DISCUSSION PAPERS IN ECONOMICS

Working Paper No. 12-10

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Department of Economics

University of Colorado at Boulder
Boulder, Colorado 80309

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mixed logit model. I control for the average book quality using the adoption rate of rookie professors, professors that are teaching the course for the first time. This quality-proxy emerges from a simple and intuitive assumption that is consistent with my theoretical model: rookie professors adopt the best book. The estimated persistence in textbook adoptions is a potentially key factor to publishers when setting prices, making revisions, and investing in product quality and marketing. Second, I isolate the effect of switching costs in adoption decisions by employing a probit model to test whether rookie professors are more likely to adopt a newly released book than veteran professors. Rookie professors are found to adopt new textbooks at 2.5 times the rate of veterans. The second strategy is unique to this paper, in part because it requires a dataset that L Q F O X G H V P D Q \ Q H Z H Q W U D Q W V D Q G D K The results of both F R Q V X models support the main implication of my theoretical model: switching costs often sway S U R I H V V R U V ¶ W H [ W E R R N F K Additionally, I observe the release of a new E R R N edition decreasing the switching cost and switching cost heterogeneity among publishers and authors D U H E H W W H U D W ³O R F N L Q J L Q´ S U R I H V V R U V W K D Q R W

In a final empirical analysis, I use heterogeneous estimates of switching costs to test whether switching costs tend to dampen competition. Using a fixed-effects OLS model, I control for idiosyncratic publisher, course, time, and course-time supply and demand shocks. I find switching costs account for as much as 9%, or $15, of textbook prices; however, I find no

created by frequent flier programs where employees choose airline tickets that are then purchased by their employers. Cairns and Galbraith show that switching costs lessen price competition and lower barriers to entry. Basso, Clements and Ross also argue that prices will rise due to the switching costs but profits may decrease. In a durable goods industry with model revision and a used market, I find that switching costs borne by an agent have a negative effect on competition, leading to non-decreasing prices and non-increasing revision cycles. However, an edition- or model-specific switching cost can increase the length of the revision cycle.

Although the effects of switching costs have been thoroughly explored in theoretical settings, due to data limitations, the empirical switching cost literature is much more sparse (Farrell and Klemperer, 2007; Grzybowski, 2008). I add textbooks to the handful of industries where switching costs have been shown to be empirically relevant.[3] Of these papers, most use aggregate level data to identify switching costs or the impact of switching costs in the various markets. For instance, Shi, Chiang, and Rhee (2006) assess the price effect of telephone number mobility, a natural experiment that decreases switching costs. Shy (2002) and Viard (2007) use an indirect method which has been used to approximate switching costs using only aggregate data (Carlsson and Löfgren, 2006).

Direct measurements of switching costs employ consumer-level panel data and random utility models to compare new customer behavior to repeat customer behavior. Only a few papers directly measure switching costs using panel data with observable

[3] A number of researchers have empirically identified the importance of switching costs in the markets for household grocery items (Jain et al., 1994; Keane, 1997; Shum, 2004), computer software (Larkin, 2004); credit cards (Ausubel, 1991; Calem and Mester, 1995; Calem, Gordy, and Mester, 2006; Stango,

their preferences for newly released books, this comparison is free of spurious state dependence concerns.

## III. THEORETICAL FRAMEWORK

### III. A. General Framework: Switching Costs and Adoption

I define a general consumer choice setting that demonstrates the tradeoff between time and course quality. Consider the scenario where a professor is choosing a book for a class he will teach in the upcoming semester. The professor receives utility from leisure, $z$, and course quality, $Q(.)$, which is a function of the professor's time effort and the book chosen.[4] The professor has a fixed time endowment, T, which he must allocate between leisure and time spent teaching. A veteran professor, one that has taught the course in the recent past, chooses between the book previously used, his status quo book, and a newly available book. If he chooses the new book, he incurs a cost in the form of increased preparation time; if he chooses his status quo book, he does not. The professor's utility is described by equation (1) when he chooses the status quo book and equation (2) when he chooses the new book.

$$u = f(z, Q(t_1, M_0), p_0) \quad (1)$$

$$u = f(z, Q(t_2, M_1), p_0 - c) \quad (2)$$

$M_0$ is the book quality of the status quo book and $M_1$ is the book quality of the newly released edition. The time input, $t$, represents professor effort and $c$ is the time cost.

[4] Leisure, in this setting, should be loosely interpreted and is not limited to recreational activity. It can include research, other professional responsibilities, outside consulting, recreation, or any non-teaching activity on which the professor chooses to spend his time.

may include preparing a syllabus, lecturing, creating exams and homework assignments, holding

Observation 2 suggests that students suffer a burden from switching costs whenever the professor considers the new book better quality than the status quo, even if the professor chooses the best book.

Observation 1: If the switching cost is large enough (or, equivalently, if the new book premium, $M_3 - M_4$ is small enough), the professor will avoid the switching cost and choose the lesser quality book. See Appendix for discussion of Observation 1.

Observation 2: $P_5^*$ is decreasing in $F$. If the switching cost does not lead the professor to choose a lower quality status quo book, he will pass on a portion of the switching cost to the students by choosing a lesser $P_5^*$. The students are better off with the new book and a lesser time input than the status quo. See Appendix for discussion of Observation 2.

In addition to the fixed cost a professor incurs if he switches books, I consider that the professor also incurs a fixed cost if he adopts a new edition of his status quo book. This cost may include rereading chapters, creating new reading and homework assignments, revising his lecture notes to coincide with the new chapter organization, etc. I label this edition-specific fixed cost $\phi$ and assume it is only a portion of the full-fledged cost to changing books entirely, $\phi < F$.

I notate the quality of the revised version status quo as $M_4$. K H S U R I H V V P ` ` ¡Ð³@ bbV%

• *f* Š ç : H á P á ¡ M O ä 6 P ä H E P Ø E P (5)

pay an edition switching cost $s$ to use the textbook; therefore, veteran professors become more likely to switch to the new entrant's book.

After the publisher chooses whether or not to revise, the professor chooses a textbook that yields the greatest second period utility. The professor's utility depends on whether she is experienced or a new adopter. A rookie professor chooses the incumbent book $B$ if

$$b_4 - p_B \geq b_4 - p_N - s,$$

persist despite a framework that assumes forward looking agents and a firm that does not price discriminate.

## IV. A. Random Utility Model

)URP WKH WKHRUHWLFDO PRGHO SUHVHQWHG LQ VHFWLR

variables, and random taste variation (Train, 2003). Conditional on the random taste coefficient, the probability a professor chooses a book for his course is:

$$\text{”:U}_{\text{ïûÖçL s æ¨öL}} \frac{\text{‡š‘8}_{\text{ïûÖçæ¨ö}}}{\text{Á Í}_{\text{Ý@5}} \text{‡š’8}_{\text{ÜÝöæçæ¨ö}}}$$

where $U_{ïûÖç}$ is equal to one if professor i chooses book k for course c in period t. The unconditional choice probability is the integral of conditional probabilities over the random parameter $æ¨Ö$

$$\text{”:U}_{\text{ïûÖçL s; L ±}} \frac{\text{‡š’8}_{\text{ïûÖçæ;o}}}{\text{Á Í}_{\text{Ý@5}} \text{‡š’8}_{\text{@ÝöæçA}}} \text{B:æ;@}$$

Simulated maximum likelihood estimation allows identification of $æ¨Ö$, $Ù^{æ}$, $Ù^{á}$, $Ù^{Ø}$, and the J×Z matrix of professor control parameters. The theoretical model presented in section II suggests $r > Ù^{á} > Ù^{æ}$ and $F Ù^{æ} > Ù^{Ø} > r$. Notice that fixed effects controls for semester, course, professor, or any combination of these would difference out when professors compare utilities across books.

IV. C. Effects of Switching Costs on Prices and Edition-life

To assess the effects of switching costs on prices and edition-life, I first estimate a separate switching cost parameter for each textbook. The methodology of Chen and Hitt (2002) interracting book-specific dummy indicators with the switching cost term is employed to determine whether some authors (and publishers) DUH EHWWHU LQ DWWUDFWLQJ UHFXUULQJ V
others. 7KH SURFHVV expected utility is given by equation (10).

$$7_{Ü Ý Ö ç} : Ú + æ ö M Ý Ö ç E Í \sum_{Ý@5}^{Ã} Ù^{æ} Q_{Ü Ý Ö ç} E Ù^{Ø} A_{Ü Ý Ö ç} E Ù^{á} J_{Ü Ý Ö ç} E ¤ Ý V E Ý_{Ü Ý Ö ç} \qquad (10)$$

The parameters in equation (10) are estimated identically to those in equation (8.1), the only difference being there will be a unique switching cost parameter estimated for each book.

Next, I run least squares regressions using the J×1 vector of odds ratios of the estimated switching cost parameters, $\hat{\beta}_{+?L}$, as the independent variable of interest. Again, I control for book quality using the rookie market share variable. The dependent variables are the natural logs of the average book price and average edition life. Equations (11) and (12) summarize the OLS regressions with publisher, course, time, and course-time fixed effect controls.

$$Ž • : = R C L_{Ý ç} N E ?ã \hat{\beta}_{+?L} E ã M_{Ý ç} E ä_a E ê_Ö E î_ç E ð_{Ö ç} E Ý_{Ý ç} \qquad (11)$$

$$Ž • : = R C A @ E R_{Ý;E} I K ã \hat{\beta}_{+?L} E ã M_{Ý ç} E ä_a E ê_Ö E Ý_Ý \qquad (12)$$

Since the switching cost parameters are estimated by equation (10), they are measured with error. The extent to which the switching cost variable is mismeasured varies by textbook and is

partially revealed by the regression results. Knowing the means and the standard errors of each parameter, I need only assume they are normally distributed, the common assumption for hypothesis testing of logit model coefficients, to fully depict the distributions of each switching cost parameter. I use this information to simulate 10,000 switching cost vectors and regress

book quantities sold. New and used book prices are backed out using the sales revenues and quantities.

In addition to the two datasets from R. R. Bowker, university-level data from the National Center of Education Statistics (NCES) database, The Integrated Postsecondary Education Data System (IPEDS), are used to control for observable heterogeneity. Although the classes chosen in the sample are likely to be similar across schools in content, courses at, for instance, Harvard are almost certainly taught differently than courses at very large state schools. A book that is optimal for a Harvard class may not be suitable at other schools. Controls for school size, SAT scores, private/public schools, tuition, the Carnegie Basic classification, average professor salaries, and the student-faculty ratio are included. All of the school-level controls are 2010 data. Details of data collection and calculation can be found on the NCES website (nces.ed.gov/ipeds/datacenter). The Carnegie Basic classifications, which are generally self-

Two key features make this dataset ideal for detecting and analyzing the importance of switching costs. First, the time-series data allows the researcher to observe histories of SURIHVVRUV¶ DGRSWLRQ FKRLFHV :LWKLQ HDFK KLVWRU\ which book he switches from, and which book he switches to. Since the data includes all the adoptions in a period for a university, I can identify the first time a professor teaches a course, or at least the first time in the recent past.

The second important feature of this data is its size; the 15 years of panel data contain more than 1.3 million total textbook adoptions in the economics discipline alone. This allows a liberal use of observations when cleaning the data and creating variables, leaving a sufficiently large subsample for empirical analysis. In addition to typical data cleaning processes such as dropping obviously miscoded observations, only a portion of the data is used for empirical analysis for several reasons. First, the first six semesters each school appears in the data are used to identify which professors face a status quo option and which do not. If a school is in the data for several semesters prior to D SURIHVVRU¶V it is assumed he is teaching the class for the first time. Second, only a handful of courses which are frequently taught and easy to group across schools are included, such as Principles of Microeconomics, Intermediate Microeconomics, Introduction to Econometrics, etc. Third, observations from schools that do not show with-in

Modules in the spring, this is not coded as a switch. In more recent years, this clarification becomes especially important because authors often produce many versions of a text with unique ISBNs: a standard version, an electronic version, a loose leaf version, etc. I try to isolate the primary texts by dropping secondary WH[WV WKDW DUH WDJJHG DV more than one RSWLRQ text remains, only the one that is most commonly adopted in the period is kept. In most cases, secondary books are study guides or other non-textbook resources that are used as a compliment the primary text.

Because there is a one- to two-semester lag between the release of a new edition and the REVROHVFHQFH RI WKH ROG HGLWLRQ WKHUH LV D ZLQGRZ RI WLPH LQ ZKLFK WKH ROG HGLWLRQ status quo choice is between the old or new edition of the book. In the empirical analysis, SURIHVVRUV GHFLGH ZKHWKHU WR DVVLJQ WKH QHZ HGLWLRQ RU WKH ROG HGLWLRQ RI D WH[WERRN WR WKHLU FODVVHV 7KH RSWLRQ LV GHILQHG as whichever edition has the greatest market share.

V. B. Truncated Samples

The number of books chosen in each time period for a course is large, as many as 60. While each of these books is an option for the professor, it may not be realistic to assume professors are comparing dozens of books for each course they teach. Additionally, the computational burden of simulated maximum likelihood increases rapidly with the number of choices and variables,

O D U J H P D U N H W V K D U H W K H L U V W D W X V T X R R S W L R Q D Q G choices in the full sample, the 1% truncated sample, and the 3% truncated sample.

Table 2

V. C. Definition of Rookie and Veteran Professors

I define a rookie as a professor that does not show up in the data for a course in the previous six semesters. I experimented with more and less stringent requirements for this cutoff and getidentical resultsListed in Table 3 are observations per period, the breakdown of rookie and veteran professors, and the number of different textbooks adopted in each period for the six economics courses in my sample. Also in Table 3 D F R O X P Q I R U ³V Z L W F K H U V ´ who choose a book other than their status quo. The average number of alternatives available to the professor is increasing each the period, which is not surprising since new books enter the market every period while veteran professors continue to adopt older books and, therefore, keep them from dropping out of the data. Table 3 also shows the Herfindahl ±Hirschman Index (HHI) by textbook (BHHI) and by publisher (PHHI) for each period. BHHI and PHHI calculations range from close to 0 for lots of firms in a perfectly competitive industry to 10,000 in a monopoly, where market shares are defined as the percent of total adoptions a book or publisher earns in a given periodThe publisher PHHI column indicates that market shares are heavily concentrated amongst a handful of publishers. Table 4 shows the market shares of each publisher for the six courses in the sample.

Table 3

V. E.

The rookie market share proxy works well as a predictor of which books veteran professors will switch to as well as which books veteran professors will switch from. The theoretical model predicts that veteran professors who used a low quality book in the previous semester should be more likely to switch. The average rookie market share of the status quo for switchers is only 6% while it is 15% for non-switchers.

# VI. RESULTS

## VI. A. Random Utility Model

book are 1/43, or 2.3%. The average odds of adopting a book increase to 85/127, or 66% of the time, when the professor has used the book in the past.

The odds of adopting the status quo book decrease by a factor of 2.34 when the previous edition is revised. Using the example of the average textbook above, the odds of adopting the status quo decrease from 85/127 to 29/72, or about 40% of the time. Finally, the odds of adopting any book other than the status quo increase by a factor of 5 when another professor at the same university has used the book in the past. If the average book is not

W K H S U R I H V V R U ¶ V V W D W X V T X R W K H R G G V R I W K H S U R I H

6ge l(a)4(tF)6(inall) f3

cost coefficients range from 3.08 to 6.01 with a mean of 5.4 and a standard deviation of .58. These estimated coefficients correspond to odds ratios of 24 to 407 with a mean of 99 and a standard deviation of 68( D F K E R R N ¶ V V Z L W F K L Q J F R V W F R H I I L F L H Q W zero; however, this does not imply they are different from each other. Of 585 pairwise chi-squared tests of equality for each of the switching cost coefficients, 298 were significantly different at a 95% confidence level.

Table 8

Table 9

Finally, Table 10 displays OLS results from equations (11) and (12). The results in column (1) suggest switching costs increase prices. The coefficient .0009 suggests a one standard deviation increase in the switching cost odds ratio leads to a 6% increase in prices. Scaling this number up to the average estimated switching cost odds ratio of 99, switching costs account for about 9% of textbook prices or about $15 per book. Column (2) suggests edition life is not significantly affected by switching costs. Although not statistically significant, the sign of the switching cost coefficient is negative in column (2), which is consistent with the theoretical predictions presented in section III.

Table 10

When the switching cost parameters are simulated using the results from Table 8, the coefficient on price is positive and significantly different the zero with a 90% confidence interval

in 6,415 of 10,000 simulations. This is true in 5,757 of the results when the confidence level is 4,.75 700

To quantify the full welfare impact of suboptimal book adoptions one must define the impact of textbooks on student utility functions, which I do not attempt in this paper; however, it is apparent that suboptimal book adoptions are frequent and it is easy to imagine that the aggregate student utility loss may outweigh the value of time the professor saves. When the disparity between book quality is significant and/or when the class size is large, the welfare loss can be large and widespread. Additionally, even when the professor switches to the better book, switching costs can decrease course quality through lesser time inputs (for instance, less lecture preparation) and higher prices.

Technological innovation in the education industry only magnifies the welfare effects since similar time costs burden professors who choose to utilize technological advances in the classroom. For instance, online homework/quiz platforms, clil9(c)4()3( )-239(inst3(on)4(pe)4(s)-(on)

than a professor facing switching costs. Departments considering this policy approach should

and, 3) Marketers should be careful to target current adopters when a new edition is being released since they are more likely to switch books at that time.

Publishers, authors, college bookstores, students, professors, and advocates of lesser costs of education and/or greater quality of education should all be among those interested in understanding the demand for college textbooks. This paper provides evidence switching costs play an important role in textbook demand. Efforts to lower costs, increase quality, or earn profits in this market should consider the role of switching costs in shaping professor adoptions and, therefore, student purchases.

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## IX. APPENDIX

Discussion of Observation 1:

Because it is assumed that U(.) is increasing in Q(.), U(.) is increasing l, and Q(.) is increasing in q, : F Û4á :-4á "4;; is always greater than k F Û5-F -qá :-5á "5; o when "5 O "4. So consider the case when "5 > "4. Since the utility function is continuous, there must exist %q such that : F Û4á :-4á "4;; L k F Û5-F %qá :-5á "5; o. Since ª: Ykjáuváqo; / ªj P r, : F -4á :-4á "4;; P 7 k F Û5-F -qá :-5á "5; o for all -q P %q.

Discussion of Observation 2:

Observation 2 follows from the diminishing marginal utility of leisure. The previously defined utility maximizing time choice, Û5, must satisfy ª: Ykjáuváqo; / ªU:ráq ®

Discussion of Observation 3:

Observation 3 follows from : F $\hat{U}_4$á :$_{\hat{U}_4}$á $\ddot{a}_4$;; F k F $\hat{U}_5$F $\bar{g}$á :$_{\hat{U}_5}$á $\ddot{a}_5$;o P : F $\hat{U}_4$F $\bar{c}$á $k_{\hat{U}_4}$á $\ddot{a}_4$; o F k F$_{\hat{U}_5}$F $\bar{g}$á :$_{\hat{U}_5}$á $\ddot{a}_5$;o when "á F "$_4$ is small. Define $\grave{U}_4$ to solve

• *f* š : Ž á

TABLES

Table 1 - Summary Statistics of Schools/Professors in Sample and IPEDS National Sample[a]

Table 3- Professor and Market Summary Statistics by Semester

| | Rookies | Veterans | Switchers | Avg # of Textbook Options |
|---|---|---|---|---|
| [redacted] | | | | |

Table 4- Publisher Market Shares

| Course | Publisher | Market Share |
|---|---|---|
| Introduction to Economics | McGraw-Hill, Inc. | 33.6% |
| | Cengage Learning | 30.4% |
| | Pearson Higher Ed. | 17.4% |
| | MacMillan | 4.4% |
| | W. W. Norton | 2.6% |
| | Total | 88.4% |
| Principles of Microeconomics | Cengage Learning | 42.1% |
| | McGraw-Hill, Inc. | 22.8% |

Table 5 -Summary Statistics of Textbooks

| | Mean | 25th Pct | 50th Pct | 75 Pct |
|---|---|---|---|---|
| Number of Book Choices | | | | |

7DEOH D 0L[HG /RJLW 5HVXOWV IRU 3ULQFLSOHV RI 0LFURHFRQRPLFV XVLQJ )XOO 'DW
D

| 9DULDEOH |
|---|
| 5RRNLH 06 |
| 5RRNLH 06 E\ 6$7 |
| 5RRNLH 06 +DW |
| 6WDWXV 4XR |
| 6FKRRO 6WDWXV 4XR |
| 6WDWXV 4XR [ 1HZ (G |
| 5DQGRP &RHIILFLHQW |
| 6$7 0DWK WK 3&7 1R 1R 1R 1R <HV 1R <HV <HV <HV |
| 6WXGHQW )DFXOW\ 5DWLR 1R 1R 1R 1R <HV 1R <HV <HV |
| $YJ 3URI 6DODU\ 1R 1R 1R 1R <HV 1R <HV <HV <HV |
| 7XLWLRQ 1R 1R 1R 1R <HV 1R <HV <HV <HV |
| /LNHOLKRRG 5DWLR |

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VLJQLILFDQW [
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Table 6 - Mixed Logit Results for Six Courses in Sample using Full Data[1]

| | Principles of Micro | Intermediate |
|---|---|---|

Table 7 - Probit Results[a]

| Variable | (1) | (2) |
|---|---|---|
| Veteran | -0.369*** | -0.339*** |
| | (0.060) | (0.065) |
| SQNewEdition | 0.219*** | 0.236*** |
| | (0.079) | (0.086) |
| Veteran x SQRookieMS | -1.036*** | -1.017*** |
| | (0.343) | (0.367) |
| SAT Math 75th PCT | - | 0.001 |
| | - | (0.001) |
| Student-Faculty Ratio | - | -0.007 |
| | - | (0.010) |
| Avg Professor Salary (x10,000) | - | 0.039* |
| | - | (0.021) |

Table 8c - Heterogeneous Switching Costs Continued

| Variable | (1) |
|---|---|
| Status Quo x Book 32 | 0.716 |
| | (0.915) |
| Status Quo x Book 33 | 1.131** |
| | (0.575) |
| Status Quo x Book 34 | -1.928* |
| | (1.046) |
| Status Quo x Book 35 | 0.438 |
| | (0.568) |
| Status Quo x Book 36 | 0.542 |
| | (0.748) |
| Status Quo x Book 37 | 0.709 |
| | (0.581) |
| SAT Math 75th PCT | No |
| Student-Faculty Ratio | No |
| Avg Professor Salary (x10,000) | No |
| Tuition (x1000) | No |
| Public/Priviate | No |

Table 9 -
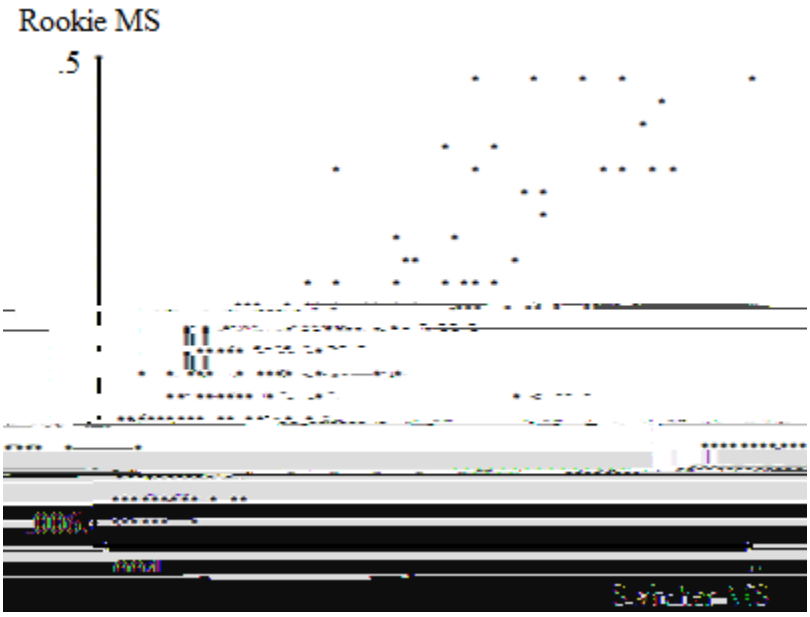
Figure 2 ±Textbook Market Shares for Veterans that Switch and Rookies