

SWARTHMORE COLLEGE

DOES TAKING ECON 101 CAUSE OVERCONFIDENCE?

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ABSTRACT:

This paper quantitatively explores the concern in the economic education literature that taking Econ 101 causes overconfidence about issues over which professional economists disagree (e.g., the minimum wage). With survey data from students at two selective colleges, I use a quasi-experimental approach to estimate the impact of taking Econ 101 on students' confidence about those controversial policy issues. The results indicate that taking Econ 101 generally causes overconfidence, and the pattern of significant outcomes implies that the tendency to underemphasize the role of context in economic thinking drives this finding. I observe large average treatment effects for several of the economic issues considered, suggesting that professors might reevaluate whether their courses effectively teach students how to think like economists.

1. Concerns that Econ 101ⁱ Causes Overconfidence

Economists generally agree that Econ 101 should teach students to “think like an economist” (Siegfried et al. 1991; Siegfried 2009).ⁱⁱ This paper evaluates the concern that Econ 101 does not adequately teach this skill because the course causes overconfidence on public policy issues over which economists disagree (e.g., raising the minimum wage increases low-wage unemployment).

Economists concerned that taking Econ 101 causes overconfidence disapprove of the standard attempt to teach a consensus view of a contextual discipline. Alan Krueger (2001) argues that Econ 101 textbooks and professors by extension tend “to teach economics as a settled science, as a set of established and universally accepted principles that govern how the economy works” instead of as “a growing body of knowledge that changes and adapts when new information becomes available and is analyzed” (244). In other words, some practitioners worry that the course does not effectively teach students how to think like the economists in President Truman’s famous joke: “Send me a one-handed economist! All of my economists say, ‘On the one hand, on the other.’”

Many practitioners view economic thinking as *contextual* because it epistemologically recognizes multiple legitimate methodological approaches in evaluating any economic situation based on the market, institutional, macroeconomic, and behavioral context. For example, economists regularly must evaluate the behavioral context and decide whether to assume perfect rationality or some variant of bounded rationality. An evaluation of the context also influences econometric decisions, such as whether or not to choose fixed effects over random effects. In contrast, the economic thinking taught in Econ 101 rests more on simple models than an analysis of the economic literature, and Reuven Brenner (1995) argues that this causes overconfidence:

“As teaching of microeconomics now stands, one should not be surprised that students express opinions with great confidence without even remotely being acquainted with facts... Students, though defending with great enthusiasm their ‘scientific’ attitude, do not even realize how many of their beliefs are based on ‘authority’ rather than on even the most superficial knowledge of facts” (108).

Similarly, Colander and McGoldrick (2009) evaluate whether undergraduate economic departments contribute sufficiently to a liberal education and find problematic areas, such as an underemphasis on teaching “big think” questions (e.g., what drives technological growth). In contrast, they argue, “Teaching ‘little think’ questions too often involves uncritical acceptance of assumptions upon which the research is built” (Colander and McGoldrick 2009, 6). Partially in response to these longstanding concerns, some commentators recommend emphasizing introductory content as *models* of reality instead of as Truths (see Colander 2006). To some extent, this approach recognizes multiple legitimate ways to model any economic situation and appreciates the role of context.

Still, commentators tend to agree that their concerns have largely fallen on deaf ears, and one potential explanation for this mirrors Nobel laureate Oliver Williamson’s (2000) recognition that economists needed quantitative studies in order to recognize New Institutional Economics as legitimate: “Initial skepticism has gradually given way to respect—it being the case that economists are very pragmatic people. Tell them something different and consequential about phenomena that are of interest to them and demonstrate that the data are corroborative: that will get their attention” (596).

In attempt to encourage Williamson’s pragmatic economists to join the conversation in the economic education literature, this paper quantitatively explores the concern that taking Econ

101 causes overconfidence about issues over which professional economists disagree (e.g., the minimum wage). With survey data from students at two selective colleges, I use quasi-experimental econometric and psychological methods to estimate a fixed effects linear probability model.

Generally, my quantitative results suggest that Econ 101 does cause overconfidence and imply that professors might consider changing introductory courses in order to meet their responsibility to teach the economics “necessary for democratic citizenship” (Leamer 1950). Specifically, the results indicate that Econ 101 does not adequately teach students to appreciate the role of context in classic examples, such as the minimum wage or the long-run self-adjustment of the macroeconomy.

The remainder of the paper is organized as follows. Section 2 describes a psychological approach to measuring overconfidence and briefly discusses the quasi-experimental data. Section 3 introduces the econometric models and estimation methods. In Section 4, I present the results. Section 5 concludes and discusses implications of my findings for teaching Econ 101.

2. A Quasi-Experiment on Econ 101 and Overconfidence

To estimate the impact of taking Econ 101 on overconfidence regarding economic predictions and policy issues, I surveyed Econ 101 students at the beginning and end of the fall 2013 semester. To incorporate a control group, I also surveyed students taking introductory courses in the natural sciences.

Measuring Overconfidence

Quantitatively studying overconfidence poses significant challenges because people do not self-report overconfidence. I use survey questions that evaluate students’ attitudes on issues

over which professional economists disagree, employing seven-point Likert-type scales that range from “Not at All Confident” to “Very Confident.”

While ordinal attitudinal data poses significant interpretive challenges, many psychologists observe that respondents are less likely circle the endpoints of Likert-type scales (Robertson 2012; Kaptein, Nass, and Markopoulos 2010), and a few psychological studies separate respondents into groups based on extreme responses (see Robinson et al. 1995). Furthermore, some psychologists (personal correspondence with Barry Schwartz 2013; Andrew Ward 2013) hypothesize that respondents rarely circle the endpoints of Likert-type scales because they do not want to appear too certain.

Thus, a psychological understanding of Likert-type scales implies that students who circle 6 or 7 on attitudinal scales about disputed economic issues demonstrate the “great confidence” that Brenner (1995) is concerned about. It is important to contrast students’ great confidence from economists’ confidence, which comes from engaging with the economic literature over many years. This paper conceptualizes overconfidence as great confidence about disputed issues without knowledge of the relevant economic literature. With this framework, the next section introduces survey data that can explore whether taking Econ 101 causes overconfidence.

Survey Data

At the beginning and end of the fall 2013 semester, I surveyed students taking either Econ 101 (treatment), introductory biology (control at College 1), or introductory chemistry (control at College 2). At College 1, a selective liberal arts school, Econ 101 students study both microeconomics and macroeconomics in the fall semester while those at College 2, a respected

research university, only study microeconomics. This could complicate comparisons between the two schools, and I return to this issue when interpreting my results.

In addition to demographic questions, the survey asks students to indicate their confidence about answers to ten public policy questions over which economists disagree, one issue over which biologists disagree, two issues over which chemists disagree, and one overly simplistic political issue (see Table 2 and the Appendix for a list or Table 3 in the Appendix for a justification of each statement). The non-economic questions attempt to test the hypothesis that introductory courses generally cause overconfidence about questions that relate to public policy (see Table 5 and Table 6 in the Appendix for a rejection of this hypothesis). Unfortunately, few appropriate analogs exist in biology and chemistry because those disciplines have fewer political implications.

In terms of response rates, 37% of students in Econ 101 (32 students) at College 1 took both surveys, and 26.6% of students in introductory biology (32 students) did as well. At College 2, the response rates were somewhat lower with 14.4% of Econ 101 students (98 students) and 13.8% of introductory chemistry students (35 students) filling out both surveys. While these rates are relatively small, selection bias only exists if the decision to participate is correlated with the models' unobservables (Verbeek 2013). I address this concern and other assumptions in the next section after describing the reduced form equations.

3. Econometric Models and Estimation Methods

In order to analyze the data, I primarily use the within estimator on fixed effects linear probability models. The before-after surveys of both Econ 101 (treatment) and introductory science (control) respondents create an opportunity to use quasi-experimental methods. The linear probability models have a binary variable for overconfidence, e_{67it} , as the dependent

variable in each model, where the e denotes an extreme view, the $_$ is a place holder for the specific issue (e.g., the minimum wage causes unemployment), and the 67 indicates that a response of 6 or 7 on the attitudinal scales is coded as e_67 equals 1 at time t , zero otherwise. On the right hand side is α_i , an individual fixed effect; $post_{it}$, a dummy variable for post-semester responses; $takingecon_i$, a dummy variable for taking economics; and the interaction between time and taking economics. The within-estimator eliminates unobserved heterogeneity across individuals, and no other variables should change over time in the reduced form equation. β_3 is average treatment effect, and it is the main coefficient of interest.

$$e_67_{it} = \alpha_i + \beta_0 + \beta_1 post_{it} + \beta_2 takingecon_i + \beta_3 post_{it} * takingecon_i + u_{it} \quad (1)$$

In order to estimate the general impact of taking Econ 101, I also sum all of the e_67 dependent variables about economic issues in order to generate a new variable, $esum67$, which indicates the number of economic statements that a student is overconfident in. I also use $esum67$ as the dependent variable when exploring whether various demographic characteristics significantly impact the average treatment effect for general overconfidence about economic issues.ⁱⁱⁱ To shed light on concerns in the economic education literature that demographic traits impact learning in Econ 101 (see Aerni et al. 1999), I test for significant differences for the following *traits*: gender, race, likely major, starting political affiliation, and previous economics courses in high school or college.

$$esum67_{it} = \alpha_i + \beta_0 + \beta_1 post_{it} + \beta_2 takingecon_i + \beta_3 post_{it} * takingecon_i + \beta_4 post_{it} * takingecon_i * trait_i + u_{it} \quad (2)$$

As with all difference-in-difference estimators, the key assumption is that the average changes in the treatment and control groups would have been similar if the treatment group

(economics students) had not received the treatment. A natural check of this assumption is to compare means for the treatment and control groups at the start of the semester, as in Table 1. While the treatment and control groups are relatively similar based on their views at the start of the semester, some highly significant differences exist based on students' characteristics at College 2. Importantly, those characteristics do not significantly affect students' views (see Table 7 in the Appendix). A second indication that this is a reasonable assumption is that in the regressions of equation (1), the coefficients on the *post* variable are rarely significant (see Table 8 in the Appendix). This implies that over time, the chemistry and biology students do not become more or less overconfident about these public policy issues, which makes sense because political views are not expected to change drastically over the course of a semester. Taken together, this evidence supports the intuitive argument that students in large introductory classes such as Econ 101 or introductory biology are not particularly different, ex-ante, and are likely to trend similarly in absence of the treatment. Because evidence and intuition suggests that students' views do not change dramatically in the course of a semester, observed changes are likely due to the treatment and not divergent trends.

A second assumption that may impact the generalizability of my results is that selection into survey participation is random. To test this, I use a probit model of the decision to participate in both surveys in order to attempt to see whether certain characteristics or general ex-ante economic views predict participation of both surveys (as opposed to just the initial survey). The results generally indicate that neither students' characteristics nor their pre-course economic views make it significantly more likely that someone will take both surveys (see Table 9 in the Appendix).^{iv} While it is impossible to prove the absence of selection bias, the difficulty in predicting the participation decision suggests that it is reasonable to assume that attrition does

TABLE 1: Comparison of Initial Means (e_67 Specification)

<i>Controversial Issues and Various Characteristics</i>	<i>College 1</i>			<i>College 2</i>		
	<i>Mean (Treatment)</i>	<i>Mean (Control)</i>	<i>T Test P-Value</i>	<i>Mean (Treatment)</i>	<i>Mean (Control)</i>	<i>T Test P-Value</i>
<i>1. Minimum Wage</i>	0.031	0.185	0.053*	0.235	0.2	0.739
<i>2. Immigration</i>	0.063	0.185	0.152	0.163	0.2	0.692
<i>3. Rent Control</i>	0.094	0.074	0.791	0.143	0.1	0.616
<i>4. Marginal Tax Rates</i>	0.125	0.111	0.872	0.132	0.1	0.693
<i>5. Discrimination</i>	0.031	0.037	0.905	0.061	0.05	0.848
<i>6. Health Care</i>	0.063	0.111	0.513	0.112	0.3	0.029**
<i>7. Government</i>	0.188	0.111	0.425	0.163	0.0	0.053*
<i>8. Fiscal</i>	0.531	0.259	0.035**	0.367	0.2	0.152
<i>9. Efficient Markets Hypothesis</i>	0.031	0.111	0.231	0.051	0.0	0.306
<i>10. Self Correcting</i>	0.219	0.185	0.755	0.153	0.05	0.223
<i>Summed Economic Issues</i>	1.38	1.37	0.991	1.58	1.2	0.293
<i>Female</i>	0.469	0.630	0.224	0.449	0.75	0.014**
<i>First Year Student</i>	0.625	0.667	0.744	0.816	0.3	0.000***
<i>Person of Color</i>	0.375	0.407	0.803	0.379	0.35	0.810
<i>Start Democrat</i>	0.844	0.815	0.773	0.633	0.65	0.884
<i>High School Econ</i>	0.387	0.385	0.985	0.439	0.2	0.047**
<i>Previous College Econ</i>	0.032	0.741	0.482	0.033	0.105	0.176

*p < 0.01

**p < 0.05

***p < 0.001

n (College 1) – 32 treatment, 27 control

n (College 2) – 98 treatment, 20 control

not cause significant selection bias. Note also that interpreting the coefficients as average treatment effects requires the assumption that those who take neither survey (and are thus not in the study) are not systematically different from those who are in the study. Without information on the traits of the abstainers, I am unable to test this directly, but it seems reasonable to assume

that people who only took one survey are not systematically very different from those who took neither survey in significant ways.

4. Results

This section describes and interprets the results of estimating equations (1) and (2) for students in the treatment and control groups at the two included colleges. Importantly, because few respondents circle 7 on Likert-type scales, the results in this section are often but not always robust to only using 7 to determine extreme responses (see Table 4 in the Appendix). Those results robust to using the e_7 specification may demonstrate more intense overconfidence, but my main results follow Robinson et al. (1995) and use both 6 and 7 to separate responses.

At both colleges, the coefficient for the average treatment effect is highly statistically significant for the minimum wage issue (#1) with a β_3 of 0.424 at College 1 and 0.316 at College 2. This indicates that taking Econ 101 at College 2 causes students to become 31.6 percentage points more likely to indicate overconfidence than if they had not taken the course, relative to a baseline (pre-semester) mean of 0.235. Similarly, the rent control issue (#3) is highly significant at both schools with a β_3 of 0.350 at College 1 and 0.314 at College 2. Also, the general overconfidence variable is statistically significant at both schools, indicating that taking Econ 101 makes students more likely to demonstrate overconfidence about approximately one more issue than if they had not taken the course.

In contrast, a few issues are statistically significant at College 2 but not at College 1. Specifically, Econ 101 at College 2 causes overconfidence about the health care issue (the estimated coefficient is 0.151) and the economy's self-correcting mechanism issue (the estimated coefficient is 0.254). These differences may be driven by the fact that the Econ 101 course at

TABLE 2: Average Treatment Effects for Controversial Issues Among Economists

<i>Controversial Issues</i>	<i>e₆₇</i> <i>(College 1)</i>	<i>e₆₇</i> <i>(College 2)</i>
1. Raising the minimum wage will increase unemployment among low-wage workers.	0.424*** (0.117)	0.316*** (0.092)
2. Reducing barriers to immigration will decrease the wages of low-wage workers.	0.063 (0.108)	0.153 (0.114)
3. In North America, rent-control programs substantially distort market prices.	0.350*** (0.115)	0.314*** (0.085)
4. Lower income taxes increase work effort.	0.0 (0.094)	0.101 (0.098)
5. Laws about discrimination in the labor market are unnecessary because differences between workers' experiences can be explained by productivity or career choices.	0.006 (0.048)	-0.019 (0.094)
6. Efforts to bring down health care costs in the United States will reduce quality of care.	-0.037 (0.079)	0.151** (0.074)
7. In terms of the economy, the government is best seen as playing a corrective role.	-0.160 (0.103)	-0.148 (0.110)
8. Government spending has a significant stimulative impact in recessions.	0.176 (0.136)	0.051 (0.114)
9. Financial markets are efficient, so any problems in them are the result of economic disruptions elsewhere in the economy.	0.006 (0.072)	0.051 (0.040)
10. The economy has a self-correcting mechanism that won't let it stay depressed in the long run.	0.094 (0.098)	0.254*** (0.076)
11. Summed economic issues	0.920** (0.387)	1.22*** (0.342)

*p < 0.01; Robust standard errors in parentheses.

**p < 0.05

***p < 0.001

n (College 1) – 59 students
n (College 2) – 118 students

College 2 is only an introductory microeconomics course, while at College 1, the semester-long course includes both introductory micro- and macroeconomics.

Furthermore, regressions estimating equation (2) explore whether demographic characteristics of students significantly impact the effect of taking Econ 101 on general overconfidence about economic issues. Generally, none of the estimated interaction effects are significant at College 2.^v This contrasts to the results from College 1, where the β_4 for both

likely econ majors and people of color are negative and statistically significant at the 5% level at College 1 using the *esum67* specification (see Table 7 in the Appendix). This indicates that likely econ majors and people of color at College 1 are less likely to become overconfident as a result of taking Econ 101, but the robustness of these results is questioned by the insignificance of the same coefficients at College 2, where the experiment has a larger sample size. Still, the result that likely economics majors at College 1 are less likely to become overconfident supports the argument in the economic education literature that Econ 101 professors should focus relatively more on non-majors than they typically do. Similarly, the evidence that students of color have a different experience at College 1 than their peers indicates the need for further research into the ways that various identities can impact how students relate to material in Econ 101.

Additionally, it is worth noting that none of the estimates of β_3 in equation (1) are significant and negative, which suggests that Econ 101 does not nuance the views of students who enter with dogmatic views. Furthermore, students tend to become more convinced of issues with a conservative bias than issues with a liberal bias (#7 and #8) at generally liberal schools like those included in the study.

In total, these results suggest that taking Econ 101 causes overconfidence in issues over which economists disagree. Generally, the results imply that courses may cause overconfidence if they do not explore the market, institutional, macroeconomic, or behavioral context appropriately. Specifically, it appears that the real-world examples of simple theoretical models prove the most problematic. Both the minimum wage issue and the rent control issue are presented as examples of price floor and price ceiling models. Because students understand examples as easy and concrete ways to think about abstract concepts, using contentious public

policy issues as examples without exploring disagreements within the discipline can cause overconfidence. Furthermore, the insignificance of β_3 for the fiscal policy is effective issue (#8), among other abstract items, could be consistent with students having a basic intuition that some issues must be understood in a larger political context.

Building off of this contextual framework, an explanation for further overconfidence at College 2 stems from inappropriate applications of the “efficiency story” from Econ 101 (see Colander 2006 for a description of this story) into contexts where markets are less likely to be efficient. For example, students taking Econ 101 may become overconfident in the efficiency of health care markets (#6) if the various ways in which markets often fail are not emphasized (e.g., adverse selection and moral hazard). Similarly, when introductory microeconomics students at College 2 become overconfident in the self-healing mechanism (#10), one explanation is that their introductory microeconomics course likely did not emphasize how political turmoil can distort economic incentives in the short run, which questions the role that long-run analysis plays in evaluating recessions. Because introductory microeconomics courses rarely include examples of prolonged shortages and surpluses, professors teaching a yearlong Econ 101 sequence face additional challenges as many of their students may stop halfway through.

Furthermore, the lack of significance on the immigration issue (#2) implies that students do not become overconfident of easy and common extensions of the supply and demand framework if those examples are not commonly emphasized in textbooks. Finally, the lack of significance in the average treatment effects for many of the other issues may stem from practitioners and textbooks better situating those issues within a political and socio-historical context. For example, even though the efficiency story implies that discrimination does not exist

in the economy (#5), textbooks tend to situate this theoretical result within a world where many people experience discrimination (Krugman and Wells 2009, 527).

5. Discussion and Conclusion

While preliminary, the results in this study suggest that taking Econ 101 does cause overconfidence about issues over which professional economists disagree. It is plausible that economists do not emphasize the importance of context in shaping economic thinking and indicating the limits of basic models. While further research is needed to explore whether or not the average treatment effects diminish over time, Sanders (1980) finds that students do retain information they learn in Econ 101. Because many students take Econ 101 in order to learn the skills necessary for responsible democratic participation, it seems reasonable that students would be even more likely to remember facts (e.g., all economists think the minimum wage increases unemployment) than epistemological methods. Thus, if a practitioner's goal is to produce economics majors and PhDs, then the current course probably meets certain expectations since students can learn about the social construction of economic knowledge later. Still, if professors consider Econ 101 to be part of the foundation for a liberal education, then they may not be meeting many of their goals.

Furthermore, subsequent research should examine the external validity of these results. Intuition suggests that researchers would observe an even larger problem at more conservative institutions or schools less known for rigorous courses. Upon reflection, it seems likely that practitioners will respond to these results in one of four ways. I briefly outline them below:

1. Do nothing: Some economists may not act on the findings in this paper because they are skeptical of both new research and of surveys in general. Furthermore, the costs of changing courses may seem too high for some practitioners. While not unreasonable, this response ignores

both qualitative work in the economic education literature and the responsibility to constantly reevaluate “the *central* messages that we wish to convey to our students in the principles course” (Stiglitz 1988, 175).

2. *Contextualize problematic examples in the textbooks*: One relatively practical response to these results is to contextualize the issues that have statistically significant average treatment effects at both colleges. The minimum wage and rent control issues are relatively easy to contextualize. Practitioners can teach multiple models of the minimum wage and discuss empirical studies. In regards to rent control, economists can describe the poor design of “first-generation” policies and the controversies around “second-generation” rent control.

This response builds on the work of Alan Krueger (2001) who argues that professors miss an opportunity to teach about the production of economic knowledge and the complexity of the discipline if they ignore debates in the literature about the minimum wage. While this response is a good first step, it ignores other statistically significant results at College 2 as well as the blunt nature of this paper’s empirical methods. To be clear, the methods in this paper do not do a good job of describing the student experience. Instead, they validate a long-standing concern in the literature, and the results at College 2 indicate that this concern likely goes beyond a few problematic examples.

3. *Teach an introduction to mainstream economics instead of an introduction to foundational models*: Econ 101 does not teach an introduction to contemporary mainstream economics. Instead, the course teaches foundational models that are “calisthenics” (i.e., logical exercises to help students develop deductive skills), which do not accurately represent reality (Colander 2005). Instead of the current course, one could teach a variety of contemporary ways to approach economic reality (e.g., empirical methods, perfect competition, imperfect

competition, New Institutional Economics, behavioral economics, and game theory) and wait to teach the foundational models until intermediate theory courses. This could give introductory students a better sense of the discipline and offer them tools that can conceptualize economic reality in ways that foundational models cannot. Practitioners who respond in this way refuse to teach introductory courses largely disconnected from reality and believe that the course should focus relatively more on the needs of the 42% of undergraduates who do not major than on the 2% who do (Salemi and Siegfried 1999).

4. *Teach a pluralist course:* The most radical response is to teach a course that highlights mainstream, heterodox, and interdisciplinary methodologies. If Econ 101 professors struggle to teach contextual economic thinking, then one response is to develop courses based on pluralist economists' argument that students would benefit from learning a variety of ways to approach economic phenomena (see Aerni et al. 1999; Nelson 2009). Considering that *Capital in the 21st Century* is currently dominating much economic discourse, it is odd that Piketty's explicitly interdisciplinary project has no place in Econ 101. Perhaps it is not surprising that the most exciting book to describe the American economy in the past decade was written by an economist who couldn't stand working in an American economics department for more than a few years. If Piketty is redefining what cutting edge economic research can look like, it is worth asking if Econ 101 excites students who want to do that cutting edge work.

In short, the results of this study are suggestive of a tendency for Econ 101 to produce students who are overconfident about difficult and contested economic issues, and the analysis builds on students' and practitioners' calls from across the world to revisit whether Econ 101 teaches students to think like economists. Thankfully, many economists have spent years studying economic pedagogy and how to better support a liberal education (see Hoyt and

McGoldrick 2012 for a expansive handbook). The results in this paper indicate that every mainstream economics professor should apply that knowledge.

NOTES

ⁱ While much of the literature on teaching Principles of Economics uses PoE as an abbreviation, this paper uses Econ 101 in order to both allude to the course as a foundation for basic citizenry and to conjure up an image of the undergraduate experience. Neither economics course surveyed is called Econ 101.

ⁱⁱ I agree with Siegfried's (2009) argument that thinking like an economist "involves not only applying economic reasoning, but also knowing when to apply it. Colander and McGoldrick call this thinking like a liberally educated person, but the difference seems largely semantic" (223).

ⁱⁱⁱ The coefficients on the demographic interaction variables for the individual-issue regressions were rarely significant, so I use equation (2) with the *esum67* variable in order to evaluate whether a general pattern exists.

^{iv} College 2 students who previously took economics in college are the only exception to the statement that the results suggest that it is not possible to predict whether or not someone will take the second survey from their characteristics and general overconfidence. Still, the p-value for the Wald test of overall significance at College 2 is 0.064, indicating that we cannot reject the general null hypothesis that students' characteristics and opinions do not impact their decision to take both surveys at the 10% level. Furthermore, these College 2 students drive the p-value down because excluding the previous college economics variable leads to an insignificant p-value of 0.23 at College 2 for the Wald test. Fortunately, only 9.6% of the students at College 2 who take the first survey have previously taken college economics, and it is unlikely that these few students would bias the results so much as to change the basic conclusions.

^v At both College 1 and College 2, students who have previously taken a college course in economics correspond to a significant β_4 for the *e_7* specification but not the *e_67* specification. This is an odd result because there is no convincing explanation for why the former would be significant if the latter is not. While it is plausible to argue that these students are only more likely to become *very overconfident*, it seems more reasonable to view this result as an anomaly that results from low variability. There are not many students who have previously taken college economics in Econ 101, so if few of these students (and thus a significant proportion) circle 7's, we could see a statistically significant result that is not economically meaningful. Regardless of one's interpretation, there are no obvious implications for the larger paper.

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APPENDIX:

The following descriptions and tables offer justifications for the survey questions as well as checks for robustness and tests of various assumptions. The appendix starts with the former.

The survey asks students to indicate their confidence about 14 controversial statements (e.g., “In North America, rent control programs substantially distort market prices”). Ten of the statements concern public policy and economics, and three of them come from chemistry and biology in order to test if the control groups become overconfident in their disciplines. A final political science issue provides the opportunity to assess whether economics students become overconfident in general. The survey program randomizes the order of the statements, and for each one, participants indicate their confidence on a Likert-type scale from “Not at All Confident (1)” to “Very Confident (7).” To choose each of the economics issues, I use three selection criteria: *controversial*, *relevant*, and *political*.

The *controversial* criterion requires that professionals disagree. For the economics issues, I relied on surveys of professional economists (Fuller and Geide-Stevenson 2003) and reflections from economists in the literature about Econ 101. While Fuller and Geide-Stevenson’s (2003) survey proves helpful in determining disagreement, their measures of consensus are unconvincing, and I instead use their statistics to make intuitive cases for a lack of consensus. On all of the survey questions from Fuller and Geide-Stevenson (2003), respondents can choose “disagree,” “agree with provisos,” or “agree.”

The *relevant* criterion requires that introductory textbooks either ignore a controversy in the literature or teach content that a student could easily apply to reach an oversimplified understanding of a controversial issue. I mostly draw on peer-reviewed journal articles that critique the treatment of certain public policy issues in Econ 101 to substantiate this criterion.

The *political* criterion requires that each statement relate to public policy. I do not thoroughly justify this criterion because statements either intuitively connect to public policy or they do not. Together, the *controversial*, *relevant*, and *political* criteria ensure that each statement presents an opinion on public policy that economists disagree about and that taking Econ 101 may cause overconfidence in.

Unfortunately, finding analogous issues from the natural sciences poses a difficult challenge, particularly in chemistry. While many economists write about basic disagreements in the profession, no studies clearly evaluate oversimplified controversies in chemistry and biology. Therefore, I rely on personal communication and non-survey online research to determine similar issues for chemistry and biology. Furthermore, I do not use these criteria to select the political science issue, which is merely an oversimplified statement. In Table 3, I justify this claim along with the criteria for all of the other statements.

Because I cannot find any contested statements related to politics in the chemistry syllabus of the class I survey, I include one apolitical statement that is controversial in the sense that some chemists are skeptical of it even though no alternative theory exists. I pair this statement with one somewhat political chemistry statement that is not discussed explicitly in the College 2 course curriculum. In Biology, the only contested issue I can find with political implications has a much stronger consensus among biologists than the economics issues that I use. These difficulties point to the uniqueness of the economics curriculum as a deeply political science striving for the separation of positive from normative analysis. For justifications of the economics statements listed in Table 2 and the other statements listed below, see Table 3.

Political Science Issue:

- “In general, the U.S. should be much more aggressive in responding to China” (shortened to *China*).

Biology Issue:

- “Genetically modified foods pose no threat to Americans” (shortened to *Genetically Modified Foods*)

Chemistry Issues:

- “The future of industrial production is in “green chemistry” (i.e. the modification of existing reactions to decrease chemical waste and increase efficiency” (shortened to *Green Chemistry*)
- "Heisenberg's uncertainty principle convincingly explains that no particle has a definite position" (shortened to *Heisenberg*)

TABLE 3: Survey Issues Justifications

<i>Issues</i>	<i>Controversial</i>	<i>Relevant</i>
1. <i>Minimum Wage</i>	26.5% of economists surveyed disagree and 27.9% of economists surveyed only agree with provisos that “Minimum wages increase unemployment among young and unskilled workers” (Fuller and Geide-Stevenson 2003).	In Krueger’s (2001) survey of 8 popular Intro Econ textbooks, he finds that despite the reality that many economists think that modest raises in the minimum wage do not impact unemployment negatively, “introductory textbooks have been reluctant to expand the consensus range [of the minimum wage’s impact on unemployment] to include zero” (249).
2. <i>Immigration</i>	In Ehrenberg and Smith’s (2012) <i>Modern Labor Economics: Theory and Practice</i> , they conclude a section about immigration, writing, “It seems fair to say, then, that it is not entirely clear how immigration of less-skilled workers to the United States has affected the wages, on average, of native workers” (343).	The concern that increases in immigration will reduce low-wage wages is a simple and clear application of the basic supply and demand model.
3. <i>Rent Control</i>	“In recent years, however, there has been a wave (or at least a swell) of revisionism among housing economists on the subject of rent control... Perhaps a majority, at least among the younger generation, would agree with the statement that a well-designed rent control program can be beneficial” (Arnott 1995, 99).	“Most of the leading texts... used rent controls as an example of what happens when price ceilings are imposed on competitive markets” (Hill and Myatt 2007, 66).
4. <i>Marginal Tax Rates</i>	30.9% of economists surveyed disagree and 42.3% of economists surveyed only agree with provisos that “Lower marginal income tax rates reduce leisure and increase work effort” (Fuller and Geide-Stevenson 2003).	While the literature about Intro Econ does not discuss the prevalence or simplicity of stories about marginal tax rates, this statement is a clear application of the “efficiency story” (Colander 2006)
5. <i>Discrimination</i>	39.3% of economists surveyed disagree and 28.2% of economists surveyed only agree with provisos that “There are relatively few compensation and promotion differentials between men and women that cannot be explained by differences in productivity and/or career choices” (Fuller and Geide-Stevenson 2003).	Within a larger conversation about contemporary discrimination, Krugman and Wells (2009) write, “The main insight economic analysis offers is that discrimination is <i>not</i> a natural consequence of market competition. On the contrary, market forces tend to work against discrimination” (527).
6. <i>Health Care</i>	13.4% of economists agree and 37.6% of economists surveyed agree with provisos that “Compared to traditional fee-for service health care, managed care has increased the general welfare of society” (Fuller and Geide-Stevenson 2003).	The idea that reducing costs will reduce welfare is an extension of the idea that the markets are efficient.
7. <i>Government</i>	35.6% of economists surveyed agree and 35.2% of economists surveyed agree with provisos that “...activist fiscal policy should be avoided” (Fuller and Geide-Stevenson 2003). This implies that the government often plays a distortionary role in contrast to a corrective role.	“Instead of using the tools of economics to analyze how the political process works, basic courses generally treat government as a corrective device” (Gwartney 2012, 302). Gwartney (2012) writes about AP economics courses, but his concern may apply to Econ 101 courses at the college level.

8. <i>Fiscal</i>	“13.4% of economists surveyed disagree and 44.3% of economists only agree with provisos that “Fiscal policy has a significant stimulative impact on a less than fully employed economy” (Fuller and Geide-Stevenson 2003).	Gwartney (2012) argues, “AP macroeconomics makes activist countercyclical policy look easy” (305). While AP macroeconomics is not a college course, the former is modeled after the later, and they may not differ significantly in this case.
9. <i>Efficient Markets Hypothesis</i>	54.4% of economists surveyed agree or agree with provisos that “some restrictions on the free flow of financial capital are essential...” (Fuller and Geide-Stevenson 2003).	Hill and Myatt (2007) describe that the heart of the “leading microeconomic principles textbooks” is “the perfectly competitive market as a depicted in the supply and demand framework” (58). The efficient markets hypothesis is an extension of this framework to the financial sector.
10. <i>Self Correcting</i>	Only 25.8% of economists surveyed agree that “An economy in short-run equilibrium at a real GDP below potential GDP has a self-correcting mechanism...” (Fuller and Geide-Stevenson 2003).	In regards to the macro issue about Aggregate Supply, Colander (2006) writes, “the long-run AS curve is related to the ‘natural rate’ equilibrium of the economy, and the argument is made that if the wage rate is flexible in the long run, the economy will always be at ‘full employment’” (146).
11. <i>China</i>	Logan (2013) describes the U.S. policy of “conengagement [which] combines military containment with economic engagement” as “incoherent” (93). The survey’s statement about “responding more aggressively to China” ignores the complex tradeoffs of aggressive responses that foreign policy experts debate.	Intro Econ does not usually address the U.S.-China relationship, and the purpose of this question is to see if taking Intro Econ causes students to be more or less certain of vague foreign policy statements.
12. <i>Genetically Modified Foods</i>	While the FDA has determined that GMOs pose no threat (Entine 2013), some skeptics with credentials disagree (e.g., The Union of Concerned Scientists).	Introductory Biology courses at College 1 portray GMO as non-threatening to humans. I am thankful to Professor Elizabeth Vallen (2013) for helping me find a somewhat controversial introductory biology issue.
13. <i>Green Chemistry</i>	While Beach, Cui and Anastas (2009) argue that “many challenges still lie ahead” (1038), they conclude that green chemistry “will be particularly important as we strive to understand the fundamentals of sustainability” (1046).	While green chemistry is not a part of every introductory chemistry course, some courses may emphasize the potential of chemistry without introducing students to the pragmatic limitations of different strategies. I am thankful to personal communication with Elie Pommier (2013), a recent chemistry graduate from McGill University, for alerting me to this potential problem. As stated earlier, finding analogous questions for the introductory chemistry course proved difficult, especially considering the lack of literature on the relationship between introductory chemistry courses and public policy.
14. <i>Heisenberg</i>	In a personal communication, Professor Donald Berry (2013) writes, “Most of us who aren't specialists have resigned ourselves that [Quantum Mechanics] is the best available model to explain physical ‘reality’ at the atomic and molecular level. But we don't really like it.”	The Heisenberg Uncertainty Principle is an expected part of introductory chemistry courses.

TABLE 4: Robustness Check for Significant Average Treatment Effect Estimates from

<i>Controversial Issues</i>	$e_{.67}$ (College 1)	$e_{.7}$ (College 1)	$e_{.67}$ (College 2)	$e_{.7}$ (College 2)
1. Minimum Wage	0.424*** (0.117)	0.068 (0.066)	0.316*** (0.092)	0.122*** (0.044)
3. Rent Control	0.350*** (0.115)	0.131** (0.064)	0.314*** (0.085)	0.071*** (0.026)
6. Health Care	-0.037 (0.079)	Omitted by Stata due to lack of variation in the dependent variable	0.151** (0.074)	0.040 (0.090)
10. Self Correcting	0.094 (0.098)	0.006 (0.066)	0.254*** (0.076)	0.031 (0.031)
11. Summed economic issues	0.920** (0.387)	0.410* (0.242)	1.22*** (0.342)	0.385*** (0.135)

*p < 0.01; Robust standard errors in parentheses.

**p < 0.05

***p < 0.001

n (College 1) – 59 students

n (College 2) – 118 students

TABLE 5: Average Treatment Effects for Controversial Political Science Issue

<i>Controversial Issue</i>	$e_{.67}$ (College 1)	$e_{.7}$ (College 1)	$e_{.67}$ (College 2)	$e_{.7}$ (College 2)
11. China	0.037 (0.079)	0.031 (0.055)	0.031 (0.085)	0.0 (0.015)

*p < 0.01; Robust standard errors in parentheses.

**p < 0.05

***p < 0.001

n (College 1) – 59 students

n (College 2) – 118 students

TABLE 6: Average Treatment Effects for Controversial Issues Among Biologists and Chemists

<i>Controversial Issues</i>	$e_{.67}$ (College 1)	$e_{.7}$ (College 1)	$e_{.67}$ (College 2)	$e_{.7}$ (College 2)
12. Genetically Modified Foods	0.076 (0.104)	-0.037 (0.058)		

13. Green Chemistry

0.135
(0.117)0.047
(0.075)

14. Heisenberg

-0.200*
(0.113)0.189*
(0.100)

*p < 0.01; Robust standard errors in parentheses.

**p < 0.05

***p < 0.001

n (College 1) – 59 students

n (College 2) – 118 students

TABLE 7: Econ 101 Students' Traits Impact on the General Average Treatment Effects

<i>Economics Students' Characteristics</i>	<i>esum67 (College 1)</i>	<i>esum7 (College 1)</i>	<i>esum67 (College 2)</i>	<i>esum7 (College 2)</i>
<i>Likely economics major</i>	-1.198 ** (0.533)	-0.460 (0.420)	-0.075 (0.385)	0.121 (0.216)
<i>Female</i>	-0.310 (0.576)	-0.102 (0.421)	0.416 (0.409)	-0.055 (0.215)
<i>Person of color</i>	-1.12** (0.501)	-0.833* (0.419)	0.169 (0.442)	0.113 (0.239)
<i>First year student</i>	-0.217 (0.562)	-0.633 (0.427)	0.411 (0.483)	0.219 (0.261)
<i>Start Democrat</i>	-0.2 (0.797)	0.222 (0.791)	-0.348 (0.424)	0.239 (0.219)
<i>Previous high school economics</i>	-.158 (.599)	-.589 (.450)	-.317 (.407)	-.252 (.219)
<i>Previous college economics</i>	-.1 (.302)	.833*** (.221)	.759 (.854)	1.460** (.737)

*p < 0.01; Robust standard errors in parentheses.

**p < 0.05

***p < 0.001

n (College 1) – 59 students

n (College 2) – 118 students

TABLE 8: Coefficients on Time in Equation 1

<i>Controversial Issues</i>	<i>e₆₇</i> <i>(College 1)</i>	<i>e₆₇</i> <i>(College 2)</i>
1. <i>Minimum Wage</i>	-0.111 (0.424)	0.0 (0.071)
2. <i>Immigration</i>	0.0 (0.075)	0.0 (0.101)
3. <i>Rent Control</i>	-0.037 (0.065)	-0.1 (0.068)
4. <i>Marginal Tax Rates</i>	0.0 (0.053)	-0.05 (0.087)
5. <i>Discrimination</i>	-0.037 (0.037)	0.05 (0.087)
6. <i>Health Care</i>	0.037 (0.065)	-0.1 (0.068)
7. <i>Government</i>	0.222*** (0.081)	0.25** (0.098)
8. <i>Fiscal</i>	0.074 (0.091)	0.0 (0.101)
9. <i>Efficient Markets Hypothesis</i>	-0.037 (0.065)	0.0*** ^a (0.0)
10. <i>Self Correcting</i>	0.0 (0.053)	-0.05 (0.049)
11. <i>Summed economic issues</i>	0.111 (0.257)	0.0 (0.276)

Note: None of the results are meaningfully significant with the *esum7* specification, so that specification is omitted for clarity.

*p < 0.01; Robust standard errors in parentheses.

**p < 0.05

***p < 0.001

n (College 1) – 59 students

n (College 2) – 118 students

^a This is not economically significant.

TABLE 9: Probit Regression Results Exploring the Selection Decision

<i>Various Characteristics and Summed Economic Issues</i>	<i>College 1</i>	<i>College 2</i>
<i>Taking Econ 101</i>	-0.298 (0.391)	0.098 (0.218)
<i>Female</i>	-0.160 (0.336)	0.104 (0.164)
<i>Likely economics major</i>	0.587 (0.447)	0.224 (0.181)
<i>First year student</i>	-0.522 (0.381)	-0.104 (0.189)
<i>Previous high school economics</i>	-0.039 (0.352)	-0.145 (0.163)
<i>Previous college economics</i>	-0.764 (0.577)	-0.748** (0.299)
<i>esum67</i>	-0.158 (0.150)	-0.076 (0.061)
<i>esum7</i>	0.278 (0.231)	-0.031 (0.089)

*p < 0.01; Robust standard errors in parentheses.

**p < 0.05

***p < 0.001

n (College 1) – 70 students

n (College 2) – 202 students