

Does the Choice of Introductory Microeconomics Textbook Matter?

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Abstract

This paper examines the effects of different introductory microeconomics textbooks on student performance in subsequent economics courses (specifically Intermediate Microeconomics I and Money and Banking). It finds evidence that in some cases the effects are significant and sizeable. It also provides evidence of other variables affecting student performance in later courses such as taking first-year microeconomics by distance, math background, effects of having taken other economics courses and the time between introductory economics and later courses.

1 Introduction

The primary aim of this paper is to see if the choice of introductory microeconomics textbook has a lasting effect on students. It does this by seeing if students who used different textbooks when they studied introductory microeconomics perform differently when they take later economics courses. It finds limited evidence that in some cases the choice of introductory microeconomics textbook does affect student grades in Intermediate Microeconomics and Money and Banking.

This appears to be a unique contribution. The author could find no evidence of others who have attempted to empirically test the effects of different textbooks in economics or other disciplines. However, Fleisher, Hashimoto and Weinberg (2002) use a somewhat similar approach in examining the effectiveness of foreign graduate teaching assistants compared to their domestic counterparts.

The paper also provides evidence of other factors that effect student performance in economics such as methods of delivery (i.e. distance versus traditional), math background, effects of having taken other economic courses and the time between introductory economics and later courses.

The data in this paper is drawn from records of students who took introductory microeconomics between the Fall term of 1995 and the Winter term of 2005 at Memorial University of Newfoundland. In the 2004-2005 academic year, Memorial had 17 785 students enrolled. Being the only university in the province of Newfoundland and Labrador, there is an advantage in using this data as students are likely to be more representative of the overall student population than students in other jurisdictions. This is because in other jurisdictions, the greater

choice of universities would likely result in individual institutions attracting and accepting different types of students.

The next section of this paper will examine the effect of the choice of introductory microeconomics textbook on student performance in Intermediate Microeconomics I. The subsequent section will examine the effect on student performance in Money and Banking. Section 4 will discuss the results and conclude the paper.

2 Intermediate Microeconomics I

Ideally one would use performance in principles of microeconomics as the measure of the effectiveness of principles textbooks. The problem with this approach at Memorial University is that there is widespread adjustment of grades in introductory economics. This makes grades in introductory economics a questionable measure of performance. Thus, grades in subsequent courses will be used instead.

In many ways, student performance in Intermediate Microeconomics I seems an appropriate choice for measuring what students learnt in Introductory Microeconomics. To see this, consider the course descriptions in the university calendar:

Introduction to Microeconomics I. Scarcity and opportunity cost. Demand and supply. Elasticity. Household demand: marginal utility. Household demand: indifference curves. Production functions. Short-run and long-run cost functions. Perfect competition in the short run and the long run. Monopoly.

Intermediate Micro Theory I. The basic microeconomic theory course; consumer demand, indifference curve analysis, theory of production and cost, factor substitution, and the theory of the firm under perfect competition and monopoly.

It will be noted that there is a close correspondence between the topics covered in the two courses. Given that the topics in Intermediate Microeconomics I build on those covered in Introduction to Microeconomics I¹, it is reasonable to assume that the better the foundation a student has in introductory microeconomics, the better he will do in Intermediate Microeconomics I.

Two other aspects of the course description for introductory microeconomics should be noted. The first is the requirement that indifference curves be covered. As several textbooks no longer contain material on indifference curves, this narrows the range of textbooks that are likely to be adopted. The second is that the course description is more detailed than descriptions for similar courses at many other institutions. This narrows instructor discretion on the choice of topics. Thus differing performances of otherwise identical students in Intermediate Microeconomics are less likely to be a result of different coverage in first-year and are more likely due to the way material was presented.

The close mapping of topics is to some extent a two-edged sword. It could be argued that student performance in Intermediate Microeconomics I is too dependent on their knowledge of the particular topics covered in principles and not their ability to “think like economists” which many argue should be the goal of economics courses.

There are other disadvantages in using student performance in Intermediate Microeconomics to evaluate textbooks. First, the sample size is relatively small. Second, only

¹ There is also an Introduction to Microeconomics II. However, it is rarely offered and it is not a prerequisite for any other courses. Thus, henceforth the ‘I’ in Introduction to Microeconomics I will be dropped, except when discussing the number of courses subsequent to it that students have taken.

economics majors and minors are required to take the course. Given that 10 039² students completed principles of microeconomics during the period in question, the 553 students who took Intermediate Microeconomics are likely to be those with the most positive view of economics.

Section 3 will attempt to overcome these disadvantages by replacing Intermediate Microeconomics with Money and Banking. The trade off will be giving up the advantage of the close mapping of topics covered.

2.1 The data

Information on the textbooks is given in Table 1. The books will be referred to by the last name of the first author. This is done (i) for brevity; (ii) to avoid confusion in cases where the coauthors have changed over the sample period; and (iii) because users of international and American editions of these books are unlikely to be familiar with the Canadian coauthors.

- Insert table 1 around here.

The dependent variable is the student's grade in Intermediate Microeconomics I. When the student made multiple attempts at the course, the first attempt the student made where he/she received a grade (did not drop) is used. Observations of the dependent variable run from Spring 1996 to Winter 2005. The mean grade is 64.247 with a standard deviation of 19.890³.

Column 2 of Table 2 gives the means and standard deviations of all the independent variables used in this section.

-insert table 2 around here.

² This figure, as well as others regarding the total number of students, involved some double counting in cases where students took courses multiple times. However, this double counting has been eliminated from the sample used in the analysis.

³ The dependent variable grades have a higher standard deviation than the prerequisite courses, in part, because it includes both students who have passed and failed the course. The grades for the prerequisite courses are generally those of students who passed the prerequisite courses.

The first independent variable is a dummy variable for the 4% of students who made a previous attempt at Intermediate Microeconomics but dropped after the first two weeks of classes.

The required prerequisites for Intermediate Microeconomics I are Introduction to Microeconomics, Introduction to Macroeconomics and Calculus I⁴ (or equivalent course). Thus, grades in each of these courses are independent variables in the initial regressions. The grades are recorded as percentages. For students who made multiple attempts at these courses, the grade in their last attempt prior or concurrently to taking Intermediate Microeconomics I is used, even when this is not their highest grade. It might be argued that the highest grade might reflect the case in which the student learnt the most. However, the most recent grade is more likely to reflect the student's knowledge when he enrolled in Intermediate Microeconomics.

Dummy variables for students who made multiple attempts at the prerequisite courses are also included. Some students attempted introductory microeconomics and introductory macroeconomics up to four times and Calculus I seven times. Nonetheless, the majority of students who repeated these courses only did so once so no effort is made to control for students who made more than one previous attempt.

Since it is recommended that students take Calculus I rather than "equivalent" courses (e.g. Differential Calculus I), a dummy variable is included for students who took equivalent courses instead.

Some students took introductory microeconomics by distance. As this is a significantly different way of presenting the material, a dummy variable is included for these students. During this time period, the distance offerings took the form of traditional correspondence

⁴ Calculus I is basically a course in single variable differentiation plus an introduction to integration.

courses, lectures transmitted by satellite and currently web-based courses. Thus, this variable is equal to one whenever the course did not involve live face-to-face interaction with the instructor.

It is reasonable to assume that after a student takes a course, his knowledge decays as time passes. Thus, a variable for the number of terms between completion of his last attempt at Introduction to Microeconomics and Intermediate Microeconomics is included.

Although introductory microeconomics is regularly offered in every term, most students take it in the Fall term. Dummy variables are included for students who took it in the Winter and Spring (summer) terms. Intermediate Microeconomics I is regularly offered in both the Fall (when most students take it) and Winter terms and occasionally in the Spring term. Dummy variables are included for students who took it in the Winter and Spring terms.

It is likely that the 68% of students who have taken additional economics courses before Intermediate Microeconomics will be better prepared. Hence, one variable is the number of economic courses in addition to Introduction to Microeconomics I and Introduction to Macroeconomics students have taken prior to Intermediate Microeconomics. This includes statistics courses offered by the department of economics but not other statistics courses (presumably the economic ones include some economic applications). For students who made multiple attempts at the same courses, only a single attempt was counted in determining the value of this variable.

Similar reasoning led to the inclusion of a dummy variable for students who have taken math courses “more advanced” than Calculus I. Some explanation is required in defining “more advanced”. At Memorial University, students are required to take a Math Placement Test before enrolling in an initial math course. The score required for enrolling for Calculus I is the highest. Students receiving a lower score are required to first enrol in more basic courses. The particular

course depends on their score. It is assumed here that whatever students learn in these courses is reflected in their Calculus I grade and thus are not counted when determining the value of this dummy variable. In addition, only math courses with course numbers beginning with a “MATH” prefix are included. Thus, most statistical courses are not counted⁵, nor are mathematical economics courses offered by the economics department.

The student’s average grade over all courses completed by the end of the term he took Intermediate Microeconomics I is controlled for. These averages are recorded in university records as a percentage rounded off to one decimal point. It should be noted for students who took a given course multiple times, only the best attempt is used in calculating the average. Thus, the recorded average overestimates the true average of these students.

If introductory textbooks have an effect on student learning, introductory instructors should also have an effect. Thus, 18 dummy variables are included to control for 19 introductory microeconomics instructors⁶. Similarly, the effects of individual intermediate microeconomics instructors must be controlled for. Hence, 7 dummy variables are used to control for 8 intermediate microeconomics instructors.

A textbook author pointed out that there may be significant differences between editions of a given textbook. Nonetheless, this writer felt that there would be serious measurement problems in having separate dummy variables for different editions of a given textbook. This is because there is strong anecdotal evidence that the use of second hand books is widespread even when editions change. Indeed, a show of hands in one class indicated that just after the 5th edition of Parkin came out, at least 1/3 of students were using an older edition.

⁵ Those offered by the economics department would be counted as additional economic courses but those offered by other departments will not enter anywhere in the regression.

⁶ In one case the instructor dummy will also control for any regional effects for students who took introductory microeconomics at a satellite campus. It will also pick up any effects from the smaller class size on that campus.

The observations on the dependent variable are from the sections of Intermediate Microeconomics offered from the spring of 1996 to the winter term of 2005. A total of 553 students completed Intermediate Microeconomics during the sample period. However, a number of observations had to be dropped because

1. The student had already taken Intermediate Microeconomics and received a grade on his previous attempt.
2. Prerequisite courses were transfer credits from other institutions. In these cases the numerical grades are not recorded in their Memorial University records.
3. They were exchange students whose academic records were not available.
4. Introductory microeconomics was taken before the Fall term of 1995 (information on the instructors for these students was not available).
5. A handful of students did not have the prerequisite courses (likely given special permission to take Intermediate Microeconomics I).
6. A few cases where I have not managed to track down the textbook used and/or instructor.

This reduced the sample size to 308. This is significantly smaller than the 2033 for the Money and Banking case discussed in section 3.

2.2 Estimation and Analysis

The basic premise of this section is that if introductory microeconomics textbooks have different effects on student learning, those differences should be reflected in student performance in Intermediate Microeconomics. One approach to test this would be to use the 5 introductory microeconomics instructors who used multiple textbooks⁷. Holding introductory and intermediate instructors constant, we could separate their students into different groups depending on the textbooks they used. If textbooks have a significant effect on student

⁷ The approach discussed here was suggested by Peter Kennedy.

performance, we should find that the mean intermediate microeconomics grades of these groups are significantly different. This was attempted for the 3 introductory instructors who both used different textbooks and had students who used the different textbooks take Intermediate Microeconomics with the same instructor. Unfortunately this reduced the sample size to only 19% of the 533 students who took intermediate microeconomics during the period in question. Moreover, in three of the eight possible pairings, one of the textbooks was only represented by a single observation. In the only case of more than 10 observations of each textbook, no significant difference was found⁸. In cases of multiple comparisons of the same textbooks, the individual t values were consolidated and the resulting test statistic was tested against the null hypothesis of its value being zero⁹. In each of these cases, the overall t statistic was found to be insignificant.

It should be noted that this analysis does not control for other explanatory variables that may differ between groups. When the process was repeated for control variables, the mean values of several control variables were significantly different. This included the one pairing with more than 10 observations of each textbook. As the results of these tests were very unconvincing, the related tables are not included here but are available on request from the author.

Given the unconvincing nature of the above results, this paper will proceed with regression analysis to analyze the data. Collectively, students in the whole sample were exposed to 6 introductory microeconomics textbooks. However, in two cases there was perfect collinearity between the textbooks and instructors. In one (O'Sullivan), there was only a single

⁸ This case involved 14 students who had used Lipsey and 15 who had used Mankiw with the same introductory instructor and had taken intermediate microeconomics with the same instructor.

⁹ Information on this test can be found in Kennedy (2003) and Christie (1990). It should be noted that it is an asymptotic test.

observation which was dropped. In the other (McConnell), there were 10 observations. In this case, both the instructor and textbook were made part of the control group. However, the other textbooks should not be compared to McConnell as it is not possible to separate the effects of this textbook from introductory and intermediate microeconomics instructors in the control group. All other textbooks in the sample were used by multiple instructors.

Initially the model was estimated with OLS regression. Various diagnostic tests were performed. During the process, null hypotheses of homoskedasticity were soundly rejected. In particular, the models failed Harvey, Glejser, Breusch-Pagan-Godfrey and dependent variable heteroskedasticity tests at the 1% level of significance¹⁰. Thus, although the estimated coefficients would still be unbiased, the t and F statistics could be called into question. Unfortunately, the above tests did not give any useful clues as to the form of heteroskedasticity. Therefore, the model was re-estimated using White's heteroskedastic-consistent covariance matrix estimation. This will not change coefficient estimates but will change the t and F statistics.

Initially the model is estimated with all the variables and then a general-to-specific model reduction approach is applied. The third column in Table 2 contains the regression coefficients and corresponding p-values for the full model. In order of descending p-values the following variables were dropped: Repeated Introduction to Macroeconomics, Took Introductory Microeconomics in the Summer Term, Repeated Calculus I, Grade in Introduction to Microeconomics, Repeated Intermediate Microeconomics, Calculus I, Grade in Introduction to Macroeconomics. The coefficients and p-values for this model are presented in the fourth column. Dummy variables for instructors were kept regardless of p-values. It was felt that

¹⁰ White's test was not conducted as it is not defined in the presence of dummy variables.

eliminating these variables could create an omitted variable bias. The fourth column contains the final model.

It may seem surprising that the introductory microeconomics grade was insignificant. One possible explanation for this is to remember that the reason it was not used as the dependent variable was due to concerns about grade adjustments in the course. If students taking the course with a given instructor and textbook did worse than students with other instructors, one would expect their grades to be adjusted upwards by a greater amount. Another explanation is that other variables such as the student's average grade did a better job of capturing student ability¹¹. Indeed, there was a high degree of collinearity between average grades and grades in specific courses. Regardless of the explanation, none of the results discussed below are affected by the exclusion or inclusion of this variable.

For every term between taking introductory microeconomics and Intermediate Microeconomics, a student's expected mark went down by almost a percentage point. Taking introductory microeconomics by distance reduced a student's expected grade by almost 8%. Both of these coefficients were significant at the 5% level. These were the only significant variables directly related to introductory economics courses.

It is not clear whether the effects of taking economics by distance are caused by the mode of delivery or are a characteristic of the type of student that chooses this mode of delivery. It should be noted that this result agrees with the findings of Brown and Liedholm (2002) that taking introductory microeconomics as a web course has a negative effect on student learning. It also agrees with Anstine and Skidmore (2005) who find that taking MBA economics courses by distance has a negative effect on learning. However, it disagrees with Navarro and Shoemaker (2000) and Agarwal and Day (1998) who find positive effects on learning from taking economics

¹¹ An anonymous referee provided this explanation.

courses with internet technology. It also disagrees with section 3 of this paper that finds distance education has no significant effect on subsequent student performance in Money and Banking.

Possible reasons for this difference will be discussed in section 4.

The affect of additional economics courses were statistically significant at the 1% level. Each additional course increased a student's grade in Intermediate Microeconomics by 1.5 percentage points. This is likely to be, at least in part, due to these students having a better background in economics. However, it may also be picking up students who like economics better and hence work harder in economic courses.

The only significant math variable was the qualitative one for students who took additional math courses. Having taken additional math courses increased a student's grade in Intermediate Microeconomics by 6.2%. The reason for this may be similar to Ballard and Johnson's (2004) explanation of the common finding that students with Calculus do better in introductory economics courses:

“If a student who has taken calculus does well in an introductory economics course, it may not be because of the calculus *per se*. Rather, students with calculus experience may do better in introductory economics courses because those who take calculus are more likely to have mastered the basic mathematical concepts that are more crucial for success.” (p. 4)

Similarly, students who have additional math courses may do better in Intermediate Microeconomics because they are more likely to have mastered the material in Calculus I and other math skills used in microeconomics.

The student averages over all courses was highly significant, indicating that students who are “good” overall tend to be good in Intermediate Microeconomics. Moreover, the value of the

coefficient exceeds 1, indicating that better students do proportionately better in economics courses¹². When it is dropped from the regression, adjusted R^2 drops by over 0.2, indicating that this is an important explanatory variable.

In the reduced model, the values of the coefficients for the Introductory Microeconomics instructors ranged from -15 to 15. The effects of the Intermediate Microeconomic instructors ranged from -15 to 5.

Two of the coefficients for the textbook dummies are significantly different than the control group. However, given that the control group includes specific instructors, it would be incorrect to make inferences with regard to the control textbook.

The variable for taking intermediate microeconomics in the spring term was significant at the 5% level. The remaining variables are insignificant but left in the regression as it was felt that the p-values were low enough for the risk of omitted variable bias to be a concern.¹³

Table 3 contains the p-values for the F statistics for differences in textbook coefficients for the reduced model. Only Parkin is significantly different than last placed Mankiw at a 5% level of significance. Otherwise identical students using Parkin in principles can expect a grade over 9% higher than those using Mankiw. The 7% difference between Lipsey and Mankiw is significant at the 10% level. Thus, at least in some cases, textbooks seem to produce different learning results.

-insert table 3 around here.

¹² The coefficient is significantly different than 1 at the 1% level of significance. As an aside, the marks were manually entered into the data file. During the process it became obvious that students with high averages did better in their economic courses than their average grade. Conversely, students with low averages did worse in their economic courses than their average.

¹³ The recommendation of Kennedy (2003, 413) was used here. Hence all variables with a t statistic greater than 1.0 were retained.

It should be noted that the above textbook comparisons assumed that instructor and textbook effects are separable. To test this, the data set was reduced to those introductory instructors who used multiple textbooks and had students who went on to intermediate microeconomics. The final model specification of Table 2 was treated as the restricted model (however, the distance variable was dropped as none of these instructors taught the distance course). In the unrestricted model, the dummy variables for introductory instructors and textbooks were replaced with dummy variables for each instructor/textbook combination. An F test was then conducted. The F statistic was 0.031141, which is highly insignificant.

It should be noted that Stiglitz was the textbook used by distance students. It is possible that distance and nondistance students may receive different benefits from the textbook. However, an interactive term between the Lipsey and the distance qualitative variables would suffer from perfect collinearity with the distance variable. Thus, the distance variable may be picking up different textbook effects between these two groups of students.

2.3 Robustness

Attempts were made to add a number of interactive and quadratic variables in case any important effects were omitted. Examples included interactive terms between grades in introductory microeconomics and the qualitative variables for repeating the course, and for taking it by distance. Likewise interactive terms between the student's grades in Calculus I and Introduction to Macroeconomics and the qualitative variables associated with them were added. Moreover, interactive terms between the student's average grade and other variables were generated. Likewise with the number of additional economic courses taken and other variables. For reasons discussed previously, it was felt that the textbook edition could not be controlled for directly. Nonetheless, an attempt was made to indirectly control for it by generating a time

variable which increased by one in successive terms and interacting this with the textbook dummies. In no case, were the results significantly affected. Thus, the results seem to be robust.

For additional checks of the robustness of these results, estimation with maximum likelihood procedures and various assumptions on the form of heteroskedasticity were attempted¹⁴. In all cases, the ranking was unchanged but in general, the differences were more significant. When variance was assumed to be a linear function of the independent variables, Lipsey and Mankiw differed at the 1% level. Lipsey and Stiglitz, as well as Parkin and Mankiw were significantly different at the 5% level. Parkin and Stiglitz differed at the 10% level. When the standard deviations were assumed to be a linear function of the independent variables all differences except for the one between Mankiw and Stiglitz were significant at the 1% level. That difference was significant at the 10% level. When dependent variable heteroskedasticity was controlled for, the only significant differences were between Lipsey and Mankiw, and Lipsey and Stiglitz. Both of these differences were significant at the 5% level. Thus, the hypothesis that the choice of introductory microeconomics textbook can have a significant effect on student learning appears to be robust with respect to the form of heteroskedasticity assumed. Furthermore, the ranking is robust. Nonetheless, White's method is highlighted as it produces consistent results when the true form of heteroskedasticity is unknown. Moreover, the estimates of the coefficients are unbiased.

3 Money and Banking

This section will use a student's grade in Money and Banking as the dependent variable. Doing so has a number of advantages. One is that the sample size is significantly larger in this case: 2033 versus 308.

¹⁴ The maximum likelihood estimation techniques built into the Shazam version 9 software package were used in these cases. For details, see Diana Whistler et al.

A second advantage is that the sample is less likely to be one of students who have a taste for economics. Money and Banking is only a required course for business students. A large majority of these students have only taken the other two economic courses they are required to take (Introduction to Microeconomics and Introduction to Macroeconomics)¹⁵. Thus, they do not appear to have a particular taste for economics. On the other hand, it is doubtful if after taking principles many students will decide to change majors simply because they are required to take three additional credit hours of economics (business students are required to take a total of 141 credit hours to obtain their degree). Thus, when it comes to preferences for economic courses, it is likely that these students are a more random sample than those taking Intermediate Microeconomics. In addition, having taken fewer economics courses, the effects of introductory textbooks should be greater as it is often their only background in economics.

A final “advantage” is the mixed blessing of a weaker link between the subject matter of Introduction to Microeconomics and Money and Banking. Hopefully the ability of a student to understand economic reasoning will play a heavier role relative to their knowledge of the specific topics covered in introductory microeconomics.

3.1 The data

The first column of Table 4 lists the independent variables. The second column gives the mean and standard deviations of these variables (the mean and standard deviations of the dependent variables are 62.495 and 14.138, respectively).

-insert table 4 around here.

¹⁵ A referee pointed out that the business courses these students have taken may contain material related to economics. Anecdotal evidence based on the opinions of Money and Banking instructors suggests that the economic knowledge of the business students in their courses is limited. However, it is possible that the number of economic courses these students have taken is not a good measure of their background in economics.

Given the different nature of Money and Banking, some of the independent variables will be different than in the Intermediate Microeconomics case. For example, the only prerequisites are Introduction to Microeconomics and Introduction to Macroeconomics. Thus, regressions will not control for a student's grade in Calculus I and other variables related to mathematical background and ability.

The different nature of Money and Banking also makes it reasonable to assume that a student's background in introductory macroeconomics may be more important than was the case for Intermediate Microeconomics. Thus, qualitative variables for introductory macroeconomics instructors and taking it by distance are included. A variable for the number of terms between taking introductory macroeconomics and Money and Banking is also included.

A variable for campus was included. The value of this variable is equal to one when students took introductory microeconomics at a regional campus¹⁶.

The remaining variables are either the same as in the Intermediate Microeconomics case or analogously defined. A high proportion of students took Money and Banking in the Spring term as business cooperative students are scheduled to take it in this term. It will also be noted that the average number of additional economic courses these students have taken is much smaller than in the Intermediate Microeconomics case (0.38711 versus 1.5227). Moreover, in this case, 85% of students took no additional economics courses (in the Intermediate Microeconomics case, only 29% had taken no additional economics courses). Thus, these students do not appear to have a taste for economics. As with Intermediate Microeconomics, the majority of students took principles courses which used Lipsey.

¹⁶ In the case of intermediate microeconomics this variable was not included due to multicollinearity problems. However, in the case of Money and Banking there were multiple observations from an instructor who switched campuses.

One additional textbook was used during this period whose observations were dropped from the sample used for regression analysis. A single instructor was the only one to use textbooks by McConnell and by Blomqvist and used no other textbooks. This created multicollinearity problems. Thus, the 7 students who took introductory microeconomics with the textbook by Blomqvist were dropped from the sample used in regression analysis. Therefore, except for the 68 observations in the control group, all the textbooks in the results reported here were used by multiple instructors.

The observations on the dependent variable are from Money and Banking sections from the Spring of 1998 to the Winter of 2005. A total of 2 592 students completed the course but some of these had to be dropped for reasons given in section 2. In addition, the observations associated with the two previously mentioned textbooks were dropped from the regression analysis. This reduced the sample size to 2 033.

3.2 Estimation and Analysis

Analogous to section 2, we could consider the 5 introductory microeconomics instructors who used multiple textbooks. Holding Money and Banking instructors constant, an attempt was made to separate their students into different groups depending on the textbook used. In this case there were 29 pairings, 8 of which contained at least 10 observations of each textbook being compared¹⁷. None of these large pairings contained any significant differences in Money and Banking grades. However, this analysis did not control for other explanatory variables. Several of these other explanatory variables exhibited significant differences in the pairings. For example, when the t values of the differences in introductory microeconomics grades and the number of terms between introductory microeconomics and Money and Banking were

¹⁷ Tables containing the results of the tests in this paragraph are available on request.

consolidated for pairings of given textbooks, the resulting test statistic was significant in many cases. Thus, it is necessary to condition with regression analysis.

The model was first estimated with a simple OLS regression. Various diagnostic tests were then performed. During the process, null hypotheses of homoskedasticity were soundly rejected. In particular, the models failed Harvey, Glejser, and Breusch-Pagan-Godfrey tests at the 1% level of significance. As the tests did not give any clues as to the form of heteroskedasticity, White's heteroskedastic-consistent covariance matrix estimation was used to control for the heteroskedasticity. However, unlike the Intermediate Microeconomics case, the results were not significantly affected when heteroskedasticity was controlled for.

Column 3 of Table 4 contains the coefficient estimates (with p-values in parentheses). As with Intermediate Microeconomics, the student's average grade and the number of additional economic courses taken are significant at the 1% level. However, although the effects of the student's average grade are similar, the effects of additional economic courses are smaller. Each additional economics course increases his grade in Money and Banking by less than 1%, while it increased his grade by 1.7% in Intermediate Microeconomics.

The coefficient for a student's grade in introductory microeconomics is negative and significant. The sign is counter intuitive. Nonetheless, it should be noted that there is significant multicollinearity between grades. For example, the coefficient of linear correlation between grades in introductory microeconomics and average grades is 0.60673. When average grade is dropped, the coefficient for introductory microeconomics grades becomes positive and significant at the 1% level.

Unlike the Intermediate Microeconomics case, the dummy variables for taking courses by distance are insignificant. The term dummies are individually insignificant compared to the

control group but an F test on the difference between the ones for taking introductory macroeconomics in the Winter term and taking it in the Summer term has a p-value of 0.05692.

Unlike the Intermediate Microeconomics case, the number of terms since the student took Introduction to Microeconomics does not seem to be significant. The remaining variables are also insignificant. Nonetheless they are left in as the additional degrees of freedom gained by dropping them are marginal, given the sample size.

The ordinal ranking of the textbook dummies are different than was the case with Intermediate Microeconomics I. Parkin still has the highest value but Mankiw is now second, followed by Lipsey and than Stiglitz. All except Stiglitz are significantly different than the control group but for reasons given earlier, little should be read into this.

The results of F tests for differences in the effects of the textbooks are presented in Table 5. The only significant differences are between Stiglitz and the other textbooks. Stiglitz is significantly different from Parkin at the 5% level and from the other textbooks at a 10% level of significance. Students in introductory microeconomics sections using Parkin can expect a grade in Money and Banking that is over 5% percentage points higher than their counterparts who were in sections that used Stiglitz.

-insert table 5 around here.

As in section 2.2, it should be noted that the above textbook comparisons assumed that instructor and textbook affects are separable. To test this, the data set was reduced to those introductory instructors who used multiple textbooks and had students who went on to take Money and Banking. The final model specification of Table 4 was treated as the restricted model (however, the distance and campus variables were dropped as they did not apply to these instructors). In the unrestricted model, the dummy variables for introductory instructors and

textbooks were replaced with dummy variables for each instructor/textbook combination. An F test was then conducted. The F statistic was 1.3413, which is highly insignificant.

3.3 Robustness

To check the robustness of these results, estimation with maximum likelihood procedures and various assumptions on the form of heteroskedasticity were attempted¹⁸. These had no significant effects on the results.

Also to check the robustness of these results with relation to the choice of variables, attempts were made to add many additional variables. These included various interactive variables. Additional qualitative variables were also generated and interacted with other variables. None of these affected the textbook results.

The only change that affected the results was the removal of the variable for the student's average grade. When the student's average grade was dropped, the textbook differences became insignificant. Moreover, the signs and significance of several explanatory variables changed. However, given the low p-value of the student's average grade, this paper will argue that many of those changes are due to an omitted error bias. Dropping other variables had no significant effect on the results. Thus, the results appear fairly robust with respect to the choice of variables.

4 Further Discussion and Conclusions

One difference in the results of sections 2 and 3 involves the effects of distance education. Section 2 found that taking introductory microeconomics by distance had a negative effect on student performance in Intermediate Microeconomics. Section 3 found no such effect for Money and Banking. There are several possible explanations. One is simply that the larger sample size

¹⁸ See footnote 14 and related text for details.

in section 3 gives more accurate estimates. Another involves the different subject matter of the two courses. Brown and Liedholm (2002) find that taking Introduction to Microeconomics has a negative effect on student performance in answering questions involving a deeper understanding of economics. However, when it came to answering more basic questions there was no difference in performance. At Memorial University, Intermediate Microeconomics is primarily a course directed at economics majors while Money and Banking is largely a service course for the business school. Thus, it may be that the depth of ideas covered in Intermediate Microeconomics are greater, supporting the findings of Brown and Liedholm (2002).

The main finding of this paper is that it appears that the choice of introductory microeconomics textbook can have an effect on student performance in later courses. The results appear to be strongest in the case of Money and Banking. Nonetheless, in most cases it is impossible to reject the hypothesis that most textbooks produce identical results in student learning. Moreover, the particular textbook that the majority differs from depends on what course a student subsequently takes.

There are several possible explanations for the differences between the two cases. One is simply that the bigger sample size in the Money and Banking case gives more accurate estimates. Moreover, students taking Intermediate Microeconomics have, on average, taken more courses in economics. This may reduce the effects of introductory textbooks. Another explanation involves the differences in the content of the two courses. The topics in Intermediate Microeconomics correspond closely to those covered in Introduction to Microeconomics. It could be that all textbooks cover the mechanics of these topics fairly satisfactory. However, as the topics may not correspond directly to those covered in Money and Banking, the lasting effect in that case may be felt by books that are better at teaching students how to think in terms of

economics rather than the mechanics of specific topics. A final explanation may be that Intermediate Microeconomics is more likely to attract students with an interest in economics than Money and Banking. These students may be less affected by the choice of textbook. Whatever the explanation, the evidence indicates that in some cases the choice of introductory microeconomics textbook can have lasting effects on student achievement in economics.

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Table 1: Textbooks used.

Authors	Title	Publisher(s)
R.G. Lipsey ^a and C.T.S. Regan/C.T.S. Regan & P.N. Courant/D.D. Purvis & P.N. Courant	<i>Microeconomics</i> 8 th , 9 th and 10 th Canadian editions	Addison-Wesley/Harper Collins
N.G Mankiw, R.D. Kneebone, K.J. McKenzie and N. Row	<i>Principles of Microeconomics</i> 1 st and 2 nd Canadian editions	Dryden-Harcourt Brace and Company/Thompson-Nelson
M. Parkin and R. Bade	<i>Microeconomics: Canada in the Global Environment</i> 2 nd , 3 rd , 4 th and 5 th editions.	Addison-Wesley
J.E. Stiglitz and R. Boadway	<i>Principles of Microeconomics and the Canadian Economy</i> 1 st and 2 nd editions.	W.W. Norton
<u>Control Group Textbook:</u>		
C.R. McConnell, S.L. Brue and T.P. Barbiero	<i>Microeconomics</i> 6 th and 7 th Canadian editions.	McGraw-Hill Ryerson
<u>Books dropped from the regression analysis sample^b:</u>		
A. Blomqvist, R. Wonnacott and P. Wonnacott ^c	<i>Microeconomics</i> 4 th Canadian edition.	McGraw-Hill Ryerson
A. O'Sullivan, S.M Sheffrin and R. Moir	<i>Microeconomics: Principles and Tools</i> , 1 st Canadian Edition	Prentice Hall

^aThe coauthors of the Lipsey textbook changed three times during the sample period.

^bAs explained in the paper, these were dropped due to multicollinearity problems.

^cOnly dropped for the case of Money and Banking. In the case of Intermediate Microeconomics, there were no observations to drop.

Table 2: Regression with Intermediate Microeconomics grade as dependent variable

Variable	Mean (St. dev.)	White's HET estimation (p-values in parentheses)	
		Full Model	Reduced Model
Repeated Intermediate Micro	0.042208 (0.20139)	2.1128 [0.575]	
Took Intermediate Micro in Winter term	0.34416 (0.47587)	-2.3174 [0.240]	-2.3610 (0.221)
Took Intermediate Micro in Spring term	0.035714 (0.18588)	10.213 [0.023]	10.562 (0.011)
Grade in Introductory Micro	72.312 (10.639)	0.059743 [0.553]	
Repeated Introductory Micro	0.12338 (0.32940)	1.2880 [0.690]	
Took Introductory Micro by Distance	0.016234 (0.12658)	-7.3032 [0.081]	-7.9258 (0.049)
Took Introductory Micro in Winter term	0.26623 (0.44271)	0.92639 [0.696]	
Took Introductory Micro in Spring term	0.090909 (0.28795)	2.0943 [0.436]	2.4488 (0.313)
Number of terms between Introductory and Intermediate Micro	4.3442 (3.0003)	-0.86432 [0.016]	-0.87823 (0.014)
Grade in Introductory Macro	73.870 (11.511)	-0.11072 [0.323]	
Repeated Introductory Macro	0.11688 (0.33177)	0.78523 [0.766]	
Number of additional economic courses	1.5227 (1.5408)	1.4534 [0.023]	1.5535 (0.008)
Grade in Calculus I	70.640 (14.052)	-0.048155 [0.472]	
Took a course equivalent to Calculus I	0.35390 (0.47896)	-1.8931 [0.292]	-1.8832 (0.288)
Repeated Calculus I	0.18182 (0.38632)	-1.2758 [0.598]	
Additional Math Courses	0.47403 (0.50014)	6.1680 [0.000]	6.2260 (0.000)
Student's average grade	69.735 (8.3238)	1.8427 [0.000]	1.7425 (0.000)
Intermediate Micro Instructors (Range)	0.0097403 - 0.49351	-14.270-4.8274	-14.644-4.5433
Introductory Micro Instructors	0.0032468 - 0.16558	-12.730-14.646	-14.644-15.329

(Range)			
Lipsey Textbook	0.59091 (0.49247)	10.809 [0.056]	9.8580 [0.085]
Mankiw Textbook	0.16234 (0.36936)	4.0257 [0.565]	2.9286 [0.670]
Parkin Textbook	0.12987 (0.33671)	12.880 [0.050]	12.446 [0.052]
Stiglitz Textbook	0.074675 (0.26329)	6.5033 [0.179]	5.5152 [0.240]
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R ²		0.6579	0.6538
R ² adjusted		0.5976	0.6049
Number of observations	308	308	308
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Table 3: Textbook ranking and results of F tests for differences in textbook coefficients for full model (Intermediate Microeconomics case).

Textbooks	Coefficient Values	P-value of differences		
		Parkin	Lipsey	Stiglitz
Parkin	12.446			
Lipsey	9.8580	0.45623		
Stiglitz	5.5152	0.18003	0.32727	
Mankiw	2.9286	0.04122	0.08361	0.66367

Table 4: Regressions with Money and Banking grade as dependent variable

Variable	Mean Value (Standard deviation)	White's HET estimation (p-values in parentheses)
Repeated Money & Banking	0.039351 (0.19448)	0.012879 [0.994]
Took Money & Banking by Distance	0.065912 (0.24819)	-1.8673 [0.406]
Took Money & Banking in Winter term	0.16429 (0.37063)	0.60428 [0.563]
Took Money & Banking in Spring term	0.52730 (0.49938)	-0.29092 [0.703]
Grade in Introductory Micro	67.338 (10.673)	-0.091206 [0.010]
Repeated Introductory Micro	0.15839 (0.36519)	0.69436 [0.453]
Took Introductory Micro by Distance	0.065912 (0.24819)	0.97640 [0.502]
Took Introductory Micro in Winter term	0.26758 (0.44281)	0.47713 [0.488]
Took Introductory Micro in Spring term	0.091490 (0.28838)	-0.32333 [0.777]
Number of terms between Introductory Micro and Money & Banking	6.9818 (3.0682)	0.12095 [0.438]
Grade in Introductory Macro	68.852 (11.145)	0.19070 [0.564]
Repeated Introductory Macro	0.14658 (0.35378)	-0.10481 [0.911]
Took Introductory Macro by Distance	0.090507 (0.28698)	-0.19114 [0.886]
Took Introductory Macro in Winter term	0.69257 (0.46154)	0.79320 [0.228]
Took Introductory Macro in Spring term	0.18938 (0.39190)	-1.2112 [0.118]
Number of terms between Introductory Macro and Money & Banking	6.2027 (2.8988)	-0.24414 [0.127]
Number of additional economic courses	0.38711 (1.2756)	0.90989 [0.000]
Student's average grade	69.055 (6.6165)	1.3553 [0.000]
Campus	0.064437 (0.24559)	-7.6892 (0.301)

Money and Banking Instructor dummies (Range)	0.010330-0.41663	-5.0099--0.081031
Introductory Micro Instructor dummies (Range)	0.00049188-0.15150	-19.780-3.9365
Introductory Macro Instructor dummies (Range)	0.0019675-0.20954	6.4543-18.561
Lipsey Textbook	0.60994 (0.48788)	4.9126 [0.162]
Mankiw Textbook	0.15937 (0.36611)	5.4969 [0.136]
Parkin Textbook	0.16134 (0.36793)	7.2321 [0.061]
Stiglitz Textbook	0.068864 (0.25328)	1.7345 [0.590]
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R ²		0.4158
R ² adjusted		0.3944
Number of observations	2033	2033
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Table 5: Textbook ranking and results of F tests for differences in textbook coefficients with Money and Banking as the dependent variable.

Textbooks	Coefficient Values	P-value of differences		
		Parkin	Mankiw	Lipsey
Parkin	7.0215			
Mankiw	5.4969	0.33470		
Lipsey	4.9126	0.17498	0.65201	
Stiglitz	1.7345	0.01827	0.05811	0.05900