To contracept or not to contracept

A dynamic model of contraceptive choice of married couples

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Research question

Is it possible to rationalize the contraception choices of married couples in a dynamic optimization framework?

Key reference:
Carro, J. and Mira, P. (2006), A Dynamic Model of Contraceptive Choice of Spanish Couples

Model

Decisions

The couple chooses one of three mutually exclusive actions:

- not to contracept (j = 1),
- to use temporary contraceptive methods (j = 2),
- or to sterilize (j = 3)

$d_{tj} = 1$, if action j is chosen at time t. Otherwise it is 0.

We want to begin by only consider the binary choice - to contracept or not to contracept.

Model

States

$$S_t = (X_t, \varepsilon_{1t}, \varepsilon_{2t}, \varepsilon_{3t})$$

Where X_t is a vector of the following state variables:

- Parity - Number of children
- Woman's age
- Contraception choice history - choice in last period
- Religious beliefs
- Education level of the couple
- Spacing between the children

We start by only having parity as state variable.

And ε_{jt} is a random variable which determines the utility of action j in period t.

Model
Utility

$$u_{tj} = \tilde{u}_{tj}(X_t) + \varepsilon_{tj}$$

We begin with a very simple version of the utility function:

$$\tilde{u}_{tj}(X_t) = \eta_1 N_t + \eta_2 N_t^2 + \mu d_{t2}$$

Where N_t is the number of children the couple have at time t and d_{t1} is the choice to contraception.

Model

Utility

The goal is to replicate their full utility-function:

$$
\begin{aligned}
\mathrm{u}_{tj} &= \eta_1 I_{1t} + \eta_2 N_2 + \eta_3 N_t^2 \\
&+ (\gamma_1 E_1 + \alpha_1 E_2) I_{1t} + (\gamma_2 E_1 + \alpha_2 E_2) I_{2t} + (\gamma_3 E_1 + \alpha_3 E_2) I_{3t} \sum_{n>2} I_{nt} \\
&+ \mu_0 d_{t-1,1} d_{t2} + \mu_{j1} + \mu_{j2} R + \mu_{33} \tilde{t} d_{t3} \\
&+ \psi_0 (t-35) 1(t \geq 36) b_t + (\psi_1 dur_{t1} + \psi_2 dur_{t2} + \psi_2 dur_{t3}) b_t
\end{aligned}
$$

Where I is the indicator for the i^{th} child, N is the number of children, E is education for wife and husband, R is a dummy for couple being religious, and *dur* is spacing between the children.

Model

Bellman Equation

$$v_{tj}(X_t) = \tilde{u}_{tj}(X_t) + \beta E[\max_j v_{t+1,k}(X_{t+1})\varepsilon_{t+1,k}|X_t, d_{tj} = 1]$$

In the terminal period of if $j = 3$ the Bellmann equation takes the following form:

$$v_{tj}(X_t) = \tilde{u}_{tj}(X_t) + \beta E[W(t+1, X_{t+1})|X_t, d_{tj} = 1]$$

Method

Nested Pseudo Likelihood (NPL)

A dynamic stochastic discrete choice model solved with maximum likelihood estimation.

$$\mathcal{L}_i(\theta_k) = \prod_t \prod_j \{P_j(X_{it};\theta)[b_{it+1}F_{tj}(\theta) + (1 - b_{it+1})(1 - F_{tj}(\theta))]\}^{d_{itj}}$$

Where b is a dummy variable indicating a birth, and $F_{jt}(\theta)$ is the conditional probability of giving birth. We begin simple by assuming that the probability of giving birth is 0 if the couple contracept.

Thus the log-likelihood:

$$L(\theta) = \sum_i \ln \sum_k \mathcal{L}_i(\theta_k) Pr(k|\underline{\mathrm{t}}_i)$$

Game Plan

1. Solve the model with simulated data
   - We begin using only one state variable
   - We choose to start with parity: the number of children
2. Try to solve the model with the actual data
3. Add another state variable and repeat step 1 and 2
4. Repeat step 3 until all state variables are added
5. Try adding the sterilization choice
6. Compare our results with the paper
7. Try to replicate their counterfactuals