Marriage Market, Labor Supply and Education Choice

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Motivation

- The central motivation for this project is to understand the long-term effects of policy on life-cycle decisions and inequality
- The secular gender-specific trends in family circumstances, education, labour supply and earnings cannot be fully understood independently of each other or of the institutional background in which they happened
- The marriage market is likely to play a key role in driving responses to policy reform
  - Long term effects change education choice and the marriage market
  - In turn, this will affect labour supply, family resources and inter/intra-household inequality
  - And leads to potentially important inter-generational impacts

- Develop a unified and theoretically consistent framework where these effects can be studied and empirically quantified
  - Life-cycle model of education, marriage, labour supply and savings embedded in equilibrium model of marriage market
  - Brings together two key Becker insights
    - Human Capital: education as an investment with returns in the labour and marriage markets
    - Matching: marriage as a matching game with the sharing of marital surplus determined in equilibrium
- Combine life-cycle information on employment and earnings with sorting patterns by education and parental background to identify marital surplus, the sharing rule and sorting patterns by human capital allowing for endogeneity of education
- Use empirical model to do counterfactual analysis and investigate the drivers of individual life-cycle choices

Background: related literature

- Collective models (Chiappori, 88, 92; Blundell, Chiappori, Meghir, 05)
  - Exogenous education and sharing rule, static framework
- Dynamic individual labor supply (Attanasio, Low, Sanchez-Marcos, 08; Low, Meghir, Pistaferri, 10; Blundell et al., 16)

  Dynamic family labour supply with limited commitment (Mazzocco 07; Voena 15)
  - Marriage and often education are exogenous
- Pre-marital investments and marriage (Chiappori, Iyigun, Weiss 09)
  - Post-marital behaviour not modelled
- Stochastic matching framework (Choo, Siow 06; Chiappori, Salanie, Weiss, 14)
  - Size of the surplus *and* its distribution are identified from matching patterns alone
  - We obtain the former from the life-cycle problem; marital patterns then identify the sharing rule

Life-cycle model: life in three stages

1. Education
   - Choice driven by present costs and expected returns in marriage and labour markets
   - Determines HC (together with unobserved ability)
2. Marriage
   - Marital surplus from public consumption and risk sharing
   - Marriage market determines who marries whom by HC
   - ... the (future, contingent) intra-household allocations
   - ... and ultimately the returns to education
3. Married/single life in T periods
   - Efficient choice of private and public consumptions, savings and labour supply
   - Full commitment and no divorce: sharing rule depends on marriage market conditions at time of marriage
   - Transferable utility: like unitary model

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- Choice of consumptions, labour supply and savings driven by time-varying preferences and income

- Within period preferences: individual i aged t over private consumption (C_{it}), public consumption (Q_t) and labor supply ($L_{it} \in \{0, 1\}$)

$$u_i\left(Q_t, C_{it}, L_{it}\right) = \ln\left(C_{it}Q_t + \alpha_i\left(t, g, s\right) L_{it}Q_t\right)$$

- Earnings: function of gender (g), education (s), ability (θ), age (t) and the persistent AR(1) shocks (e)

$$\ln w_i = \ln W(\theta_i, s_i, g_i) + \delta_{1G}(s_i)t + \delta_{2G}(s_i)t^2 + \delta_{3G}(s_i)t^3 + e_{it}$$

$$u_i\left(Q_t, C_{it}, L_{it}\right) \quad = \quad \ln\left(C_{it}Q_t + \alpha_i\left(t, g, s\right) L_{it}Q_t\right)$$

- Result: These preferences satisfy TU property both *ex-post* and *ex-ante*, in expectations
- $\longrightarrow$ there exists a cardinalisation of preferences such that the household maximises the total lifetime utilities of its members
- Take couple $\left(H_m,\, H_f\right)$ with expected values $\left(V_{mt},\, V_{ft}\right)$ at time t: textcolorblue

$$\exp\left\{\delta V_{mt}\right\} + \exp\left\{\delta V_{ft}\right\} = \exp\left\{\delta \Upsilon_t\right\}$$

- $\left(V_m,\, V_f,\, \Upsilon\right)$ are functions of $\left(H_m,\, H_f\right)$ and other state variables $\left(V_m,\, V_f\right)$ also depend on the sharing ruleq

- Problem of household (H_m, H_f) in state X_t in its recursive form:

$$\Upsilon_t(H_m, H_f, X_t) = \max_{K_{t+1}, L_t, Q_t, C_t} \left\{ \begin{array}{l} \ln\left[Q_t\left(C_t + \alpha_{mt} L_{mt} + \alpha_{ft} L_{ft}\right)\right] + \\ \beta \mathrm{E}\Upsilon_{t+1}(H_m, H_f, X_{t+1}) \end{array} \right\}$$

$$s.t.$$

$$w_{mt} + w_{ft} + y_t^C + RK_{t-1} = K_t + C_t + w_{mt} L_{mt} + w_{ft} L_{ft} + pQ_t$$

- Solution determines (C, Q, L_m, L_f, K) but not (C_m, C_f)

- To determine private consumptions and the sharing of marital surplus we need to solve the marriage problem

- When evaluated at the time of marriage, the function $\exp\{\delta\Upsilon_t\}$ is the economic value of marriage

$$U_m + U_f = \exp\{\delta V_m\} + \exp\{\delta V_f\} = \exp\{\delta\Upsilon_t\} = g(H_m, H_f)$$

- Functions (U_m, U_f) determine the sharing rule

- And the economic surplus generated by couple (m, f) is

$$\Sigma(H_m, H_f) = g(H_m, H_f) - g^M(H_m) - g^F(H_f)$$

- Assume there are only a finite number of H-types and add subjective preferences for marrying a spouse of type H (Choo and Siow, 2006)

- The total gain generated by match (m, f) is

$$g_{mf} = g(H_m, H_f) + \beta_m^{H_f} + \beta_f^{H_m}$$

- Result: there exist numbers $\left(\bar{U}_M(H_m, H_f), \bar{U}_F(H_m, H_f)\right)$:

$$\begin{aligned} g(H_m, H_f) &= \bar{U}_M(H_m H_f) + \bar{U}_F(H_m, H_f) \\ U_j &= \bar{U}_{G_j}(H_m, H_f) + \beta_j^{H_i} \quad \text{for } i, j = m, f,\ i \neq j \end{aligned}$$

In words: the value for m of marrying f is the total of a deterministic component and an idiosyncratic preference for spouses of type H_f

- For every man (likewise for woman) the optimal match satisfies

$$\bar{U}_M\left(H_m, H_f\right) + \beta_m^{H_f} \geq \bar{U}_M\left(H_m, H\right) + \beta_m^{H}, \quad \forall_H$$

- H discrete: multinomial discrete choice model identifies $\bar{U}_G$ and, hence, the sharing rule

- Since the marital economic gain is identified by lifecycle behavior, we have over-identifying restrictions
  - Can relax distributional assumptions on β by adding a systematic effect to the value of j marrying i:

$$U_j = \bar{U}_{G_j}\left(H_m, H_f\right) + X_j\gamma + \beta_j^{H_i}$$

- Identifying assumption: marriage does not cause changes in earnings capacity

- Education Choices made in anticipation of marriage
- Cost of education and references for spouses know at this stage
- Costs of education depend on observables and a random shock
- The education choice of individual i satisfies

$$s_i = \arg\max_s \left\{ \bar{V}_G(H_i) - c_{Gsi}(X_i, \upsilon_{Gsi}) \right\}$$

where

$$\begin{aligned} \bar{V}_G(H_i) &= \max_{H'} [\bar{U}_G \left(H_i, H'\right) + \beta_i^{H'}] \\ c_{is} &= \iota_{Gs,0} + \iota_{Gs,1} y_i^p + \kappa_s \end{aligned}$$

- Identifying assumption: exclusion restriction on y^p is residual parental income, it is assumed to measure parental liquidity shocks at the time the individuals make education choices

The Data

- Data: British Household Panel Survey for the years 1991-2008
- 3,046 Couples, 620 Single men and 629 single women aged 20-40 in 1991 who are observed past age 30
- Marital status assessed at age 30 or above
  - Singles: those never married
  - Those married followed for the entire marital spell
  - Ignore divorce as not included in the model
- Three education levels (statutory, high school, college)
- Employment defined as working 5 hours or more per week
- We net out aggregate growth from wages

Stepwise procedure

1. Set 2 parameters from literature: interest rate (1.5%) and discount factor (0.98)

2. Estimate the education and gender specific age profiles using a control function approach, allowing for endogenous labour supply and education choice (Heckman, 1979)

3. The sorting patterns by human capital and the other parameters in preferences and earnings are estimated within the structural model by SMM using moments describing the distribution earnings and employment for different family circumstances

4. Estimate cost of education and sharing rule in one step within the structural model under the assumption that the observed sorting patterns correspond to the efficient equilibrium

Earnings process I

	Men			Women		
	Stat	HS	Univ	Stat	HS	Univ
log earnings (sec, age 23)	3.00			2.44		
	(.01)			(.03)		
education premium		0.065	0.096		0.246	0.497
		(0.029)	(0.036)		(0.055)	(0.075)
ability premium (high)	0.148	0.143	0.095	0.457	0.287	0.280
	(.03)	(.02)	(.04)	(.03)	(.06)	(.06)
age (δ_1)	0.339	0.622	1.002	-0.242	0.177	0.664
	(0.063)	(0.062)	(0.092)	(0.114)	(0.111)	(0.180)
age squared (δ_2)	-0.160	-0.318	-0.527	0.128	-0.205	-0.597
	(0.052)	(0.050)	(0.077)	(0.091)	(0.092)	(0.146)
age cubic (δ_3)	0.023	0.053	0.091	-0.007	0.063	0.156
	(0.013)	(0.012)	(0.019)	(0.021)	(0.022)	(0.035)
Autocorr coeff (ρ)	0.836	0.808	0.904	0.854	0.909	0.851
	(0.051)	(0.070)	(0.039)	(0.049)	(0.027)	(0.047)
Var innov in prod (σ^2_ξ)	0.014	0.012	0.014	0.026	0.037	0.038
	(0.005)	(0.004)	(0.006)	(0.008)	(0.012)	(0.013)
Var ME (σ^2_ϵ)	0.019	0.013	0.011	0.006	0.005	0.000
	(0.011)	(0.009)	(0.019)	(0.016)	(0.019)	(0.020)
N	9,116	11,990	4,291	8,432	7,469	3,962

Table: Ability conditional on Education among couples

		Men					
		Stat Ed		HS		Univ	
		ab 1	ab 2	ab 1	ab 2	ab 1	ab 2
	Stat Ed						
	ab 1	0.216	0.429	0.213	0.270	0.200	0.242
		(.01)	(.02)	(.02)	(.02)	(.07)	(.07)
	ab 2	0.124	0.231	0.209	0.308	0.103	0.456
		(.02)		(.02)		(.05)	
	HS						
	ab 1	0.117	0.247	0.132	0.156	0.078	0.155
		(.01)	(.02)	(.01)	(.02)	(.04)	(.04)
	ab 2	0.153	0.483	0.262	0.450	0.154	0.613
		(.02)		(.01)		(.04)	
	Univ						
	ab 1	0.148	0.287	0.276	0.071	0.112	0.118
		(.05)	(.40)	(.08)	(.06)	(.04)	(.10)
	ab 2	0.093	0.472	0.051	0.603	0.078	0.692
		(.08)		(.09)		(.03)	

Table: Proportion of ability type 1 among singles by gender and education

	secondary	high school	university
men	0.753	0.705	0.505
	(.03)	(.02)	(.03)
women	0.439	0.171	0.109
	(.04)	(.06)	(.08)

Marital sorting by education

	Women's education					
Men's educ	Sec	HS	Univ	Sec	HS	Univ
	Simulated moments			Data moments		
	sorting patterns: men vs data					
Sec	0.249	0.080	0.012	0.275	0.062	0.008
HS	0.133	0.108	0.028	0.136	0.102	0.027
Univ	0.016	0.038	0.045	0.009	0.039	0.046
	sorting patterns: women vs data					
Sec	0.249	0.080	0.012	0.277	0.062	0.007
HS	0.133	0.108	0.028	0.137	0.101	0.027
Univ	0.016	0.038	0.045	0.009	0.039	0.046

Additional utility parameters

Complementarity in the HC induced by the model is not enough to capture the amoount of marital sorting observed in the data

	men by ability		women by ability	
	low	high	low	high
preferences for remaining single, by education				
Sec	1.375	-1.544	-0.404	1.587
	(0.207)	(0.583)	(0.093)	(0.565)
HS	2.262	-1.203	1.115	3.728
	(0.575)	(0.457)	(0.164)	(0.862)
Univ	3.312	-0.543	3.427	4.826
	(0.827)	(0.106)	(1.545)	(1.753)
taste for differently educated spouses				
1 level diff	0.631	-0.750	-0.241	0.082
	(0.034)	(0.243)	(0.244)	(0.116)
2 levels diff	-2.186	-0.971	-4.576	-0.500
	(0.660)	(0.358)	(1.548)	(0.114)

Table: Utility cost of education

	men		women	
	HS	Univ	HS	Univ
constant	0.942	3.735	2.105	6.478
	(0.337)	(1.321)	(0.503)	(2.341)
parental income (residual)	-0.421	-0.117	-0.581	-0.086
	(0.155)	(0.095)	(0.135)	(0.037)

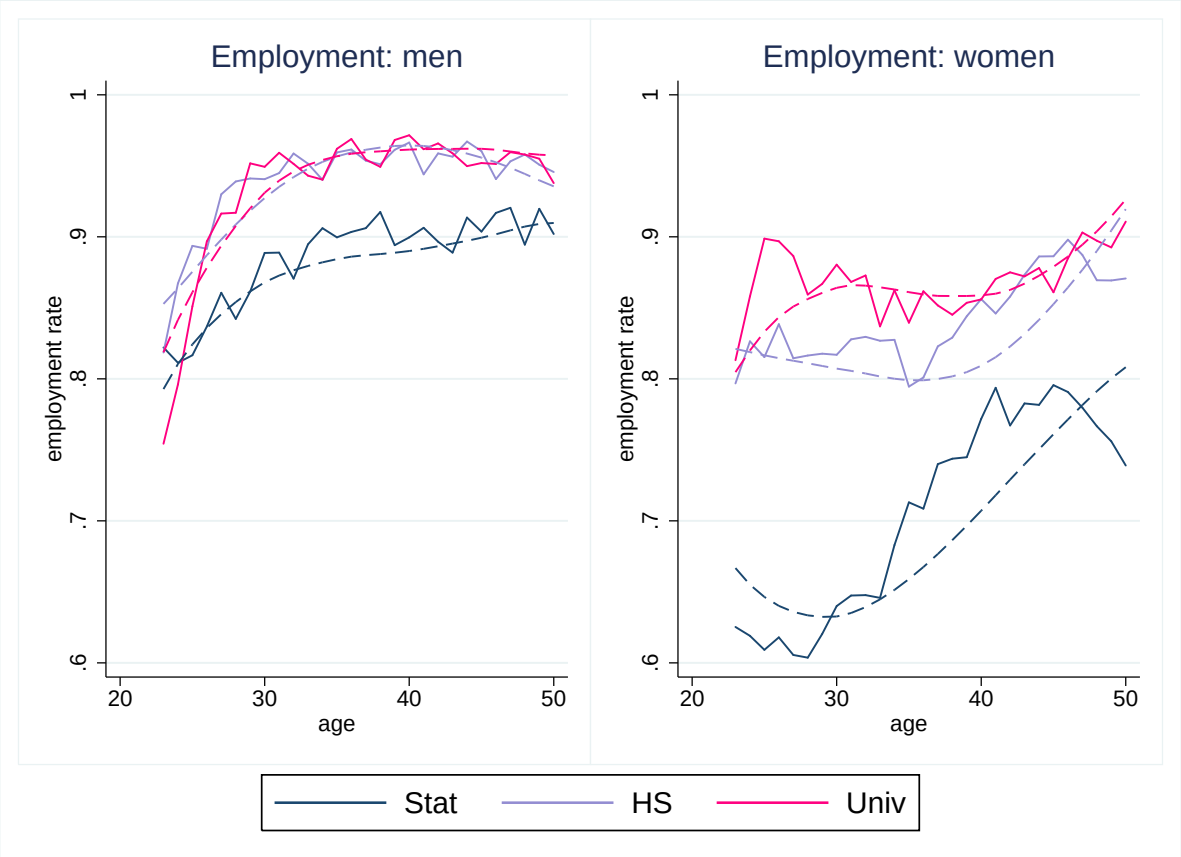
- Given the estimates of all parameters in wages and preferences, we can compute the economic Surplus.
- Matching is not PAM or NAM

Men's educ and ability	women's ability and education					
	low ability			high ability		
	Sec	HS	Univ	Sec	HS	Univ
Sec, low ab	62.45	103.93	139.98	173.98	214.68	235.04
HS, low ab	67.75	103.21	142.98	176.32	211.70	231.20
Univ, low ab	69.94	112.77	188.11	212.14	256.94	319.31
Sec, high ab	92.36	144.30	221.29	238.25	292.53	363.22
HS, high ab	114.10	161.39	250.74	266.75	318.39	400.39
Univ, high ab	101.36	154.38	269.36	279.83	338.49	453.12

Sharing Rule: men's share

Men's educ and ability	women's ability and education					
	low ability			high ability		
	Sec	HS	Univ	Sec	HS	Univ
Sec, low ab	0.985	0.291	0.300	0.524	0.206	0.140
	(0.261)	(0.114)	(0.073)	(0.148)	(0.080)	(0.040)
HS, low ab	0.990	0.630	0.010	0.579	0.375	0.066
	(0.335)	(0.254)	(0.024)	(0.212)	(0.152)	(0.021)
Univ, low ab	0.940	0.893	0.451	0.969	0.621	0.357
	(0.330)	(0.343)	(0.165)	(0.335)	(0.231)	(0.110)
Sec, high ab	0.635	0.393	0.013	0.418	0.309	0.134
	(0.225)	(0.172)	(0.047)	(0.155)	(0.127)	(0.052)
HS, high ab	0.794	0.458	0.154	0.564	0.332	0.217
	(0.252)	(0.193)	(0.037)	(0.188)	(0.142)	(0.065)
Univ, high ab	0.671	0.773	0.391	0.715	0.580	0.348
	(0.330)	(0.285)	(0.136)	(0.262)	(0.213)	(0.121)

Figure: BHPS data and model predictions: employment of men and women over the lifecycle



Notes: Full lines are for BHPS data and the dashed lines are for model simulations.

Figure: BHPS data and model predictions: log annual earnings for men and women over the lifecycle

Notes: Full lines are for BHPS data and the dashed lines are for model simulations. Annual earnings in real terms (GBP 1,000, 2008 prices).

Concluding Remarks

- We develop a rich equilibrium framework for considering life-cycle decisions in a unified way
- It allows us to analyze the long term effects of policies in a systematic way
- It also provides an empirical framework for understanding marital patterns
- On the agenda (shorter and longer run):
  - Counterfactual policy simulations
  - Divorce
  - Imperfectly transferable utility
  - Limited commitment in equilibrium