Why is learning important in economics?

Why is learning important in economics?

- Uncertainty and learning can explain some empirical puzzles

Why is learning important in economics?

- Uncertainty and learning can explain some empirical puzzles

    - Why engage in something costly and not finish it? (e.g. college)

Why is learning important in economics?

- Uncertainty and learning can explain some empirical puzzles

  - Why engage in something costly and not finish it? (e.g. college)

- Agents might act differently if they had greater amounts of information

Why is learning important in economics?

- Uncertainty and learning can explain some empirical puzzles

    - Why engage in something costly and not finish it? (e.g. college)

- Agents might act differently if they had greater amounts of information

- This means we need to model how *beliefs* map into *actions*

Why is learning important in economics?

- Uncertainty and learning can explain some empirical puzzles

  - Why engage in something costly and not finish it? (e.g. college)

- Agents might act differently if they had greater amounts of information

- This means we need to model how *beliefs* map into *actions*

  - $\implies$ learning should be part of a DDC model!

Why is learning important in economics?

- Uncertainty and learning can explain some empirical puzzles

  - Why engage in something costly and not finish it? (e.g. college)

- Agents might act differently if they had greater amounts of information

- This means we need to model how *beliefs* map into *actions*

  - $\implies$ learning should be part of a DDC model!

- A persistent question is how can we help agents become more informed?

Why is learning important in economics?

- Uncertainty and learning can explain some empirical puzzles

  - Why engage in something costly and not finish it? (e.g. college)

- Agents might act differently if they had greater amounts of information

- This means we need to model how *beliefs* map into *actions*

  - $\implies$ learning should be part of a DDC model!

- A persistent question is how can we help agents become more informed?

- Information is valuable, but usually costly to obtain

Education papers that use learning models:

- High school dropout (Fu et al. 2022 QE)

Wandering astray: Teenagers' choices of schooling and crime

Chao Fu
Department of Economics, University of Wisconsin and NBER

Nicolás Grau
Faculty of Economics and Business, University of Chile

Jorge Rivera
Faculty of Economics and Business, University of Chile

We build and estimate a dynamic model of teenagers' choices of schooling and crime, incorporating four factors that may contribute to the different paths taken by different teenagers: heterogeneous endowments, unequal opportunities, uncertainties about one's own ability, and contemporaneous shocks. We estimate the model using administrative panel data from Chile that link school records with juvenile criminal records. Counterfactual policy experiments suggest that, for teenagers with disadvantaged backgrounds, interventions that combine mild improvement in their schooling opportunities with free tuition (by adding 157 USD per teenager-year to the existing high school voucher) would lead to an 11% decrease in the fraction of those ever arrested by age 18 and a 13% increase in the fraction of those consistently enrolled throughout primary and secondary education.

Keywords. Teenage crime, education, information friction, institutional friction, dynamic model, structural estimation.

JEL classification. I2, K42.

1. Introduction

Teenage years are a critical period in life, featuring major physical, psychological, and attitudinal transitions. Faced with all these complications, some teenagers may experience a particularly difficult transition to adulthood and wander astray, dropping out of school and/or engaging in criminal activities. Juvenile delinquency is a serious problem worldwide. For example, in the U.S., over 725,000 teenagers were in detention centers

Chao Fu: cfu@ssc.wisc.edu
Nicolás Grau: ngrau@fen.uchile.cl
Jorge Rivera: jrivera@fen.uchile.cl

Education papers that use learning models:

- High school dropout (Fu et al. 2022 QE)

- College major choice (Arcidiacono 2004 JE)

Ability sorting and the returns to college major

Peter Arcidiacono*

Department of Economics, Duke University, Box 90097, Durham, NC 27708, USA

Abstract

Large earnings and ability differences exist across majors. This paper seeks to estimate the monetary returns to particular majors as well as find the causes of the ability sorting across majors. In order to accomplish this, I estimate a dynamic model of college and major choice. Even after controlling for selection, large earnings premiums exist for certain majors. Differences in monetary returns explain little of the ability sorting across majors; virtually all ability sorting is because of preferences for particular majors in college and the workplace, with the former being larger than the latter.
© 2003 Elsevier B.V. All rights reserved.

JEL classification: I21; C35; J24; D83

Keywords: Dynamic discrete choice; Returns to education; Human capital

1. Introduction

Students who choose natural science majors earn substantially more than humanities majors. In fact, economists have reported that differences in returns to majors are much larger than differences in returns to college quality. James et al. (1989, p. 252) argue that "… while sending your child to Harvard appears to be a good investment, sending him to your local state university to major in Engineering, to take lots of math, and preferably to attain a high GPA, is an even better private investment." Although a number of researchers have documented the large differences in earnings across majors (see Daymont and Andrisani, 1984; Grogger and Eide, 1995; James et al., 1989; Loury, 1997; Loury and Garman, 1995), none of the papers model the choice of major itself and we do not know whether these are actual monetary premiums or whether the observed premiums are driven by the differing abilities of individuals choosing the different majors.

* Tel.: +1-919-660-1816.
  E-mail address: psarcidi@econ.duke.edu (P. Arcidiacono).

Education papers that use learning models:

- High school dropout (Fu et al. 2022 QE)

- College major choice (Arcidiacono 2004 JE; Stinebrickner & Stinebrickner 2014 REStud)

A Major in Science? Initial
Beliefs and Final Outcomes for
College Major and Dropout

RALPH STINEBRICKNER

Berea College and The University of Western Ontario

and

TODD R. STINEBRICKNER

The University of Western Ontario

Taking advantage of unique longitudinal data, we provide the first characterization of what college
students believe at the time of entrance about their final major, relate these beliefs to actual major outcomes,
and provide an understanding of why students hold the initial beliefs about majors that they do. The data
collection and analysis are based directly on a conceptual model in which a student's final major is best
viewed as the end result of a learning process. We find that students enter school quite optimistic about
obtaining a science degree, but that relatively few students end up graduating with a science degree. The
substantial overoptimism about completing a degree in science can be attributed largely to students
beginning school with misperceptions about their ability to perform well academically in science.

Key words: Education, College major, Dropout, Science, Learning, Expectations data.

JEL Codes: I2, J24.

1. INTRODUCTION

It is well known that lifetime earnings are influenced strongly by a student's college major.[1]
Further, certain disciplines, such as math and other sciences, are viewed as being particularly
important for the future path of the economy (COSEPUP, 2007). Then it is not surprising that
policymakers often express a desire to influence the number of graduates in certain majors.[2]
Nonetheless, much remains unknown about how college majors are determined. In this article,
we use a unique combination of survey and administrative data to provide new evidence about
this issue.

We provide the first characterization of what students believe at the time of college entrance
about whether they will graduate and their majors at graduation if they do graduate, relate these

---

1. See Daymont and Andrisani (1984), Grogger and Eide (1995), Hamermesh and Donald (2008), Loury (1997),
Loury and Garman (1995), and James *et al.* (1989).
2. This desire has received much attention. See, for example, "Why Science Majors Change Their Minds (It's just
so darn hard)," *NY Times*, November 4, 2011.

Education papers that use learning models:

- High school dropout (Fu et al. 2022 QE)

- College major choice (Arcidiacono 2004 JE; Stinebrickner & Stinebrickner 2014 REStud)

- College dropout (Stinebrickner & Stinebrickner 2014 JOLE)

Academic Performance and College Dropout: Using Longitudinal Expectations Data to Estimate a Learning Model

Ralph Stinebrickner, *Berea College and University of Western Ontario*

Todd Stinebrickner, *University of Western Ontario*

We estimate a dynamic learning model of college dropout, taking advantage of unique expectations data to greatly reduce our reliance on standard assumptions. Our simulations show that 45% of dropout in the first 2 years of college can be attributed to what students learn about their academic performance, with this type of learning playing a smaller role later in college. Poorly performing students tend to leave because staying is not worthwhile rather than because they are at risk of failing out of school. Poor performance substantially decreases the enjoyability of school and substantially influences beliefs about postcollege earnings.

I. Introduction

The importance of understanding why many entering college students do not complete a degree has been widely recognized (Bowen, Chingos, and McPherson 2009; Bound, Lovenheim, and Turner 2010). Dropout that arises naturally as students figure out whether their skills/interests are

Education papers that use learning models:

- High school dropout (Fu et al. 2022 QE)

- College major choice (Arcidiacono 2004 JE; Stinebrickner & Stinebrickner 2014 REStud)

- College dropout (Stinebrickner & Stinebrickner 2014 JOLE; Arcidiacono et al. 2025 JPE)

College Attrition and the Dynamics
of Information Revelation

Peter Arcidiacono

Duke University, Institute of Labor Economics (IZA), and National Bureau of Economic Research (NBER)

Esteban Aucejo

Arizona State University, Centre for Economic Performance, Centre for Economic Policy Research, CESifo, and NBER

Arnaud Maurel

Duke University, IZA, and NBER

Tyler Ransom

University of Oklahoma, IZA, and Global Labor Organization

We examine how informational frictions impact schooling and work outcomes by estimating a dynamic structural model where individuals face uncertainty about their academic ability and productivity, which determine their schooling utility and wages. We account for different college types, majors, occupational search frictions, and work hours. Individuals learn from grades and wages, which may affect their choices. Removing informational frictions would increase graduation by 4.4 percentage points and by an additional 2 points without search frictions. Providing students with full information about their abilities would increase the college and white-collar wage premia while reducing the graduation gap by family income.

Labor papers that use learning models:

- Occupational choice (Miller 1984 JPE)

Job Matching and Occupational Choice
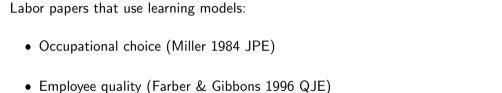
Robert A. Miller

Carnegie-Mellon University

This paper presents a model of job matching that generalizes the existing literature by allowing for different job types, or occupations. Such differences affect the value of job-specific experience, inducing a career profile where certain types are sampled before others. More specifically, the analysis shows that it is optimal for the young and inexperienced to gravitate toward jobs exhibiting a certain kind of risk. Then, after deriving the equilibrium job turnover rate for an economy in which people do not switch occupations, panel data are used to estimate its underlying parameters. The hypothesis that people do not switch occupations is rejected against the alternative that they do, thus providing empirical support for the theoretical extension undertaken here.

I. Introduction

The relationship linking skills that are job specific to turnover decisions has long been considered an important issue in the economics of labor mobility. Earlier writers, most notably Becker (1962, 1975), Mincer (1962), and Oi (1962), perceived a two-way flow between job-specific training and tenure. On the one hand, Becker asserts the "willingness of workers or firms to pay for specific training should . . . closely depend [negatively] on the likelihood of labor turnover" (1962, p. 19). On the other hand, these authors also recognized that the more job-specific capital a worker has, the more destructive a

Labor papers that use learning models:

- Occupational choice (Miller 1984 JPE)

- Employee quality (Farber & Gibbons 1996 QJE)

LEARNING AND WAGE DYNAMICS*

Henry S. Farber and Robert Gibbons

We develop a dynamic model of learning about worker ability in a competitive labor market. The model produces three testable implications regarding wage dynamics: (1) although the role of schooling in the labor market's inference process declines as performance observations accumulate, the estimated effect of schooling on the level of wages is independent of labor-market experience; (2) time-invariant variables correlated with ability but unobserved by employers (such as certain test scores) are increasingly correlated with wages as experience increases; and (3) wage residuals are a martingale. We present evidence from the NLSY that is broadly consistent with the model's predictions.

I. Introduction

When a worker enters the labor market, the worker's education level and other characteristics observable by employers seem likely to convey only partial information about the worker's productive ability. As the worker accumulates experience in the labor market, however, further information seems likely to be revealed. In keeping with this intuition, a small literature now exists on the role of learning in specific labor-market contexts.[1] This literature has produced some important achievements. Spence [1973] and Jovanovic [1979], for example, have fundamentally changed the way economists analyze broad collections of problems, not limited to labor economics. Nonetheless, we feel that this literature is incomplete in two respects. First, the literature has not made sufficient contact with the data.[2] Second, the litera-

1. Examples include Spence [1973], Salop and Salop [1976], and Guasch and Weiss [1981] on signaling and sorting at labor-market entry; Jovanovic [1979], MacDonald [1980], Flinn [1986], Lazear [1986], Murphy [1986] and McCall [1990] on the dynamics of matching; Harris and Holmstrom [1982], Holmstrom [1982], MacLeod and Malcomson [1988], and Gibbons and Murphy [1992] on career concerns; Waldman [1984, 1990], Milgrom and Oster [1987], Ricart i Costa [1988], Meyer [1991], O'Flaherty and Siow [1992, 1995], Bernhardt and Scoones [1993], Bernhardt [1995], and Gibbons and Waldman [1996] on task assignment within the firm; and Greenwald [1986], Gibbons and Katz [1991] and Acemoglu and Pischke [1996] on turnover.

2. Almost all the papers cited in footnote 1 offer new theory, but only a minority present new evidence: Flinn [1986]; McCall [1990]; Murphy [1986]; Gibbons

Labor papers that use learning models:

- Occupational choice (Miller 1984 JPE)

- Employee quality (Farber & Gibbons 1996 QJE; Altonji & Pierret 2001 QJE)

EMPLOYER LEARNING AND STATISTICAL DISCRIMINATION*

JOSEPH G. ALTONJI AND CHARLES R. PIERRET

We show that if firms statistically discriminate among young workers on the basis of easily observable characteristics such as education, then as firms learn about productivity, the coefficients on the easily observed variables should fall, and the coefficients on hard-to-observe correlates of productivity should rise. We find support for this proposition using NLSY79 data on education, the AFQT test, father's education, and wages for young men and their siblings. We find little evidence for statistical discrimination in wages on the basis of race. Our analysis has a wide range of applications in the labor market and elsewhere.

I. INTRODUCTION

People go through life making an endless stream of judgments on the basis of limited information about matters as diverse as the safety of a street, the quality of a car, the suitability of a potential spouse, and the skill and integrity of a politician. When hiring, employers must assess the value of potential workers with only the information contained in resumes, recommendations, and personal interviews. Do employers "statistically discriminate" among young workers on the basis of easily observable variables such as education, race, and other clues to a worker's labor force preparation? As they learn over time, do they rely less on such variables? These questions are directly relevant for many issues in labor economics including the signaling model of education [Spence 1973; Weiss 1995], statistical theories of discrimination [Aigner and Cain 1977; Lundberg and Startz 1983], the interpretation of earnings dynamics, and the design of institutional mechanisms for hiring and firing workers.

IO papers that use learning models:

- Learning about experience goods (Erdem & Keane 1996 MS)

Decision-making Under Uncertainty: Capturing Dynamic Brand Choice Processes in Turbulent Consumer Goods Markets

Tülin Erdem • Michael P. Keane
University of California at Berkeley
University of Minnesota

Abstract

We construct two models of the behavior of consumers in an environment where there is uncertainty about brand attributes. In our models, both usage experience and advertising exposure give consumers noisy signals about brand attributes. Consumers use these signals to update their expectations of brand attributes in a Bayesian manner. The two models are (1) a dynamic model with immediate utility maximization, and (2) a dynamic "forward-looking" model in which consumers maximize the expected present value of utility over a planning horizon. Given this theoretical framework, we derive from the Bayesian learning framework how brand choice probabilities depend on past usage experience and advertising exposures. We then form likelihood functions for the models and estimate them on Nielsen scanner data for detergent.

We find that the functional forms for experience and advertising effects that we derive from the Bayesian learning framework fit the data very well relative to flexible ad hoc functional forms such as exponential smoothing, and also perform better at out-of-sample prediction. Another finding is that in the context of consumer learning of product attributes, although the forward-looking model fits the data statistically better at conventional significance levels, both models produce similar parameter estimates and policy implications. Our estimates indicate that consumers are risk-averse with respect to variation in brand attributes, which discourages them from buying unfamiliar brands.

Using the estimated behavioral models, we perform various scenario evaluations to find how changes in marketing strategy affect brand choice both in the short and long run. A key finding obtained from the policy experiments is that advertising intensity has only short run effects, but a strong cumulative effect in the long run.

The substantive content of the paper is potentially of interest to academics in marketing, economics and decision sciences, as well as product managers, marketing research managers and analysts interested in studying the effectiveness of mar-
keting mix strategies. Our paper will be of particular interest to those interested in the long run effects of advertising.

Note that our estimation strategy requires us to specify explicit behavioral models of consumer choice behavior, derive the implied relationships among choice probabilities, past purchases and marketing mix variables, and then estimate the behavioral parameters of each model. Such an estimation strategy is referred to as "structural" estimation, and econometric models that are based explicitly on the consumer's maximization problem and whose parameters are parameters of the consumers' utility functions or of their constraints are referred to as "structural" models.

A key benefit of the structural approach is its potential usefulness for policy evaluation. The parameters of structural models are invariant to policy, that is, they do not change due to a change in the policy. In contrast, the parameters of reduced form brand choice models are, in general, functions of marketing strategy variables (e.g., consumer response to price may depend on pricing policy). As a result, predictions of reduced form models for the outcomes of policy experiments may be unreliable, because in making the prediction one must assume that the model parameters are unaffected by the policy change.

Since agents in our models choose among many alternative brands, their choice probabilities take the form of higher-order integrals. We employ Monte-Carlo methods to approximate these integrals and estimate our models using simulated maximum likelihood. Estimation of the dynamic forward-looking model also requires that a dynamic programming problem be solved in order to form the likelihood function. For this we use a new approximation method based on simulation and interpolation techniques. These estimation techniques may be of interest to researchers and policy makers in many fields where dynamic choice among discrete alternatives is important, such as marketing, decision sciences, labor and health economics, and industrial organization.
(*Brand Choice; Buyer Behavior; Choice Models; Econometric Modelling; Information Processing; Advertising*)

IO papers that use learning models:

- Learning about experience goods (Erdem & Keane 1996 MS; Ackerberg 2003 IER)

ADVERTISING, LEARNING, AND CONSUMER CHOICE IN EXPERIENCE GOOD MARKETS: AN EMPIRICAL EXAMINATION*

By   Daniel A. Ackerberg[1]

Economics Department, University of California, Los Angeles and NBER

This article empirically analyzes different effects of advertising in a nondurable, experience good market. A dynamic learning model of consumer behavior is presented in which I allow both "informative" effects of advertising and "prestige" or "image" effects of advertising. This learning model is estimated using consumer level panel data tracking grocery purchases and advertising exposures over time. Empirical results suggest that in this market, advertising's primary effect was that of informing consumers. The estimates are used to quantify the value of this information to consumers and evaluate the welfare implications of an alternative advertising regulatory regime.

1. INTRODUCTION

Theoretical work in economics has long been concerned with different influences of advertising on consumer behavior. Marshall (1919) praised "constructive" advertising, described as advertising that conveys economically relevant information to consumers. On the other hand, he termed the "incessant iteration of the name of a product" as "combative" advertising, and criticized the "social waste" of such behavior. More recently, economists have developed formal models of advertising. Stigler (1961), Butters (1977), and Grossman and Shapiro (1984) examine models where firms send advertising messages to explicitly inform consumers of their brand's existence or observable characteristics. In contrast to this *explicit* information, Nelson (1974), Kihlstrom and Riordan (1984), and Milgrom and Roberts (1986) analyze models in which firms producing nondurable experience goods use advertising to *implicitly* signal information on their brand's *experience* characteristics (e.g., unobserved quality). In these equilibria, brands with higher unobserved quality advertise more and consumers rightfully interpret these high advertising levels as a signal of this higher quality.

Marriage & family paper that uses learning models:

- Marriage match quality (Brien et al. 2006 IER)

COHABITATION, MARRIAGE, AND DIVORCE IN A MODEL OF MATCH QUALITY*

By Michael J. Brien, Lee A. Lillard, and Steven Stern[1]

*Deloitte Financial Advisory Services LLP, Washington, DC, U.S.A.;
University of Michigan, U.S.A. (deceased); University of Virginia, U.S.A.*

The objective of this research is to further our understanding of how and why individuals enter and leave coresidential relationships. We develop and estimate an economic model of nonmarital cohabitation, marriage, and divorce that is consistent with current data on the formation and dissolution of relationships. Jovanovic's (*Journal of Political Economy* 87 (1979), 972–90) theoretical matching model is extended to help explain household formation and dissolution behavior. Implications of the model reveal what factors influence the decision to start a relationship, what form this relationship will take, and the relative stability of the various types of unions. The structural parameters of the model are estimated using longitudinal data from a sample of female high school seniors from the United States. New numerical methods are developed to reduce computational costs associated with estimation. The empirical results have interesting interpretations given the structural model. They show that a significant cause of cohabitation is the need to learn about potential partners and to hedge against future bad shocks. The estimated parameters are used to conduct several comparative dynamic experiments. For example, we show that policy experiments changing the cost of divorce have little effect on relationship choices.

1. INTRODUCTION

It has long been the goal of social scientists to better understand how and why individuals enter and leave relationships. A substantial body of research has shown these relationships greatly impact individuals as well as society at large. Complicating this line of research is the fluid and diverse nature of family structure. It has been estimated, for example, that over half of all first marriages will be disrupted (Cherlin, 1992). It has also been shown that a significant number of