THEORY AND EVIDENCE OF SWITCHING COSTS IN THE MARKET FOR COLLEGE TEXTBOOKS

by

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Theory and Evidence of Switching Costs in the Market for College Textbooks

Thesis directed by Professor Donald Waldman

This dissertation develops and estimates a model of switching costs in the market for college textbooks. First, in a theoretical setting, this paper characterizes the professor's adoption decision, which includes a trade-off between time and course quality. The professor faces a time cost when he switches textbooks. This switching cost leads to state dependence and adoptions of textbooks that are sub-optimal for students. In a two-period duopoly model, switching costs are shown to lead to higher prices and shorter revision cycles. Predictions of the theoretical model are tested empirically using a unique 30-semester history of professors' textbook adoptions. Using professors teaching the course for the first time as a counterfactual, switching costs are identified to be large and significant in a random utility model that allows for observed and unobserved professor preference heterogeneity. Results show both book-specific and edition-specific switching costs affect adoption decisions in directions and magnitudes consistent with the theoretical model. A final empirical analysis identifies heterogeneous switching costs across textbooks and shows switching cost magnitudes are positively correlated with textbook prices, suggesting switching costs may dampen competition. In my sample, switching costs account for as much as 9% of textbook prices; however, there is no empirical evidence of correlation between switching costs and revision cycles.

JEL codes: L14, D23, I21

Keywords: Switching costs, mixed logit, random utility model, textbooks, higher education

To Pierce, who sat through 18 credits of field courses, but was unable to stay and complete his (pe)degree.

And to Mom and Dad. From *Hop on Pop* to flashcards to Colonial Williamsburg to college tuition… You didn't just encourage academic achievement, you earned it. Thank you.

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CHAPTERS

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I. INTRODUCTION

Trends in textbook prices and revision-cycles have become popular topics on campuses, in social media, and even in the U.S. Congress, which recently passed a law to improve the transparency of textbook pricing (H.R. 4137, 2008).[1] Textbooks comprise a significant portion of students' budgets, and they have demonstrated remarkable price growth in spite of improved technology and increased availability of rental and electronic substitutes. Despite public awareness of these issues, the textbook market has received relatively little attention in economic literature. At least part of this neglect is due to a complicated market which includes interactions between authors, publishers, bookstores, resellers, professors, and students. This paper helps untangle these relationships and, by doing so, suggests a new potential cause for high textbook prices: switching costs.

An important dynamic in the textbook market is the principal-agent relationship between student and professor: though the final purchase decision lies with the student, the professor chooses the textbook. Demand for textbooks depends on the professor's adoption decision and, conditional on that decision, the students' willingness to pay. With significant variation in textbook prices and qualities, this principal-agent problem has important welfare implications. Previous literature on this market, which focuses on pricing and edition life decisions, ignores the professor's adoption problem or assumes it away, portraying him as an altruistic mediator who simply chooses the best book for his students (Miller, 1974; Foster and Horowitz, 1996; Iizuka, 2007; Chevalier and Goolsbee, 2009). Although this lack of attention is often appropriate

[1] Section 112 of the Higher Education Opportunity Act is specifically dedicated to textbook affordability. Section 112 makes six requirements and one "suggestion" of publishers and universities, which are intended to improve affordability by better informing professors and students of available textbook options and unbundling textbook materials .

for the researcher's purpose, to fully understand publishers' pricing and edition life decisions, it is necessary to understand the competing influences on the professor's adoption decision.

Relaxing the assumption that the professor benevolently chooses a book, I construct a simple but intuitive theoretical model in which the professor obtains utility from the quality of his course and disutility from the time he spends preparing. Time becomes an important influence as I consider that the professor bears a significant time cost if he chooses to upgrade to a new and improved textbook. This time cost may include reading the book, rewriting lecture notes, learning new terms and definitions, etc. When faced with a switching cost, convenience often motivates the professor to choose an inferior book. I extend the analysis to consider that the professor may also bear a cost to switch to a new edition. When a new edition of the incumbent book is released, an edition-specific switching cost lowers the additional cost of switching to an entirely new book.

My model highlights the welfare implications of switching costs on professor behavior. Switching costs may impede the quality of instruction if the professor chooses a second-rate book or spends less time preparing for class. In addition, theoretical switching cost literature suggests that switching costs may lead to a number of implications on firm behavior including higher prices, lesser variety of goods supplied, lower quality of goods supplied, and deterred market entry (Klemperer, 1995). My model supports theories of reduced competition due to switching costs, which compounds the welfare implications. Not only will switching costs lead to inferior textbook adoptions, my model suggests they lead to higher prices and less time between edition revisions.

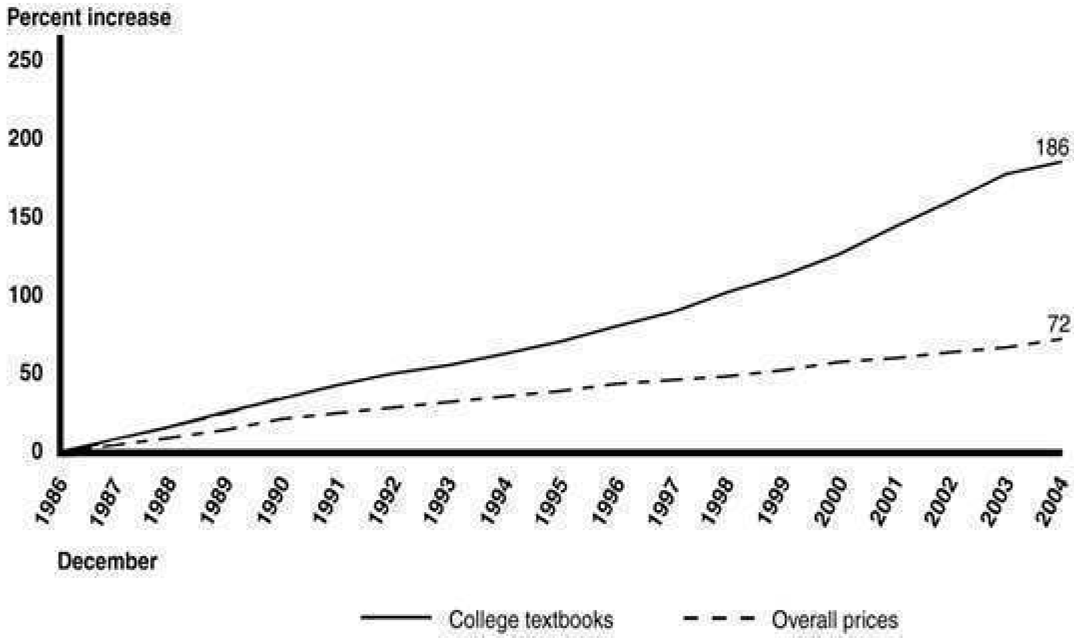
Employing 30 semesters of professor-level panel data, I identify persistence in professors' book choices using two empirical strategies. First, following previous literature, I estimate a mixed logit model. I control for the average book quality using the adoption rate of rookie professors, professors 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 includes many new entrants and a history of consumers' product purchases. The results of both models support the main implication of my theoretical model: switching costs often sway professors' textbook choices from the best book. Additionally, I observe the release of a new edition decreasing the switching cost and switching cost heterogeneity – some publishers and authors are better at "locking in" professors than others.

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 significant effect on edition life.

Due to data limitations, mainly the inability to observe historical consumer-level purchase decisions, the literature on switching costs has remained mostly theoretical (Farrell and Klemperer, 2007; Grzybowski, 2008). This paper contributes to a growing empirical literature on consumer switching costs. This is the first paper that identifies switching costs in a durable goods market in which producers make life-cycle decisions. My theoretical framework compliments that of Cairns and Galbraith (1990) and Basso, Clements, and Ross (2009) which model the effects of switching costs in a principal-agent setting where employees choose airline tickets that are then purchased by their employers. This paper also adds to the limited literature on the textbook industry and is related to a larger literature in education and economics which examines the incentive structure influencing instructors and implications for effectiveness of instruction.

The higher education textbook market is an important setting to analyze switching costs. The retail market for textbooks is large and growing. Net sales of new textbooks reached approximately $4.3 billion in the U.S. in 2009 (Association of American Publishers, 2009). The textbook market is not only important in aggregate, it represents a significant portion of students' expenditures. The California Public Interest Research Group (CALPIRG, 2005) reports that the average full-time student in California spends $900 on textbooks each year. Figure 1 shows textbook prices rising twice the annual inflation rate between 1986 and 2004 (GAO, 2005). Moreover, the price realized by the student is not simply the list price; the availability of used texts and the student's potential to resell the text also affect the net price the student pays. Thus, the publisher makes two decisions that determine the price paid by the student: list price and edition life. As prices of books have risen, edition lives have been simultaneously shrinking. Chevalier and Goolsbee (2009) report the current modal edition life of economics, psychology, and biology textbooks is just 2.5 years or 5 semesters. Finally, in addition to financial impacts, textbooks affect student welfare through book quality. In many classes, textbooks are the professor's primary teaching tool and, consequently, are an integral factor in the production of student learning.

Figure 1 – Textbook Price Trend vs. CPI[a,b]



[a] Graph from U.S. Government Accountability Office (GAO, 2005)
[b] Data source is Bureau of Labor Statistics.

II. LITERATURE REVIEW

A large strand of theoretical literature explores the effects of switching costs on price competition. For a complete survey of this literature, see Farrell and Klemperer (2007). My two-period setup is unique to the switching cost literature since the cost is borne by an agent without regard to price and involves a model revision decision; however, it is rooted in the widely adopted theoretical frameworks pioneered by von Weizsacker (1984) and Kemperer (1987). Under various assumptions, Klemperer and von Weisacker and numerous researchers to follow have shown that the ability of firms to earn profits on switching costs depends on their ability to exploit their existing customer base and assumptions on the type of competition. For instance, in a two-period model, Klemperer (1987) shows that firms will compete away the second period profits in the first period when there is one consumer and they cannot commit to future prices. In a multi-period duopolist market, Beggs and Klemperer (1992) show that firms will yield greater profits by exploiting their existing customer base and charging higher prices. Similarly, Padilla (1995) shows firms with larger customer bases will set higher prices to exploit locked-in customers while firms with smaller market shares will set lower prices. von Weisacker (1984) shows that switching costs can lower equilibrium prices when firms commit to one price and consumers are uncertain about future preferences. Chen (1997) shows firms will offer the same price to new and old consumers and profits will be lower in a market with homogenous products and heterogeneous switching costs across consumers.

This is not the first paper to explore the effects of switching costs in a principal-agent setting. Cairns and Galbraith (1990) and Basso, Clements, and Ross (2009), model switching costs 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.[2] 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) outlines a "quick-and-easy," 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 because this requires the researcher's ability to observe a history of consumers' purchase decisions. Chen and Hitt (2002) use a conditional logit model to directly measure switching costs between online investment brokers. They find heterogeneous

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[2] 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, 2002), cigarettes (Elzinga and Mills, 1998 and 1999), airlines (Fernandes, 2001; Carlson and Löfgren, 2006; Carlton, Landes, and Posner, 1980), utilities (Knittel, 1997; Park, 2005; Shi et al., 2006; Epling, 2002; Viard, 2007; Grzybowski, 2008), auto insurance (Schlesinger and von der Schulenberg, 1991 and 1993; Israel, 2005; Waterson, 2003), online brokerage (Chen and Hitt, 2002), health insurance (Handel, forthcoming) and bank accounts (Shy, 2002). [This is a growing list].

switching costs by firm. Epling (2002) finds significantly different switching costs across consumers in the long distance telephone market.

Heckman (1981) distinguishes between true and spurious state dependence. He describes spurious state dependence as a consequence of consistent heterogeneous preferences across consumers. Consumers may repeatedly buy the same product because it fits their unobservable preferences. True state dependence arises from observable factors such as switching costs. If ignored, spurious state dependence can result in over-estimates of switching costs. Hence, a few papers have made efforts to separate spurious state dependence from switching cost estimates. A common approach is to estimate a mixed logit model, which allows random coefficients to account for unobservable heterogeneous preferences (Jain, Vilcassim and Chintagunta, 1994; Keane, 1997; Grzybowski, 2008; Handel, forthcoming). A few authors have taken slightly different approaches. Shum (2004) estimates a nested logit model to account for heterogeneous preferences for cereal brands. Goldfarb (2006) measures costs of switching internet portals by estimating a separate regression for every household. Chen and Forman (2008) combine the mixed logit model with a difference-in-difference technique that exploits changes in consumer purchases over time in the market for wireless internet routers. In this paper, I take two approaches to identify switching costs. First, I follow the previous literature to distinguish true state dependence by estimating a mixed logit model. Then, I take advantage of a unique attribute of my data set to make a simple but valuable comparison that is free of spurious state dependence. Frequent market entry in the textbook industry allows me to compare textbook adoptions of incumbent and newly released textbooks. Since professors have not yet revealed their preferences for newly released books, this comparison is free of spurious state dependence concerns.

III. THEORETICAL FRAMEWORK

III. A. General Framework – Switching Costs' Incentives on Adoption Decisions

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, l, and course quality, Q(.), which is a function of the professor's time effort and the textbook quality.[3] 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 maximization problem is described by equation (1) when he chooses the status quo book and equation (2) when he chooses the new book.

$$\max_t \mathrm{U}(l, \mathrm{Q}(t, q_0)) \;\; s.t.\; T = l + t \tag{1}$$

$$\max_t \mathrm{U}(l, \mathrm{Q}(t, q_1)) \;\; s.t.\; T = l + t + t^s \tag{2}$$

q_0 is the book quality of the status quo book and q_1 is the book quality of the newly released book. The time input, t, represents the professor's time spent preparing for class. This time cost may include preparing a syllabus, lecturing, creating exams and homework assignments, holding office hours, etc. If the professor chooses a textbook he used in the previous semester, he avoids incurring one-time fixed costs associated with familiarizing himself with the book. These fixed

[3] 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.

costs, t^s, may include reading the book, learning the book's notation and terms, learning to use test bank software and online tools, etc. I make the common assumptions of continuity, strict monotonicity, and diminishing marginal rate of substitution in the utility function and strict monotonicity in the production function of quality. I denote the solutions to equations (1) and (2) as t_0^* and t_1^*, respectively. The veteran professor chooses the new book if $\mathrm{U}\big(T - t_1^* - t^s, \mathrm{Q}(t_1^*, q_1)\big) > \mathrm{U}(\mathrm{T} - t_0^*, \mathrm{Q}(t_0^*, q_0))$.

Now consider the adoption decision of a "rookie professor," a professor teaching a course for the first time. Since he does not have a status quo option, he solves:

$$\max_{t,q} \mathrm{U}(l, \mathrm{Q}(t, q)) \;\; s.t. \;\; T = l + t + t^s \tag{3}$$

The model yields several basic predictions of professor behavior. First, the rookie professor always chooses the best book. Since all books are new to him, he must input the one-time fixed cost with any book he chooses. Therefore, the rookie professor does not face a trade-off for choosing a high quality book. He simply surveys the books available, chooses the best book, and determines his time input. Second, if $q_0 > q_1$, the veteran professor chooses the status quo book. If the veteran professor thinks his status quo book is better than the new book, he has no incentive to adopt the new book. Observation 1, below, states that the veteran professor will choose a book he considers second best if the switching cost is large enough (or, equivalently, if the book premium is small enough) and he considers the new book an upgrade from his status quo. 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,*$q_1 - q_0$*, 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: t_1^* *is decreasing in* t^s*. 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* t_1^**. 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 t^e and assume it is only a portion of the full-fledged cost to changing books entirely: $0 < t^e < t^s$.

I notate the quality of the revised version status quo as $q_{\hat{0}}$. The professor's optimal time inputs are determined by the solutions to the maximization problems given in equations (4), (5) and (6), when he uses the old edition of his status quo, the new edition of his status quo, and the new book, respectively. He then chooses the book that yield the greatest utility.

$$\max_t \mathrm{U}(l, \mathrm{Q}(t, q_0)) \ \ s.t.\ T = l + t \tag{4}$$

$$\max_t \mathrm{U}(l, \mathrm{Q}(t, q_{\hat{0}})) \ \ s.t.\ T = l + t + t^e \tag{5}$$

$$\max_t \mathrm{U}(l, \mathrm{Q}(t, q_1)) \ \ s.t.\ T = l + t + t^s \tag{6}$$

Bookstores customarily stop selling the dated edition after a single transitional semester (Chevalier and Goolsbee, 2009). Especially in large classes, this essentially forces the professor to adopt either the new edition or an entirely new text (Chevalier and Goolsbee, 2009; Allen et al., 2012). Since this data are not available, I assume the dated edition becomes obsolete immediately, reducing the professor's adoption problem to two choices. Additionally, 76% of professors agree the majority of new editions improve so insignificantly, they are unjustified (Allen et al., 2012). These assumptions yield an additional prediction of switching costs based on professor behavior:

Observation 3: *If* $q_{\hat{0}} - q_0$ *is small, the edition-specific switching costs lower the additional cost of switching to an entirely new book. Without the edition-specific switching cost, the professor compares the benefit of switching to a new book,* $q_1 - q_0$*, to the cost,* t^s*. If the professor must choose between a new edition of his status quo book and an entirely new book, he compares a similar benefit,* $q_1 - q_{\hat{0}}$*, to a lesser cost,* $t^s - t^e$*. See Appendix for discussion of Observation 3.*

III. B. Two-Period Duopoly Model

I model the firm's price and revision decisions in a two-period framework where an incumbent firm faces competition from a new entrant. The firm's customer is a principle-agent team – professors with heterogeneous preferences select a textbook for a class of students who then choose between purchasing a new book, purchasing a used book, or an outside option, such as not purchasing the book, sharing with a friend, etc. The incumbent firm begins with an existing base of adopters, V_1, and a wave of rookie adopters enters each period, R_1 and R_2. In period 2, the professors who were rookies in period 1 become veterans so that $V_2 = V_1 + R_1$. All classes have N students.

Let the professor's utility and production functions take simple, linear forms: $\mathrm{U}\left(l, \mathrm{Q}(t, q_j)\right) = \alpha l + \beta \mathrm{Q}(t, q_j) = \alpha l + \beta q_j + \beta \mu t$, where l depends on whether or not the professor must incur costs t^s or t^e, as described in *III.A.* In this two-period game, I assume the time input t is a constant; it does not depend on the book choice. Thus, professors get utility from book quality and disutility from their time inputs, t^s and t^e. The book quality of the incumbent's book is q_0, a constant less than 1 and greater than 0. The quality of the new entrant's book is q_1, which is uniformly distributed across professors from 0 to 1. Conditional on their professors' adoptions, students must decide whether or not to buy the new book. Each class's conditional demand is a function of price and the number of students in the class. I assume students have a downward sloping, linear demand curve for the assigned textbook: $Q_d = \mathrm{N} - \theta \mathrm{P}$, where θ is increasing in edition life. Or, stated differently, price elasticity of demand increases when the used market is more prominent. In this model, $\theta \in (\theta_l, \ \theta_h)$. In period 1, θ takes the value θ_l. It also takes the value θ_l in period 2 if the publisher revises the textbook and kills off the used market. If the publisher does not revise the textbook, the supply of used books increases and θ increases from θ_l to θ_h.

In the first period, firms choose a new book price, which they commit to for both periods. In the second period, firms have an option to revise their text to kill off the used market. The effect of revision is to eliminate the used market; it does not affect the quality of the book. If the firm does not revise, each class's conditional demand curve for new books flattens so that $Q_d = \mathrm{N} - \theta_h \mathrm{P}$. There is a fixed cost to revision, c. Additionally, when a book is revised, veteran professors pay an edition switching cost t^e 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 his status as an experienced or a new adopter. A rookie professor chooses the incumbent book if $q_0 > q_{i1}$. A veteran professor has used the incumbent book in the past and will choose it in the first period as long as $2\beta q_0 > 2\beta q_{i1} - \alpha t^s$. In the second period, the veteran's decision is the same if the incumbent firm does not revise the book so no veterans will switch; however, if the incumbent firm does revise, the professor will continue choose it as long as $\beta q_0 - \alpha t^e > \beta q_{i1} - \alpha t^s$.

Knowing the distribution of professors' preferences, the firm will choose P_r^* and P_n^* to maximize profits if it revises and if it does not, respectively. The firm's revision decision poses a clear trade-off. If the firm revises, it avoids losing customers to the used market, but it will lose adopters to the competitor. Given a price chosen in period 1, the firm is indifferent to revision if equation (7) holds, where the left hand side of the equation represents the benefit to revision and the right hand side represents the cost.

$$P^2(\theta_h - \theta_l)[\left(q_0 + \frac{\alpha}{\beta}t^s\right)2V_1 + q_0(2R_1 + R_2)] = 2P\left(q_0 - \frac{\alpha}{2\beta}t^e\right)(V_1 + R_1) \qquad (7)$$

Equation (7) suggests two key effects of switching costs on firms' revision incentives. As the edition-specific switching cost increases, the cost of revision decreases. Thus, edition-specific switching costs are expected to have a positive effect on edition life. As the book-specific cost increases, the benefit to revision increases. Thus, book-specific switching costs are expected to have a negative effect on edition life.

Since price is endogenous, these relationships must be confirmed more formally by comparing the optimal profit equations. The profit functions, Π_r and Π_n, and optimal prices, P_r^*

and P_n^*, when the firm revises and when it does not are given below. The firm will revise the textbook if $\Pi_r^* - \Pi_n^* > 0$.

$$\Pi_r = P_r[N - \theta_l P_r]\left[\left(q_0 + \frac{\alpha}{2\beta}(t^s - t^e)\right)2V_1 + \left(q_0 - \frac{\alpha}{2\beta}t^e\right)2R_1 + q_0 R_2\right] - c$$

$$\Pi_n = P_n[N - \theta_l P_n]\left[\left(q_0 + \frac{\alpha}{2\beta}t^s\right)V_1 + q_0 R_1\right] + P_n[N - \theta_h P_n]\left[\left(q_0 + \frac{\alpha}{2\beta}t^s\right)V_1 + q_0(R_1 + R_2)\right]$$

$$P_r^* = \frac{N}{2\theta_l}$$

$$P_n^* = \frac{N}{2\theta_l}\left(\frac{2\left[\left(q_0 + \frac{\alpha}{2\beta}t^s\right)V_1 + q_0 R_1\right] + q_0 R_2}{(1 + \frac{\theta_h}{\theta_l})\left[\left(q_0 + \frac{\alpha}{2\beta}t^s\right)V_1 + q_0 R_1\right] + \theta_h q_0 R_2}\right)$$

$\frac{\partial(\Pi_r^* - \Pi_n^*)}{\partial t^s} > 0$ and $\frac{\partial(\Pi_r^* - \Pi_n^*)}{\partial t^e} >$ confirm the two statements above: switching costs tend to shorten revision cycles while edition-specific switching costs lengthen them. Furthermore, the firm chooses a lesser price when it revises than when it does not and, although P_r^* is not affected by the switching cost, P_n^* is increasing in t^s.

In summary, this firm's problem has yielded six important predictions about the effect of switching costs on competition: 1) profits are increasing in the switching cost, t^s; 2) profits are non-increasing in the edition-specific switching cost, t^e; 3) prices are non-decreasing in the switching cost, t^s; 4) prices are not affected by the edition-specific switching cost, t^e; 5) revision cycles are non-increasing in t^s; and, 6) revision cycles are non-decreasing in t^e. These results persist despite a framework that assumes forward looking agents and a firm that does not price discriminate.

IV. EMPIRICAL METHODOLOGY

Three distinct empirical methodologies are detailed in this section in order to: 1) measure switching costs in the textbook industry; 2) ensure consistent heterogeneous preferences are not the sole source of state dependence; and, 3) analyze how switching costs affect competition amongst firms. First, to measure the level of persistence in book choice, a random utility model is employed with controls for overall book quality, professor characteristics, and unobservable taste heterogeneity. Since these estimates indicate how likely a professor is to stick with his status quo (or, conversely, how likely he is to switch to a new book), they are relevant figures to publishers when making pricing, edition life, quality investment, marketing investment, and market entry decisions. These estimates are also relevant to students and university policy makers concerned with course quality and incentivizing professors to make choices in students' best interests. Second, I isolate the true state dependence by considering only switches to new books. A probit regression compares the likelihood of rookie and veteran professors choosing a new textbook. The results ensure at least a portion of the switching cost estimated by the random utility model is a "true" state dependence and not simply unobserved preference heterogeneity. Finally, in *IV.C.,* heterogeneous switching costs are estimated for each of the largest books in the sample. Using the variation in these estimates, I test for correlation between prices and switching costs.

IV. A. Random Utility Model

From the theoretical model presented in section II, the professor's utility from a book choice is a function of his perceived book quality and his time costs. Since professor utilities are not observed by the researcher, this paper employs the commonly used random utility framework introduced by McFadden (1974). A linear approximation of the professor's expected utility function is:

$$
\begin{aligned}
U^*_{ijct} &= \beta_{ic} q_{jct} + \alpha(t_{ict} - t^s \times s_{ijct} + t^e \times e_{ijct} - t^n \times n_{ijct}) + \gamma_j z_i + \varepsilon_{ijct} \qquad (8) \\
&= (\beta + \xi_{ic}) q_{jct} + \alpha(t_{ict} - t^s \times s_{ijct} + t^e \times e_{ijct} - t^n \times n_{ijct}) + \gamma_j z_i + \varepsilon_{ijct} \\
&= V_{ijct}(\xi_{ic}) + \varepsilon_{ijct}
\end{aligned}
$$

In this model, U^*_{ijct} is the unobserved utility for professor i if he chooses book j for course c in semester t and V_{ijct} is the observable portion of his utility, q_{jct} is the overall quality of book j in time t, t_{ict} is the professor's time he inputs preparing for the course, t^s is the additional time the professor incurs if he chooses a new book, t^e is the edition-specific preparation time and t^n is the time the professor can avoid if he has access to a colleague's lecture notes for a specific book. Book j* denotes the professor's status quo book. s_{ijct} indicates the professor's experience with a textbook and is equal to one if j=j* and 0 otherwise. The dummy variable e_{ijct} is equal to one if the professor has used an old version of a text in the past and 0 if he has used the current edition or never used it. n_{ijct} is equal to one if the professor has never used the textbook for the course, but someone at his university has.

$s_{ijct} = 1$ if book j is the status quo book, 0 otherwise

$e_{ijct} = 1$ if $s_{ijct} = 1$ and book j has been revised, 0 otherwise

$n_{ijct} = 1$ *if* $s_{ijct} = 0$ and a university colleague has used book j, 0 otherwise

The ε_{ijct} are disturbances, assumed to be independent and identically distributed (iid). β and α are the marginal utilities of book quality and time inputs, respectively. The 1×Z vector of professor characteristics, z_i, controls for observed heterogeneity while the random coefficient, β_{ic}, accounts for unobservable taste heterogeneity. The random portion of β_{ic}, ξ_{ic}, is a mean zero normal random variable.

Without information on time inputs, t^s, t^e, and t^n, α cannot be separately identified. Also, since t_{ict} does not carry the book subscript, it is differenced out when professors make utility comparisons. After dropping all variables that will be differenced out, equation (8) can be rewritten:

$$U^*_{ijct} = (\beta + \xi_{ic})q_{jct} + \alpha^s s_{ijct} + \alpha^e e_{ijct} + \alpha^n n_{ijct} + \gamma_j z_i + \varepsilon_{ijct} \qquad (8.1)$$

where α^s, α^e, and $\alpha^n$are all estimable parameters and are equal to $-\alpha t^s$, αt^e, and $-\alpha t^n$, respectively.

Professor i chooses book h in time t for course c if U_{ihct}>U_{ijct} for all j ≠h. I assume the disturbances, ε_{ijct}, to be distributed extreme value, resulting in the mixed logit model. Mixed logit is distinguished from other members of the random utility family by one or more random coefficients. By decomposing the unobserved factor into two parts, one that contains all the correlation and heteroskedasticity and one that is iid, the mixed logit improves on the standard logit model by allowing for unrestricted substitution patterns, correlation in unobserved variables, and random taste variation (Train, 2003). Conditional on the random taste coefficient, the probability a professor chooses a book for his course is:

$$\Pr(y_{ihct} = 1 \mid \xi_{ic}) = \frac{\exp(V_{ihct}(\xi_{ic}))}{\sum_{j=1}^{J} \exp\left(V_{ijct}(\xi_{ic})\right)}$$

where y_{ihct} is equal to one if professor i chooses book h for course c in period t. The unconditional choice probability is the integral of conditional probabilities over the random parameter ξ_{ic}:

$$\Pr(y_{ihct} = 1) = \int \frac{\exp\left(V_{ihct}(\xi)\right)}{\sum_{j=1}^{J} \exp\left(V_{ijct}(\xi)\right)} f(\xi) d$$

Simulated maximum likelihood estimation allows identification of β, ξ_{ic} α^s, α^n, α^e, and the J×Z matrix of professor control parameters. The theoretical model presented in section III. suggests $0 < \alpha^n < \alpha^s$ and $-\alpha^s < \alpha^e < 0$. Notice that fixed effects controls for semester, course, professor, or any combination of these would difference out when professors compare utilities across books.

IV. B. Probit Model

There is some evidence that the random coefficients in mixed logit specifications do not fully account for unobserved preference heterogeneity. Goldfarb (2006) finds smaller switching costs in his within-family specifications than mixed logit. Similarly, Chen and Forman (2008) estimate smaller switching cost parameters when they add additional controls for unobserved heterogeneity. In response to these studies, I suggest a new strategy for identifying true state dependence by taking advantage frequent market entry, a convenient property of the textbook industry. I provide evidence that at least a portion of the random utility model estimates are true switching costs by comparing rookie and veteran professor adoption rates of newly released textbooks. The advantage of this comparison is it is free from preference sorting since neither type of professor has revealed his preferences for the new book.

When a new book is released, professors' choice sets increase. Presumably, rookie and veteran professors review this new text and compare it to previously released texts. Absent switching costs, rookie and veteran professors should be equally likely to choose the new book. In the presence of switching costs, some veteran professors may choose their status quo books to avoid incurring the switching costs, even though they think the new book is better. The underlying assumption of this identification strategy is, switching costs aside, there is no fundamental difference in the way rookie and veteran professors value textbooks. While this approach has the distinct advantage of isolating true state dependence effects on adoption decisions, it does not allow for estimation of heterogeneous switching costs, its coefficient magnitudes are not comparable to the random utility model, and it is limited to tracking switches to new books. For these reasons, the results of this model are presented as evidence of true state dependence and validation of the RUM results, but the discussion of the results focuses on the coefficients estimated in section *IV.A*.

The null hypothesis in this model is that rookie and veteran professors adopt newly released books at the same rate. To test this hypothesis, a probit model is estimated where the dependent variable is a dummy for the adoption of a textbook released in the past year. The primary independent variable of interest is the professor's rookie/veteran status, v_{ict}, which is equal to 1 if the professor is a veteran for the course and 0 otherwise. The e_{ikct} are defined as before: equal to one if the professor is a veteran and his status quo book has been revised, where the subscript k denotes the professor's status quo book. q_{ikct} is the quality of the status quo book, proxied by the rookie market share.

$new_{ikct} = 1$ if professor i adopts a newly released textbook, 0 otherwise

$v_{ict} = 1$ if the professor is a veteran, 0 otherwise

$e_{ikct} = 1$ if $v_{ict} = 1$ and i's status quo book has been revised, 0 otherwise

The probit model, is summarized by equation (9), where $\mathbf{\Phi}(.)$ represents the cumulative density function for the normal distribution and σ_c, φ_t, and ψ_{ct} are course, time, and course-time fixed effects. The theoretical model predicts $\delta_1 < 0$, $\delta_2 > 0$, and $|\delta_1| > \delta_2$, implying rookie professors are more likely to adopt a new book than veterans but the difference narrows when a veteran's status quo book has been revised. Additionally, $\delta_3 < 0$ implies veteran professors are more likely to choose a new book when the status quo book is low quality and less likely when the status quo is high quality. These hypotheses are tested with estimation of equation (9).

$$\Pr(\mathrm{new}_{\mathrm{ikct}} = 1) = \Phi(\delta_0 + \delta_1 \mathrm{v}_{\mathrm{ict}} + \delta_2 \mathrm{e}_{\mathrm{ikct}} + \delta_3(\mathrm{v}_{\mathrm{ict}} \times \mathrm{q}_{\mathrm{ikct}}) + \sigma_{\mathrm{c}} + \varphi_{\mathrm{t}} + \psi_{\mathrm{ct}}) \qquad (9)$$

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) are better at "locking-in" professors than others. The professor's expected utility is given by equation (10).

$$U_{ijct}^{*} = (\beta + \xi_{ic})q_{jct} + \sum_{j=1}^{J} \alpha_j^s s_{ijct} + \alpha^e e_{ijct} + \alpha^n n_{ijct} + \gamma_j z_i + \varepsilon_{ijct} \tag{10}$$

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, $\widehat{sc_j^s} = e^{\widehat{\alpha_j^s}}$, 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.

$$\ln(avgprice_{jt}) = \lambda_1 \widehat{sc_j^s} + \lambda_2 q_{jt} + \mu_p + \sigma_c + \varphi_t + \psi_{ct} + \varepsilon_{jt} \tag{11}$$

$$\ln(avgeditionlife_j) = \lambda_1 \widehat{\alpha_j^s} + \mu_p + \sigma_c + \varepsilon_j \tag{12}$$

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 equations (11) and (12) on each of the simulated datasets.

V. DESCRIPTION OF DATA, SAMPLE SELECTION, AND KEY VARIABLES

The main data for this study come from R.R. Bowker, the primary data source in the textbook industry. Though best known as the sole assigners of ISBNs in the United States, Bowker collects data from college bookstores and creates databases it sells to textbook publishers. Bowker solicits schools for their adoption and sales information each semester. School participation has grown from approximately 400 schools in 1997 to over 1600 in 2011. In many cases, once a school begins participating it continues to provide data in each subsequent semester; however, some schools neglect to report data for one or more semesters.

I merge two datasets from Bowker, a database of textbook assignments from Spring 1997 to Fall 2011 and a database of textbook sales that ranges from Spring 1997 to Spring 2011. I have access to a sample including all sales and assignments in the economics discipline. Each observation in the adoption data includes the adopting professor's name, the university specific course number, Bowker's generic course name classification, the semester and year of the adoption, school information (name, location, two-year or four-year), bibliographic information (ISBN, author, title, edition, publisher, publication date), and whether the book assignment was required or optional. The sales data includes the same bibliographic and school information, the semester and year, new book revenues, new book quantities sold, used book revenues, and used 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-explanatory, are the highest level of groupings of schools developed by the Carnegie Foundation for the Advancement of Teaching. They are the basis of U.S. News college rankings and are widely used by many research organizations including the Department of Education. A detailed description of Carnegie's Basic Classification methodology can be found on the Carnegie Foundation website (classifications.carnegiefoundation.org). Table 1 displays summary statistics for each of these controls for each university in my sample. The first column in Table 1 shows the IPEDS national average for schools in the eight Carnegie Classification categories in my sample.

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 professors' adoption choices. Within each history, I observe when a professor switches books, which book he switches from, and which book he switches to. Since the data includes all the

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

	IPEDS Mean	Mean	25th Pct	50th Pct	75 Pct
Average Panel Length in Semesters	-	5.5	2.0	5.0	8.0
Number of Books Per Panel	-	1.2	1.0	1.0	1.0
Average Salaries					
Professor	$83,629	$88,974	$72,330	$84,550	$101,967
Associate Professor	$66,293	$69,427	$59,656	$67,641	$77,134
Assistant Professor	$56,913	$59,223	$51,222	$57,703	$65,892
Instructor	$46,217	$47,741	$40,842	$45,630	$52,517
Lecturer	$49,544	$49,729	$42,284	$48,747	$55,953
School Type					
Baccalaureate Colleges--Arts and Sciences	0.16	0.13	-	-	-
Baccalaureate Colleges--Diverse Fields	0.23	0.13	-	-	-
Masters Colleges and Universities (large)	0.05	0.07	-	-	-
Masters Colleges and Universities (med.)	0.25	0.32	-	-	-
Masters Colleges and Universities (small)	0.11	0.12	-	-	-
Doctoral Universities	0.08	0.05	-	-	-
Doctoral Universities--High Research	0.06	0.09	-	-	-
Doctoral Universities--Very High Research	0.06	0.10	-	-	-
Public/Private					
Public	0.67	0.59	-	-	-
Private	0.33	0.41	-	-	-
School Size					
Under 1,000	0.15	0.05			
1,000 - 4,999	0.48	0.46	-	-	-
5,000 - 9,999	0.15	0.18	-	-	-
10,000 - 19,999	0.12	0.17	-	-	-
20,000 and above	0.09	0.15	-	-	-
School Selectivity					
Percent Admitted	64%	64%	54%	66%	77%
SAT Math 75th Percentile	592	590	540	580	630
SAT Math 25th Percentile	482	481	440	470	520
SAT Reading 75th Percentile	585	581	530	580	620
SAT Reading 25th Percentile	474	472	430	460	510
SAT Writing 75th Percentile	581	574	522	570	620
SAT Writing 25th Percentile	574	470	420	460	510
Yearly Tuition	$17,712	$18,575	$7,132	$18,805	$28,202
Students/Faculty	15.6	15.5	13	15	18

[a] IPEDS means are national averages of all schools in the IPEDS database in the eight Carnegie Classification categories listed above.

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 a professor's first appearance, 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 period variation in book choice are dropped to avoid a bias from schools that dictate textbooks at the department level. Finally, secondary textbook adoptions are dropped from the data; only the professors' primary textbook adoptions are included.

V. A. Definition of a Textbook Choice

I define the professor's book choice by author and edition. For example, if a professor chooses Krugman's Macroeconomics 2e in the fall and Krugman's Macroeconomics 2e 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 texts that are tagged as "optional" and, if more than one 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 obsolescence of the old edition, there is a window of ambiguity as to whether the professor's status quo choice is between the old or new edition of the book. In the empirical analysis, professor's option is defined 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, resulting in convergence problems.[1] To address this and better represent the professor's choice set, I create two samples with truncated book id values. One sample categorizes all books that have less than 1% market share in that semester-course as "other." The other sample categorizes all books that earn less than 3% market share as "other." In these truncated samples, the professor's choice is no longer between 60 textbooks; it is between a handful of books that earn a large market share, their status quo option, and an "other" book. Table 2 compares the book choices in the full sample, the 1% truncated sample, and the 3% truncated sample.

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 get

[1] The statistical software used for this analysis is Stata/SE, Version 12 (2011) produced by Stata Corp.

Table 2 - Comparisons of Full and Truncated Samples

	Full Sample	Truncated <1%	Truncated <3%
Observations	44,507	44,507	44,507
Average Number of Book Choices			
Intro to Economics	34	20	10
Principles of Micro	34	20	10
Principles of Macro	37	22	10
Intermediate Micro	14	12	9
Intermediate Macro	10	9	7
Intro to Econometrics	16	12	7
Average Market Share of "Other" Book			
Intro to Economics	-	0.16	0.61
Principles of Micro	-	0.09	0.50
Principles of Macro	-	0.09	0.53
Intermediate Micro	-	0.03	0.19
Intermediate Macro	-	0.04	0.16
Intro to Econometrics	-	0.06	0.21

identical results. Listed 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 is a column for "switchers," veteran professors 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 period. The 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.

V. D. Professor Matching

The main drawback of Bowker's adoption data is inconsistent reporting of professor names. Schools report the names in a free field, which means they show up in the data in many different forms (last only; first.last; last, first; first last; firstinitial. last; etc.). In order to match names across time periods and create an instructor-semester panel of data, I split the instructor name cell into first and last name cells that are logically consistent with frequently occurring name formats. The name columns are used to conservatively match instructors across observations, linking only observations with identical last names within a university. This process, though generally accurate, inevitably leads to under-matching, i.e. two instructors will appear in the data when they should have been matched as one. Overmatching can also occur if two professors with

Table 3 - Professor and Market Summary Statistics by Semester

Term	Year	n	Rookies % of n	Veterans % of n	Switchers % of vets	Avg # of Textbook Options Full Data	1% Data	3% Data	BHHI	PHHI
Spring	2000	854	18%	74%	18%	20	16	9	1,025	3,177
Fall	2000	853	19%	65%	25%	21	17	9	945	3,066
Spring	2001	999	14%	72%	20%	21	16	8	1,027	3,150
Fall	2001	1,058	15%	65%	31%	23	17	9	935	3,027
Spring	2002	784	11%	72%	24%	21	16	11	929	3,120
Fall	2002	934	14%	66%	31%	24	17	9	993	3,027
Spring	2003	792	9%	76%	20%	22	17	10	1,092	3,105
Fall	2003	528	13%	66%	31%	18	15	9	1,120	3,220
Spring	2004	548	15%	73%	17%	18	15	9	1,136	3,278
Fall	2004	791	18%	65%	25%	21	15	9	1,072	3,214
Spring	2005	711	16%	69%	22%	21	15	9	1,109	3,050
Fall	2005	1,023	18%	64%	28%	22	16	8	1,043	2,989
Spring	2006	953	19%	65%	24%	22	16	8	1,080	2,971
Fall	2006	1,067	16%	67%	26%	24	16	9	1,084	2,951
Spring	2007	1,261	15%	75%	14%	23	15	9	1,194	3,055
Fall	2007	1,953	19%	65%	25%	26	17	9	1,150	3,093
Spring	2008	1,654	14%	72%	19%	26	15	9	1,180	3,022
Fall	2008	2,577	27%	58%	26%	29	16	9	1,102	2,903
Spring	2009	3,274	13%	78%	11%	28	15	9	1,207	3,038
Fall	2009	3,408	18%	68%	20%	29	16	9	1,158	2,885
Spring	2010	3,893	13%	78%	12%	30	17	8	1,151	2,820
Fall	2010	4,304	17%	73%	14%	31	15	8	1,174	2,804
Spring	2011	4,924	8%	86%	7%	31	16	7	1,213	2,736
Fall	2011	5,364	14%	79%	9%	32	16	7	1,248	2,775
Sum	44,507									

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%
	Pearson Higher Ed.	21.4%
	MacMillan	8.0%
	John Wiley & Sons	1.5%
	Total	95.8%
Principles of Macroeconomics	Cengage Learning	38.4%
	McGraw-Hill, Inc.	25.5%
	Pearson Higher Ed.	22.9%
	MacMillan	6.9%
	The MIT Press	1.2%
	Total	94.8%
Intermediate of Microeconomics	Pearson Higher Ed.	44.9%
	John Wiley & Sons	14.6%
	McGraw-Hill, Inc.	14.2%
	W. W. Norton	13.1%
	Cengage Learning	11.8%
	Total	98.6%
Intermediate of Macroeconomics	MacMillan	44.2%
	Pearson Higher Ed.	31.1%
	W. W. Norton	8.5%
	McGraw-Hill, Inc.	6.9%
	Cengage Learning	3.5%
	Total	94.1%
Introduction to Econometrics	McGraw-Hill, Inc.	26.1%
	Pearson Higher Ed.	24.2%
	John Wiley & Sons	12.7%
	Cengage	11.5%
	The MIT Press	10.4%
	Total	82.3%

the same name teach the same subject at the same university, but this is very rare in the data and will have no impact on the results.

The implications of under-matching are shorter panels and, since veteran professors are coded as rookies, measurement error in the quality control variable. There are two types of under-matching that are likely to occur. If the under-matching is due to oddly coded names or typos, there is no reason to think this is correlated with the professor's choice. The second type of under-matching is due to professors changing universities. If professors are more or less likely to switch books when they switch schools, under-matching will be correlated with the book choice decision.

V. E. Book Quality Variable

The main empirical challenge of measuring switching costs is isolating the switching cost effects on professor choices from book quality effects and professor preferences. To control for the varying quality of books, I take advantage of the fact that rookie professors are not affected by the switching cost; or, at least, rookies are less affected than veterans. In each semester, there is a given number of rookie professors teaching each course. I proxy for book quality using rookie adoption rates of the book in the given time period. Since rookie professors are assumed to consider all book characteristics (or at least the same characteristics veteran professors consider) when making their adoption choice, the quality control variable is a comprehensive control accounting for price, quality of instruction, ancillary products, resale value, etc.

The key assumption of using rookies as a counterfactual is, absent switching costs, rookie and veteran professors value books similarly – there is a positive correlation between rookies' valuations of books and veterans' valuations. Recall the theoretical framework that both rookies, who never incur the switching cost, and switchers, who always incur the switching cost, choose what they consider to be the highest quality book. Figure 2 demonstrates the strong `positive correlation between rookies' textbook valuations and veterans' valuations. Each point represents a book in a semester. The x-axis is the percentage of rookies that adopt the book in the semester. The y-axis is the percentage of veteran switchers, veteran professors that choose to incur the switching cost and abandon their status quo books.

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.

To account for observable heterogeneity across rookies, I test alternative measures of the quality variable. In one approach, the rookie professors are grouped by the 75th percentile math SAT scores of the school's entering class and I calculate rookie market shares within groups: 500-599, 600-699, and 700-800. The idea behind this grouping is that more "math heavy" books will be better fits for some schools than others. In the most comprehensive alternative control, the rookie market share variable is replaced with fitted values from the conditional logit regression in equation (13), which includes all the university-level controls. Only the rookie professors are used for this exercise. The result is a quality variable that varies by the university level controls. Notation in equation (13) is identical to equation (8). Table 5 shows descriptive statistics of textbooks including various quality variables, average price, edition-life, and the number of book choices.

$$U_{ijct}^{*} = \gamma_j z_i + \varepsilon_{ijct} \quad (13)$$

Figure 2 – Textbook Market Shares for Veterans that Switch and Rookies

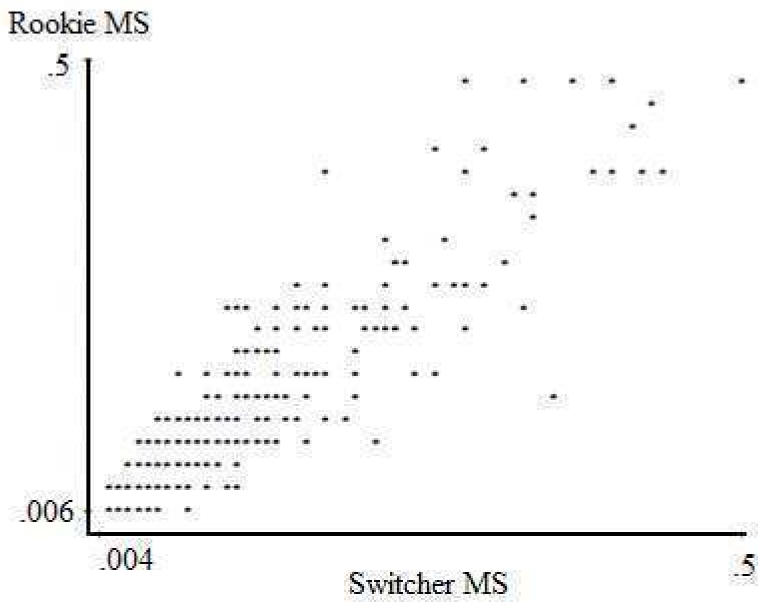

Table 5 - Summary Statistics of Textbooks

	Mean	25th Pct	50th Pct	75 Pct
# of Book Choices Per Semester-Course (Full Data)	25.5	13.8	24.0	35.0
# of Book Choices Per Semester-Course (1% Data)	16.1	11.0	16.5	21.0
# of Book Choices Per Semester-Course (3% Data)	8.6	7.0	8.5	10.0
Edition Life in Semesters	6.1	3.0	5.0	7.0
Average Price	$138.39	$129.22	$141.34	$152.31
Rookie Market Share (all SAT scores)	2.8%	0.0%	1.2%	3.4%
Rookie Market Share (500<SAT<599)	2.9%	0.0%	0.0%	3.5%
Rookie Market Share (600<SAT<699)	2.7%	0.0%	0.0%	4.0%
Rookie Market Share (700<SAT)	3.2%	0.0%	0.0%	4.2%
Predicted Rookie Market Share (Rookie MS Hat)	2.4%	0.1%	0.7%	2.5%
New Entrants Per Semester-Course	0.86	0	1	1

VI. RESULTS

VI. A. Random Utility Model

Mixed logit results from equation (8.1) are presented in Table 6.[5] Results from the sample with the full set of options are displayed in the first three columns and results from two samples with truncated choice sets are presented in columns (4) – (9). In all specifications, the signs and relative magnitudes are statistically significant and in accordance with the theoretical predictions: $0 < \alpha^n < \alpha^s$, $\alpha^e < 0$, and $|\alpha^e| < \alpha^s$. These results suggest that switching costs do affect professors' textbook adoptions. Additionally, the costs of switching to a new book are lessened when a colleague has adopted the book in the past, and the benefit of staying with the status quo book is lessened when a new edition of the professor's status quo replaces the old.

The magnitudes of the coefficients can be interpreted as odds ratios, which are calculated by raising the constant e to the power of the coefficient (for instance, e^{α^s}). The odds ratio on the main switching cost coefficient in column (1) implies the odds of re-adopting the status quo book is 85 ($e^{4.438}$) times the odds of adopting a book that is not the status quo, other things constant. In this sample, the professor faces up to 43 choices, so the average odds of a professor adopting a 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 .34 ($e^{-1.074}$) 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

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[5] Results for specification (1) for the other subjects are presented in Table 6b in the appendix. It was necessary to run the regressions separately for each course because the required computing power to converge the mixed logit simulations becomes too great for Stata/SE, Version 12 (2011) as the data size, control variables, and choice sets increase.

Table 6a - Mixed Logit Results for Principles of Microeconomics using Full Data (1 - 3) and Data Truncated at 1% (4 - 5) and 3% (6 - 9)[a]

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Rookie MS	5.177***			3.828***	4.363***	3.475***	3.924***		
	(0.253)			(0.265)	(0.914)	(0.299)	(0.987)		
Rookie MS by SAT		4.332***						2.073***	
		(0.209)						(0.454)	
Rookie MS Hat			4.710***						3.285***
			(0.250)						(0.789)
Status Quo	4.438***	4.422***	4.424***	4.266***	4.371***	4.191***	4.286***	4.271***	4.276***
	(0.0540)	(0.0539)	(0.0525)	(0.0525)	(0.0667)	(0.0635)	(0.0782)	(0.0771)	(0.0778)
School Status Quo	1.611***	1.681***	1.683***	1.275***	1.178***	1.165***	1.084***	1.090***	1.073***
	(0.0597)	(0.0587)	(0.0594)	(0.0636)	(0.0714)	(0.0725)	(0.0804)	(0.0804)	(0.0806)
Status Quo x New Ed.	-1.074***	-1.052***	-1.036***	-1.013***	-0.995***	-0.950***	-0.980***	-0.957***	-0.947***
	(0.0682)	(0.0682)	(0.0682)	(0.0729)	(0.0820)	(0.0817)	(0.0901)	(0.0896)	(0.0899)
Random Coefficient	3.027***	2.534***	3.457***	3.145***	4.191***	2.871***	3.827***	3.287***	2.873***
	(0.535)	(0.520)	(0.440)	(0.550)	(0.522)	(0.690)	(0.605)	(0.541)	(0.418)
SAT Math 75th PCT	No	No	No	No	Yes	No	Yes	Yes	Yes
Student-Faculty Ratio	No	No	No	No	Yes	No	Yes	Yes	Yes
Avg Prof. Salary	No	No	No	No	Yes	No	Yes	Yes	Yes
Tuition	No	No	No	No	Yes	No	Yes	Yes	Yes
Likelihood Ratio χ^2	-7737	-7750	-7789	-6020	-5065	-4439	-3769	-3761	-3766

[a]Dependent variable is the professor's book choice in all specifications. Asymptotic standard errors are reported in parenthesis. N = 44,507.

* significant at the 10% level

** significant at the 5% level

*** significant at the 1% level

odds of adopting any book other than the status quo increase by a factor of 5 ($e^{1.611}$) when another professor at the same university has used the book in the past. If the average book is not the professor's status quo, the odds of the professor adopting it increase from 1/43 to 5/47, or about 10% of the time, when another professor at the same school has used it.

The book quality coefficient suggests an increase in rookie market share of 1%, leads to an increase in odds of adoption by a factor of 1.05 or, for the average book, an increase of only .1% of veteran professors. For the average textbook to increase the odds of a veteran professor adopting by 1%, it must increase its rookie market share by 7.5%. The switching cost effect on veteran adoptions dwarfs the effect of book quality. In order for a veteran to be indifferent between adopting a new text and staying with the status quo, a text would have to attract over 80% of the rookie market share.

Controls, variable construction, and sampling have a limited effect on the results; the coefficients of interest are consistent across all specifications. The results in Table 6 strongly support the theoretical model and dispel the notion that professors choose the textbook that is best for students. Switching costs are large and, in many cases, far outweigh book quality in determining textbook adoptions. Not only are professors not purely benevolent, they are hardly benevolent.

VI. B. Probit Model

Probit results from equation (9) are displayed in Table 7 and are consistent with results from the mixed logit and the theorized hypothesis: $-\delta_1 < \delta_2 < 0$ and $\delta_3 < 0$. Switching costs are significant and decrease the veteran professor's incentive to adopt a new book. The results in column (2) of Table 7, which are interpreted as marginal effects, predict a rookie professor will adopt a new text about 1.65% of the time, while a veteran professor will adopt a new text only

.65%. However, when a new edition of the veteran's status quo book is released, the odds of the veteran adopting a new textbook improve 5 basis points. Moreover, the rookie market share of the status quo book has a negative coefficient, indicating a professor is more likely to choose a new book if his status quo book is low quality. The probit results support rejection of the null hypothesis that the switching cost parameters estimated by the random utility model in *VI.A.* are due entirely to persistent heterogeneous preferences. Although it is interesting that professor salary is slightly correlated with new book adoptions, the results do not change much when school controls are added,

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

Table 8 displays the heterogeneous switching cost results corresponding to equation (10). The computational burden of equation (10) is too great for Stata using the full sample, so the results of this equation are limited to the 3% truncated sample and the Principles of Microeconomics and Principles of Macroeconomics courses. Table 9 displays the basic summary statistics for the variables used in the OLS estimations of equations (11) and (12). The switching 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. Each book's switching cost coefficient is statistically different than 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.

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

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)
Tuition (x10,000)	-	0.013
	-	(0.085)
Public	-	0.119
	-	(0.203)
Carnegie Classification	No	Yes
Time Fixed Effects	Yes	Yes
Course Fixed Effects	Yes	Yes
Time-Course Fixed Effects	Yes	Yes
N	22,086	18,705
Likelihood Ratio χ2	-1532.647	-1295.4848

[a] Dependent variable is new_{ikct} in all specifications. Asymptotic standard errors are reported in parenthesis.
* significant at the 10% level
** significant at the 5% level
*** significant at the 1% level

Table 8 - Heterogeneous Switching Costs for Data Truncated at 3%[a]

Table 8a – Heterogeneous Switching Costs

Variable	(1)
Rookie Market Share	4.105***
	(0.598)
Status Quo x New Edition	-0.99***
	(0.054)
Status Quo	4.302***
	(0.498)
School Status Quo	1.196***
	(0.049)
Status Quo x Book 2	-0.585
	(0.513)
Status Quo x Book 3	1.671
	(1.363)
Status Quo x Book 4	1.504**
	(0.678)
Status Quo x Book 5	0.047
	(0.614)
Status Quo x Book 6	0.973
	(0.617)
Status Quo x Book 7	-0.489
	(0.839)
Status Quo x Book 8	-0.203
	(0.539)
Status Quo x Book 9	-0.089
	(0.655)
Status Quo x Book 10	-0.271
	(0.551)
Status Quo x Book 11	-0.628
	(0.524)
Status Quo x Book 12	-0.704
	(0.512)
Status Quo x Book 13	0.097
	(0.521)
Status Quo x Book 14	-0.142
	(0.578)

Continued on Table 8b

Table 8b - Heterogeneous Switching Costs Continued

Variable	(1)
Status Quo x Book 15	-0.234
	(0.526)
Status Quo x Book 16	-0.231
	(0.552)
Status Quo x Book 17	-0.892
	(1.315)
Status Quo x Book 18	-1.722
	(1.398)
Status Quo x Book 19	-0.322
	(0.523)
Status Quo x Book 20	0.141
	(0.534)
Status Quo x Book 21	-0.177
	(0.540)
Status Quo x Book 22	0.078
	(0.521)
Status Quo x Book 23	-1.644**
	(0.726)
Status Quo x Book 24	0.244
	(0.538)
Status Quo x Book 25	-1.117*
	(0.588)
Status Quo x Book 26	0.22
	(0.590)
Status Quo x Book 27	0.443
	(0.730)
Status Quo x Book 28	1.708
	(1.160)
Status Quo x Book 29	0.667
	(0.938)
Status Quo x Book 30	-0.425
	(0.543)
Status Quo x Book 31	0.404
	(0.550)

Continued on Table 8c

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
Carnegie Classification	No
Likelihood Ratio $\chi 2$	-3520356

[a]Dependent variable is the professor's book choice. Asymptotic standard errors are reported in parenthesis. N = 18,177.
* significant at the 10% level
** significant at the 5% level
*** significant at the 1% level

Table 9 - Summary Statistics for OLS Regression

	Mean	Std. Dev.
Average Price	$143.94	21.51
Edition Life in Semesters	4.30	1.16
Rookie Market Share	0.06	0.06
Switching Cost Odds Ratio	99.48	68.35
Switching Cost Coefficient	4.42	0.58

Table 10 - OLS Results[a]

Variable	(1)	(2)
Switching Cost (x1000)	0.879***	0.265
	(0.203)	(0.536)
Rookie MS	0.825***	-0.303
	(0.205)	(0.673)
Constant	4.659***	1.496***
	(0.066)	(0.123)
Publisher Fixed Effects	Yes	Yes
Time Fixed Effects	Yes	No
Course Fixed Effects	Yes	Yes
Time-Course Fixed Effects	Yes	No
N	185	31

[b] Dependent variable is ln($avgprice_{jt}$) in column (1) and ln($avgeditionlife_{j}$) in column (2). Standard errors are reported in parenthesis.
* significant at the 10% level
** significant at the 5% level
*** significant at the 1% level

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.

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 5,775 of the results when the confidence level is set at 95% and 4,345 when the confidence level is set at 99%. On the other hand, the coefficient on edition life is found to be significant, positive or negative, in 80, 67, and 45 of 10,000 simulated regressions at 90%, 95%, and 99% confidence levels, respectively.

VII. CONCLUDING COMMENTS AND POLICY IMPLICATIONS

This paper uses a unique dataset of professor adoption histories to make several important inferences about switching costs and the market for college textbooks. These conclusions are especially important because switching costs are not typically identifiable due to insufficient data, and research on the competitive effects of switching costs is inconclusive. The college textbook industry is an important setting to study influences on demand as textbook costs represent an increasingly large portion of students' budgets despite technological improvements in production.

The results of my model and empirical analysis support the existence and significance of switching costs and show they heavily influence textbook adoption decisions. In order for a veteran to be indifferent between adopting a new text and staying with the status quo, a text would have to attract more than 80% of the rookie market share. Rookie professors are more than twice as likely as veteran professors to adopt a newly released book. Moreover, in accordance with the theory laid out in section III., a professor is more likely to switch books when a new edition of his status quo book is released. I also provide evidence that some authors and publishers are better at locking-in professors than others and higher switching costs tend to lead to higher prices. Switching costs account for as much as $15, or about 9%, of textbook prices.

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, clickers, voice dubbed slideshow presentations, etc. can all require a one-time setup cost. In many instances, these costs will save the professor time in the long run; however, some are only beneficial to student learning. These startup costs are similar in nature to the costs I identify and likely have similar consequences.

In some instances, suboptimal textbook choices can be avoided by department-level adoptions. From discussions with publisher sales representatives, higher-education textbook professionals, and professors in various fields, department-level adoptions are more common among lower-division courses, especially in the hard sciences and at two-year schools. Of course, while this adoption process ensures professors are not neglecting book quality, it can be burdensome on professors when they are forced to switch and, as shown in section III., that cost can be passed on to students (not to mention, this may stifle the professor's creative freedom). Additionally, when the department reviews its adoptions infrequently, it can be less adaptive than a professor facing switching costs. Departments considering this policy approach should weigh the time cost to the professor and the disparity in book qualities.

When the professor chooses a book and time input, he maximizes his utility and considers course quality, but he does not maximize a societal or student welfare. The principal-agent relationship between professors and students provides a more "economic" solution than a high-level adoption mandate: incentivize professors to adopt in the students' interests. Misaligned incentives are a well-documented criticism of higher education and run much deeper than switching costs. The production function, Q(.), enters the professor's utility function because he cares about the quality of education he provides and/or because his salary may be tied to his quality of teaching. The latter of these motivators suggests adjustments to student-professor wage contracts can strengthen or lessen the effect of Q(.) on professors' utilities. In practice, professor salaries are only loosely tied to course quality, if at all. A recent survey found that less than 50% of professors think their university has a system well-suited to assess the quality of instruction (Allen, Seaman, Lederman, and Jaschik, 2012). Financial incentives related to course-quality, the tenure system, etc. all suffer at the expense of a heavy focus on research and professor autonomy. Nevertheless, one-time course materials adoption subsidies or other financial incentives tied to course quality could better align the professor’s utility maximizing choices with the students’.

Finally, implications of this research on publisher strategies are three-fold: 1) To the extent that researchers can affect switching costs, they should increase the costs of switching from their product and decrease those switching to their product; 2) New product marketing should be geared towards rookie professors as they adopt new products at 2.5 times the rate of veterans; 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, $U(T - t_0^*, Q(t_0^*, q_0))$ is always greater than $U\big(T - t_1^* - t^s, Q(t_1^*, q_1)\big)$ when $q_1 < q_0$. So consider the case when q_1>q_0. Since the utility function is continuous, there must exist a $\overline{t^s}$ such that $U(T - t_0^*, Q(t_0^*, q_0)) = U\big(T - t_1^* - \overline{t_s}, Q(t_1^*, q_1)\big)$. Since $\frac{\partial(\,U(l,Q(t,q_1)))}{\partial l} > 0$, $U(T - t_0^*, Q(t_0^*, q_0)) > U\big(T - t_1^* - t^s, Q(t_1^*, q_1)\big)$ for all $t^s > \overline{t^s}$.

Discussion of Observation 2:

Observation 2 follows from the diminishing marginal utility of leisure. The previously defined utility maximizing time choice, t_1^*, must satisfy $\frac{\partial(\,U(l,Q(t,q_1)))}{\partial Q(t,q_1)} \cdot \frac{\partial Q(t,q_1)}{\partial t} + \frac{\partial(\,U(l,Q(t,q_1)))}{\partial l} \cdot \frac{\partial l}{\partial t} = 0$, where $l = T - t - t_s$. Since it is assumed that $\frac{\partial(\,U(l,Q(t,q_1)))}{\partial Q(t,q_1)}$>0, $\frac{\partial(\,Q(t,q_1))}{\partial t} > 0$, $\frac{\partial(\,U(l,Q(t,q_1)))}{\partial l} < 0$, and $\frac{\partial^2(\,U(l,Q(t,q_1)))}{\partial l\,\partial l} < 0$,it follows that $\frac{\partial t_1^*}{\partial t_s} < 0$. The professor will choose a lesser time input as long as $\frac{\partial^2(\,U(l,Q(t,q_1)))}{\partial l\,\partial l} + \big(\frac{\partial(\,U(l,Q(t,q_1)))}{\partial Q(t,q_1)} \cdot \frac{\partial Q(t,q_1)}{\partial t} - \frac{\partial(\,U(l,Q(t,q_0)))}{\partial Q(t,q_0)} \cdot \frac{\partial Q(t,q_0)}{\partial t}\big) \leq 0$, which seems intuitive: the professor's marginal product of time is unlikely to increase significantly with book quality. The students are necessarily better off with the new book despite a lesser choice time input because professor's choice implies $U\big(T - t_1^* - t_s,\ Q(t_1^*, q_1)\big) > U\big(T - t_0^*,\ Q(t_0^*, q_0)\big)$. Since $\frac{\partial(\,U(l,Q(t,q_1)))}{\partial l} > 0$, $\frac{\partial(\,U(l,Q(t,q_1)))}{\partial Q(t,q_1)}$>0, and $T - t_1^* - t_s < T - t_0^*$, it must be that $Q(t_1^*, q_1) > Q(t_0^*, q_0)$.

Discussion of Observation 3:

Observation 3 follows from $U(T - t_0^*, Q(t_0^*, q_0)) - U\big(T - t_1^* - t^s, Q(t_1^*, q_1)\big) > U(T - t_{\hat{0}}^* - t^e, Q\big(t_{\hat{0}}^*, q_{\hat{0}})\big) - U\big(T - t_1^* - t^s, Q(t_1^*, q_1)\big)$ when $q_{\hat{0}} - q_0$ is small. Define $\breve{t}_0^*$ to solve $\max_t U(l, Q(t, q_0))$ s.t. $T = l + t + t^e$ and $t_{\hat{0}}^*$ to solve equation 6. The extra time cost, $t^e > 0$, implies $U(T - t_0^*, Q(t_0^*, q_0)) > U(T - \breve{t}_0^* - t^e, Q\big(\breve{t}_0^*, q_0\big)\big)$. Therefore, since the utility function is continuous, there must be some $q_{\hat{0}} > q_0$ such that $U(T - t_0^*, Q(t_0^*, q_0)) > U(T - t_{\hat{0}}^* - t^e, Q\big(t_{\hat{0}}^*, q_{\hat{0}}\big)\big)$.

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

Variable	Principles of Micro (1)	Intermediate Micro (2)	Principles of Macro (3)	Intermediate Macro (4)	Intro to Economics (5)	Intro to Econometrics (6)
Rookie MS	5.177***	3.864***	6.291***	2.169***	7.421***	4.370***
	(0.253)	(0.234)	(0.315)	(0.173)	(0.390)	(0.367)
Status Quo	4.438***	4.099***	4.392***	3.617***	4.099***	3.588***
	(0.0540)	(0.0811)	(0.0553)	(0.117)	(0.0615)	(0.0932)
School Status Quo	1.611***	1.083***	1.748***	1.227***	2.441***	1.329***
	(0.0597)	(0.0960)	(0.0598)	(0.143)	(0.0663)	(0.105)
Status Quo x New Edition	-1.074***	-1.263***	-1.094***	-0.839***	-1.098***	-0.444***
	(0.0682)	(0.107)	(0.0686)	(0.164)	(0.0754)	(0.161)
Random Coefficient	3.027***	0.114	2.862***	0.0237	3.857***	-1.483
	(0.535)	(0.711)	(0.787)	(0.440)	(1.058)	(1.439)
SAT Math 75th PCT	No	No	No	No	No	No
Student-Faculty Ratio	No	No	No	No	No	No
Avg Prof. Salary (x10,000)	No	No	No	No	No	No
Tuition (x1000)	No	No	No	No	No	No
N	11,470	4,585	10,799	3,030	11,426	3,197
Likelihood Ratio χ^2	-7737	-2523	-7738	-1129	-6303	-2161

[a] Dependent variable is the professor's book choice in all specifications. Asymptotic standard errors are reported in parenthesis.
* significant at the 10% level
** significant at the 5% level
*** significant at the 1% level