.411 significant at the 10% level). Interestingly, the presence of competitive incentives results in no statistically significant estimate for female students, where we should expect a positive effect from the gender advantage of female students. Again, attendance is significant, both economically and statistically, in relation to many performance measures. With these conflicting results it becomes clear why the combination of competitive and cooperative AL groups presented in Table 2 has no significant effect: the impact of the varied incentive types balance out when combined in the general AL measure.

Table 3: Effect of Incentives in Active Learning Exercises

	(1) posttest	(2) gainscore	(3) PL
Female*Control	0.282	-0.0924	0.411**
	(0.261)	(0.267)	(0.230)
Female*Competitive	0.0413	-0.136	0.0085
	(0.323)	(0.231)	(0.337)
Male*Competitive	0.202*	-0.0995	0.124*
	(0.215)	(0.202)	(0.166)
Female*Cooperative	0.494	-0.0629	0.635**
	(0.448)	(0.374)	(0.377)
Male*Cooperative	-0.0304	0.0717	0.00299
	(0.199)	(0.216)	(0.185)
Related Major	-0.192	-0.198	-0.126
	(0.189)	(0.163)	(0.130)
Previous Econ	0.665**	0.595**	0.358
	(0.273)	(0.250)	(0.259)
Quantiles of Median HH Income	-0.0311	-0.0825	-0.0147
	(0.0667)	(0.0649)	(0.0456)
Cond. Admit or Remedial	-0.201	-0.0342	-0.206*
	(0.177)	(0.173)	(0.116)
Black	0.107	-0.138	0.283
	(0.266)	(0.203)	(0.193)
Attended	0.679***	0.438**	0.394***
	(0.211)	(0.193)	(0.148)
Athlete	0.194	-0.315	0.326*
	(0.234)	(0.252)	(0.169)
Freshman	-0.0509	0.0144	-0.131
	(0.242)	(0.261)	(0.196)
Age	-0.225	-0.121	-0.143
	(0.164)	(0.171)	(0.122)
Observations	256	256	256

Note: Clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The magnitude of the results requires some interpretation. In the PL specification, there is a positive effect for male students of a fraction of a question (0.124 significant at 10% level) in competitive environments over the control group. This represents a 12.38% improvement in PL compared to the average male PL of 1.009 questions. Importantly, this economically and statistically significant impact results from a change in the incentive structure of a *single* classroom activity. Further, for female students there is no statistically significant difference between the performance of the female student in a competitive environment over that of male students in a control group, that is to say that the change in the incentives eliminates the well-documented gender advantage. However, in a cooperative setting female students will outperform male students by 0.635 questions on average (a 44% increase over the average level of PL of 1.417). This implies

a 0.224 question increase over the gender advantage observed in the female control group. This improvement in female performance represents a 15.81% improvement in female performance from the average female PL. Again, this is a substantial improvement from changing the incentives in a single day's activity.

The results presented in Tables 2 and 3 represent a compelling story on incentives and learning. In Table 2 there is no significant impact on learning from moving to group-dependent incentives. However, in Table 3 one can see that decomposing those incentives into cooperative and competitive environments provides insight in how male and female students respond to their group dynamics. Specifically, female students see their performance improve when working in cooperative settings and male students in competitive settings.

Discussion

This paper presents results from an experiment designed to measure the gender specific impact of cooperative and competitive incentives in a single active learning exercise. While this approach limits the ability to measure any cumulative effect, estimated positive impacts from a change on a single class session speak to the broader importance of incentives in the learning environment. The data limitations in this study inhibit the generalizability of the findings, indeed there are only 18 female students in the sample. However, these results are suggestive of an important aspect of learning that warrants further study.

The essential results imply that cooperative learning environments foster learning for female students, with no significant impact on male learning. In contrast, competitive learning environments have a positive impact on male performance and a deleterious impact on female performance. These impacts derive from a change from individualized incentives in a traditional lecture setting followed by a quiz. When these individualized incentives are compared with group dependent incentives (independent of their cooperative or competitive nature) there is no clear impact. However, previous studies have repeatedly shown a positive impact from AL. The divergence here likely arises from the expectation by the students of a quiz in these control groups. As a result, the control group is not as "passive" as those in previous studies. Indeed, this is the intention of the study design: to determine the impact of different incentive structures.

These results are a part of a larger story on female representation in economics and other disciplines. Many factors that contribute to female persistence in the major are outside of the control of the individual educator. However, as discussed above, the persistence of female students is particularly sensitive to their performance in the classroom. If female students are taught in ways that are particularly effective for them they are more likely to persist in the major. It bears noting that, given the findings of this work, while competitive incentives help male students, they harm the learning of female students, as observed in the absence of the usual gender advantage. However, the reverse is not true regarding cooperative incentives. Male students are not harmed by these incentives, except in the context of the opportunity cost of the missed chance for the impact resulting from competitive incentives. This implies that an appropriate mix of pedagogy and incentive structures could foster greater opportunities for the success of female students. Further research on this topic is called for to arrive at causal estimates of these effects.

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The Culture and Performance of the International Graduate Student in the Finance Classroom

Clay M. Moffett and J. Edward Graham[1]

ABSTRACT

We examine the success of international finance graduate students using various academic metrics and starting salaries as proxies for "success." Developing a unique data set, we measure outcomes for a coterie of students from across the globe, considering such prosaic factors as age, gender, marital status, and undergraduate major. We employ Hofstede's cultural dimensions to frame results, suggesting dimensions of "cultural values" influence outcomes. We find graduate GPAs most powerfully anticipated by undergraduate GPAs, likelihood of thesis completion predicted by GPA and Hofstede dimensions – Power Distance and Individualism. We find women, higher GPAs and GMATs earn higher salaries after graduation.

Introduction

Student performance, and the factors that influence or anticipate the grades that students might earn in sundry academic settings, attracts endless comment and study in the academic and lay literature. Parents of underperforming students might attribute their child's grades to such prosaic factors as class size or undeserved teacher tenure; as those children leave the home and enter college, a new set of factors come into play, and students must take greater "ownership" of their grades. This is especially true at the graduate level. Some of the variables associated with those grades, for the international graduate student earning an MBA, are considered in this study.

Student performance in the finance classroom varies across a multitude of factors – a given faculty member might attribute varying grades to the student's age, marital status, academic major, or extracurricular responsibilities and activities. Prior research on students in the United States, considered briefly in the next section, uncovers a number of issues that seem to contribute to student success; workloads, extracurricular activities, the undergraduate's major, sleep habits, gender, and class-time all play a role in describing grades for the student in the US. Less certainty attaches to the understanding of factors contributing to graduate student success. And a dearth of research considers the variations in graduate student "success" across borders. In that context, we try to anticipate graduate student outcomes as a function of their native cultures.

We add to the extant research with a consideration of three proxies for graduate student success: GPA, the likelihood of completing a thesis required for graduation, and salaries after graduation. Those three factors are our dependent variables. We model student success with traditional measures like undergrad GPA and age, and then employ Hofstede's (2001, 2011) six dimensions of national culture as additional independent variables. Those dimensions, scaled from "roughly 0 to 100," have been derived for countries across the world through a comparison of each country to the others. We find that at least two of the dimensions help to describe student outcomes.

We consider the broad academic research examining student success in the next section. We introduce Hofstede's six dimensions. We then describe our data collection, modeling, and report our results. After conducting a series of tests for robustness, we reflect on the implications of our findings for various stakeholders and provide some concluding remarks.

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Background

A Review of the Literature

Any experienced faculty member can quickly recall students with continuing work, family, or other personal issues that contributed to poor performance in the class. The extant research suggests that such things as outside work, sleep habits and academic major are statistically significantly associated with grades, but what of the contrasts for the Spanish or German or Russian student? How might a different culture on a different continent manifest itself with the factors explaining grades in general, and the grades of the graduate finance student in particular? We were curious about these issues. We consider factors that might both help to explain differing academic outcomes on either side of the Atlantic and assist the administrator or professor in anticipating classroom needs. The student, as well, apprised of this study's findings, might be able to better brace themselves for their academic duties.

Factors impacting student performance have long attracted interest among a plethora of stakeholders. Whether in the economics or finance classroom, or in a non-business environment, faculty and administrators (and parents and students) have long wondered what factors might be expected to influence classroom outcomes (grades) as well as career placement. While the simple maturity and diligence of the student can be reasonably expected to favorably influence grades, the impacts of other factors – such as outside work, age, marital status, extracurricular activities, gender, student backgrounds, and other skill sets – are unclear. And the varying impact between cultures - of factors specific to one country or another - upon grades is uncertain. This study seeks to reduce that last uncertainty. No circulating study examines the contrasts across borders of the influence of varying cultural factors upon student grades in the finance or econ classroom. Over the past few decades, however, research has been conducted on related issues impacting grades.

Some of the earlier work was done by Clauretie and Johnson (1975), who find the student closer to graduation, with a higher GPA, who is male and an economics major, performs better than his peers in an introductory economics class; their findings would likely be echoed in an intro finance class. Grace and Black (2011) explore the impact of the Graduate Management Admission Test (GMAT) scores as well as undergraduate grade point averages (GPAs) for graduate student performance in a Master of Accountancy program. They confirm findings of prior studies that increases in GMATs and undergraduate GPAs are strongly associated with better performance in the graduate courses; however, the undergraduate GPA is significant only for U.S. students. Language skills of international students better explained classroom performance than undergrad GPA. Further, Grace and Black also find no significance associated with either GMAT or GPA in job opportunities for either US or international students.

Ren and Hagedorn (2012) discover that both GPA and gender, for both masters and doctoral students, are significant with US and International students. Females tend to outperform males at the master's level, but the opposite is true at the doctoral level with males outperforming females.

In terms of cultural impacts, Nelson et al. (2004) grouped graduate students by region, based on culture and language, and find that South Asian students graduated at the highest rates, with Europeans and Africans significantly lower.

Several studies find students' lifestyle choices, including time spent on educational studies, working, and socially, affect academic performance (Fischer et al. 2008; Gomes et al. 2011). Spending long hours on the Internet and long hours watching TV can adversely affect students' academic performance (Frangos et al. 2010; Trudeau and Shephard 2008) as well as alcohol consumption (Welcome et.al. 2010; Ning et al. 2012). While not specific cultural traits, all of these reflect on the student's lifestyle choices and ultimately cultural influences in the aggregate. To better capture and proxy those effects, we employ Hofstede's analysis. We in effect extend Freiberger et al.'s (2012) notion that beliefs contribute to motivation and achievements.

There is some caution to be exercised when using general measures of culture, personality, or temperament. Signorini et. al (2009) argue that Hofstede's model is too simplistic to apply to individuals and urge some caution in its application, but they offer no meaningful alternative. Smith (2002) recommended similar caution, saying that "…if we compare culture A and culture B on some attribute, the mean scores that we achieve will tell us nothing about variability within each nation, nor will it tell us whether the particular individuals whom we sampled are typical or atypical of that culture."

Hofstede (2001) urged caution with respect to how the cultural dimensions are applied to individuals, identifying them as general cultural traits. We take our modest sample and seek to better understand how these factors, influenced by culture, play out in an international educational setting.

Hofstede's Six Dimensions of Culture

Each of the varied cultures across the world portrays patterns of dealing with such factors of humanity as elder care, the roles of the different sexes in society, the relationships between societies and their "rulers," the tolerance of those societies for individual behavior, and the provision by those cultures for the needs of its members. Those issues, and the manner with which countries around the world manifest themselves with respect to them, anticipate the work done over the decades by Hofstede (2001, 2011), with his six dimensions of culture.

These six dimensions are: Power Distance, Uncertainty Avoidance, Individualism/Collectivism, Masculinity/Femininity, Long/Short Term Orientation, and Indulgence/Restraint. Hofstede (2011) holds that "Culture is the collective programming of the mind that distinguishes the members of one group or category of people from others." The unread novice, introduced to Hofstede's "dimensions," might be set back; how on Earth might someone go about "classifying cultures?" But upon even a cursory introduction to Hofstede's dimensions of culture, the paradigm becomes intuitively appealing, and measurable.[2]

Power Distance: This dimension measures the extent to which a culture or a society observes and expects the power of that culture to be "distributed unequally." Russia and Saudi Arabia are examples of societies where the unequal sharing of power is observed, and largely accepted by members of those cultures.

Uncertainty Avoidance: This dimension concerns itself with the manner with which a society tolerates uncertainty and ambiguity. In Hofstede's notes, this "uncertainty avoidance has nothing to do with risk avoidance … It has to do with anxiety and distrust in the face of the unknown, and conversely, with a wish … to know the truth." Russia is an example of a culture that strongly wishes to avoid uncertainty, with the US (and China, surprisingly) more tolerant of uncertainty.

Individualism/Collectivism: This dimension is a measure of the degree to which members of a society or a culture "feel independent, as opposed to being interdependent," as with citizens of one country or another. The United States and Australia are seen as being strongly individualist, with China and countries along the Pacific Coast of South America being more collectivist.

Masculinity/Femininity: This dimension concerns itself with "the extent to which the use of force" is accepted by a culture. With a masculine society, "quantity" and "winning" are important. If measures of femininity are higher, competition is less celebrated, "the genders are emotionally closer," and "there is sympathy for the underdog." Germany, the UK, China, and Colombia are more masculine, while Scandinavia is more feminine.

Long/Short Term Orientation: Longer-term orientations ("Flexhumility") in a society are associated with the generational focus of such countries as China and Russia, where plans are commonly made for a century from now. Short-term orientation captures the attention of such cultures as Venezuela and North Africa, with the US and Canada and Australia falling between the two orientations.

Indulgence/Restraint: Indulgence concerns itself with "the good things in life," where "friends are important" and life is, largely, "good." Much of North and South America are indulgent. Restraint is associated with cultural beliefs that "life is hard, and duty, not freedom, is the normal state of being." Russia, much of Eastern Europe, and China are portrayed as being restrained.

Data

Table 1 provides a description of the data gathered to conduct this study. The data was drawn from the 233 students that attended UNC Wilmington's International MBA program between 2008 and 2017. The IMBA program markets itself as providing graduating students with two graduate degrees – one from UNCW (an MBA), with a finance thesis completed, and one Business Masters (or separate MBA) from one of the core schools. The students begin their graduate studies at the core institution in the fall of their entering year, and then migrate to the specialization classes in the Spring. The core schools provide a traditional "tour" of business classes (management, marketing, statistics, etc.) before the students leave to complete a concentration in one of several specialties. All the schools in the IMBA consortium teach the same courses in the fall 'core' with matching syllabi. They then attend a separate school in the fall to "specialize" in a particular field. UNCW's specialty is finance, with other schools specializing in marketing (as with Universidad de Valencia), logistics (as with Hochschule Bremen), or other areas. For the US finance

[2] See, for example: http://geerthofstede.com/culture-geert-hofstede-gert-jan-hofstede/6d-model-of-national-culture/

specialization at UNCW, classes begin in January with two mini-semesters covering seven classes in finance, before beginning work on their theses in June.

Table 1: Sample Descriptive Statistics

Variable	Number	Mean	Minimum**	Maximum
UNCW GPA	222	3.8	2.8	4
Undergrad GPA	103	3.6	2.9	4
Work Experience	86	1.5	0	10.0
GMAT Scores*	101	533	210	700
Age	152	25	21	37
Thesis Completion	213			
Power Distance	228	52	31	100
Individualism	228	70	12	91
Masculinity	228	57	8	100
Uncertainty/Avoidance	228	57	30	100
Indulgence	228	54	15	100
Long-term	228	40	7	87
Salary Upon Graduation (rounded to nearest $'000)	29	50,000	9,000	90,000
Student Nationality				
American	124			
Chinese	9			
French	3			
Russian	16			
Spanish	9			
German	17			
African	7			
Middle Eastern	46			
Missing or Not Specified	2			
Core School Attended				
Hochschule Bremen	44			
Universidad de Valencia	86			
Hertfordshire (London)	10			
Euromed Marseilles	14			
Inst of Bus Studies (Moscow)	8			
Novancia (Paris)	38			
UNCW	33			

Notes: *The GMAT is not required for IMBA admission, and scores on that test were reported by 101 of the 233 students. Age, as well, was available for only 152 of the 233 students. Eighty-six of the students reported work experience up to ten years. **GPAs in the graduate program of less than 3.0 led to dismissal from the program.

Though this coterie has changed in the past couple of years, at the time of this study those schools were Hertfordshire (outside London), Hochschule Bremen (in northern Germany), Universidad de Valencia (in Spain), Euromed Marseilles (in France, and no longer a part of the program), Novencia (near Paris, and no longer in the program), and the Institute of Business Studies (in Moscow, a partnership that is suspended given the war in Ukraine).

Descriptive data are provided in Table 1. Approximately 40% of the students were female, with average undergraduate GPAs of almost 3.3, and graduate GPAs of over 3.5. Students came largely from the US, but others from China, France, Russia, Spain, Germany, Africa, and the Middle East attended, as well. The youngest was 21, and the oldest 37. Two-hundred and six, or about 88%, of the enrollees, had completed their theses, and graduated, as of the date of this study. The countries of origin varied, of course, with many of the students beginning, or ending, their IMBA work in their "home" country. Our focus with our sample, and with the results outlined in the next section, was on the nationality of the students that chose to concentrate in finance, and travel to the US and UNCW to satisfy that concentration with a thesis in finance.

We gathered a wealth of other information on the students. Very few of the students were married. Many of the students had no work experience, and the greatest was ten years. Recalling the uncommon nature of the GMAT in many of the student countries, it was unsurprising to see scores ranging from 210 to 700, the

lower measure likely a function of some unknown influence (the student "Christmas treeing" the answer sheet?). The GMAT is not required for IMBA admission internationally (often not available), and less than half (101) of the 233 students reported a GMAT score. Forty-four of the students came to UNCW from Bremen, 86 from Valencia, ten from Hertfordshire, 14 from Marseilles, eight from Moscow, and 38 from Novancia in Paris. This totals 200; the other 33 were either unreported or completed both "halves" of their degrees at UNCW. In special circumstances, with athletes and students in trying circumstances, UNCW allowed students to effectively earn their MBA in the IMBA program, taking both the core classes in the fall and the finance concentration in the following spring and summer at UNCW.

Methodology and Results

Factors Influencing GPA

We report the results of our examinations of factors influencing GPA in Table 2 below. The dependent variable is the GPA at the end of the student's enrollment, or graduation. Here, we find only the undergraduate GPA (UndergradGPA), among the factors modeled in Table 2, is a significant descriptor of the graduate level GPA. We considered the other Hofstede dimensions as well, and though our gut feeling was that such factors as uncertainty avoidance and long/short term orientation might play some role in describing differing academic outcomes between cultures, such was not the case. P-values are given below the coefficients.

Table 2: Effects of Student Characteristics and Selected Hofstede Dimensions on GPA

Variable	GPA		GPA		GPA	
Constant	3.2496	*	2.9467	***	2.7890	***
	0.0650		0.0000		0.0000	
SexDum	0.0523		0.0515		0.0181	
	0.3470		0.3400		0.7100	
UndergradGPA	0.2363	***	0.2346	***	0.2390	***
	0.0020		0.0020		0.0000	
WorkExperience	0.0205		0.0195			
	0.1330		0.1360			
GMAT	0.0002		0.0002			
	0.6050		0.5580			
PowerDistance	-0.0032					
	0.7860					
Masculinity	-0.0050		-0.0053		-0.0025	
	0.5960		0.1360		0.4360	
Indulgence	-0.0028					
	0.9140					
Age					0.0063	
					0.4330	
N	76		76		97	

Notes; Only dimensions with at least moderate explanatory power are included. Others were insignificant or had coefficient estimates near zero. *Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level

In another set of tests, reported in Table 3, we examine the relationships between differing home countries or regions and GPA. We employed dichotomous variables to capture the influence on GPA of nationality or area of origin. American students were held out as a control. Results portrayed in Table 3 affirm the higher GPAs of Spanish students, and the lower GPAs of students from the Middle East and Africa. Other geographical results were not significant, and the average graduating GPA of over 3.5 is implied by our findings, as well. P-values are shown below the estimates.

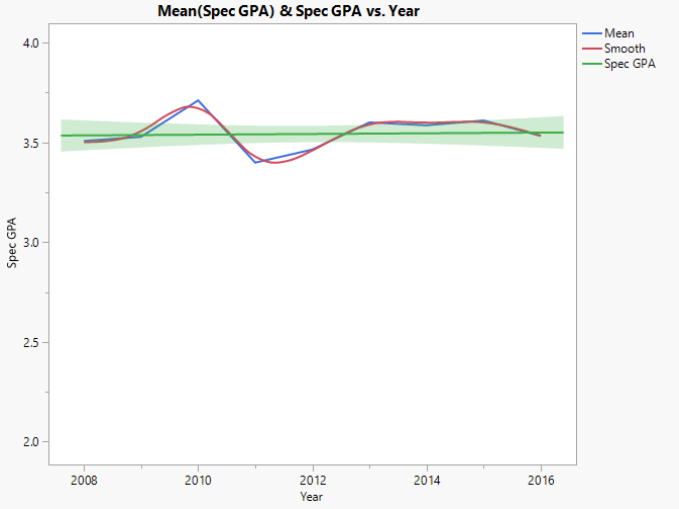
Table 3: Relationships between Areas of Origin and GPA

Variable	GPA	
African Nations	-0.261	**
	0.026	
German National	0.112	
	0.151	
Chinese National	-0.092	
	0.379	
French National	0.050	
	0.776	
Russian National	-0.034	
	0.678	
Middle East (Other)	-0.094	*
	0.083	
Spanish National	0.309	***
	0.005	
Constant	3.555	***
	0.000	
N	222	

Notes: *Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level

To allay concerns about possible grade inflation impacting the results over time, Figure 1 shows grading patterns over the period of study. The relatively consistent distributions and means of student GPAs in the IMBA program should mute concerns of grade inflation impacting the results.

Figure 1



Factors Influencing Salary

We conduct standard least squares analyses to measure the factors associated with salary and GPA, in Tables 4 and 5 below. Table 4 provides our initial findings on factors associated with post-graduation salaries. While our ultimate intent with this study is to discover the importance of Hofstede's cultural dimensions as "influences" on measures of student success, we needed first to control for traditional measures (like age and sex). Table 4 lists the factors associated with reported student salaries after graduation from the IMBA program. Data was gathered for the years 2008 – 2017. The dependent variable is the salary the first year after graduation. At the 5% level of significance, we find that the undergraduate and graduate GPAs

(UndergradGPA and SpecGPA, respectively) are significantly associated with salaries after graduation. Also associated with salary are the years of work experience of a student (WorkExperience), and their GMAT score; both are positively related to the reported salaries.

Table 4: Effects of Student Characteristics on Salary after Graduation

Variable	Value	
Sex (Female = 1)	-21,274.66	
	0.087	*
SpecGPA	12,626.03	
	0.03	**
UndergradGPA	16,560.86	
	0.033	**
WorkExperience	14,087.77	
	0.083	*
GMAT	14,087.76	
	0.083	*

Notes: N=29. *Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level

In our tests, we at first generated results suggesting that, following graduation, women earned less. However, when we excluded graduates in 2008 and 2009 from China and Africa, who had far lower salary structures than elsewhere in the world, women reported higher salaries. We had several female Chinese and African students over the years, and employment in those areas pay significantly lower overall salaries. They biased our results. Considering only US and Europe employment, among students that reported their post-graduation salaries, the women earned significantly more than the men.

We recognize that we had only 29 responses, not a large sample, but have included this data primarily to encourage further discussion. These results are interesting. Secondly, with regard to significance, our sample is unimodal without large outliers, and though we fall (by 1) short of the "large sample condition" or Central Limit Theorem generalized requirement of 30 observations, our sample remains normally distributed with no severe outliers and hence remains 'large enough' and thus valid.

In Table 5, we find several of the Hofstede dimensions are correlated with salaries after graduation. PowerDistance is common with the lower salaries observed among the reporting Russian students; Individualism, associated with higher salaries, underscores the higher salaries reported by students from the US. The LongTerm dimension is also common with higher salaries. Finally, Indulgence has a significantly negative effect. There, the higher salaries, observed in such "indulgent" countries as the US, are underscored.

Table 5: Effects of Hofstede Dimensions on Salary after Graduation

Variable	Value	
PowerDistance	-10,184	***
	0.007	
Individualism	6,809.85	***
	0.009	
Masculinity	-3,892.22	
	0.12	
UncertaintyAvoidance	-1,669.10	
	0.192	
LongTerm	2,068.20	***
	0.003	
Indulgence	-16,358	***
	0.011	

Notes:N=29. *Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level

Factors Influencing Thesis Completion and Graduation

Table 6 reports a final set of tests. Here, we examine the relationships between selected cultural dimensions and the likelihood of students completing the program. Upon finishing their theses, students graduate. Unsurprisingly, students with higher GPAs were more likely to complete their theses. The Hofstede cultural dimensions help tell part of the story, as well; the PowerDistance and Individualism dimensions were telling. The results attaching to those factors in Table 6 imply that students from cultures (such as China's) that accept a largely inalterable power, or that celebrate the prospective achievements of an individual (as with the US), are cultures that are more likely to deliver students that complete their theses, and graduate.

The dependent variable Thesis Completion is a dichotomous variable equal to 1 if the student completed their thesis, and graduated, and 0 otherwise. A Nominal Logistics model was used, with P-values greater than ChiSq listed.

Table 6: Relationships between Selected Hofstede Dimensions and Thesis Completion

Variable	1	2	3	4	5
Gender (Female)	-0.0729				
	0.8965				
SpecGPA	4.1603 *	4.208 *	3.399		
	0.0984	0.091	0.127		
UndergradGPA	0.7189	0.669	1.198	1.286	1.423 *
	0.557	0.563	0.266	0.121	0.079
Age	-0.1345	-0.14			
	0.2968	0.253			
PowerDistance	0.3076 **	0.312 **	0.257 **	0.174 *	0.108 *
	0.0318	0.025	0.025	0.078	0.094
Individualism	0.1659 **	0.167 **	0.145 ***	0.104 **	0.061 **
	0.0123	0.01	0.009	0.032	0.048
UncertaintyAvoidance	0.0921	0.093	0.067	0.085	
	0.3325	0.324	0.394	0.268	
Constant	-41.6727 **	-41.908 **	-38.919 **	-21.783 *	-11.686 **
	0.0208	0.019	0.014	0.053	0.038
N	86	97	97	102	102

Notes: *Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level.

Conclusion

With this research, we gathered a new set of data to describe academic outcomes for a group of graduate finance students in an international setting. We were curious about the factors that influenced their success. We allowed three outcomes to proxy for that "success": Salaries after graduation, GPA, and the likelihood of the students' completion of their theses. The theses completions were a requirement for graduation; the GPA and salary are two other measures that are commonly used to portray success. We then measured the importance of varied factors that might influence those outcomes.

We found women earning less after graduation; this "story" attached to several influential outliers. Excluding those, women earned more than men. We affirmed that GPAs at the undergraduate and grad levels are significant predictors of salaries after graduation, as are GMAT scores. Extending work by Hofstede (2001, 2011), we found that several cultural dimensions also anticipated higher salaries: Power/distance and individualism (as in the US) were dimensions associated with higher salaries. Similarly, a long-term focus and indulgence (it assuming the goodness of a people or culture) occurred alongside higher salaries. We generated largely insignificant results when we tried to describe graduate GPAs using student characteristics

and the Hofstede dimensions; only the undergraduate GPA, in our sample, among our selected characteristics, was a significant predictor of the graduate GPA. When we considered the student's home country alongside GPAs, our findings were more meaningful; students from China, Spain, and the US (the control country in our dichotomous tests) generally earned higher GPAs than their counterparts.

We considered our last proxy for student success – the likelihood of thesis completion and graduation – using GPAs and selected Hofstede dimensions. GPAs were not as powerful a predictor of this success as we expected, though they were significant. Among the Hofstede cultural dimensions, Power/distance and individualism were associated with a higher likelihood of student success. Other Hofstede dimensions were insignificant in this and other models.

These findings are meaningful not just for the mid-size regional university being examined, but for faculty members and students across the spectrum of countries being considered. Every nation and culture is different, and anticipating some of these differences, and their impacts on varied student outcomes, is important to the student, teacher, and administrator.

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Using R Programming in a Financial Derivatives Course

Adam Y.C. Lei and Huihua Li[1]

ABSTRACT

R is a popular and free programming language and software environment for statistical computing and graphics. We use a class project in an undergraduate financial derivatives course to introduce students to R programming. Specifically, through pricing options using the Black-Scholes model and the multi-period binomial option pricing model, students learn to import and manipulate data in R, use R to do calculations, construct user-defined functions, and apply third-party packages in R. The inclusion of relevant technology through this project also serves to maintain our curriculum currency, and we obtain overwhelmingly positive student responses to the project.

Introduction

With the development of fintech and big data over the past decades, familiarity with programming languages has become a highly valuable skill for finance graduates (e.g., Dishman 2016). Even just the understanding of how programming works could provide graduates an edge over other job candidates. In this paper we illustrate a class project to introduce students to R programming in an undergraduate derivatives course. R is a free programming language and software environment for statistical computing and graphics. It is compatible with most computer operation systems and has thousands of free add-on packages that users can choose from. In 2019, R ranks 5th in job advertisements that highlight knowledge of data science software as a requirement, and 2nd in the most frequently used data science tools in scholarly articles (Muenchen 2020). As of September 2020, R ranks as the 9th most popular programming language (Wikipedia 2020).

In the class project, students use R to price options using the Black-Scholes model and the multi-period binomial option pricing model. Students learn not only the applications of option pricing models, but also the major characteristics of R programming and how to access R packages. The ability to employ third-party packages is one of R's most powerful functions. The open-source nature, the compatibility, and the abundance of third-party packages together distinguish R from other programming languages.[2] The R project not only allows our students to pursue more advanced applications using R, but also allows us to maintain the currency of our curriculum.

The paper is organized as follows: In the next section we review the background and structure of R programming language and related studies. The following section introduces our financial derivatives course and its organization. The fourth section illustrates the class project in detail. The fifth section discusses the fit of the project within our curriculum and student responses. The final section concludes and an appendix summarizes the specific R functions we use in this paper.

R and Related Literature

R is a free programming language and software environment that was initially developed by Ross Ihaka and Robert Gentleman at the University of Auckland in 1991, and it has since enjoyed growing popularity

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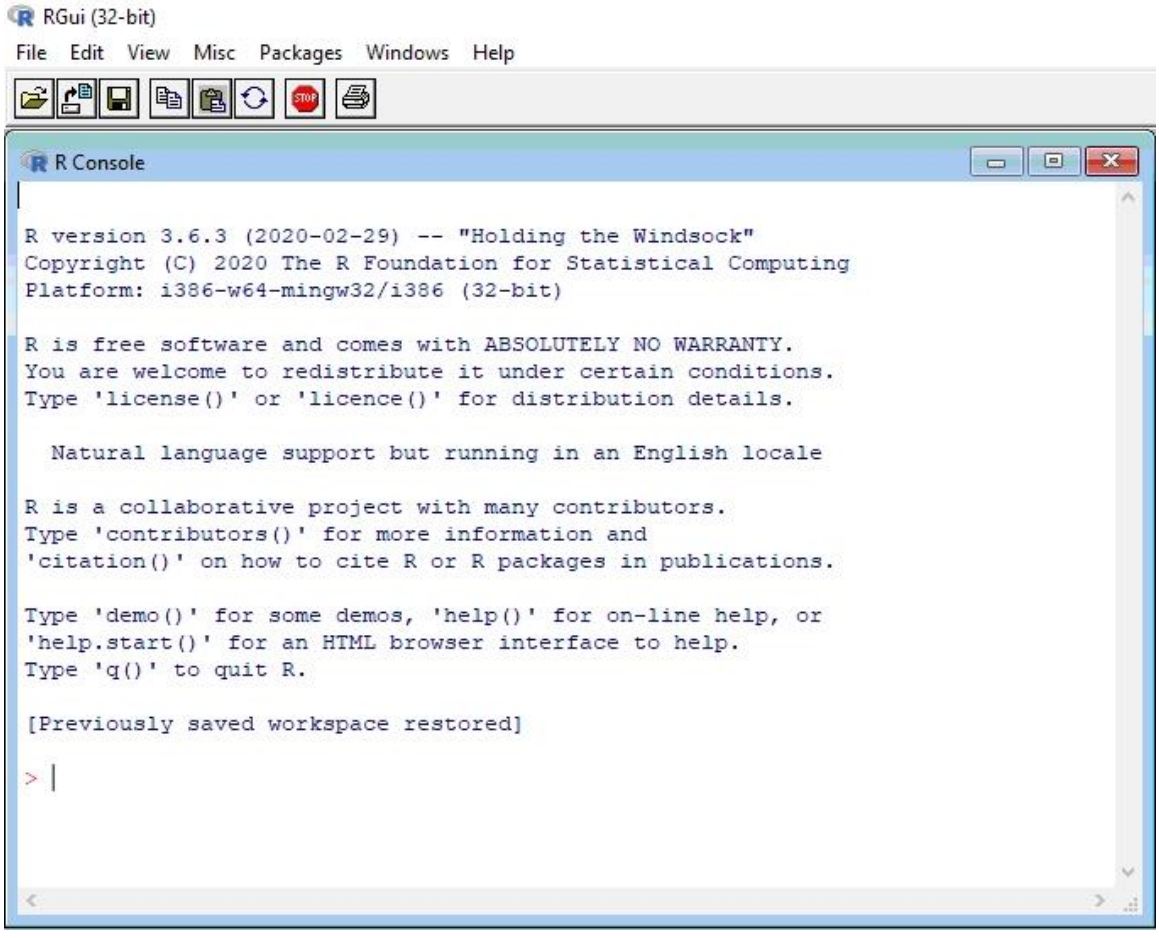
[2] Examples of other programming languages that have been used to price options include Java (e.g., Sedgewick and Wayne 2017), SAS (e.g., Clemmensen 2017), and Matlab (e.g., Zagaglia 2021). We thank an anonymous referee for pointing out those references.

(Wikipedia 2020). R currently has more than two million users worldwide and has an engaged community of programmers, educators, and users. Vries and Meys (2015) discuss several characteristics of R that could have contributed to its success and popularity: First, R is a powerful statistical programming and graphic tool. It can perform a variety of functions in areas such as linear/nonlinear modeling, statistical tests, time series analysis, graphics, data manipulation, and data visualizations. Second, R is open source and is free to install and use. This characteristic attracts expert programmers to continuously contribute to the maintenance and improvement of R, making it more stable and reliable over time. Third, R can run in most operating systems including Windows, MacOS, and Unix, is highly extensible, and has thousands of free add-on packages that users can choose from. The abundance of free third-party packages makes R even more attractive and convenient for its users. Finally, R can easily connect with other programming languages such as SAS and SPSS, and with finance databases such as Bloomberg.

In practice, many users use R within the RStudio, an integrated development environment for R that offers a richer and easier editing environment. Users can download R from *https://www.r-project.org/*, and RStudio from *https://rstudio.com/products/rstudio/download/*. Once a user enters R, the starting screen (the R Console) lists its basic information such as version, license, and how to access online help and demo. The line starting with a symbol ">" indicates where the user can write codes/commands in R. Figure 1 shows the starting screen of R.

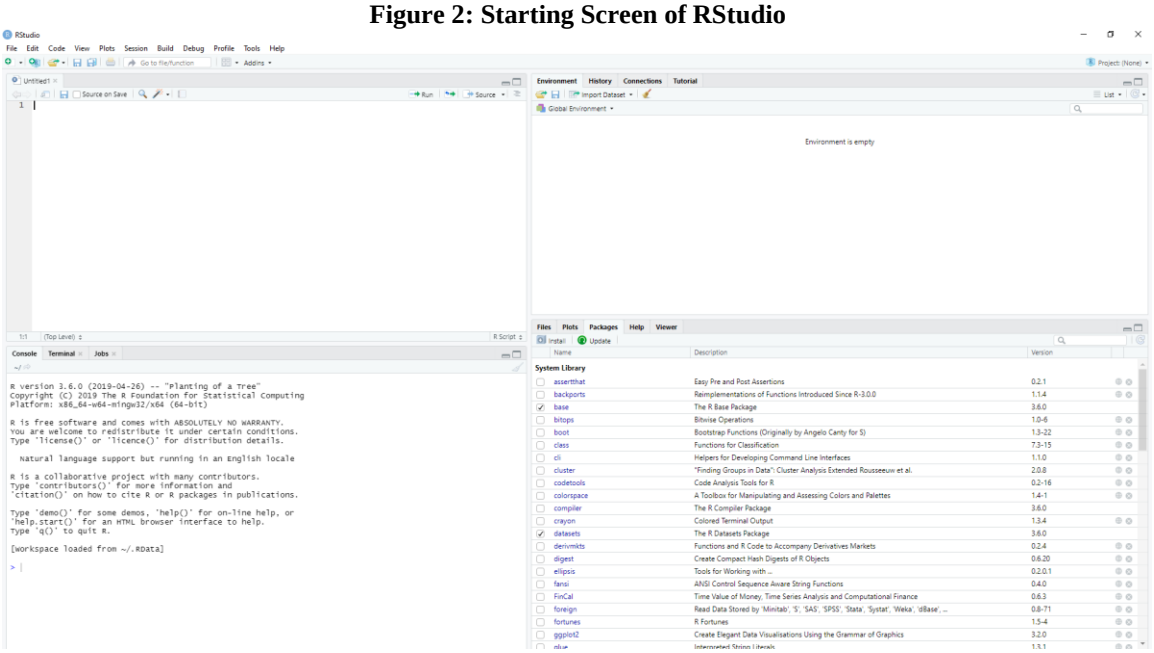
Figure 1: Starting Screen of R



In the starting screen of RStudio, there are four blocks. The upper-left block is Source, a text editor. In this text editor block, a user can enter/edit codes, save the codes, and work with other source script files (the codes are also called scripts in R). The lower-left block is Console, which shows all the interactive work with R. This part can be used the same way as the R Console in R. The upper-right block is Environment and History, in which a user can view the variables that have been created in the sessions and the history of the

commands that the user has issued. The lower-right block shows Files, Plots, Package, Help, and Viewer. Through this block a user can browse existing files, view the plots, view the list of packages installed/available, access the built-in help, and view local web content (e.g., web graphics generated by packages). Figure 2 shows the starting screen of RStudio.

Figure 2: Starting Screen of RStudio



Despite the popularity of R in practice, only a few academic studies address the uses of R in business disciplines, and virtually none focuses on the pedagogical applications of R. For instance, Allen (2017) and Ozgur et al. (2018) provide an introduction and overview of the R programming language. Das (2014) and Krotov and Tennyson (2018) use R for text extraction and web scrapping to obtain data. Turner (2015) provides the R codes to calculate the weights for optimal stock portfolios. Gallagher and Trendafilov (2018) compare and contrast the uses of R and Python on basic statistical analyses. Our paper linking the use of R with an undergraduate financial derivatives course through a class project thus fills a gap in the literature.

The Financial Derivatives Course

Our financial derivatives course serves as an upper-level elective for finance majors and requires the business/managerial finance course as a prerequisite (completion of the investments course is preferred). Per the course description, this course examines the "characteristics and functions of financial derivatives, corporate risk management applications of financial derivatives; and pricing models of derivatives and trading strategies using derivatives to hedge financial risks." We allocate 75% of the course content to address options and their applications, including the structure of options market, principles of option pricing, option pricing models, and option strategies. The remaining 25% of the course content addresses futures, forwards and swaps, and their applications in hedging and risk management.

Given that this course does not have much content overlap with other finance courses, our emphasis foremost is on course-specific knowledge. We additionally aim to address practical applications of the course content and to incorporate relevant technology. Following this philosophy, we assign 55% of the semester grade on the assessment of a student's course-specific knowledge (5% on quizzes, 15% on the first midterm exam, 15% on the second midterm exam, and 20% on the final exam). We assign 15% of the semester grade on a student's individual assignments, mostly end-of-chapter problems, to ensure that students have enough practice to digest the course material. 10% of the semester grade depends on a student's class participation. The remaining 20% is based on two team-based projects, with each accounting for 10% of the semester grade. Students form teams of four or five students, depending on the class size, for the team-based projects.

The first team project requires students to manage a simulated portfolio in Stock-Trak using options, futures, and stocks (e.g., Lei and Li 2012). Each team reports its trading activities and justification on a weekly basis and submits a report detailing its takeaways at the end of the semester. This semester-long project allows students to apply their knowledge and gain practical experience. We grade this project based on whether a team executes and justifies its trades over time as required, and the quality of its semester-end report.

The second team project, through which we incorporate the use of R, is a computer-based option pricing project. In this project, we require students to use both R programming and Excel to price European options of a stock the team chooses, using the Black-Scholes model and the multi-period binomial option pricing model. Each team starts with the collection of the underlying stock prices and the risk-free rate for the project. Option pricing, an important component for the financial derivatives course, involves complicated calculations and can be intimidating to students. Using both R programming and Excel to price options help students solidify their understanding of the pricing models. Each team eventually submits its inputs and outputs in R and in Excel worksheets for grading, and we grade the project based on the correctness of the inputs and the accuracy of the outputs. We provide further details of this project (the R project) in the following section.

The R Project

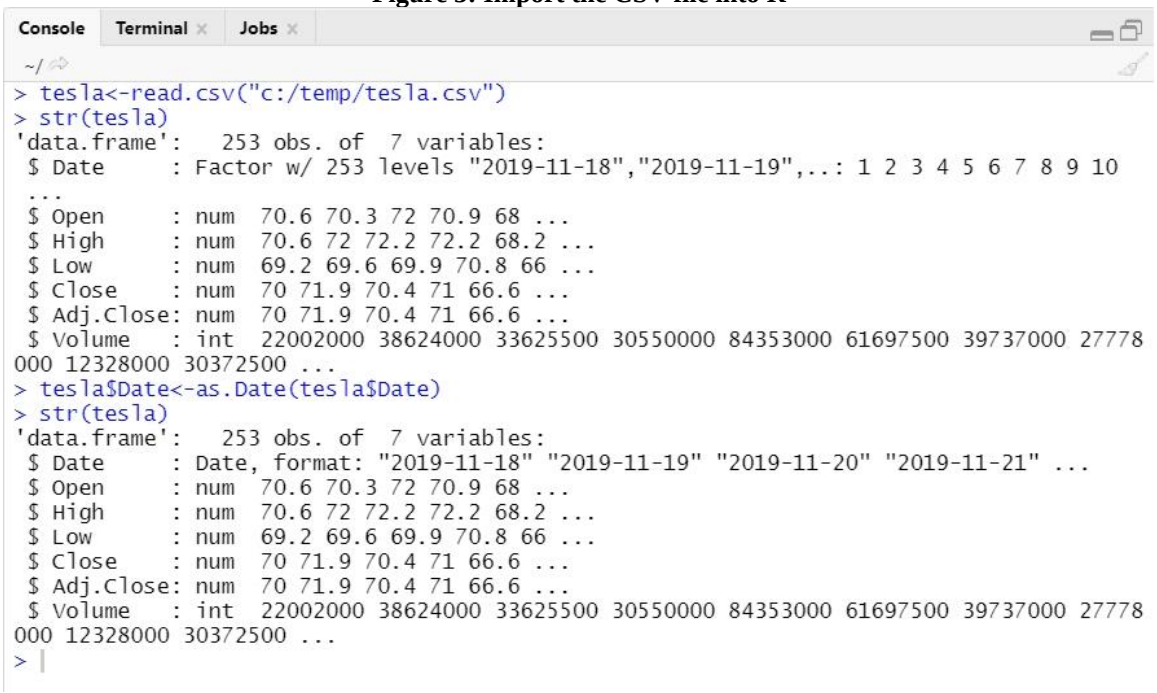
Our R project requires students in teams to use R (and Excel) to import data, calculate stock returns and return standard deviation, and price a European call option and a European put option of a stock they choose, using the Black-Scholes model and the multi-period binomial option pricing model. Specifically, students are required to: 1) choose a non-dividend paying stock and one European call option and one European put option of the stock to value. The expiration date of the options should be around one to three months and the options should not be deep in or deep out of the money (so the option value would not be predominantly from the time value or the intrinsic value), 2) obtain the daily stock prices from Yahoo! Finance over the most recent 12 months and calculate the stock returns and return standard deviation, in addition to obtaining the corresponding risk-free rate from the Treasury security with the maturity closest to the option expiration date from the Wall Street Journal *(https://www.wsj.com/market-data/bonds/treasuries*), 3) use R programming (and Excel) to calculate the option values using the Black-Scholes model, 4) use R programming (and Excel) to calculate the option values using the multi-period binomial option pricing model.

Given the inexperience of our students with R programming, we illustrate in class the key commands and functions of R that students need to understand for this project. We also spend some, but less time discussing the relevant Excel functions for this project, since most students already have some degree of familiarity with Excel. Below we illustrate the step-by-step procedures to implement the project.

Data Import and Stock Returns/Return Standard Deviation Calculation

In our illustration we use the stock of Tesla, Inc. (TSLA) as an example for the underlying (non-dividend paying) stock. The daily stock price data we download from Yahoo! Finance are in a file of the CSV format, and in R we use "*read.csv()"* to import the CSV file. We download the most recent one-year daily stock price data of Telsa (from November 18, 2019 to November 17, 2020) and save the file as *"c:\temp\tesla.csv"*. We use the R command *"tesla<-read.csv("c:/temp/tesla.csv")"* to import the CSV data into a data frame named *"tesla"*, where the data frame is effectively a dataset in R. One caveat is that, in R, to list the location of the file we need to replace "\" with "/" (i.e., instead of using *"c:\temp\tesla.csv"* we use *"c:/temp/tesla.csv"*). After the import, we can use the R function *"str()"* to display the structure of the data frame *tesla*, referred to within the parentheses (i.e., *"str(tesla)"*). The variable *Date*, however, is not imported in the correct date format at this time. To convert it to the date format, we use the function *"as.Date()"* (the "*Date"* must be capitalized). Specifically, in the command *"tesla$Date<-as.Date(tesla$Date)"*, *tesla$Date* refers to the variable of interest, i.e., the *Date* variable in the *tesla* data frame. We can then verify the structure of the data frame again using the function *"str()"*, and see that the *Date* variable is now in the correct date format. Figure 3 shows the implementation of these steps.

Figure 3: Import the CSV file into R



```
Console   Terminal   Jobs
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> tesla<-read.csv("c:/temp/tesla.csv")
> str(tesla)
'data.frame':   253 obs. of  7 variables:
 $ Date     : Factor w/ 253 levels "2019-11-18","2019-11-19",..: 1 2 3 4 5 6 7 8 9 10
 ...
 $ Open     : num  70.6 70.3 72 70.9 68 ...
 $ High     : num  70.6 72 72.2 72.2 68.2 ...
 $ Low      : num  69.2 69.6 69.9 70.8 66 ...
 $ Close    : num  70 71.9 70.4 71 66.6 ...
 $ Adj.Close: num  70 71.9 70.4 71 66.6 ...
 $ Volume   : int  22002000 38624000 33625500 30550000 84353000 61697500 39737000 27778
000 12328000 30372500 ...
> tesla$Date<-as.Date(tesla$Date)
> str(tesla)
'data.frame':   253 obs. of  7 variables:
 $ Date     : Date, format: "2019-11-18" "2019-11-19" "2019-11-20" "2019-11-21" ...
 $ Open     : num  70.6 70.3 72 70.9 68 ...
 $ High     : num  70.6 72 72.2 72.2 68.2 ...
 $ Low      : num  69.2 69.6 69.9 70.8 66 ...
 $ Close    : num  70 71.9 70.4 71 66.6 ...
 $ Adj.Close: num  70 71.9 70.4 71 66.6 ...
 $ Volume   : int  22002000 38624000 33625500 30550000 84353000 61697500 39737000 27778
000 12328000 30372500 ...
>
```

After importing the data, we can view the content of the data frame using the function *"View()"* (i.e., *"View(tesla)"*; this function must be capitalized). The data frame *tesla* has seven variables: *Date, Open Price, High Price, Low Price, Close Price, Adjusted Close Price,* and *Volume*. Figure 4 shows the sample content of the *tesla* data frame.

Figure 4: View of Data File *tesla*

Filter

	Date	Open	High	Low	Close	Adj.Close	Volume
1	2019-11-18	70.584	70.630	69.220	69.998	69.998	22002000
2	2019-11-19	70.350	71.998	69.560	71.904	71.904	38624000
3	2019-11-20	72.000	72.240	69.914	70.444	70.444	33625500
4	2019-11-21	70.902	72.168	70.800	70.966	70.966	30550000
5	2019-11-22	68.032	68.200	66.000	66.608	66.608	84353000
6	2019-11-25	68.864	68.914	66.892	67.268	67.268	61697500
7	2019-11-26	67.054	67.100	65.420	65.784	65.784	39737000
8	2019-11-27	66.224	66.786	65.714	66.258	66.258	27778000
9	2019-11-29	66.222	66.252	65.500	65.988	65.988	12328000
10	2019-12-02	65.880	67.276	65.738	66.974	66.974	30372500
11	2019-12-03	66.524	67.582	66.438	67.240	67.240	32868500

To calculate the stock returns, we need the two variables *Date* and *Adjusted Close Price* from the original data frame *tesla*. We use the command *"tesla1<-tesla[,c("Date","Adj.Close")]"* to create a new data frame

tesla1 containing those two variables. We then create a new variable *price1* to represent the one-day lag of the *Adjusted Close Price*, i.e., the adjusted close price of the stock on the previous trading day. Specifically, we use the R functions *"c()", "head()",* and *"cbind()"* to create a new data frame *tesla2* that combines the data frame *tesla1* and the lagged variable *price1*. The R commands we use are *"price1<-c(NA,head(tesla1$Adj.Price,-1))"* and *"tesla2<-cbind(tesla1,price1)".* In this case "*head(tesla1$Adj.Price,-1)"* retains all but the last row of the variable *Adjusted Close Price* in the data frame *tesla1*, and *"c(NA,head(tesla1$Adj.Price,-1)"* creates the one-day lag of the *Adjusted Close Price* by adding a missing value *"NA"* as the first observation. *"cbind(tesla1,price1)"* combines the data frame *tesla1* and the lagged variable *price1*. We then calculate the daily stock return (variable *return*) on day *t* as the natural log of (adjusted close price on day *t*/adjusted close price on day $t - 1$) and create a new data frame *tesla3* that combines the data frame *tesla2* and the *return* variable, using the commands *"return<-log(tesla2$Adj.Price/tesla2$price1)"* and *"tesla3<cbind(tesla2,return)".* We use the function *"sd()"* to obtain the daily return standard deviation (variable *std*), and annualize it (variable *annualstd*) by multiplying the daily return standard deviation (*std*) with the square root of 252 (trading days per year), using the function *"sqrt()"*. The R commands we use are respectively *"std<-sd(tesla3$return,na.rm=TRUE)"* and *"annualstd<-std*sqrt(252)"* (the argument *"na.rm=TRUE"* in the *"sd()"* function removes missing values, if any, from the calculation of the standard deviation). Once the variables are created, a command of the variable name shows the value of the variable (i.e., *std* = 0.05538341 and *annualstd* = 0.8791844 in this example). Figure 5 shows the calculations.

Figure 5: Return and Return Standard Deviation Calculations

Import data and calculating return and ...* | tesla3

Filter

	Date	Adj.Close	price1	return
1	2019-11-18	69.998	NA	NA
2	2019-11-19	71.904	69.998	0.026865198
3	2019-11-20	70.444	71.904	-0.020513814
4	2019-11-21	70.966	70.444	0.007382863
5	2019-11-22	66.608	70.966	-0.063376211
6	2019-11-25	67.268	66.608	0.009859890
7	2019-11-26	65.784	67.268	-0.022308009
8	2019-11-27	66.258	65.784	0.007179656
9	2019-11-29	65.988	66.258	-0.004083365

Showing 1 to 9 of 253 entries, 4 total columns

Console | Terminal | Jobs

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```
>
> #arrange the data
> tesla1<-tesla[,c("Date","Adj.Close")]
> price1<-c(NA,head(tesla1$Adj.Close,-1))
> tesla2<-cbind(tesla1,price1)
> return<-log(tesla2$Adj.Close/tesla2$price1)
> tesla3<-cbind(tesla2,return)
>
> #calculate the annualized standard deviation
> std<-sd(tesla3$return,na.rm=TRUE)
> std
[1] 0.05538341
> annualstd<-std*sqrt(252)
> annualstd
[1] 0.8791844
```

Using the Black-Scholes Model

Black and Scholes (1973) and Merton (1973) develop the widely used model, i.e., the Black-Scholes model, to price European options on non-dividend paying stocks. Although later the model was extended to price European options on dividend-paying stocks, we use the original model in our project for its simplicity. Specifically, the Black-Scholes model prices a European call option on a non-dividend paying stock as follows:

$$C_0 = S_0 N(d_1) - X e^{-rT} N(d_2)$$

where

$$d_1 = \frac{\ln(S_0/X) + (r + \sigma^2/2)T}{\sigma\sqrt{T}}$$
$$d_2 = d_1 - \sigma\sqrt{T}$$

and where

C_0 = Current call option value.
S_0 = Current stock price.
$N(d)$ = The probability that a random draw from a standard normal distribution will be less than d.
X = Exercise price.
e = Base of the natural log function.
r = Risk-free rate (annualized continuously compounded).
T = Time until expiration of option in years.
σ = Annualized standard deviation of the continuously compounded stock return.

Using the put-call parity, the Black-Scholes model prices a European put option on a non-dividend paying stock as follows:

$$P_0 = X e^{-rT}[1 - N(d_2)] - S_0[1 - N(d_1)]$$

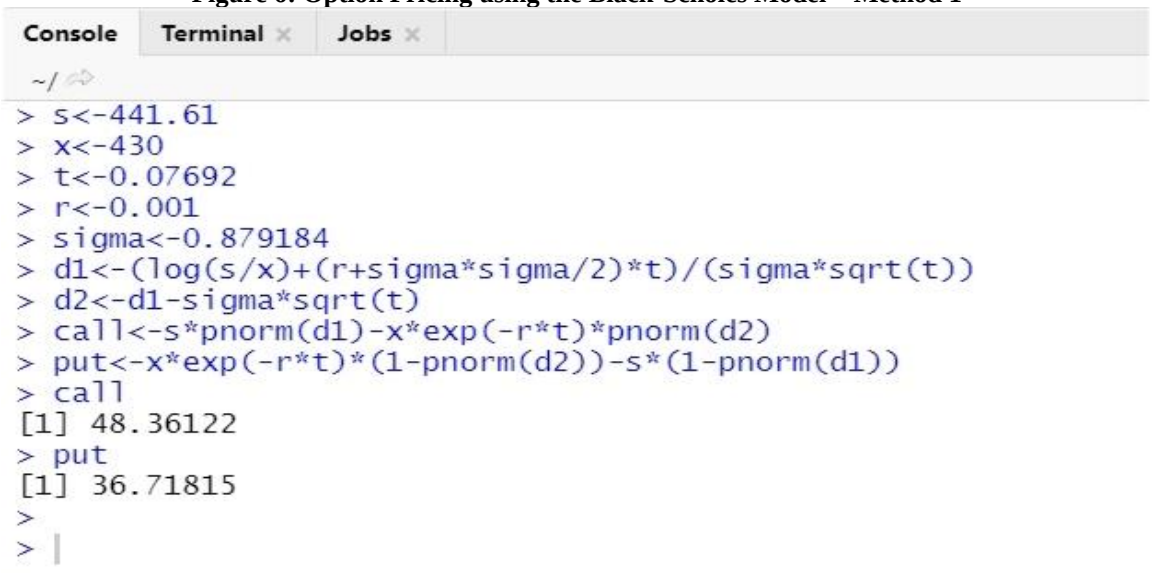
where

P_0 = Current put option value, and the other variables are as defined before.

To help students better understand R programming, we illustrate two methods in R to find the Black-Scholes option values. The first method effectively uses R as a calculator, and the second method involves a user-defined function. We use European options on the non-dividend paying stock of Tesla as an example: The stock price on November 17, 2020 is \$441.61. The call option and put option we intend to price expire on December 18, 2020 (in about 4 weeks, T = 4/52 = 0.07692) and have an exercise of \$430. The annualized standard deviation is 0.879184 as previously calculated, and the annualized yield of the Treasury security with the maturity date closest to December 18, 2020 is 0.10%.

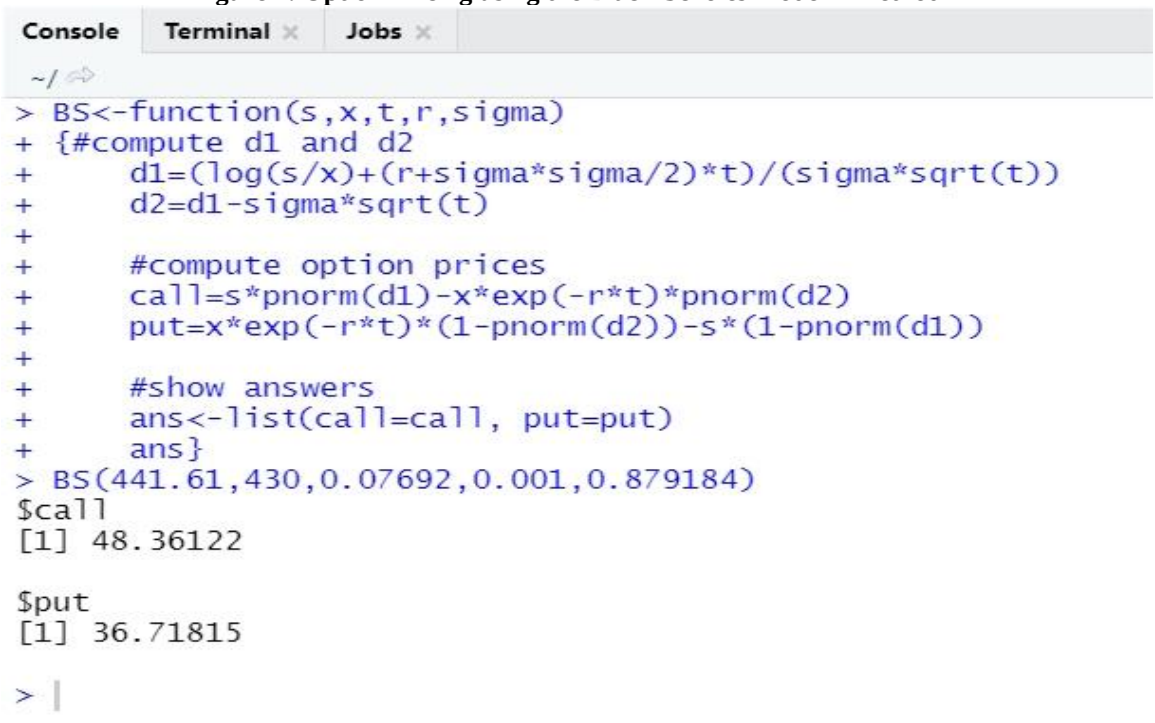
Figure 6 illustrates the first method. Specifically, we assign the value to each input variable, including stock price *s* = 441.61, exercise price *x* = 430, time to expiration *t* = 0.07692, risk-free rate *r* = 0.001, and return standard deviation *sigma* = 0.879184, by using *"<-"* in R. We then explicitly define d1, d2, and the call and put option values in R using the Black-Scholes model. In this later step, we also use the R functions *"log()"* for the natural log, *"sqrt()"* for the square root, *"pnorm()"* for the cumulative normal distribution function, and *"exp()"* for the power of *e*. The calculated call option value is \$48.36122 and the put option value is \$36.71815.

Figure 6: Option Pricing using the Black-Scholes Model – Method 1



The second method using the Black-Scholes model requires a user-defined function, and Figure 7 illustrates this method. Specifically, the user-defined function follows the format *"name <- function(arguments) {commands}"*. We define the BS function to calculate the call and put option values using the Black-Scholes model as *"BS<-function(s,x,t,r,sigma) {#compute d1 and d2, commands; #compute option prices, commands; #show answers, commands}"*(lines starting with # in R shows explanatory comments). The *"list()"* function within creates a list of the call option value and the put option value. After defining the BS function, we run the function script in the RStudio Console and input the variables in the format of *"BS(s,x,t,r,sigma)"* to obtain the option values. Compared to the first method, the second method with the user-defined function is more flexible in that we can easily price a different option by changing the inputs.

Figure 7: Option Pricing using the Black-Scholes Model – Method 2



Using the Multi-period Binomial Option Pricing Model

It is challenging for beginners to directly write codes in R for the multi-period binomial option pricing model. Therefore, we introduce the third-party packages concept to students as an alternative. R has a large number of third-party packages that a user can install for specific purposes. The packages are available on the Comprehensive R Archive Network (CRAN) at *https://cran.r-project.org/*. For our purpose, we search for the term "derivatives" on CRAN and use the package "derivmkts: Functions and R Code to Accompany Derivatives Markets" (*https://cran.r-project.org/package=derivmkts*) for the application of the multi-period binomial option pricing model.

To use a third-party package, we first need to install the package in R using the command *"install.packages ("package-name")"* (e.g., *"install.packages("derivmkts")"*). After installing the package, we use the command *"library ("package-name")"* (e.g., *"library("derivmkts")"*) to load it and make it ready to use. We remind students that each time when they restart RStudio, they need to load the package again before using it.

From the manual of the *"derivmkts"* package (McDonald 2019), we find that the function *"binomopt()"* uses the multi-period binomial option pricing model to compute the prices of European and American call options and put options. The detailed specification of the function is as follows:

binomopt(s, k, v, r, tt, d, nstep=10, american=TRUE, putopt=FALSE,
specifyupdn=FALSE, crr=FALSE, jarrowrudd=FALSE, up=1.5, dn=0.5,
returntrees=FALSE, returnparams=FALSE, returngreeks=FALSE)

For this function, the required inputs include the following six variables:

s = Current stock price.
k = Exercise price.
v = Annualized standard deviation of the continuously compounded stock return.
r = Risk-free interest rate (annualized continuously compounded).
tt = Time until expiration of option in years.
d = Dividend yield (annualized continuously compounded).

The other arguments that we use for our project include:

nstep = Number of binomial steps. Default is *nstep* = 10.
american = Indicate whether the option is an American option. Default is *american* = TRUE.
putopt = Indicate whether the option is a put option. Default is *putopt* = FALSE.
returntrees = Indicate whether to return four trees in the output: the price of the underlying asset (stree), the option price (oppricetree), where the option is exercised (exertree), and the probability of being at each node (probtree). If TRUE, this argument overrides the default *returnparams*= FALSE and *returngreeks* = FALSE arguments below. Default is *returntrees* = FALSE.

The arguments that we do not specify or change their defaults include:

specifyupdn = Indicate whether to manually enter the binomial parameters *up* and *dn* below. If TRUE, this argument overrides the *crr* and *jarrowrudd* arguments below. Default is *Specifyupdn* = FALSE.
crr = Indicate whether to use the Cox-Ross-Rubinstein tree. Default is *crr* = FALSE.
jarrowrudd = Indicate whether to use the Jarrow-Rudd tree. Default is *jarrowrudd* = FALSE.
up, dn = The specified up and down moves on the binomial tree if *specifyupdn* = TRUE.
returnparams = Indicate whether to return the vector of inputs and computed pricing parameters as well as the price. Default is *returnparams* = FALSE.
returngreeks = Indicate whether to return time 0 delta, gamma, and theta in the vector greeks. Default is *returngreeks* = FALSE.

Additionally, the function *"binomopt ()"* defines the risk-free rate per period (*rp*), the per-period up (*up*) and down (*dn*) parameters, and the binomial (risk-neutral) probability (*p*) as follows:

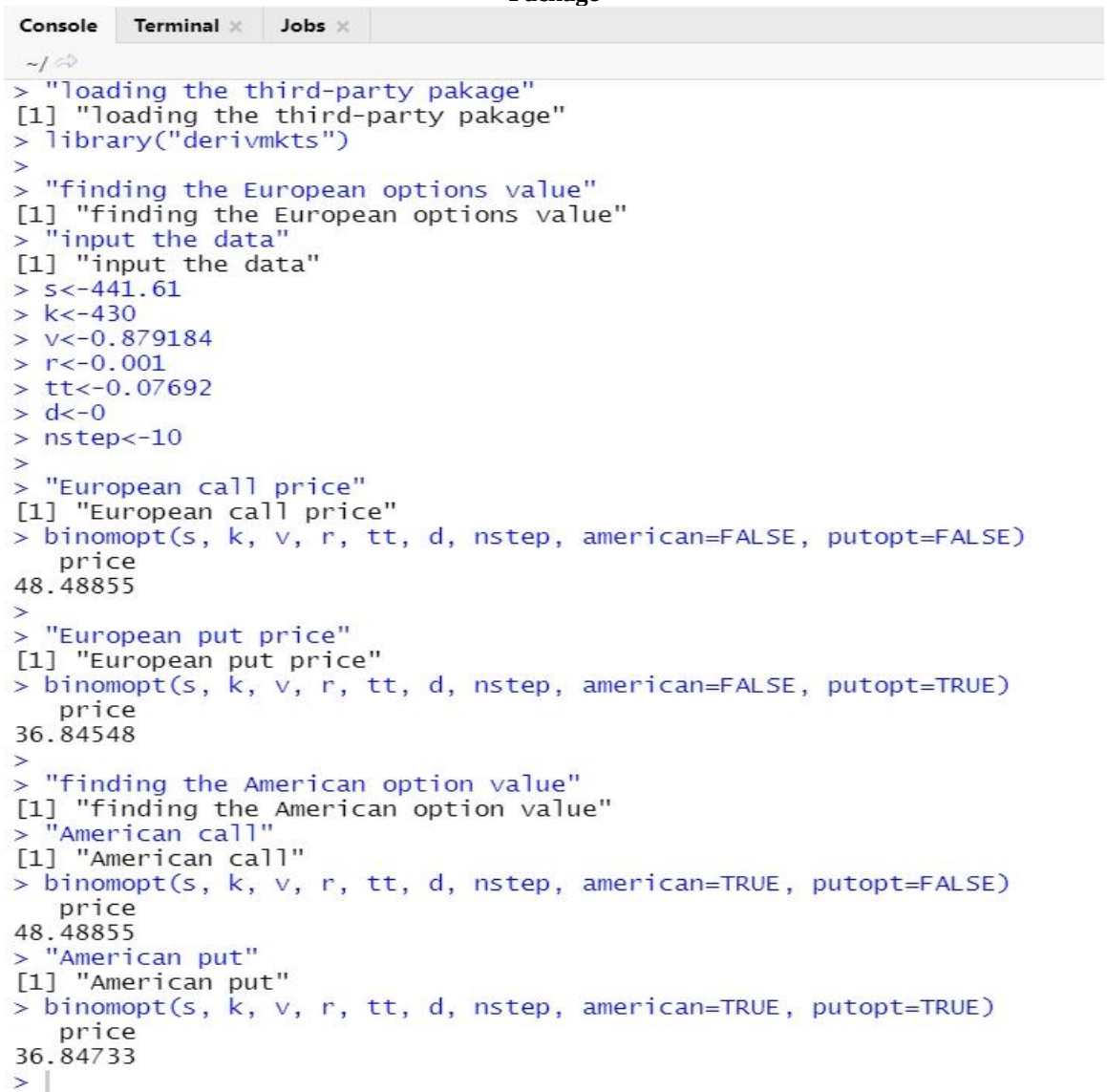
$h = tt/\#periods$
risk-free rate per period (rp) = $\exp(r \times h) - 1$
$up = \exp\left[(r - d) \times h + v\sqrt{h}\right]$
$dn = \exp\left[(r - d) \times h - v\sqrt{h}\right]$
binomial (risk-neutral) probability (p) = $(1 + rp - dn)/(up - dn)$

where

 # periods = Number of periods (steps), and the other variables are as defined before.

Using the same option inputs on the non-dividend paying stock of Tesla as an example, Figure 8 illustrates the step-by-step procedures using the multi-period binomial option pricing model with the derivatives package. Specifically, after we load the package using the command *"library("derivmkts")"*, we input the values for the required six variables (i.e., s = 441.61, k = 430, v = 0.879184, r = 0.001, tt = 0.07692, and d = 0) and specify the number of steps at its default = 10. We later require students to try 100 instead of 10 steps.

Figure 8: Option Pricing using the Multi-period Binomial Option Pricing Model with a Derivatives Package



By calling up the function *"binomopt ()"*, we first calculate the value of the European call option (i.e., *"american=FALSE, putopt=FALSE"*) and the value of the European put option (i.e., *"american=FALSE, putopt=TRUE"*). The value of the European call (put) option is $48.48855 ($36.84548) given the 10 binomial steps. We then calculate the value of an American call option (i.e., *"american=TRUE, putopt=FALSE"*) and the value of the American put option (i.e., *"american=TRUE, putopt=TRUE"*) with the same input variables. The value of the American call (put) option is $48.48855 ($36.84733) given the 10 binomial steps. The identical value of the American call option and the European call option, and the larger value of the American put option than the European put option, are consistent with theory that an American call option on a non-dividend paying stock has the same value as a European call option, and that an American put option is more valuable than a European put option (see Black and Scholes, 1973, and Merton, 1973).

Finally, in illustrating the procedures, we also use the *"returntrees=TRUE"* argument in the function *"binomopt()"* to show the greek variables (*greeks*), the input variables and the computed pricing parameters (*params*), the option price tree (*oppricetree*), and the stock price tree (*stree*), among other outputs. For brevity, Figure 9 shows the partial output of the *"binomopt()"* function with the *"returntrees=TRUE"* argument for the European call option.

Figure 9: European Call Option Tree and Underlying Stock Price Tree

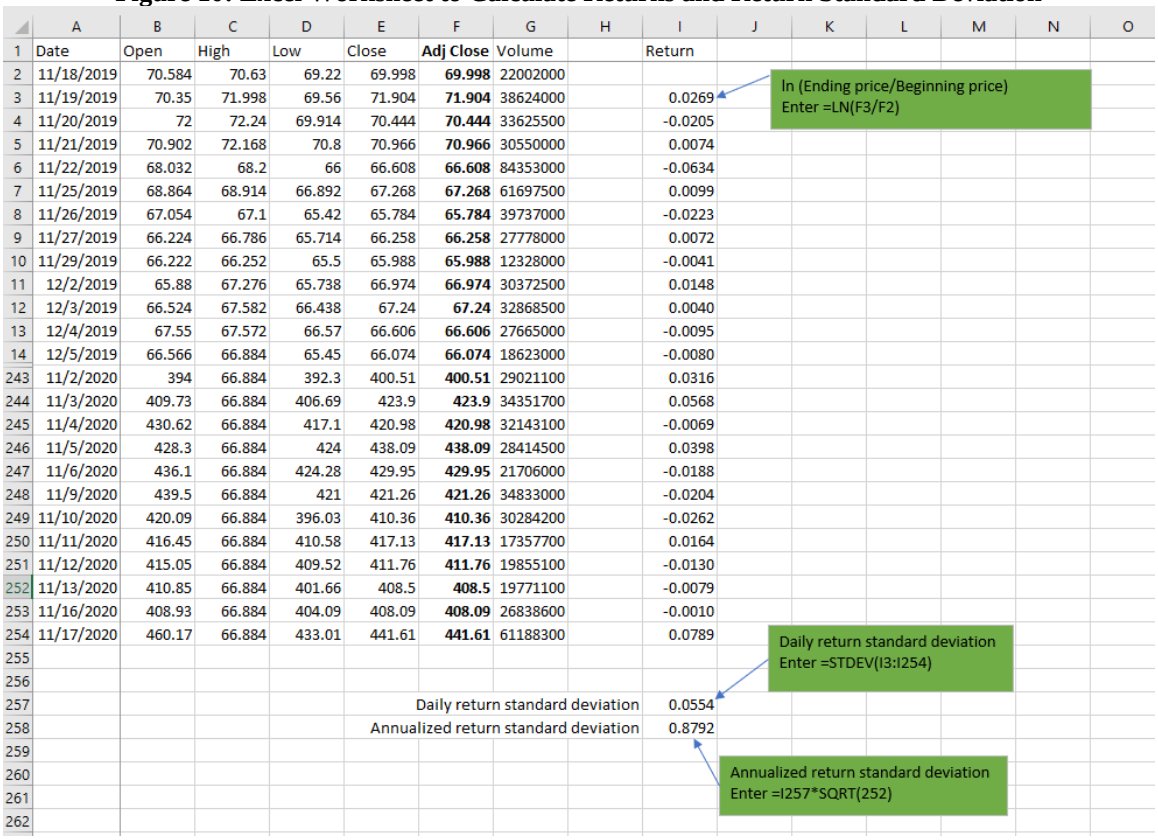
```
Console  Terminal  Jobs
~/
> binomopt(s, k, v, r, tt, d, nstep,american=FALSE,returntrees=TRUE)
$price
   price
48.48855

$greeks
       delta        gamma        theta
 0.590714202  0.003796474 -0.784950332

$params
          s           k           v           r          tt           d       nstep           p          up          dn
441.6100000 430.0000000   0.8791840   0.0010000   0.0769200   0.0000000  10.0000000   0.4807325   1.0801670   0.9257970
          h
  0.0076920

$oppricetree
           [,1]     [,2]     [,3]       [,4]       [,5]       [,6]       [,7]       [,8]       [,9]      [,10]      [,11]
 [1,] 48.48855 69.39971 96.74480 131.052819 172.206169 219.3884306 271.4433399 327.671602 388.407782 454.013266 524.87841
 [2,]  0.00000 29.12993 44.08494  64.984210  92.955405 128.5278600 171.1997729 219.391806 271.447516 327.676643 388.41376
 [3,]  0.00000  0.00000 15.28516  24.737267  39.089723  60.0241639  89.0245393 126.586613 171.202407 219.395181 271.45169
 [4,]  0.00000  0.00000  0.00000   6.534715  11.450276  19.7094089  33.1767994  54.251270  85.283639 126.588561 171.20504
 [5,]  0.00000  0.00000  0.00000   0.000000   1.984035   3.8042231   7.2417271  13.666759  25.522622  47.045224  85.28495
 [6,]  0.00000  0.00000  0.00000   0.000000   0.000000   0.2989524   0.6218732   1.293605   2.690924   5.597592  11.64397
 [7,]  0.00000  0.00000  0.00000   0.000000   0.000000   0.0000000   0.0000000   0.000000   0.000000   0.000000   0.00000
 [8,]  0.00000  0.00000  0.00000   0.000000   0.000000   0.0000000   0.0000000   0.000000   0.000000   0.000000   0.00000
 [9,]  0.00000  0.00000  0.00000   0.000000   0.000000   0.0000000   0.0000000   0.000000   0.000000   0.000000   0.00000
[10,]  0.00000  0.00000  0.00000   0.000000   0.000000   0.0000000   0.0000000   0.000000   0.000000   0.000000   0.00000
[11,]  0.00000  0.00000  0.00000   0.000000   0.000000   0.0000000   0.0000000   0.000000   0.000000   0.000000   0.00000

$stree
       [,1]     [,2]     [,3]     [,4]     [,5]     [,6]     [,7]     [,8]     [,9]    [,10]    [,11]
 [1,] 441.61 477.0126 515.2532 556.5596 601.1773 649.3719 701.4301 757.6617 818.4012 884.0100 954.8784
 [2,]   0.00 408.8412 441.6168 477.0199 515.2612 556.5681 601.1865 649.3819 701.4409 757.6733 818.4138
 [3,]   0.00   0.0000 378.5040 408.8475 441.6236 477.0272 515.2691 556.5767 601.1958 649.3919 701.4517
 [4,]   0.00   0.0000   0.0000 350.4178 378.5098 408.8538 441.6304 477.0346 515.2770 556.5853 601.2050
 [5,]   0.00   0.0000   0.0000   0.0000 324.4158 350.4232 378.5156 408.8601 441.6372 477.0419 515.2850
 [6,]   0.00   0.0000   0.0000   0.0000   0.0000 300.3431 324.4208 350.4286 378.5214 408.8664 441.6440
 [7,]   0.00   0.0000   0.0000   0.0000   0.0000   0.0000 278.0568 300.3478 324.4257 350.4340 378.5273
 [8,]   0.00   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000 257.4241 278.0611 300.3524 324.4307
 [9,]   0.00   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000 238.3225 257.4281 278.0653
[10,]   0.00   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000 220.6382 238.3261
[11,]   0.00   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000 204.2662
```

Using Excel in Option Pricing

In our R project, we also require students to use Excel to import data, calculate stock returns and return standard deviation, and price a European call option and a European put option of a stock they choose, using the Black-Scholes model and the multi-period binomial option pricing model. Using both R programming and Excel to price options help students solidify their understanding of the pricing models. Holden (2012) provides detailed illustrations on how to apply both the Black-Scholes model and the multi-period binomial option pricing model in Excel. Wann (2015) focuses on the Excel application of the Black-Scholes model, and Baril, Betancourt, and Briggs (2005) focus on the Excel application of the binomial (lattice) model. Since most of our students already have some experience with Excel, we focus on important Excel functions when we illustrate the Excel part of this project in class.

Figure 10 shows the calculation of the stock returns and return standard deviation, using the same non-dividend paying stock of Tesla as the example. After opening the CSV data file downloaded from Yahoo! Finance, we use the Excel function *"ln()"* to calculate the daily stock return based on the adjusted close price, and the function *"stdev()"* to calculate the daily return standard deviation. We obtain the annualized return standard deviation by multiplying the daily return standard deviation with the square root (*"sqrt()"*) of 252 (trading days per year). The annualized return standard deviation is 0.8792.

Figure 10: Excel Worksheet to Calculate Returns and Return Standard Deviation



	A	B	C	D	E	F	G	H	I
1	Date	Open	High	Low	Close	Adj Close	Volume		Return
2	11/18/2019	70.584	70.63	69.22	69.998	**69.998**	22002000		
3	11/19/2019	70.35	71.998	69.56	71.904	**71.904**	38624000		0.0269
4	11/20/2019	72	72.24	69.914	70.444	**70.444**	33625500		-0.0205
5	11/21/2019	70.902	72.168	70.8	70.966	**70.966**	30550000		0.0074
6	11/22/2019	68.032	68.2	66	66.608	**66.608**	84353000		-0.0634
7	11/25/2019	68.864	68.914	66.892	67.268	**67.268**	61697500		0.0099
8	11/26/2019	67.054	67.1	65.42	65.784	**65.784**	39737000		-0.0223
9	11/27/2019	66.224	66.786	65.714	66.258	**66.258**	27778000		0.0072
10	11/29/2019	66.222	66.252	65.5	65.988	**65.988**	12328000		-0.0041
11	12/2/2019	65.88	67.276	65.738	66.974	**66.974**	30372500		0.0148
12	12/3/2019	66.524	67.582	66.438	67.24	**67.24**	32868500		0.0040
13	12/4/2019	67.55	67.572	66.57	66.606	**66.606**	27665000		-0.0095
14	12/5/2019	66.566	66.884	65.45	66.074	**66.074**	18623000		-0.0080
243	11/2/2020	394	66.884	392.3	400.51	**400.51**	29021100		0.0316
244	11/3/2020	409.73	66.884	406.69	423.9	**423.9**	34351700		0.0568
245	11/4/2020	430.62	66.884	417.1	420.98	**420.98**	32143100		-0.0069
246	11/5/2020	428.3	66.884	424	438.09	**438.09**	28414500		0.0398
247	11/6/2020	436.1	66.884	424.28	429.95	**429.95**	21706000		-0.0188
248	11/9/2020	439.5	66.884	421	421.26	**421.26**	34833000		-0.0204
249	11/10/2020	420.09	66.884	396.03	410.36	**410.36**	30284200		-0.0262
250	11/11/2020	416.45	66.884	410.58	417.13	**417.13**	17357700		0.0164
251	11/12/2020	415.05	66.884	409.52	411.76	**411.76**	19855100		-0.0130
252	11/13/2020	410.85	66.884	401.66	408.5	**408.5**	19771100		-0.0079
253	11/16/2020	408.93	66.884	404.09	408.09	**408.09**	26838600		-0.0010
254	11/17/2020	460.17	66.884	433.01	441.61	**441.61**	61188300		0.0789
255									
256									
257							Daily return standard deviation		0.0554
258							Annualized return standard deviation		0.8792
259									
260									
261									
262									

Figure 11 shows the application of the Black-Scholes model to price the same European call option and European put option we define before. We use the Excel function *"normsdist()"*, the standard normal cumulative distribution function, to obtain the probability that a random draw from a standard normal distribution will be less than a specific number. The value of the European call option is $48.3612 and the value of the European put option is $36.7182, the same as what we obtain from using R programming.

Figure 11: Excel Worksheet for the Black-Scholes Model

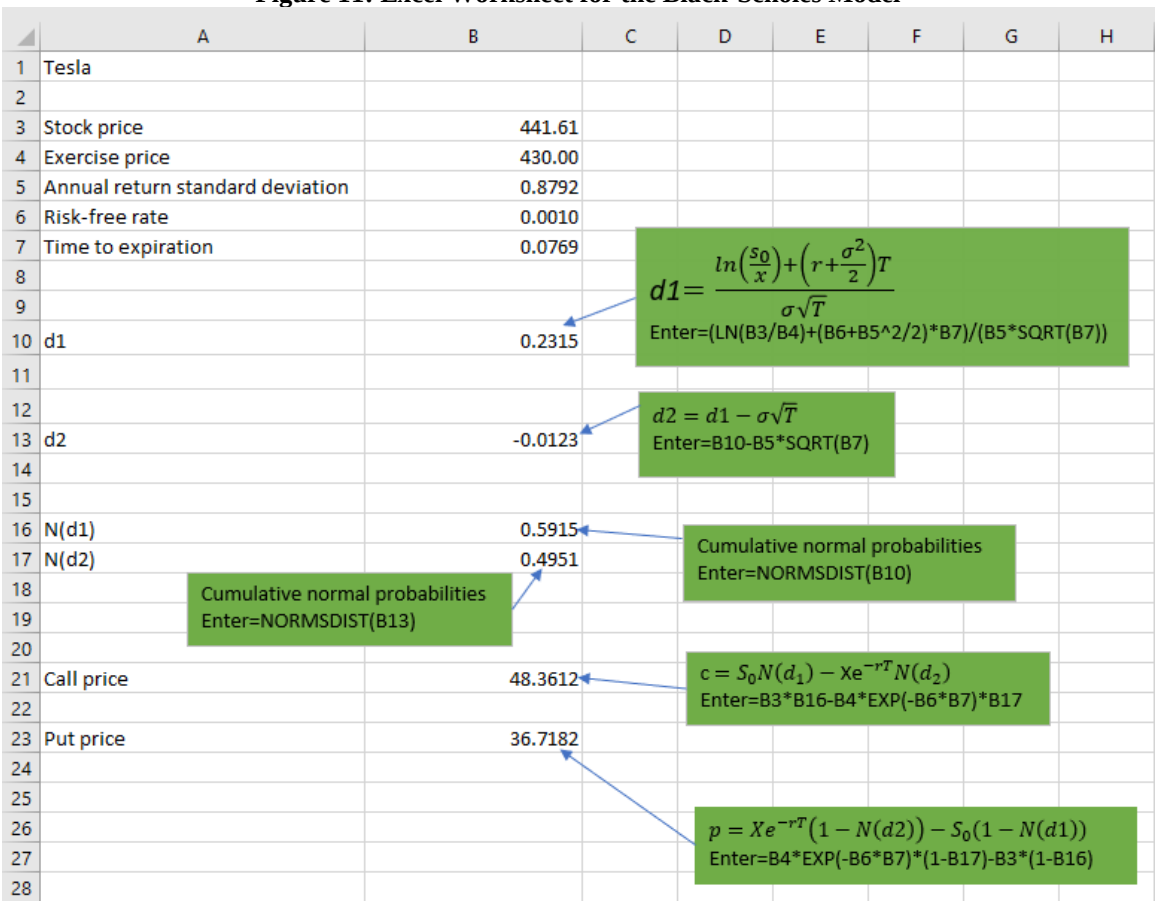
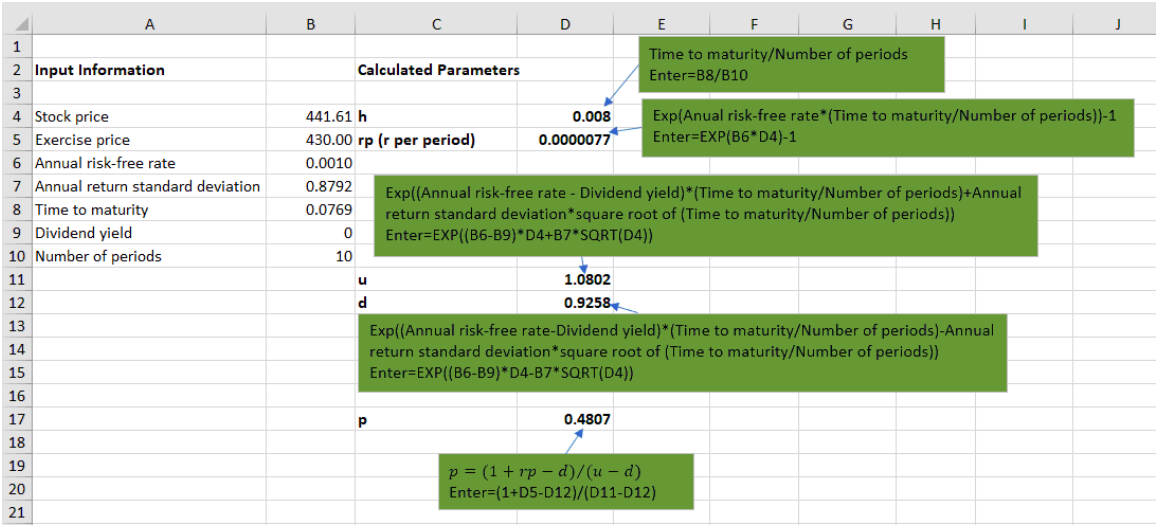


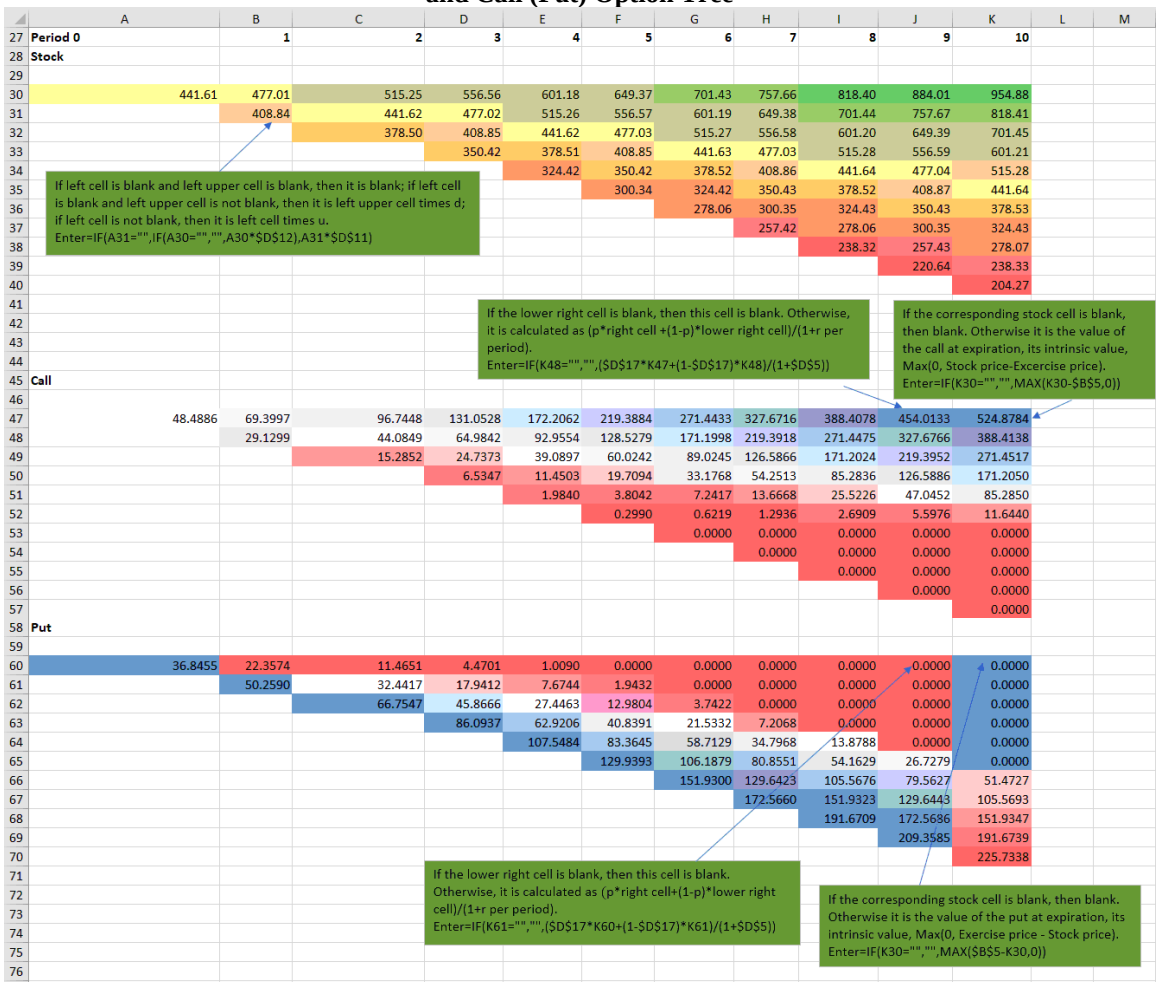
Figure 12 shows the parameter calculation for the multi-period binomial option pricing model. The definitions of the risk-free rate per period (*rp*), *u(p)*, *d(n)*, and the binomial (risk-neutral) probability (*p*) are the same as in the R package *"derivmkts"*, and their values are respectively 0.0000077, 1.0802, 0.9258, and 0.4807 in this example.

Figure 12: Excel Worksheet for the Multi-period Binomial Option Pricing Model – Parameter Calculation



Once we have the parameter values, we use the Excel functions *"if()"* and *"max()"* to construct the stock price tree and the call (put) option tree. The *"if()"* function performs a logical test on the content of a cell and returns a specific value depending on whether the result of the logical test is TRUE or FALSE. The *"max()"* function returns the maximum value among the inputs within the parentheses. Figure 13 shows the stock price tree, the call (put) option tree, and the derived values of the European call option and the European put option.

Figure 13: Excel Worksheet for the Multi-period Binomial Option Pricing Model – Stock Price Tree and Call (Put) Option Tree



Using the calculated parameters, we first construct the 10-period (step) stock price tree shown in Figure 13 as follows. We start with the current stock price at cell A30, then set up the function in cell B31 and copy the function to the other cells to obtain the 10-period binomial stock price tree. Once we have the stock price tree, we move backwards from period 10 to period 0 to construct the call (put) option tree. Specifically, we use both the *"if()"* and *"max()"* functions in cell K47 (K60), the first cell of the call (put) option tree in period 10, to get the option value at expiration, and copy the function to the other period-10 cells. We then use the *"if()"* function in cell J47 (J60) to get the call (put) option value in the first cell of period 9, and copy the function to the other period-9 cells. We repeat the same procedure backwards for other periods until we reach period 0 with the option value. In this case the value of the European call option is $48.4886 and the value of the European put option is $36.8455, the same as what we obtain from using R programming.

Overall we find both procedures in R programming and in Excel to price European options using the Black-Scholes model easy to implement. Using the multi-period binomial option model, however, R programming with the third-party package has the advantage of being more flexible and accommodating. For instance, it is time-consuming to construct a 100-period stock price tree and option trees in Excel. In R

programming with the third-party package, moving from a 10-period tree to a 100-period tree involves only one change in the package parameters. R programming is thus more efficient than Excel in handling complicated problems.

Discussion

Our goal of incorporating the R project into the undergraduate financial derivatives course is to expose students to the popular R programming language. After the successful completion of this project, students gain experience in importing and manipulating data in R, using R to do calculations, constructing user-defined functions, and applying third-party packages in R. The R project not only allows our students to pursue more advanced applications using R, but also allows us to maintain the currency of our curriculum. For instance, the Association to Advance Collegiate Schools of Business (AACSB International) recently issued the 2020 Business Accreditation Standards (AACSB International 2020a) and the associated Interpretive Guidance (AACSB International 2020b). Among the standards, Standard 4.1 on Curriculum (Content) requires that "[t]he school delivers content that is current, relevant, forward-looking, globally-oriented, aligned with program competency goals, and consistent with its mission, strategies, and expected outcomes. The curriculum content cultivates agility with current and emerging technologies." In addition, the Interpretive Guidance on Curriculum Content states that "[t]he purpose of this requirement is to demonstrate that schools are providing learners with relevant technology competencies in line with what might be expected for business degree graduates." Using the R programming language in the financial derivatives course through the class project thus maintains our curriculum currency by incorporating relevant technology into the curriculum.

Over the past few years in the financial derivatives course, we obtain overwhelmingly positive student responses to the R project through our class surveys. Students seem to be surprised by the fact that, they too, can write codes using the R programming language, and they have enjoyed the experience with the project. A few comments suggest that some students prefer a deeper coverage of R, which we find difficult to implement given the limited amount of time in a single course. Coordinated efforts through different courses, however, could possibly provide a deeper and more comprehensive coverage of R through the curriculum.

Conclusion

R is a popular and free programming language and software environment for statistical computing and graphics. Its open-source nature, compatibility with different operating systems, and the abundance of third-party packages together distinguish R from other programming languages. In this paper we illustrate in detail a class project in an undergraduate financial derivatives course that we use to introduce students to R programming. Specifically, through pricing options using the Black-Scholes model and the multi-period binomial option pricing model, students learn to import and manipulate data in R, use R to do calculations, construct user-defined functions, and apply third-party packages in R. The project equips our students with the knowledge of R for more advanced applications, and allows us to maintain the currency of our curriculum.

The R project discussed in this paper can be used directly in an undergraduate financial derivatives course. Components of the project, however, can also be used in other finance courses such as investments and corporate finance, and courses in other disciplines that have a need for data analysis. Students equipped with the knowledge of the R programming language surely will have a competitive advantage on the job market over those without.

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APPENDIX: R FUNCTIONS USED

This appendix summarizes the R functions used in this paper. Details of these functions are available through the Help function of RStudio.

as.Date(): date conversion function to and from character.
c(): combine values into a vector or list.
cbind(): combine R objects by rows or columns.
exp(): calculate the power of *e.*
head(): returns the first or last part of a R object.
install.packages(): download and install packages from CRAN-like repositories or local files.
library(): load packages.
list(): create a list of R objects.
log(): calculate the natural logarithm.
pnorm(): return the probability under the cumulative normal distribution function.
read.cvs(): import a CSV file and create a data frame.
sd(): calculate the standard deviation.
sqrt(): calculate the square root.
str(): display the structure of a R object.
View(): show the content of a data frame.

The Topic of Socialism in University Principles of Economics Textbooks

John L. Scott and Jonah A. Scott[1]

ABSTRACT

Polls show that socialism is more accepted by the public than in many decades. University-age students are especially enthusiastic about socialism. Do economics textbooks address this important topic? This research surveys twenty university principles texts' coverage of socialism. We measure textbook coverage of socialism and characterize the coverage regarding various definitions of "socialism" and whether those definitions match current usages of the term. We also explore the coverage of the characteristics of socialism. We find that there is great variety in coverage, though scant coverage of the type of socialism that 49% of young people today view favorably.

Introduction

Socialism is viewed about as positively as capitalism by today's young adults (Saad 2019). In one poll, 61% of younger voters who expressed a preference favored socialist candidate Bernie Sanders over traditional Democratic candidates (Vinopal 2020). But, at the same time, free enterprise is viewed favorably by a large majority of them (Saad 2019). When young adults enter university principles of economics courses, do they find textbooks that educate them regarding this subject that they are so interested in?

Bryan Caplan (2017) notes that university students who studied advanced placement economics in high school may have learned from a textbook which works to "sanitize the horrors of communism." Will principles students interested in socialism find textbooks that do not sanitize these horrors?

We analyze twenty of the top textbooks in university principles of economics courses regarding their coverage of socialism. We count total words of coverage and characterize the authors' views of the definitions of socialism and communism, including the relations between the two forms. We code eleven variables which describe authors' coverage of various issues with the two forms of organization, including Caplan's concern of misery, Mises's (1966) view of pervasive price controls as socialism, as well as the textbook authors' mentions of property, planning, efficiency, incentives, governmental structures, regulations, equality, and the welfare state. We also code variables representing authors' mentions of reform and of Karl Marx (Magness 2019). Finally, we code six geographic area variables that serve to illustrate which parts of the world that authors favor in recounting history and giving examples.

In the following section we briefly review the scant literature devoted to the analysis of textbooks on the subject of socialism. We then discuss what "socialism" means today. Following that, we discuss data collection and coding methods. In the main body of the paper, we discuss our variables and the authors' coverage of the issues those variables represent. In the final section we offer conclusions.

Literature

To our knowledge, little research has been done on the topic of textbook coverage of socialism. Most notably, Ise (1932) reviewed principles texts, including their coverage of socialism. He was complimentary of such coverage:

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> *Schlicter's new book merits more than passing attention, for its liberal, progressive attitude, and even socialistic points of view…. "Modern Economic Society" represents an important landmark in the development of economics. [Schlicter] foresees the final disappearance of capitalism, which would presumably mean the disappearance of the economics of capitalism…There are reasons for believing that [economics] may now be headed for the academic ash can.* (pp. 396-397)

Levy and Peart (2011) trace the development in economics texts of an error regarding economic growth in the USSR. For years, two of the most successful economics texts (Samuelson 1948-1980, and McConnell 1960-1990) (1) claimed that the USSR's GDP was half of US GDP but was (2) growing twice as fast. These texts were inconsistent over 20 years of editions (1960-1980) by repeating these two claims, unchanged. In reality, if the USSR were growing twice as fast, its GDP, as a fraction of US GDP, should have risen. But many textbook authors missed this inconsistency. Levy and Peart tie this error to the use of definitive, "thin" models, such as the production possibilities frontier. In their abstraction, these models omit crucial institutional details such as whether one could measure efficiency in the same manner for the US and USSR economies, though the two systems were markedly different in nature. Authors who used "thick" institutional treatments, which noted the differences between bottom-up and top-down economic institutions—on dimensions such as efficiency of operations, efficiency of investment in capital, and even reporting of production—did not fall prey to this error.

Views on What Socialism Means in the US Today

Gallup Polls taken in 1949 and in 2018 reveal that the US population's view of the term "socialism" has changed. Of those expressing an opinion in 1949, 23% viewed socialism as government benefits, liberal/reform government, or equal standing/rights/distribution, while in 2018 46% viewed socialism in this way. In 1949, 56% of those expressing an opinion viewed socialism as government ownership/control/planning or restrictions of freedom, while in 2018 27% viewed socialism in this way (Newport 2018). Hence, in the popular understanding, decades ago socialism was predominantly seen as government ownership/command and control, while today socialism is primarily seen as equality and the welfare state. Instructors who prefer the traditional definition may want to be aware of current usage and treatment of both concepts in textbooks.

Many students who enroll in principles courses come with their own language of socialism, which is consistent with the more current language of the rest of the world. Social democrat parties have existed in Europe for many decades, and today's US students are interested in similar policies under the name "democratic socialism." It may be desirable for economics texts to speak the language of today. This does not negate the need for teaching about the "socialism" of 1949, but necessitates a slightly expanded vocabulary and slightly expanded coverage. Since student attention is scarce, however, authors may not desire to alter their coverage, and there is room in the marketplace for many approaches—or even no approach—to covering the topic.

Data Collection Method

We collected data from 20 university principles of economics textbooks. After asking industry professionals, we were not able to find a list of textbooks, ranked by sales, because the companies do not share this information. However, our sources did provide their own estimations of tiers of the top selling texts. We wrote to book representatives of the companies who sold these texts and asked for online access to them, which they provided.

We used the textbooks' search functions to find the terms "socialist," "socialism," "communist," and "communism." The search functions in the online textbooks do not accept partial words for search, such as "sociali," which might reveal unexpected, but relevant, forms of the words. Nor did those search functions accept "wildcards" used in search such as "sociali*." Hence, our method may have missed related terms. In this paper, we often use the single term "socialism" to include "communism" as well, so as to avoid repetitions of both. We clarify where necessary.

We did not record glossary entries that were not in the main body of the text. Nor did we parse videos, except for explanatory text associated with the videos. We also did not record entries that only used the terms in footnotes, including several references to Schumpeter's *Capitalism, Socialism, and Democracy*

(1950), which sometimes appeared at the bottom of a page, and sometimes could only be accessed by clicking on a link. We did include entries in problem sets. For each search result, we counted the words in the relevant text. We included the words that would be necessary to understand the result. Some results mentioned the term in only an incidental way, with no real content regarding socialism or communism. For instance, Schiller and Gebhardt (2019) include the following, which, by our rules, we include:

> *So what if the Federal Reserve System controls the nation's money supply? Why is this significant? Does it matter how much money is available? Vladimir Lenin thought so. The first communist leader of the Soviet Union once remarked that the best way to destroy a society is to destroy its money.* (p. 312)

When we found a search term mentioned, we counted all the relevant words in the section containing the term. We do not define "sections" by sub-headings in the text, but by relevancy to the search term. For some mentions this meant counting a multi-page feature strictly devoted to the subject, such as a lengthy section on Chinese communism and reform. For other mentions of a term, this meant counting only a paragraph or a sentence.

Often a search term was used in the introduction to a passage of text, then was not mentioned again in the passage, though the rest of the passage clearly illuminated the term. The entire passage was counted in this case. For instance, Rubb and Sumner (2019, p. 484) include a story that is in a few of the textbooks we sample—the photo of North Korea and South Korea, by night, from space, showing the vibrancy of South Korea in contrast to dismal, communist North Korea. Their story is told in two paragraphs, though the second paragraph does not mention the search terms. We include both paragraphs in our data and use similar methods for all similar examples in the textbooks.

Our measurement of the coverage of socialism using word counts is complicated by the fact that writing styles vary between the authors. Since we have no good way to adjust for writing styles, the reader might consider word counts as a proxy for coverage.

Finally, some mentions of the topic in a textbook do not contain our search terms. A text might say, "China's reforms have brought prosperity," as a comment on how the world is getting better, but without mentioning our search terms. Besides the difficulties of locating all such statements, the mention might not be understood by principles students to be connected to the topic of socialism, so we do not attempt to include these references.

Coding Conventions

For each of the 20 textbooks, we read each section of text containing the search terms and coded variables that describe the characteristics and issues regarding socialism and communism. For each section, we iterate the count of each variable only once. That is, if a section mentioned property rights five times and China twice, we only iterated the count of the "property rights" variable by 1 and the "China" variable by 1. This method was straightforward to apply with only two difficulties arising.

First, Tucker's (2019) textbook has an entire chapter devoted to socialism which contains over 25 percent of our data set's words devoted to the topic. We enter it in the data set as one section. However, we code variables as if it contained multiple sections, with each segment defined by either a new section heading or a new topic. For instance, section 29-2c begins with a lengthy paragraph containing definitions and examples of socialism. The second paragraph gives arguments of proponents and opponents of socialism. The third paragraph explores various political systems under which socialism is implemented. Property rights are mentioned in the first and third paragraphs, which, treating the paragraphs as different sections of text, we iterate the count of the "property rights" variable by 2. Because of this different treatment of Tucker, we report the data with one total that includes Tucker and a second total which excludes Tucker.

The second difficulty arises when the variables we code are not explicitly stated in the text. So, we occasionally made judgments based on how clear the text is. For example, we use variables to measure mentions of (1) inequality and (2) incentives. The following passage from Case, Fair, and Oster (2020) explicitly mentions inequality, but does not explicitly say that socialism lacks incentives.

> *The distribution of income in a capitalist economy is likely to be more unequal than it is in a socialist economy. Why is this so? Is there a tension between the goal of limiting inequality and the goal of motivating risk taking and hard work? Explain your answer in detail.* (p. 720)

We code this section as including incentives because in our judgment, "motivating risk taking and hard work," clearly refers to incentives. When in doubt, we attempted to view passages through the eyes of our students, who have less experience in reading textbooks than professors do.

Definitions and Analysis of Measured Variables

Definitions of our variables are found in Table 1. Our data are found in Exhibit 1.

Table 1: Variables and Definitions

Variable	Definition/Coding
Words	Total words that an author devotes to sections containing the search terms "Socialism, Communism, Socialist, Communist"
Sections	Number of sections in which an author uses the search terms
Socialism	Mentions of "socialism" by author, regardless of the number of sections
Communism	Mentions of "communism" by author, regardless of the number of sections
Definition	Number of sections in which the author defines a search term
Misery	Number of sections in which the author discusses misery, including starvation, murders, incarcerations, shortages, lines, etc.
Property	Mentions of private property, government property, ownership
Planning	Mentions of government planning of the economy
Efficiency	Mentions of efficiency or inefficiency regarding the search terms
Incentives	Mentions of incentives or lack of, including clearly implied mentions
Dictator	Mentions of autocratic rulers, autocratic governing bodies, or clearly implied mentions of same
Price controls	Mentions of price controls
Cronies	Mentions of cronies, whether by word of implication
Equality	Mentions of equality or inequality regarding any economic form
Welfare state	Mentions of the welfare state, whether by word or implication
Regulation	Mentions of regulation in connection with the search terms
Reform	Mentions of reform in connection with the search terms
Marx	Mentions of Marx in connection with the search terms
USSR&East	Mentions of the USSR or Eastern Europe with search terms
China	Mentions of China in connection with search terms
NK&Cuba&Ven	Mentions of North Korea, Cuba, or Venezuela with search terms
US Socialism	Mentions of socialism in the US with the search terms
Scandanavia	Mentions of socialism in Scandinavian countries with the search terms
Europe	Mentions of socialism in European countries with the search terms, except as coded in connection with the USSR and Eastern Europe
Total	Total mentions of all variables by the author; the sum of *Definition* through *Europe*
Wds/sect	*Words* divided by *Sections*: Average words in a section with the search terms
Categories	The number of the 20 variables mentioned by the author, *Definition* through *Europe*; *Categories* has a maximum value of 20

Total Coverage and the Words Variable

We measured the total number of words (*Words*) in sections which mentioned socialism and/or communism in column 1. Tucker devotes 5,605 words to socialism, while Hubbard and O'Brien (2021) devote 3,148 words. Cowen and Tabarrok (2021) and Baumol et al. (2019) each devote about 2,000 words, followed by McConnell et al. (2021), Acemoglu et al. (2018), and Gwartney et al. (2022) at about 1,000 words each. Exhibit 1 is sorted by *Words* devoted to the topic.

To make the concept of word counts more vivid to the reader, a typical double-spaced typed document in 12-point type has about 300 words per page. Hence, Hubbard and O'Brien's (2021) 2,148 words are equivalent to about 10.5 double-spaced typed pages. The average words devoted to socialism in a textbook is 981, a little over 3 pages, and the median textbook, McEachern (2017), devotes about 1.5 pages to the topic.

Of our 20 textbooks, the 10 with the most coverage devote 18,452 words, for an average of 1,845 words per textbook, while the bottom 10 devote 2,150 words, for an average of 215 words per textbook. Stevenson and Wolfers (2020) did not mention socialism. Thus, the market provides options for instructors who think covering socialism either is or is not important.

Exhibit 1: Data

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	WORDS	Sections	SOCIALISM	COMMUNISM	DEFINITION	MISERY	PROPERTY	PLANNING	EFFICIENCY	INCENTIVE	DICTATOR	PCONTROLS	CRONIES	EQUALITY	WELFARE ST	REGULATION	REFORM	MARX	USSR&EAST	CHINA	NK&CUBA&VEN	USSOCIALISM	SCANDANAVIA	EUROPE	TOTAL	WDS/SECT	categories
Tucker	5,605	4	56	28	1	5	9	4	3	4	2	4	3	3	1	1	6	1	8	3	7	2	1	1	69	1401.3	20
Hubbard	3,148	12	17	17	3	3	5	3	6	2	2	1	1		1	1	3	2	5	3	3	2	1	2	49	262.33	19
Cowen	1,949	8	0	13		5	2	1	5	3	1	2	1				3		2	4	1	1			31	243.63	13
Baumol	1,863	17	8	14		6	3	4	4			2	2	1	1		3	3	13	5	1	1	1		50	109.59	15
McConnell	1,251	7	4	7	1	1	2	2	2		1	1	1		1		4		2	2	2				22	178.71	13
Acemoglu	1,199	5	0	13		3	3	3		1	2	1	2				3		2	2	2				24	239.8	11
Gwartney	1,088	3	18	0	1	1	1	2			2					2			1		2	1	1		14	362.67	10
Rubb	799	7	1	10		3	2	1	1	1				2			2		1	3	2				18	114.14	10
Frank	780	8	0	15		2		1				1	1			1	3		5	2	3	1			20	97.5	10
Shiller	770	7	4	9		2	2	2	2	1	1	1		2	1		1	1	3	1	1				21	110	14
McEachern	486	3	1	2		1	2	2	1	1							1			1	2				11	162	8
Karlan	402	2	0	4		1		1	1										2						5	201	4
Chiang	363	3	2	6				2			2				1			1		1			2		9	121	6
Mankiw	348	2	2	2					1					1	2				1					1	6	174	5
Krugman	201	4	3	3																3					3	50.25	1
Case	139	2	1	1						1				1			1		1						4	69.5	4
Arnold	94	2	2	0																					0	47	0
Bade	94	3	1	2	1		1	1									2		2						7	31.333	5
Miller	23	1	1	0															1						1	23	1
Stevenson	0	0	0	0																					0	NA	0
Totals	20,602	100	121	146	7	33	32	29	26	14	13	13	11	10	8	5	32	8	49	30	26	8	6	4	364		
w/o Tucker	14,997	96	65	118	6	28	23	25	23	10	11	9	8	7	7	4	26	7	41	27	19	6	5	3	295		
Authors					5	12	11	14	10	8	8	8	7	6	7	4	12	5	15	12	11	6	5	3			
First 10	18,452	78	108	126	6	31	29	23	23	12	11	13	11	8	5	5	28	7	42	25	24	8	4	3	318		
Last 10	2,150	22	13	20	1	2	3	6	3	2	2	0	0	2	3	0	4	1	7	5	2	0	2	1	46		

Integration and the Sections Variable

Sections, reported in column 2 of Exhibit 1, is the number of passages containing the socialism and capitalism terms. Note that often a single section will contain the search terms multiple times. One of Tucker's four sections is an entire chapter, hence the textbook with the most *Words* has few sections.

A relevant issue regarding coverage concerns whether the topic of socialism is integrated throughout the text in small sections or is contained in large sections. (Both are possible, with many smaller mentions and some large mentions.) Our analysis shows that this is mostly not an issue of concern in selecting a text because the total words of coverage (*Words*) roughly correspond with the words per section (*Wds/Sect*), as seen in Column 26 of Exhibit 1. Excluding Tucker (an outlier), the correlation coefficient between *Words* and *Sections* is 0.810. Including Tucker, the coefficient is 0.435.

There are two obvious outliers with regard to this general tendency. First, Gwartney et al.'s (2022) 3 sections contain 362 words per section. Second, Baumol et al.'s (2019) 1,863 words are contained in 17 sections—about 110 words per section. Hence, in this respect, Baumol's coverage is the most integrated, containing the fourth most *Words* of any textbooks in the most *Sections* of any textbook.

Terminology: The Socialism, Communism, and Definition Variables

Columns 3 and 4 of Exhibit 1 contain our counts of the search terms in the textbook. *Socialism* counts the times that the words "socialist" and "socialism" appear in the text, while *Communism* counts the times

that the words "communist" or "communism" appear. With Tucker included, *Communism* is mentioned 20% more than *Socialism*. Excluding Tucker, *Communism* is mentioned about 82% more than *Socialism*. Hence, most principles of economics students are exposed more to a discussion of *Communism* than of *Socialism*. Some texts with substantive coverage only use *Communism*—Cowen and Tabarrok (2021); Acemoglu et al. (2018); Frank et al. (2019), and Karlan and Morduch (2021), while Gwartney et al. (2022) only uses *Socialism.* Arnold (2019) and Miller (2021) only use *Socialism*, but they have no substantive content regarding the topic—only passing mentions of the term.

Only five texts attempt to explicitly define the terms outside of the glossary (recall that we do not count glossary mentions). The *Definition* variable is in column 5 of Exhibit 1. Many textbooks mention characteristics of socialism and communism without proposing an explicit definition. Given that there is some controversy regarding definitions, an author who includes the topic as an end in itself, rather than to use the topic to illustrate related issues, such as property rights or inefficiency, might include a formal definition.

Tucker's (2019) definition is typical. "Socialism is an economic system characterized by government ownership of resources and centralized decision making" (section 29-2c). Tucker distinguishes between predominantly socialist economies, noting the existence of some privatization in them, and also notes that there are elements of socialism in predominantly capitalist economies—such as the United States' Tennessee Valley Authority. He summarizes this view: "there are elements of socialism in every nation" (section 29-2c). Tucker differentiates between socialism and communism using a rule that characterizes many authors' treatments of the topics, though most do not explicitly state the rule:

> *Generally, socialist economies run by non-democratic governments are referred to as communist nations today. On the other hand, democratic socialism exists when the government is a freely and fairly elected democracy.* (section 29-2c)

Other than Tucker (2019), only Gwartney et al. (2022) use the term "democratic socialism." But whereas Tucker uses the term to describe democratically elected government ownership and centralized decision making, Gwartney argues that those who designate themselves "democratic socialists" are not socialists at all. His argument is that those like Bernie Sanders, who call themselves "socialists," associate the term with the Scandinavian countries, but, in Gwartney's view—and the view of some of those country's leaders—those countries are not socialist. Hence, Tucker's point is that one can characterize parts of an economy as socialist or market-based, while Gwartney's point is that countries should be characterized by their predominant mode of economic organization. While Tucker allows that democratic socialists' claims to the term are valid, Gwartney implies they use an invalid designation—in effect, telling 47% of those surveyed in one poll that they are mistaken when they claim they would vote for a socialist candidate (Younis 2019).

Hubbard and O'Brien (2021) address the "democratic socialist" idea, using the more European designation "social democratic." They apply the term in the following way.

> *Several prominent socialist politicians, including Vermont Senator Bernie Sanders and New York Congresswoman Alexandria Ocasio-Cortez, have increased interest in socialism in the United States. These politicians advocate a larger role for government in the economy, including (1) "Medicare for All," under which the federal government would provide medical insurance to the whole population, eliminating private medical insurance; (2) government-paid tuition at two-year and four-year colleges; (3) the "Green New Deal," which would commit the federal government to a variety of steps to ensure that within 10 years energy generation in the United States would involve zero carbon emissions; and (4) higher tax rates on individuals and corporations. These policies resemble those of the social democratic parties of Western Europe.* (pp. 61 and 62)

Thus, while most authors, including those we have discussed, strictly characterize socialism as government ownership and control, Hubbard and O'Brien (2021), apply the term to redistributive socialism. Hubbard and O'Brien (2021) discuss Marx's definitions of communism and socialism. Marx favored "a communist economy in which workers would control production" (p. 61). However, Russia and China, whose revolutions were undertaken in Marx's name, "became centrally planned economies, with the Communist Party, rather than workers, in control" (p. 61). These authors explain the relationship between the terms in more detail than any authors in this study, "although most countries in Western Europe have larger government sectors, have higher income tax rates, and provide more social services compared with the United States, they are not socialist in the earlier Marxist sense." Thus, Hubbard and O'Brien (2021) differentiate between communism, Marxist socialism, and social democracy/democratic socialism.

Gallup Polls taken in 1949 and in 2018 reveal that the US population's view of the term "socialism" has changed. Of those expressing an opinion in 1949, 23% viewed socialism as government benefits, liberal/reform government, or equal standing/rights/distribution, while in 2018 46% viewed socialism in this way. In 1949 56% of those expressing an opinion viewed socialism as government ownership/control/planning or restrictions of freedom, while in 2018 27% viewed socialism in this way (Newport 2018). Hence, using only the "government ownership, command and control" definition makes a text less relevant in discussing socialism today than a definition including redistribution. Textbook authors not wishing to take a great deal of space making the distinction might use the term "communism" or "Marxist socialism" to describe command and control, and use "democratic socialism," "social democracy," "redistributive socialism," or "welfare state," to describe redistribution.

Friedman (1993) sums government spending and government mandated spending as a measure of government command and control of the economy. "At least 50% of the total productive resources of our nation are now being organized through the political market. In that sense . . . we are more than half socialist" (time stamp 23:17 – 24:57). No author in our research uses this specific approach, though some authors discuss the amount of socialism as having to do with the amount of government production (e.g., Tucker 2019, section 29-2c).

Misery

Columns 6-16 contain eleven variables measuring textbook mentions of characteristics of socialism, sorted, left to right, by the number of times the characteristic was mentioned. Mentions of the *Misery* associated with socialism and communism are recorded in column 6. It was the most mentioned of all our "socialist characteristics" variables. The 11 authors with the most words devoted to socialism mention misery. The 10 authors with the least words—each one with fewer than 400 words devoted to socialism—do not mention misery.

Caplan (2017) points out that in previous decades many textbook authors

> *seemed deeply ignorant of actual communism, basing their assessment on second-hand information about communists' stated intentions, plus a few anecdotes about inefficiencies. Many textbook authors were, in a phrase, communist dupes: Non-communists who believe and spread a radically overoptimistic image of communism.*

That is, Caplan reports that decades ago many textbook authors downplayed the misery associated with communism.

In current textbooks, Cowen and Tabarrok (2021) mention Chinese starvation during China's Great Leap Forward twice (pp. 551 and 570). Acemoglu et al. (2018, p. 705) and Rubb and Sumner (2019, p. 487) mention it once. McConnell et al. (2021, p. 54) feature starvation in Venezuela. Shiller's and Gebhardt's (2019) section on Venezuela mentions misery, but not starvation. Other authors mention extreme misery, while some use less stark language, as in Baumol discussing long lines and persistent shortages. We did not separate out shortages, but coded them under the *Misery* variable. Since *Misery* received the most mentions of any of our characteristics of socialism (33), evidently much of the neglect that Caplan refers to has been corrected.

Property

With 32 mentions by 10 authors, *Property*, in column 7 of Exhibit 1, is our second most mentioned characteristic of socialism. Our coding of *Property* included mentions of private property and of state ownership. Since most authors discuss socialism as (1) state ownership of property and/or (2) command and control of the economy, it is not surprising that *Property* is often mentioned. The eight authors who devote the most words to socialism all mention property.

Authors sometimes go further than listing the *Property* characteristic, explaining how private property is important in the economy, such as McEachern (2017), who says, "Because nobody in particular owns resources, each person has less incentive to employ them in their highest-valued use, so some resources are wasted" (section 2-4c). The most detailed explanation of the importance of private property is provided by Cowen and Tabarrok (2021).

> *Imagine that a day's work can produce an extra bushel of corn. Thus, an extra day's work on a commune with 100 families earned the worker 1/100th of a bushel of corn. Would you work an*

> *extra day for a few earfuls of corn? Under communal property, working an extra day doesn't add much to a worker's take-home pay and working a day less doesn't subtract much. Thus, under communal property, effort is divorced from payment so there is little incentive to work—in fact, there is an incentive not to work and to free ride on the work of others.* (p. 551)

Planning

While the *Planning* variable, in column 8 of Exhibit 1, is the third most mentioned topic, it is mentioned by more authors (14) than any other characteristic. Authors who do not mention planning mostly have either no coverage of socialism or incidentally mention socialism.

Summing up a rich discussion of planning, Tucker (2019) says,

> *National goals may seem to be easily formulated and pursued under state directives, but there are problems. For example, proponents of such an economy can claim there is no unemployment because the government assigns all workers a job and allocates resources to complete their production goals. However, economic inefficiency results because the government often uses many workers to perform work requiring only one or two workers.* (section 29-2f)

Efficiency

The *Efficiency* variable, found in column 9 of Exhibit 1, counts mentions of socialist inefficiency or market efficiency. It is the fifth most mentioned characteristic of socialism, with 26 total mentions from 10 authors.

Some coding of *Efficiency* was done by implication, as mentioned earlier. For instance, Mankiw (2021), in a section titled "Markets Are Usually A Good Way to Organize Economic Activity," says

> *Communist countries operated on the premise that government officials were in the best position to allocate the economy's scarce resources…. Most countries that once had centrally planned economies have abandoned the system and instead have adopted market economies.* (Section 1-2b)

More typical is McEachern's (2017) statement regarding communism, "Running an economy is so complicated and requires so much information that some resources are used inefficiently" (section 2-4c).

A more complete description of inefficiency under state planning is given by Baumol, Blinder and Solow (2019), who describe the problems that the Chinese Communist Party has in identifying unprofitable firms, because local officials keep subsidizing them so that they will not be shut down (section 11-2a).

Incentives

Incentives, in column 10 of Exhibit 1, were mentioned 14 times by 8 authors. The word "incentive" appeared many times, such as in Hubbard and O'Brien (2021, p. 714): "The drive for profit provides an incentive for technological change that centrally planned economies are unable to duplicate." The example we listed in the *Property* section above, regarding Cowen and Tabarrok's example of producing corn that is split among many farmers, is another rich example of incentives. Some coding of *Incentives* was done by implication, as discussed above in the "coding" section with our quote from Case et al. (2020). We only coded by implication when we felt the implication would be clear to the typical principles student.

Dictator

The fact that socialism is associated with dictators is mentioned 13 times in column 11 of Exhibit 1 by eight authors. We did not code phrases like "command and control" by implication on this variable. We required a mention of a ruler or of a small governing body imposing decisions on the populace. Sometimes this consisted of a reference to a specific individual, without mention of the word "dictator," such as the following by McConnell et al. (2021):

> *With Maduro's troops imprisoning anybody who dared to sell at higher prices, many firms decided to go out of business. As they did, shortages of every imaginable good and service arose. People began to starve and over 3 million Venezuelans fled to other countries.* (p. 54)

Democratically imposed and maintained socialism was not coded here. The importance of the *Dictator*

variable indicates that Caplan's (2017) concerns about the previous state of principles textbooks has been, in part, addressed. Further, as we proceed down our list of variables, with fewer and fewer mentions, mostly by texts with less coverage, we should expect fewer authors to mention each characteristic that we coded.

Price Controls

The *Price controls* variable, in column 12 of Exhibit 1, shows that eight authors mention price controls 13 times. All the mentions have the typical economics view, with two exceptions. The usual economic analysis of price controls is static, but Tucker (2019) describes the dynamic problems with attempting to adjust price controls to match conditions,

> *If consumers desired more cars than were available, the authorities increased the price of cars. If people wished to purchase less of an item than was available, planners lowered prices. The problem was that this decision process took time. And while the market awaited its orders from the Soviet planners, excess inventories of some items accumulated, and consumers stood in line for cheap products that never seemed to be available.* (section 29-2e)

Cowen and Tabarrok (2021) quote Hedrick Smith (1976), who describes Russia's system of universal price controls.

> *The list of scarce items is practically endless. They are not permanently out of stock, but their appearance is unpredictable. … Leningrad can be overstocked with cross-country skis and yet go several months without soap for washing dishes. In the Armenian capital of Yerevan, I found an ample supply of accordions, but local people complained that they had gone for weeks without ordinary kitchen spoons or tea samovars.* (p. 154)

Mises (1966) asserts that such a pervasive system of price controls, even in a state with ostensibly private property, is government planning of the economy. That is, even with purported private property, an economy with ubiquitous price controls is a socialist command economy.

Cronies

The subject of political *Cronies* is mentioned 11 times by seven authors, as shown in column 13 of Exhibit 1. The mentions range from Venezuela (McConnell et al. 2021, p. 54) to North Korea (Acemoglu et al. 2018, p. 499), to the USSR (Tucker 2019, section 9-1b).

Equality

Six authors mention *Equality* or inequality 10 times in our selections, as shown in column 14 of Exhibit 1. Rubb and Sumner (2019) fully explore the issue of equality/efficiency tradeoff.

> *Thus, policies that improve equity may come at the cost of less efficiency. Indeed, this was a major problem in many communist countries during the twentieth century. Countries that attempted to eliminate inequality (such as the former Soviet Union) typically saw reductions in efficiency as well. In response, many formerly communist regimes (such as China) have adopted some of the ideas of Adam Smith and increased their reliance on markets. Consequently, most societies today do not advocate complete income equality.* (p. 12)

Similarly, Case et al. (2020, p. 720) ask, "Is there a tension between the goal of limiting inequality and the goal of motivating risk taking and hard work?"

Increasing inequality due to Chinese reforms is mentioned by Tucker (2019, section 29-3c), Schiller and Gebhardt (2019, p. 17), and Rubb and Sumner (2019, p. 12).

Welfare State

The *Welfare state* variable, in column 15 of Exhibit 1, show eight mentions of the topic by seven authors. The welfare state is mentioned in connection with European countries, including Scandinavia by Baumol et al. (2019, section 2-5e): "In Sweden, which borrowed many ideas from socialism when it established its generous social welfare system, incomes are far more equally distributed than those in the United States." Note that this says Sweden borrowed from socialist countries, indicating that Sweden is not

socialistic. Gwartney et al. (2022, 2-7a), devotes 65% of its total coverage to explaining that the Scandinavian countries' welfare states do not make them socialistic.

Two authors indicate that a welfare state contributes to labeling the European/Scandinavian countries as socialist. Mankiw's (2021, section 12-3i) reprint of a Martin Feldstein (2017) publication explains that Schumpeter's views of socialism are realized in the rise of welfare states in Europe—and causes slow growth. Chiang (2020) says,

> *"people in socialist countries such as Sweden and Denmark enjoy a high degree of political freedom, but pay high taxes so that government can play a large role in providing services."* (p. 33)

Regulation

The *Regulation* variable, in column 16 of Exhibit 1, indicates that four authors make five mentions of regulation. Tucker (2019, section 29-3a) mentions regulations as an aspect of Cuba's command and control. Gwartney et al. (2022, section 2-7a) lists regulations as part of socialist command and control, and says market economies are characterized by minimal regulation. None of the authors explore the possibility that government could exert pervasive command and control of the economy through regulation, without taking title to property, like Mises' ideas about price controls.

Reform

We include two variables that describe coverage of socialism that are not "characteristics of socialism," like the previously explained 11 variables. *Reform*, in column 17 of Exhibit 1, is mentioned 32 times by 12 authors. These reforms include multiple mentions of China, Russia, and eastern European countries. The nature of these reforms is captured in the previous variables, with issues such as misery, inefficiency, property, and planning.

Marx

Five authors make 8 mentions of Karl Marx, a seminal figure in the development of socialism, as shown in column 18 of Exhibit 1. Extensive features on Marx are contained in Hubbard and O'Brien (2021 pp. 61 and 62), Tucker (2019, section 29-2d), and Chiang (2017, p. 312). A smaller feature on Marx is included by Shiller and Gebhardt (2019, p. 14). As mentioned in the *Definitions* section above, Hubbard and O'Brien (2021) differentiate between Marx's vision of worker-owned businesses and the state-owned economies of China, Russia, etc.

Country-specific Variables

Our remaining six variables measure coverage of various countries in text devoted to socialism. The USSR & Eastern Europe, in column 19 of Exhibit 1, are mentioned in 49 sections by 15 authors. The relevant issues involving coverage are summarized in our discussion of the characteristics of socialism for this, and for most of the other country-specific variables. We make an exception for mentions of socialism in the United States, which is likely more relevant to US principles students.

China

China, in column 20 of Exhibit 1, is mentioned in 30 sections by 12 authors.

North Korea, Cuba, and Venezuela

North Korea, Cuba, and Venezuela, in column 21 of Exhibit 1, is mentioned in 26 sections by 11 authors. We did not separate mentions of the three countries to conserve space. They were often mentioned together, with many mentions simply referring to them, especially North Korea and Cuba, as being the only remaining communist countries. However, as indicated in our previous discussion, there were features on

North Korea's picture from space by night by multiple authors: Tucker (2019, section 29-2g), Acemoglu et al. (2018, p. 532), and Rubb and Sumner (2019, p. 484). Venezuela's poverty was the subject of features by McConnell et al. (2021, p. 54) and Shiller and Gebhardt (2019, p. 807). Tucker (2019) had a large section on Cuba (section 29-3a).

US Socialism

US Socialism, found in column 22 of Exhibit 1, is mentioned in eight sections by six authors. As previously noted, Tucker (2019) explains that the US has state-owned and operated enterprises and states there is socialism in every nation (section 29-2c). Baumol et al. (2019, section 2-1), like Tucker, mentions the Tennessee Valley Authority and the United States Postal Service as government owned and operated enterprises, but calls the United States primarily "privatized." Frank et al. (2019) note that

> *The major remaining examples of centralized allocation and control now reside in the bureaucratic agencies that administer programs like New York City's rent controls—programs that are themselves becoming increasingly rare.* (p. 57)

Gwartney et al. (2022, section 2-7a) show that many countries that we call socialist have higher economic freedom scores on the *Economic Freedom of the World* report, published by the Fraser Institute, which lists Gwartney as first author (Gwartney et al. 2021).

As previously noted, Hubbard and O'Brien (2021) explain that Bernie Sanders and Alexandria Ocasio-Cortez do not fit the mold of Marxism, but are in the mold of the European social democrats.

Scandinavia

Scandinavia, in column 23 of Exhibit 1, is mentioned in six sections by five authors. We have previously explored the area in discussions of the characteristics of socialism.

Europe

Europe, in column 24 of Exhibit 1, is mentioned in four sections by three authors. This does not include countries referenced as previously having been in the USSR or having been dominated by the USSR. We have previously explored the area in discussions of the characteristics of socialism.

Categories

The *Categories* variable in column 27 of Exhibit 1 sums each author's mentions of the categories we used in analyzing their coverage. Tucker (2019) mentions every category we listed. Hubbard and O'Brien (2021) mention every category except *Equality*. In general, the fewer words devoted to coverage, the fewer categories that are covered. Schiller and Gebhardt (2019) is an outlier, with the tenth ranked words of coverage, but the fourth ranked coverage of topics. They lightly hit many topics in their few words.

Summary

There is variety in modern university principles of economics textbooks' coverage of socialism. Instructors can choose between texts with extensive coverage, moderate coverage, and no coverage of socialism at all. In general, textbooks emphasize the misery associated with socialism, the property rights structures, and inefficiency. Coverage mostly concerns the USSR, China, and the failed states of North Korea, Venezuela, and Cuba.

However, typical textbook coverage leaves today's university student uneducated about the socialism that they hear about in the common discourse. Today's coverage applies well to the 56% who viewed socialism as concerning only government ownership and command and control in 1949. However, today that number is 27%, while today 46% view socialism as government benefits, liberal/reform government, or equal standing/rights/distribution (Newport 2018). For the 49% who have positive views of the socialism of Bernie Sanders, Alexandria Ocasio-Cortez, and four other members of the US Congress (Saad 2019), few principles textbooks address that economic system they prefer. And some textbook authors indicate

that those who prefer redistributive socialism have misnamed it—but those authors do not address this area of economics—an area those segments of the population are interested in learning about.

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