Education, Family Composition, Fertility and Trend

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Lunch Talk or Something
Fundamentally, Get your Help
Inexistent
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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	1.99	-	-
2000	2.10	2.16	-
1995	2.43	2.46	-
1990	2.91	2.90	2.93
1985	3.19	3.11	3.14
1980	3.10	-	3.05
1975	2.88	-	2.82
1970	2.60	-	2.56
1965	-	-	2.37
1960	-	-	2.28
1955	-	-	2.29

Note: Females are aged 50-54 in each year

TCFR by education, gender and marital status: 1985

- Joint distribution of the average number of children, and their marginals Mg, normalized by spouses marginals, Mg^A, and by marital sorting in 1985, Mg^B.

	Husband						
	Single	DP	HS	CG	Mg	Mg^A	Mg^B
Dropout DP	3.65	3.54	3.61	3.69	3.60	3.61	
High School HS	2.92	3.21	3.14	3.08	3.07	3.14	
College CG	1.81	3.42	2.81	2.53	2.36	2.92	
Mg	3.02	3.38	3.19	2.85	3.11	-	
Mg^A	3.02	3.39	3.19	3.10	-	3.16	

TCFR by education, gender and marital status: 1995

		Husband					
	Single	DP	HS	CG	Mg	Mg^A	Mg^B
DP	2.94	3.49	2.87	2.25	3.11	2.87	3.11
HS	2.22	2.74	2.58	2.55	2.47	2.62	2.48
CG	1.54	1.78	1.96	2.09	1.90	1.94	1.88
Mg	2.23	3.11	2.55	2.30	2.46	-	-
Mg^A	2.23	2.67	2.47	2.30	-	2.40	-
Mg^B	2.37	3.11	2.59	2.33	-	-	2.56

TCFR by education, gender and marital status: 2005

	Single	Husband DP	HS	CG	Mg	Mg^A	Mg^B
Dropout DP	2.61	2.82	2.80	1.92	2.71	2.51	2.55
High School HS	1.78	2.24	2.14	2.10	2.04	2.16	2.04
College CG	1.01	1.74	1.86	1.98	1.73	1.86	1.58
Mg	1.68	2.46	2.13	2.02	2.00	-	-
Mg^A	1.68	2.27	2.27	2.00	-	2.04	-
Mg^B	1.95	2.53	2.22	2.04	-	-	2.15

Properties of TCFR

- It Goes down dramatically
- It depends a lot negatively in Education, especially for females.
- Changes in composition exacerbate the drop, but it is not only composition.
- Still we need a theory of why education conflicts with fertility.

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.	-
High School	1667.	795.	747.	584.
College	1619.	-	910.	741.
COHORT 2: Females 40-49 in 1995				
Dropout	1174.	691.	787.	-
High School	1723.	919.	1025.	908.
College	1820.	-	1053.	1181.
COHORT 3: Females 40-49 in 2005				
Dropout	1142.	651.	750.	488.
High School	1679.	998.	1161.	916.
College	1848.	-	1360.	1265.

- Females work with more education. Inverse U with husbands'.

Children's education conditioned to fathers' education

Children's education			
Cohort 1 (Females aged 50-54 in 1985)			
		Fathers	
Children	Dropout	High School	College
Dropout	21.6	6.0	0.9
High School	69.6	73.2	49.3
College	8.8	20.8	49.8
Cohort 3 (Females aged 50-54 in 1995)			
Dropout	9.9	4.3	1.0
High School	28.4	22.4	12.9
College	61.7	73.3	86.1
Cohort 5 (Females aged 50-54 in 2005)			
Dropout	40.5	13.4	6.0
High School	59.5	48.5	37.5
College	-	38.1	56.5

- Massive increase in education. Quite persistant. The data on the last cohort is not that reliable due to age effects.

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	22.3	5.6	1.6
High School	71.3	69.5	41.1
College	6.4	24.9	57.3
Cohort 3 (Females aged 50-54 in 1995)			
Dropout	9.7	3.3	2.4
High School	23.7	21.6	10.3
College	66.6	75.1	87.3
Cohort 5 (Females aged 50-54 in 2005)			
Children have not yet computed their education			
Dropout	26.1	11.0	-
High School	37.9	43.0	50.5
College	36.0	46.0	49.5

- Massive increase in education. Quite persistant. Same about last cohort.

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 that $P_{e'|e} = P_{e'|e,e^*}$ and also (see Sánchez-Marcos and Ríos-Rull (2002)):

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

$$P_h = (1 - P_c)\left(1 - e^{-\alpha_3\left[\left(\frac{x}{n}\right)^{\rho_1} + (\bar{h} - h)^{\rho_2}\right]^{\alpha_2}}\right) \quad \text{Pr } e' = H \text{ if father } e = C, H, D$$

where $\bar{h}$ is the maximum number of yearly hours.

- All in all, we have 9 parameters:

$\theta = (\gamma, \mu_1, \mu_2, \mu_3, \ \rho_1, \rho_2, \alpha_{1,c}, \alpha_{1,h.d}, \alpha_3)$ plus those of the earnings equations.

Mapping the model to Data: Statistics Details

- First we estimate the female earnings equations separately with individual data.

- We estimate the model for the earlier cohorts (1985) and so on, that had the baby boom, targetting

  1. The number of children for each of the 12 types. **Done**
  2. The allocation of time of females for each of the 12 types. **Done**
  3. The educational attainment of children for each of the 12 types.**We are having a bit of trouble**

- 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 First Estimation: Number of Children TCFR: 2.65/**2.65***

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/ **1.64**	2.43/ **2.43**	2.30/ **2.30**	2.23/ **2.23**

A First Estimation: Female hours worked and Earnings

Data/**Model**			HOURS	
			Husband	
	Single	DP	HS	CG
DP	1180/**1181**	522/ **522**	579/ **579**	467/ **467**
HS	1667/**1668**	795/ **796**	747/ **747**	584/ **581**
CG	1619/**1618**	668/ **669**	910/ **913**	741/ **745**

			EARNINGS*	
DP	7871/ **7877**	2533/**2533**	3125/ **3120**	2194/**2198**
HS	14406/**14422**	4483/**4489**	5074/ **5078**	4096/**4075**
CG	21061/**21063**	5966/**5974**	9982/**10020**	8243/**8299**

Children's education conditioned Fathers' education

Data/**Model**			
	Father's Education		
	DP	HS	CG
DP	22.3/**12.7**	9.6/**12.5**	2.8/ **9.2**
HS	68.8/**72.4**	77.4/**72.4**	55.3/**53.8**
CG	8.9/**15.0**	13.0/**15.0**	41.9/**37.0**

- Not so good: Too similar between dropouts and high school. Too much failure in college. Too similar between all.

Other properties of the allocation I

	Father's Education			
	–	DP	HS	CG
		Child Care		
DP	78.31	196.07	257.11	219.20
HS	712.49	258.32	344.81	460.54
CG	1047.26	264.92	377.02	588.07
		Consumption		
DP	7798	19707	24647	22084
HS	13709	25793	34190	46256
CG	20016	26264	37461	56529

Other properties of the allocation II

	Father's Education			
	–	DP	HS	CG
	Childcare per child			
DP	23.78	54.70	77.55	69.91
HS	286.58	87.16	126.98	186.56
CG	635.06	108.87	163.84	263.64
	Female Hours per child			
DP	1410	1479	1582	1709
HS	1671	1696	1869	2124
CG	2550	2119	2134	2277

Preliminary Assessment of the Model

- Fertility and allocation of time goes well.
- Not so the pattern of education attainment.
- Next we want to make changes in the model to see how to improve it.
  - College mothers want more college children.

Extension I: College mothers like college children more

- **FIRST: Children's utility**

Children total value remains the same for all types of parents but NOW we allow mothers college have a relative large utility if their children are college as well, α is the premium.

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

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

- **SECOND: Technology of producing children's quality**
- We fixed the technology parameter of producing children college $\alpha_{1,h.d}$ to the solution of Baseline model, 0.1 and
- We redefine $\alpha_{1,c}$ as the relative efficiency of fathers college producing children college.

Preliminary Findings of this extension

- Still Insufficient to get the patterns of intergenerational persistence.

Extension II: Increasing Returns in investment per kids

- We include the possibility of childcare was more productive increasing the children's education when the number of children increase.

- Parameter ϕ measures the possible economies of scale.

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

$$
P_h = (1 - P_c)\left(1 - e^{-\alpha_3\left[\left(\frac{x}{n^{\phi}}\right)^{\rho_1} + (\bar{h}-h)^{\rho_2}\right]^{\alpha_2}}\right) \quad \text{Pr } e' = H \text{ if father } e = C, H, D
$$

- Baseline model: $\phi = 1$

- Some improvements but still unsuccessful.

Extension III: Subsistence consumption

- Parameter $\bar{c}$ denotes the consumption of subsistence.

- Baseline model: $\bar{c} = 0$

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

- Some improvements but still unsuccessful.

Extension IV: CES utility in Quantity and Quality

- δ denotes the parameter of the CES utility function.
- New model:

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

- Baseline model:

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

- Samo, Samo

Extension V: All father types differ in educating technology

- We include the possibility of different fathers had different technologies of producing children college, i.e., parameters $\alpha_{1,c}, \alpha_{1,h}, \alpha_{1,d}$

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

- Baseline model: $\alpha_{1,h} = \alpha_{1,d}$

- Samo, Samo

Continuing Strategy (if we get those darn persistences)

- 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.

- Guess: severe overprediction of fertility in later periods.

The missing link? 1. Technology: The pill.

- The problem is identification. How to measure that errors are lower. Some students are exploring alternatives such as timing between last children and the like.

The missing link 2: Divorce is cheaper

It is not clear how to incorporate this. Or what role does it play. Certainly not in this trivial model that we have posed.

The missing link: 3 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.

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.

- The models so estimated have overpredicting implications that we will use to assess them, e.g. The composition of the education of the off-spring.

And / Or

- *Philip* The missing link could be a forecast of the increased skill premia. But the timing looks a bit wrong (late reduction of fertility but should rethink).

- *Ahu* General equilibrium of skill prices. Not to worry.

- *Jeremy* The externality mechanism does not only operate on educationally triggered fertility reductions but on anything.

Recap

- We estimate a model that accounts for the joint behavior of fertility and investment in the cross-section (preferences are cultularly determined).
- We ask whether stationary preferences and changes in certain prices have power to account for aggregate fertility drops (and we will say no).
- Still the model (will surely) predicts some reduction in fertility due to (exogenous) increases in education.
- We will use the fertility drop to measure a an externality in preferences for child rearing.
- We still need overidentifying restrictions. We think they will come from other countries/periods.

References

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