Education, Family Composition, Fertility and Trend

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2007 Analytical Labor Economics Conference
University of Chicago Economics Research Center
November 15, 2007
Embarrassingly Preliminary

Aggregate Fertility: Goes down and there is a baby boom

- Evolution of Total Cohort Fertility Rate (TCFR) or Completed Fertility:

	TOTAL COHORT FERTILITY RATE		
YEAR	INDD&ODE	CPS 1995	Census 1990
2005	2.02	-	-
1995	2.05	2.06	-
1985	2.67	2.65	2.68
1975	3.15	3.10	3.10
1965	2.74	-	2.70
1955	-	-	2.33

Note: Females are aged 40-49 in each year

TCFR by education, gender and marital status: 1985

	Husband					
	Single	DP	HS	CG	Mg	Mg^A
Dropout DP	3.29	3.58	3.31	3.13	3.40	3.33
High School HS	2.48	2.96	2.71	2.46	2.63	2.60
College CG	1.64	2.43	2.30	2.23	2.05	2.18
Mg	2.50	3.26	2.74	2.35	2.65	-
Mg^A	2.50	2.99	2.77	2.61	-	2.69

Joint distribution of the average of children, and their marginals Mg, and normalized by spouses marginals, Mg^A.

TCFR by education, gender and marital status: 1995

	Husband						
	Single	DP	HS	CG	Mg	Mg^A	Mg^B
Dropout DP	2.74	3.10	2.63	2.37	2.83	2.71	2.84
High School HS	1.78	2.41	2.29	2.14	2.12	2.05	2.12
College CG	1.04	2.27	1.94	1.80	1.62	1.77	1.59
Mg	1.75	2.71	2.26	1.94	2.06	-	-
Mg^A	1.75	2.59	2.29	2.10	-	2.14	-
Mg^B	1.85	2.76	2.30	1.97	-	-	2.15

Normalized by 1985 distribution spouses marginals, Mg^B.

TCFR by education, gender and marital status: 2005

	Husband						
	Single	DP	HS	CG	Mg	Mg^A	Mg^B
Dropout DP	2.42	2.92	2.60	1.87	2.64	2.46	2.63
High School HS	1.75	2.34	2.23	2.10	2.08	2.02	2.07
College CG	0.97	1.87	1.86	1.80	1.63	1.66	1.57
Mg	1.64	2.58	2.19	1.92	2.00	-	-
Mg^A	1.64	2.38	2.23	1.92	-	2.03	-
Mg^B	1.76	2.63	2.24	1.94	-	-	2.07

Properties of TCFR

- It Goes down substantially. In 20 years TCFR goes from 2.65 to 2.00 (almost 25%).

- It depends a lot negatively in Education, especially for females.

- Changes in composition exacerbate the drop, but composition alone only accounts for about 12% of the overall change.

- Still we need a theory of why education conflicts with fertility and of what other changes may be involved.

- While typically cross sectional data has a lot more variation than time series, this is not the case for fertility. It indeces us to ask where there is something to be learned from one about the other.

Female annual hours worked (23-45) **(40-49)

	Single	Husbands Dropout	Husbands High School	Husbands College
COHORT 1: Females 40-49 in 1985				
Dropout	1180.	522.	579.	467.
High School	1667.	795.	747.	584.
College	1619.	667.	910.	741.
COHORT 2: Females 40-49 in 1995				
Dropout	1174.	691.	787.	*476.*
High School	1723.	919.	1025.	908.
College	1820.	*750.*	1053.	1181.
COHORT 3: Females 40-49 in 2005				
Dropout	1142.	651.	750.	488.
High School	1679.	998.	1161.	916.
College	1848.	813.	1360.	1265.

- More Educ more work, Inverse U with husbands'.
- Increase over time. Especially college and married.

Children's education conditioned on fathers' education

Children's education			
Cohort 1 (Females aged 40-49 in 1985)			
		Fathers	
Children	Dropout	High School	College
Dropout	22.3	9.6	2.8
High School	68.8	77.4	55.3
College	8.9	13.0	41.9
Cohort 3 (Females aged 40-49 in 1995)			
Dropout	18.2	7.0	2.9
High School	47.7	49.9	37.7
College	34.1	43.1	59.4

- Massive increase in education.
- Quite persistent.
- Data problems with Cohort 5 (children are not old enough)

Children's education conditioned to mothers' education

Children's education			
Cohort 1 (Females aged 50-54 in 1985)			
		Mothers	
Children	Dropout	High School	College
Dropout	23.0	7.7	4.1
High School	71.3	73.9	54.9
College	5.7	18.4	41.0
Cohort 3 (Females aged 50-54 in 1995)			
Dropout	13.3	6.7	4.3
High School	42.9	47.2	35.3
College	43.8	46.1	60.4

- Massive increase in education.
- Quite persistent education.
- Data problems with Cohort 5 (children are not old enough)

A "model" to think cross–sectionally

$$\max_{c,n,h,x} \quad u_{e,e^*}(c,n,h,x) \;=\; \max_{c,n,h,x} \quad \log\left(\frac{c}{\psi(n)}\right) \;+\; \frac{\left(n\sum_{e'} P_{e'|e,e^*}\mu_{e'}\right)^{1-\gamma}}{1-\gamma}$$

$$s.t. \qquad c + x \;=\; y^{e^*} \;+\; \bar{\omega}_0(e)\; h^{\hat{\omega}_1(e)}$$

$$P_{e'|e,e^*} \;=\; f_{e'}^{e,e^*}\left(\frac{x}{n}, h\right)$$

- x is pecuniary investment in children, n is number of children, y^{e^*} is father's earnings, $y^f \;=\; \bar{\omega}_0(e)\; h^{\hat{\omega}_1(e)}$ is mother's earnings, a non–linear function of hours.

- $P_{e'|e,e^*}$ is the prob of educational attainment; $\mu_{e'}$ are utility weights. $\psi(n)$ are equivalent scales.

Mapping the model to Data: Model Details

- Equivalence scales ψ are off the shelf (OECD or others):

$$\text{OECD}(n) = \begin{cases} 1 + 0.7 + n * 0.5 & \text{if there is father} \\ 1 + n * 0.5 & \text{if there is NO father} \end{cases}$$

- We assume $P_{e'|e,e^*}$ that only depends in the father's education.

$$P_c = \begin{cases} P_{c|c} = 1 - e^{-\alpha_{1,c}\left[\left(\frac{x}{n}\right)^{\rho_1} + \left(\bar{h} - h\right)^{\rho_2}\right]\left(\left(\alpha_2\right)\right)} & \text{Prob. } e' = CO \text{ if father } CO \\ P_{c|h;d} = 1 - e^{-\alpha_{1,h.d}\left[\left(\frac{x}{n}\right)^{\rho_1} + \left(\bar{h} - h\right)^{\rho_2}\right]\left(\left(\alpha_2\right)\right)} & \text{Prob. } e' = CO \text{ if father } HS, DO \end{cases}$$

$$P_h = (1 - P_c)\left(1 - e^{-\alpha_3\left[\left(\frac{x}{n}\right)^{\rho_1} + \left(\bar{h} - h\right)^{\rho_2}\right]\left(\left(\alpha_2\right)\right)}\right) \qquad \text{Prob. } e' = HS$$

where $\bar{h}$ is the maximum number of yearly hours (see Sánchez-Marcos and Ríos-Rull (2002)).

- All in all, we have 9 parameters:

$$\theta = (\gamma, \mu_1, \mu_2, \mu_3, \quad \rho_1, \rho_2, \alpha_{1,c}, \alpha_{1,h.d}, \alpha_3)$$

plus those of the earnings equations.

Mapping the model to Data: Statistics Details

- We estimate female earnings equations separately (with individual data).

- We estimate the model for the earliest cohort (1985), that had the baby boom, targetting

  1. The number of children for each of the 12 types.
  2. The allocation of time of females for each of the 12 types.
  3. The educational attainment of children for each of the 12 types.

- Other data that we feed in the model are males earnings (PSID)**.

- We also keep track of the measures of each of the 12 groups (CPS) to aggregate and obtain the aggregates for the whole cohort.

A Preliminary Estimation of the Model (Still a lot of room for improvement)

Data/**Model**	Husband			
	Single	DP	HS	CG
DP	3.29/ **3.50**	3.58/ **3.58**	3.31/ **3.56**	3.13/ **2.82**
HS	2.65/ **3.44**	2.81/ **3.43**	2.76/ **2.90**	2.46/ **2.82**
CG	2.46/ **3.03**	2.77/ **3.05**	2.67/ **2.75**	2.54/ **2.76**

A First Estimation: Female hours worked and Earnings

Data/**Model**				
			HOURS	
			Husband	
	Single	DP	HS	CG
DP	1180/**1201**	522/ **522**	579/ **576**	467/ **467**
HS	1667/**1783**	795/ **799**	747/ **742**	584/ **566**
CG	1619/**3068**	668/ **701**	910/ **916**	741/ **724**

			EARNINGS	
DP	7871/ **8030**	2533/**2533**	3124/ **3110**	2193/**2194**
HS	14406/**15609**	4483/**4505**	5074/ **5035**	4096/**3947**
CG	21061/**39986**	5966/**6287**	9982/**10066**	8243/**8012**

Children's education conditioned Fathers' education

Data/**Model**	Father's Education		
	DP	HS	CG
DP	22.3/**12.8**	9.6/**13.0**	2.8/ **0.6**
HS	68.8/**13.3**	77.4/**13.4**	55.3/ **0.6**
CG	8.9/**73.9**	13.0/**73.6**	41.9/**98.8**

Preliminary Assessment of the Model $S^* = 1799.8$

- The model gets the negative decline by education of husband.
- Not so the pattern of education by females.
- The model can account for the patterns of hours of females.
- The model does very badly wrt the educational distribution of children conditoined on the education of the father (in particular the differential performance of dropouts and high school parents).
- So terrible but we need to try harder to find better estimates.
- We now try a variation of the baseline model that substitutes the comparative advantage in education of the educated by posing a possible stronger preference for educated children.

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Two changes respect to the Baseline model

- **FIRST: Role of children in the tility function**

Children total value remains the same for all types of parents but NOW we allow mothers that attended college to put a larger weight on their children attending college, (α is the premium).

- Baseline model: $\mu = \mu_c + \mu_h + \mu_d$
- New model: $\mu = \mu_c * \alpha + (\mu_h + \mu_d) * b$

where $b = 1 + \mu_c * (1 - \alpha)/(\mu_h + \mu_d)$ and $\alpha = 1$ for mothers
$e = h, d$

- **SECOND: Technology of producing children's quality**
- We fix the technology parameter of children attending college $\alpha_{1,h.d}$ to the solution of Baseline model, 0.15 and
- We redefine $\alpha_{1,c}$ as the relative efficiency of fathers college producing children college.

Preliminary Estimation of Model 2

Data/**Model**			Husband	
	Single	DP	HS	CG
DP	3.29/ **3.29**	3.58/ **3.58**	3.31/ **3.31**	3.13/ **3.13**
HS	2.48/ **2.48**	2.96/ **2.96**	2.71/ **2.71**	2.46/ **2.46**
CG	1.64/ **1.91**	2.43/ **2.43**	2.30/ **2.30**	2.23/ **2.23**

Female hours worked and Earnings

Data/**Model**				
			HOURS	
			Husband	
	Single	DP	HS	CG
DP	1180/**1180**	522/ **522**	579/ **579**	467/ **467**
HS	1667/**1667**	795/ **795**	747/ **747**	584/ **584**
CG	1619/**1619**	668/ **668**	910/ **910**	741/ **741**

			EARNINGS	
DP	7871/ **7871**	2533/**2533**	3124/ **3124**	2193/**2193**
HS	14406/**14426**	4483/**4483**	5074/ **5074**	4096/**4096**
CG	21061/**21061**	5966/**5966**	9982/ **9982**	8243/**8243**

Children's education conditioned Fathers' education

Data/**Model**	Father's Education		
	DP	HS	CG
DP	22.3/**12.3**	9.6/**12.0**	2.8/ **7.7**
HS	68.8/**67.7**	77.4/**67.8**	55.3/**44.4**
CG	8.9/**20.0**	13.0/**20.2**	41.9/**48.0**

Preliminary Assessment of Model 2 $s^* = 36.5$

- So much better.

- A couple of sore spots (fertility of single college females, equal educational performance of high school and dropouts)

- We are still working on this.

Continuing Strategy

- Once we are satisfied with our estimates from a cross-section,

- Then we USE the model to ask what would have happened if the only changes are the ones observable:
  1. Changes in the level and shape of earnings.
  2. Changes in the educational and marriage composition (which we know only accounts for 12%)

- We reestimate the educational achievement technologies without changing the preference technology.

- Guess: severe overprediction of fertility in later periods: The drop is just too high.

The missing link? 1. Technology

- We have heard about the home production technology. It is unlikely that it has happened this fast.

- Another clear alternative is an improvement in the effectiveness with which people achieve the number of children that they want. Mostly birth control. It is not easy to identify this directly. Timing looks better. Perhaps using difference in children ages. Or age of first child.

The missing link: 2 An Externality

- A *natural* candidate for an explanation for the drop in fertility is an externality in preferences. It can work (at least) through two channels:

1. The more children of others the more I want children: Let $\mu = \mu_d + \mu_h + \mu_c$ be given by $\mu(N)$ where N is the number of children per mother. We could estimate such a function. This adds one parameter if we chose a power function $\mu(N) = \chi_0 N^{\chi_1}$, and we recognize that then we only need two μ's.

2. The more the education of others, the more education that I want. This implies that $\frac{\mu_c}{\mu}(x_c)$ where x_c is the fraction of college graduates.

- We hope that there is enough variation across time in earnings and in population composition to provide tight estimates.

Recap

- We estimated a model that accounts for the joint behavior of fertility and investment in the cross-section.

- We plan ask whether stationary preferences and changes in certain prices have power to account for aggregate fertility drops (chances are that no).

- Still the model mechanically generates secular reductions in fertility through increases in education.

- We will use the fertility drop to measure a an externality in preferences for child rearing.

References

Sánchez-Marcos, V., AND J.-V. Ríos-Rull (2002): "Female College Attendance," *Review of Economic Dynamics*, 5(4), 965–998.

Parameter Estimates

	Model	
	1	2
γ	6.60	1.99
μ_1	0.03	0.73
μ_2	0.06	1.08
μ_3	0.41	1.09
μ_4	-	1.03
$\alpha^*_{1,c}$	0.48	*2.86*
$\alpha_{1,h.d}$	0.15	0.15^*
α_3	0.08	0.08
ρ_1	0.09	0.09
ρ_2	0.24	0.24
Accur.	1799.7	36.50