Structural Estimation and Policy Evaluation

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Overview

- Ex post vs. ex ante approaches to policy evaluation
- Use of behavioral models for ex-ante evaluation
- Static vs. dynamic frameworks
- Some Health-Related Applications
- Opportunities for Model validation

Ex Post Evaluation

- Goal is to evaluate impacts of an existing program
- Data on a treated group and on a comparison group
- Alternative approaches
    - Randomization
    - Difference-in-difference
    - Matching
    - Regression-discontinuity
    - Control function methods
    - IV methods, MTE, LATE
    - Estimation of a behavioral model

Ex Ante Evaluation

- Evaluate the impact of a new program prior to its implementation
- Evaluate effects of changing parameters of an existing program
    - Needed for optimal program design and placement, which requires simulating program effects and costs
- Evaluate effects of longer terms of exposure to an existing program than are observed in the data

Some Examples of Ex Ante Evaluations Using Static Models

- Forecast demand for a new good introduced into the choice set
  - e.g. McFadden (1977) - BART subway
- Forecast effect of changing the characteristics of a good on consumer demand
  - Berry,Levinsohn and Pakes (1995) - changing car characteristics (e.g. price, fuel efficiency)
  - BLP model often used to analyze effects of mergers

Some Examples of Ex Ante Evaluations Using Dynamic Models

- Wise (1985): Predict the effect of housing subsidy on housing demand
- Lumsdaine, Stock and Wise (1992): Predict the effect of retirement bonus on retirement patterns
- Lise, Seitz and Smith (2003) - Predict effects of welfare bonus program on job search
- Todd and Wolpin (2006) - Predict effects of school subsidy program on school attendance and work behaviors

The Importance of Economic Models in Ex Ante Policy Evaluation

- Koopmans (1947), Marschak (1953), Hurwicz (1962)
  - Recognize that an economic model provides a way of extrapolating from historical experience
  - Observe that it is not necessary to know the entire structure of the problem to answer certain policy questions (e.g. tax changes)

Evaluate Effects of School Attendance Subsidy with Partial Observability of Child Wage Offers

static model

- A couple chooses between sending their child to work ($d_{it} = 1$) or school ($d_{it} = 0$)
- Utility is

$$U_{it} = C_{it} \ + \ \alpha_{it} \ (1 - d_{it}),$$

  where C_{it} is household i's consumption at period t.
- The utility the couple attaches to the child's school attendance, α_{it}, is time-varying:

$$\alpha_{it} \ = \ x_{it}\beta \ + \ \varepsilon_{it}$$

- x_{it} ($\subseteq X_{it}$) include, perhaps, parents' schooling or the child's gender.
- ε_{it} is an iid random preference shock to the utility of the child's school attendance (iid assumption can be relaxed)

- The child receives a wage offer of w_{it} and the household otherwise generates income y_{it}.
- The budget constraint is

$$C_{it} = y_{it} + w_{it} d_{it} ,$$

where there are assumed to be no costs associated with attending school.
- Wage offers only observed for children who work (partial observability), so we also need a wage offer equation:

$$w_{it} = z_{it} \gamma + \eta_{it},$$

- z_{it} ($\subseteq Z_{it}$) would contain, for example, the child's age, gender, or factors affecting the demand for child labor, such as distance to a city.
- η_{it} is an iid wage shock
- We do not include the child's current educational attainment in z to maintain the static nature of the model.

- Alternative-specific utilities, U_{it}^1 if the child works and U_{it}^0 if the child attends school as

$$\begin{aligned} U_{it}^1 &= y_{it} + w_{it} \ , \\ U_{it}^0 &= y_{it} + x_{it}\beta + \varepsilon_{it}. \end{aligned}$$

- Substituting the wage equation yields U_{it}^1 - U_{it}^0

$$\begin{aligned} v_{it}^*(x_{it}, z_{it}, \varepsilon_{it}, \ \eta_{it}) &= z_{it}\gamma - x_{it}\beta + \eta_{it} - \varepsilon_{it} \\ &= \xi_{it}^*(\Omega_{it}^-) + \xi_{it}, \end{aligned}$$

where $\xi_{it} = \eta_{it} - \varepsilon_{it}$, $\xi_{it}^*(\Omega_{it}^-) = z_{it}\gamma - x_{it}\beta$ and Ω_{it}^- consists of z_{it} and x_{it}.

Estimation: Likelihood Function

- The likelihood function, incorporating the wage information, is

$$L(\theta; x_{it}, z_{it}) = \Pi_{i=1}^{I} Pr(d_{it} = 1, w_{it} | \Omega_{it}^{-})^{d_{it}} Pr(d_{it} = 0 | \Omega_{it}^{-})^{1-d_{it}}$$

Ex Ante Evaluation: Predict Effects of a Subsidy

- Assume that f(ε, η) is joint normal with variance-covariance matrix, $\Lambda = \begin{pmatrix} \sigma_\varepsilon^2 & \cdot \\ \sigma_{\varepsilon\eta} & \sigma_\eta^2 \end{pmatrix}$.
- Parameters to be estimated include β, γ, π, σ_ε^2, σ_η^2, and $\sigma_{\varepsilon\eta}$.
- Joint normality is sufficient to identify the wage parameters (γ and σ_η^2) as well as (σ_η^2 - $\sigma_{\varepsilon\eta)}$)/$\sigma_\xi$ (Heckman 1979).

- The probability that the child works is

$$pr(d_{it} = 1 | z_{it}, x_{it}) = \Phi(z_{it}(\gamma/\sigma_{\xi}) - x_{it}(\beta/\sigma_{\xi}))$$

where Φ is the standard normal cumulative distribution.
- Data on work choices identify γ/σ_{ξ} and β/σ_{ξ}.
- To identify σ_{ξ}, there are three types of variables: - variables only in z (in the wage function), - variables only in x (in the utility function), and - variables in both x and z.
- Having identified the $\gamma' s$, the identification of σ_{ξ} (and thus also $\sigma_{\varepsilon\eta}$) requires at least one variable only in the wage equation.
- For example, a variable that affects the demand for labor but does not affect the utility value the couple places on the child's school attendance.

Predict effects of a subsidy

- Suppose the government wants to predict the effects of a schooling subsidy
- With the subsidy τ

$$pr(d_{it} = 1 | z_{it}, x_{it}) = \Phi(z_{it}(\gamma/\sigma_{\xi}) - x_{it}(\beta/\sigma_{\xi}) - (\tau/\sigma_{\xi}))$$

- It is necessary to have identified σ_{ξ} to predict the effects of the subsidy
- Government outlays on the program equal the number of children times the probability of attending school.
- Can study effects of a range of subsidies.
- Exogenous variation in the wage (independent of utility) is crucial for identification.

Ex Ante Evaluation Using Dynamic Models

- In the static model, there was no connection between the current period decision and future utility.
- Suppose that child's wage increases with work experience

$$w_{it} = z_{it}\gamma_1 + \gamma_2 h_{it} + \eta_{it},$$

where $h_{it} = \sum_{\tau=1}^{\tau=t-1} d_{i\tau}$ is work experience at the start of period t.

- Alternatively, parents' utility could depend on the number of school years completed, so that current attendance affects future utility.

Dynamic Model continued

- The couple maximizes the PDV of remaining lifetime utility starting from t=1 and ending at T.
- $V_t(\Omega_{it})$ denotes the maximum expected present discounted value of remaining lifetime utility at t given the state space and discount factor δ,
- The state space at t consists of all factors, known to the individual at t, that affect current utility or the probability distribution of future utilities.

$$V_t(\Omega_{it}) = max_{d_{it}} E(\sum_{\tau=t}^{T} \delta^{\tau-t}[U^1_{i\tau} d_{i\tau} + U^0_{i\tau}(1 - d_{i\tau})|\Omega_{it}].$$

- With the wage equation, h_{it} becomes part of the state space and evolves according to $h_{it} = h_{i,t-1} + d_{i,t-1}$

- The value function can be written as the maximum over the two alternative-specific value functions, $V_t^k(\Omega_{it})$, k $\in\{0, 1\}$

$$V_t(\Omega_{it}) = max(V_t^0(\Omega_{it}), V_t^1(\Omega_{it}))$$

each of which obeys the Bellman equation

$$\begin{aligned} V_t^k(\Omega_{it}) &= U_{it}^k + \delta E[V_{t+1}(\Omega_{i,t+1})|\Omega_{it}, d_{it} = k] \text{ for } t < T, \\ &= U_{iT}^k, \text{ for } t = T. \end{aligned}$$

- The expectation is taken over the distribution of the random components of the state space at t+1 conditional on the state space elements (here the shocks are mutually serially independent.)

- The latent variable in the dynamic case is $V_t^1(\Omega_{it}) - V_t^0(\Omega_{it})$:

$$
\begin{aligned}
v_t^*(\Omega_{it}) &= z_{it}\gamma_1 + \gamma_2 h_{it} - x_{it}\beta - \varepsilon_{it} + \eta_{it} \\
&+ \delta([E[V_{t+1}(\Omega_{i,t+1})|\Omega_{it}, d_{it} = 1] \\
&- [E[V_{t+1}(\Omega_{i,t+1})|\Omega_{it}, d_{it} = 0]) \\
&= \xi_{it}^*(\Omega_{it}^-) + \xi_{it}.
\end{aligned}
$$

- A full solution of the dynamic programming problem consists of finding E[max($V_t^0(\Omega_{it})$, $V_t^1(\Omega_{it})$)] at all values of Ω_{it}^-, denoted by Emax(Ω_{it}^-), for all t=1,...,T.
- Same as static case, except now includes the difference in the future component of the expected value functions under the two alternatives.

Estimation: Likelihood function

- Assume researcher has data from t_{1i} to t_{Li}.

$$L(\theta; x_{it}) = \Pi_{i=1}^{I} \Pi_{\tau=t_{1i}}^{t_{Li}} Pr(d_{i\tau} = 1, w_{i\tau} | \Omega_{i\tau}^{-})^{d_{i\tau}} Pr(d_{i\tau} = 0 | \Omega_{i\tau}^{-})^{1-d_{i\tau}}$$

- where Pr(d$_{i\tau}$ = 1, w$_{i\tau}$) = Pr($\xi_{i\tau} \geq -\xi_{i\tau}^{*}(\Omega_{i\tau}^{-})$, $\eta_{i\tau}$ = w$_{i\tau}$ - z$_{i\tau}\gamma_1$ - γ_2 h$_{it}$) and Pr(d$_{i\tau}$ = 0) = 1 - Pr($\xi_{i\tau} \geq -\xi_{i\tau}^{*}(\Omega_{i\tau}^{-})$).
- If the error is not additive, then calculating the joint regions of the error that determine the probabilities that enter the likelihood can be done numerically.

Extension to Multinomial Choice

- If there are K>2 mutually exclusive alternatives, there will be K-1 latent variable functions (relative to one of the alternatives, arbitrarily chosen).
- Having to solve the dynamic multinomial choice problem, that is, for the $E[\max(V_t^0(\Omega_{it}), V_t^1(\Omega_{it}), \ldots\ldots, V_t^K(\Omega_{it}))]$ function at all values of Ω_{it}^- and at all t, is computationally more intensive.
- Defining d_{it}^n as the discrete {0,1} choice variable corresponding to the nth choice (n =1,..,N) and $\widetilde{d}_{it}$ as the N element vector of those choices, there would be at most $K = 2^N$ mutually exclusive choices.

Allowing for Permanent Unobserved Heterogeneity

- Unobservables were iid, but serial dependence is feasible.
- A standard specification assumes agents can be distinguished, in terms of preferences and opportunities, by a fixed number of types. (Keane and Wolpin, 1997, similar to Heckman and Singer, 1981, in duration analysis)
- If a family is of type j, the preference for school attendance and the wage offer might be specified as

$$\alpha_{ijt} = \alpha_{oj} + x_{it}\beta + \varepsilon_{it}$$
$$w_{ijt} = \gamma_{oj} + z_{it}\gamma_1 + \gamma_2 h_{it} + \eta_{it}.$$

- The dynamic program must be solved for each type and the likelihood is a weighted average over each type in the sample.

Application # 1: Gilleskie (1998, *Econometrica*)

"A Dynamic Stochastic Model of Medical Care Use and Work Absence" (Econometrica, 1998)

- A model of decisions to visit a doctor and/or to miss work during an episode of acute illness
- Recognizes that absenteeism can be a substitute of a complement to medical care use
- Uses data from the 1997 National Medical Expenditure Survey (NMES)
- Uses the model to evaluate the effects of expanding health care access on illness-related absenteeism
  - Policy instruments - health insurance, sick leave coverage, access to medical care

Data

- Individuals kept daily logs of illness-related behaviors - all illness episodes, all medical services use, all disability days
- Information on each provider visit - total charge and amount paid by individual, use of prescription medicines
- Information on whether person had paid sick leave if ill
- Estimation sample consists of 3797 employed males, age 25-64 who experienced at least one acute illness lasting at most three weeks

Individuals differ in

- Daily income (three income classes)
- Sick leave availability
- Health insurance coverage $\in$ { no ins., 0-10 %, 20-90%,100 % }
- Health status $\in$ { excellent, good, poor }
- Age, race, education, marital status

Model features

- Each period, individual faces a probability of contracting acute illness dependent on demographic and health factors
- He decides whether to seek treatment and whether to be absent from work
- By seeking treatment or staying home, an individual improves chance of recovery (there is no preventative care)
- Infinite horizon model

Model

$k+1$ health states

- $k = 0$ if well
- $k \in \{1, ...K\}$ if have acute illness of type k

Choices about working and seeing treatment

- $d_t^1 = 1$ if works, does not seek treatment, =0 else
- $d_t^2 = 1$ if works, seeks treatment, =0 else
- $d_t^3 = 1$ if does not work, does not seek treatment, =0 else
- $d_t^4 = 1$ if does not work, seeks treatment, =0 else

State variables

- Illness type, elapsed length t
- Number of physician visits (for acute illness) v_t
- Number of absences a_t

Stochastic processes

H = exogenous health-related and demographic variables such as health status and age

- Prob of contracting illness

$$\pi^s(k) = \frac{exp(\delta_{0k} + \delta_{1k}H)}{\sum_{k'=0}^{K} exp(\delta_{0k'} + \delta_{1k'}H)}$$

- Prob recovery

$$\pi^w(z_{t+1}) = \frac{exp(\nu_k' E_{t+1})}{1 + exp(\nu_k' E_{t+1})}$$

- Recovery depends on whether the individual continues to work or stays home, on duration of time (interacted with whether stays home), and on health and demographic factors.

Utility and Budget constraint

- Utility of person who is well depends only on consumption.
- Utility of person who is ill depends on consumption, type of illness and a vector of medical care use and work absence choice indicators.
- Per period budget constraints incorporates medical expenditure and whether person has sick leave coverage.

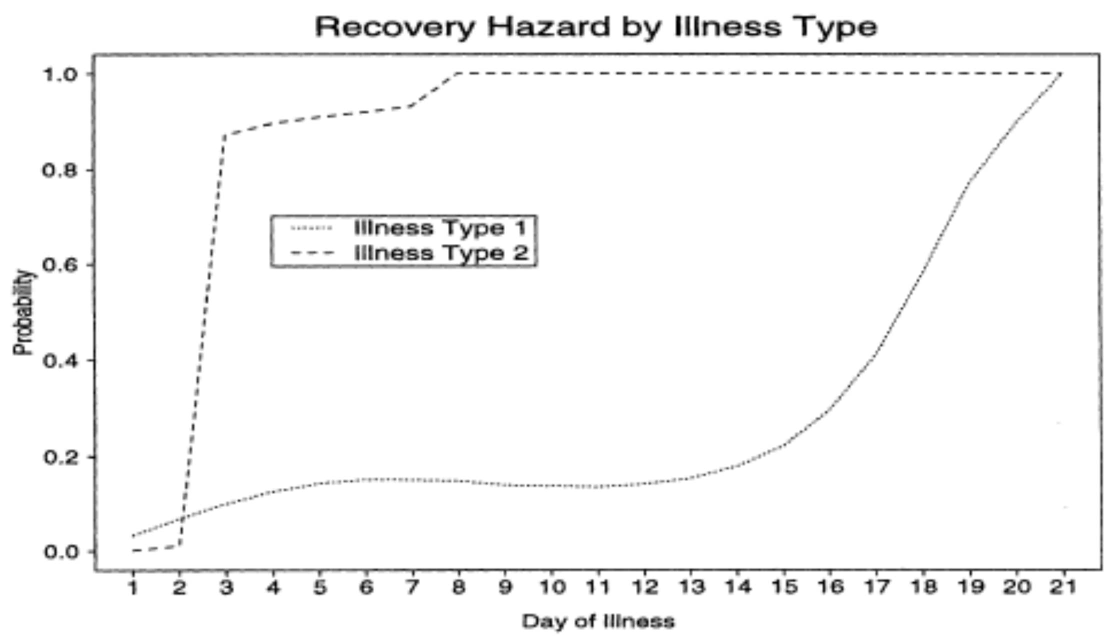

FIGURE 3.—Recovery hazard: unconditional on treatment and absence history.

TABLE VIII

CHARACTERISTICS OF SPECIFIC ILLNESSES

ICD-9 Illness	%	Length	$p(v > 0)$	$E(v)$	$E(v\|v > 0)$	$p(a > 0)$	$E(a)$	$E(a\|a > 0)$
Viral Enteritis	4.13	5.17	0.37	0.37	1.00	0.77	1.37	1.78
Strep Throat	6.20	10.69	0.93	1.00	1.07	0.53	1.60	3.00
Viral Infection	5.37	6.64	0.49	0.59	1.21	0.82	1.44	1.75
Cold	27.41	8.08	0.32	0.33	1.03	0.75	1.18	1.58
URI	3.86	10.11	0.86	1.00	1.17	0.43	0.89	2.08
Flu	38.57	5.38	0.26	0.28	1.07	0.88	1.58	1.80
Other	14.46	9.98	0.82	1.03	1.26	0.49	1.47	2.96

Note: Viral enteritis, strep throat, and viral infection are classified as infectious and parasitic diseases. Cold, upper respiratory infection (URI), and flu are classified as respiratory conditions. The remaining category contains ICD-9 coded illnesses of each classification.

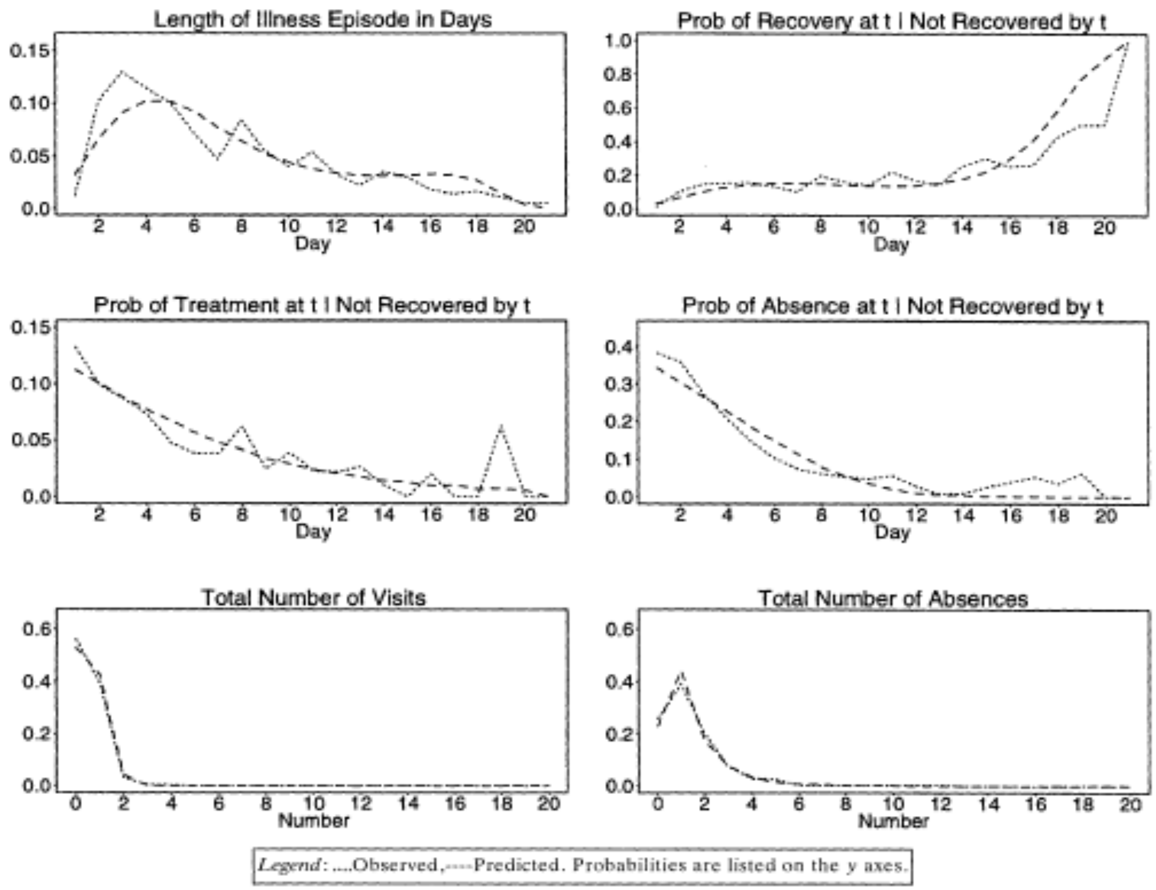

FIGURE 4.—Comparisons of observed and predicted behavior.

Policy experiments

- Experiment #1: Providing universal health care, such that the coinsurance or out-of-pocket expense is zero.
  - Physician visits per episode increases by 12 %.
  - # Individuals with zero visits falls by 8.8 %
  - Individuals in poorest health increase visits by a larger percentage
  - Increase in cost is $20.40 per episode for each ill worker.
  - Prob of any absences, conditional on having an illness, falls by 9.5%.
  - Results imply that absences and visits are substitutes

Policy experiments

- Experiment #2: Add to experiment #1 paid sick leave coverage.
    - Average number of absences increases by 10.6 %.
    - 13.1 % decrease in proportion of individuals with no absences
    - Doctor visits increase by 5.6%
    - Lowers average illness duration by 1.2%
- Experiment #3: Analyze effects of queuing by restricting access to medical care during first three days of illness.
    - 38.2% decrease in average number visits per episode
    - Prop. of individuals with no absences decreases by 27.3% (people stay home to recuperate) but average number of absences falls by 6.1%

Key findings

- Analyzes health care consumption over an illness episode
- Changing from 0% out-of-pocket to 100% results in a 20% decrease in physician visits
- Changing from no sick leave to providing full sick leave coverage results in a 45% increase in illness-related absences
- Sick leave availability and health insurance are important determinants of demand
- Model can be extended to allow for endogenous offering and take-up of jobs with health insurance (e.g. current work by Andrews and Fang)

Application # 2: Amador (2014)

The Consequences of Abortion and Contraception Policies on Young Women's Reproductive Choices, Schooling and Labor Supply

Since legalization in 1973, abortion has become increasingly regulated.

- Many new restrictions on patients, providers and doctors.
- More laws passed in 2011-2013 than in whole previous decade.
- Restrictions recently discussed and enacted are particularly severe.

Abortion restrictions may affect:

- Abortion and contraceptive choices
- Fertility outcomes
- Schooling and labor supply decisions

Goals of paper

- Specify and structurally estimate a discrete choice dynamic programing (DCDP) model of contraceptive use, abortion, schooling, and labor supply choices of U.S. women.
- Simulate effects of policies restricting abortion access and subsidizing contraception.

Model Features

- Choices are contraceptive use, abortion, schooling and labor supply.
- Pregnancies imperfectly controlled through contraceptive use.
- Abortion costs depend on state-specific regulation and local service availability.
- Standard labor market with human capital accumulation through schooling and experience.
- Permanent unobserved heterogeneity.

Data and Estimation

- Longitudinal data from NLSY97, Guttmacher Institute, state-specific regulation.
- Allow for biased measurement error to address abortion underreporting. Use aggregate abortion rates to identify bias.
- Estimate by Simulated Maximum Likelihood

Model

At each age a, after graduation from high school ($\underline{a}_i$) until retirement (A), women make the following choices to maximize their expected life-time utility.

- Contraceptive method (bc).
- Abortion (ab).
- School attendance (s).
- Labor Supply (h).

Within each period, the timing is:

1. All shocks and state variable transitions are realized (except pregnancies).
2. Women make contraceptive choices, pregnancies happen
3. Conditional on the pregnancy status, women make schooling, labor supply, and abortion decisions.

Model: Preferences

- Each period, women receive flow utility U_a:

$$U_a = C_a + g(\mathbf{N}_a, f_a, h_a, s_a, ab_a; \eta_a, type, \mathbf{\Omega}_a) + e(bc_a; \nu_a, \mathbf{\Omega}_a)$$

C_a	:	Consumption
$\mathbf{N_a}$	:	Number of children in different age groups (new born, age 1 to 5, age 6 to 17)
f_a	:	Pregnancy.
$\eta_{\boldsymbol{a}}$, $\nu_{\boldsymbol{a}}$	:	Preference shocks.
$type$	:	Unobserved type.
$\mathbf{\Omega_a}$	:	State space.

Model: Contraceptive Choice

bc =	Method	Examples
0	No method	No contraception, “old school" ...
1	Standard	Pill, condoms, other modern ...
2	Irreversible	Sterilization

- Each option k entails a monetary cost (c_a^k) and a psychic cost (e_a^k)
- $dbc_a^k \in \{0, 1\}$ indicates method k chosen.
- Pregnancy probability :

$$\Pi_a^k = \begin{cases} \Pi(dbc_a^k = 1, SX_a, S_a, a) & \text{for } k = 0, 1 \\ 0 & \text{for } k = 2 \end{cases}$$

S_a: Schooling, SX_a: Sexual activity.

Model: Abortion decision

Abortion decision, if pregnant:

- Monetary cost (budget constraint):

$$\kappa_a = \kappa_0 + \kappa_1(1 - loc_a)$$

  $loc = 1$: abortion provider in the county of residence.

- Psychic cost (from U):

$$\xi + \chi reg_a$$

  ξ is drawn from a distribution where the mean (μ_ξ) varies according to religiosity and unobserved type.

  $reg = 1$: state imposes mandatory counseling restrictions.

Model: Labor supply and schooling

- Receive part-time and full-time wage offers w_a^p and w_a^f.
- Decide on labor supply and school attendance, conditional on pregnancy outcome.
  - The (dis)utility of working or attending school depends on $\mathbf{N}_a$.
  - School attendance requires paying tuition costs T^{coll} and T^{grad}.
- Earnings $y_a^w = h_a^p w_a^p + 2h_a^f w_a^f$
- Wage offers are the product of human capital Λ and its rental price r:

$$w_a^o = r^o \Lambda_a(S_a, H_a, type, \varepsilon_a) \text{ , for } o \in \{p, f\}$$

- S_a is schooling and H_a is labor market experience.

Model: Evolution of endogenous state variables

Children:

Newborn child: $n_{a+1} = f_a(1 - ab_a)(1 - mc_a)$

Children 1 to 5 years old: $N^5_{a+1} = \sum_{\tau=a-1}^{a-1} n_\tau$

Children 6 to 17 years old: $N^{17}_{a+1} = \sum_{\tau=a-17}^{a-6} n_\tau$

Schooling: $S_a = 12 + \sum_{\tau=\underline{a}}^{a-1} s_\tau$ Labor market experience:

$H_a = \sum_{\tau=\underline{a}}^{a-1} (h^p_\tau + 2h^f_\tau)$

Model: Exogenous state variables

- Marital Status $M \in \{\text{single,cohabiting, married}\}$.
  - $dm_a = 1$ if married or cohabiting, 0 if single.
  - affects preferences for children.
  - Husbands provide income y_a^h
- Sexual activity:
  - Sexual initiation (si) if not sexually active.
  - Amount of sexual activity (SX), which affects chance of becoming pregnant.
- Probability distribution over next period's marital status and sexual activity variables depends on a subset of state variables.
- Geographical variables loc and reg evolve according to Markov processes.

Model: Budget Constraint

Consumption (C_a) is income net of expenditures.

$$
\begin{aligned}
C_a = & \underbrace{(1-dm_a)y_a^w}_{\text{income if single}} + \underbrace{dm_a\tau^h(y_a^w + y_a^h)}_{\text{income if married or cohabiting}} \\
& - \underbrace{s_a(T^{coll}1\{S_a < 16\} + T^{grad}1\{S_a \geq 16\})}_{\text{tuition costs}} \\
& - \underbrace{\kappa_a ab_a}_{\text{abortion costs}} - \underbrace{\sum_{k=1}^{K} dbc_a^k c_k}_{\text{contraception costs}}
\end{aligned}
$$

Model: Initial heterogeneity (at age at graduation, $\underline{a}$)

- Sexual initiation
- Availability of abortion provider
- Mandatory counseling in state
- Having a child or not
- Religiosity
- 4 unobserved types

Data: High school graduate females from NLSY97

- School enrollment and attainment.
- Weekly employment histories.
- Monthly marriage and cohabitation histories.
- Earnings and earnings of the husband/partner during the previous year.
- Pregnancies and outcomes, including miscarriages and induced abortions.
- Whether a person has ever had sex or not, and the amount of sexual activity in the last year if she has.
- Contraceptive method used, if any, and the fraction of sexual relations in which a birth control method was used.
- Detailed geographic information (confidential 'Geocode' version).

Other data sources

- Guttmacher Institute census of abortion providers (258 counties in 2000, 252 counties in 2008 (239 remained and 23 new))
  - Location of specialized and non specialized clinics.
  - Account for 94% of abortion procedures in the U.S.
  - Available for years 2000, 2004, 2005, 2007, 2008.
- Publicly available information on mandatory counseling laws
  - 26 states currently impose these restrictions.
- Monetary costs of contraception and abortion:
  - Contraception: c_k's imputed based on reported average prices paid (Planned Parenthood).
  - Abortion: κ_0 imputed based on median price (Jones and Kooistra, 2011).

Descriptive statistics

Table : Distribution of initial conditions

Age finished high school	
18	64%
19	36%
Religiosity	
Low	32%
Medium	51%
High	16%
At initial age	
Has children	13%
Has initiated her sexual life	77%
Lives in a county with abortion provider	54%
Lives in a state that ever imposes mandatory counseling	49%
Lives in a state with mandatory counseling	29%

Descriptive statistics

Table : Pregnancy and choice distributions, by age

Age	Pregnant	Abortion	Enrolled	Working		Birth control		
				Part time	Full time	No	Standard	Sterilization
18	0.11	0.016	0.58	0.43	0.22	0.35	0.64	0.00
19	0.11	0.019	0.49	0.42	0.28	0.42	0.58	0.00
20	0.12	0.018	0.43	0.39	0.35	0.48	0.52	0.00
21	0.13	0.013	0.37	0.37	0.39	0.51	0.49	0.00
22	0.13	0.017	0.25	0.29	0.49	0.54	0.46	0.00
23	0.13	0.013	0.17	0.24	0.56	0.56	0.43	0.00
24	0.12	0.009	0.15	0.22	0.59	0.56	0.44	0.00
25	0.12	0.007	0.13	0.20	0.59	0.56	0.43	0.00
26	0.11	0.011	0.11	0.19	0.59	0.56	0.44	0.01
27	0.11	0.007	0.12	0.20	0.59	0.55	0.44	0.02
28	0.10	0.007	0.11	0.18	0.58	0.55	0.42	0.03
29	0.07	0.002	0.11	0.19	0.57	0.57	0.39	0.04
30	0.04	0.004	0.11	0.18	0.59	0.55	0.39	0.06

Counterfactual Policies

Analyze the long-run effects of four policies:

1. Perfectly enforced ban on abortions.
2. Expansion of mandatory counseling to all states.
3. All providers in a county closing (TRAP laws).
4. Free contraception.

Perfectly enforced ban

- Use of contraception $\uparrow$ 11.1 ppts.
- Pregnancy rate $\downarrow$ 18.6 pregnancies per 1000 women (13.6%).
- Birth rate $\uparrow$ 18.6 births per 1000 women (21.3%).
- 47% of abortions would become births.
- Total fertility $\uparrow$ 0.42 children per woman (28%).

Table : Schooling and Earnings Loss with respect to Baseline

	All women		At least one abortion	
Years of Schooling	0.15	4.9%	0.36	13.2%
% with college (ppts)	2.34	5.6%	5.30	14.3%
Experience (hours)	642	1.0%	1567	2.4%
Earnings	$ 20,716	1.9%	$ 50,784	4.6%

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Universal mandatory counseling

- Abortion rate $\downarrow$ 3.7 abortions per 1000 women (8.3%).
- Use of contraception $\uparrow$ 1.4 ppts.
- Pregnancies decrease by 2.4 pregnancies per 1000 women (1.7%).
- 68% of abortion drop accounted for by fewer pregnancies.
- No significant effect on schooling or labor supply.

Closing of local provider

If all providers in a given county close:

- Abortion rate $\downarrow$ 2.6 abortions per 1000 women (6.8%).
- Use of contraception $\uparrow$ 1 ppts. on average.
- Pregnancies decrease by 1.6 pregnancies per 1000 women (1.2%).
- 66% of abortion drop accounted for by fewer pregnancies.
- No significant effect on schooling or labor supply.

Free contraception

Reproductive choices:

- Share of women not using any contraception $\downarrow$ 13 ppts.
- Abortions $\downarrow$ 14.7 abortions per 1000 women (38%).
- Pregnancies $\downarrow$ 21.4 pregnancies per 1000 women.
- Total fertility $\downarrow$ 0.2 children (12%).

Schooling and labor supply:

- 1-1.3 ppts increase in % of college graduates among college types.
- Labor supply increases between ages 18-30 for no college, working type. Lifetime labor market experience unaltered.

Conclusions

- A major benefit of the structural modeling approach is that it allows for ex ante evaluation of policy interventions
- However, models rely on extra-theoretic modeling and distributional assumptions, so model validation is an important concern

Conclusions

- Different approaches to Validation
  - Check robustness to alternative modeling assumptions
  - Examine within sample fit
  - Examine out of sample fit to data that were not used in estimation
- Randomized social experiments provide special opportunities for model validation
  - Can estimate the behavioral model on the control group and predict the behavior of the treatment group (or vice versa)
  - Randomization ensures that unobserved heterogeneity distribution same across groups that differ in the treatment