

DINKS, DEWKS & Co.
Marriage, Fertility and Childlessness in the US

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Various family types

traditional family:



single woman:



childless couple (DINKS):



Parenthood <> marriage

Q: Which single women become mothers and which married women remain childless?

Answers from the literature

Dynamic models of marriage (and divorce) with endogenous fertility:

- Greenwood, Guner & Knowles (2003) (expl. decline of marriage and rise of divorce)
- Regalia, Ríos-Rull & Short (2008) (expl. increase in singleness)

On childlessness:

- Social sciences distinguish **Involuntary vs Voluntary childlessness** (Poston & Trent (1982), Morgan (1991), Toulemon (1996))
- Economics: Gobbi (2011) childlessness rate and fertility rate not necessarily negatively correlated over time at macro level

Our contribution

A theory to explain jointly marriage/singleness and parenthood/childlessness decisions.

Co-existence of involuntary and voluntary causes of childlessness is key to explain facts (US, 1990)

- 5.8% of American women are involuntarily childless
- 9% are voluntarily childless

Predictions: How better education of women and men affect both types of childlessness and fertility.

US Census data

Data: US Census, 45-70 year old married and never married women in 1990. **Completed fertility**

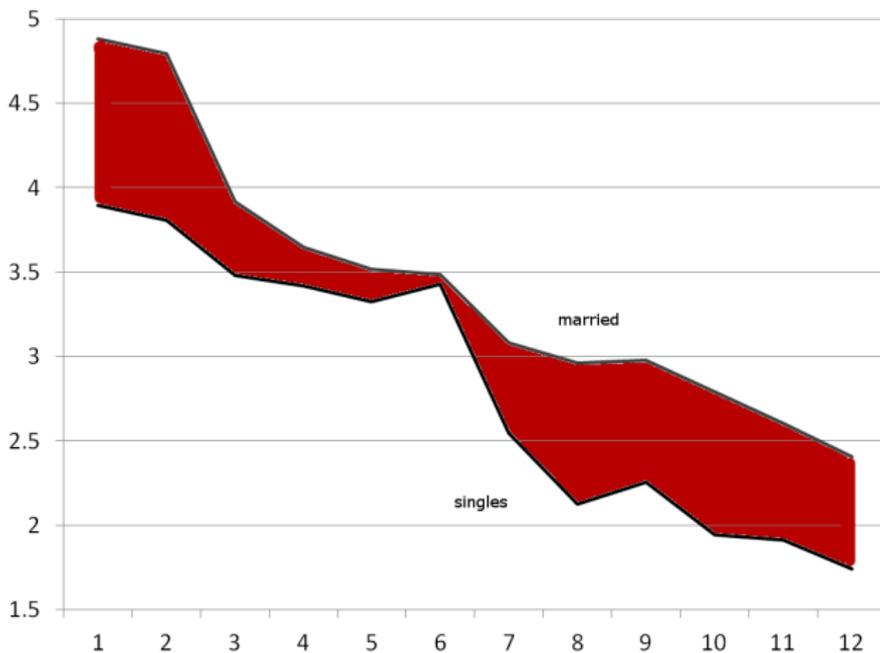
Drop Separated, Widowed and Divorced ($\approx 30\%$), concentrate on Married and Single

Potential income - 12 education categories - 1127080 obs

| Nb | Category | N. obs. | Nb | Category | N. obs. |
|----|-----------|---------|----|--------------------|---------|
| 1 | No school | 12122 | 7 | Grade 12 | 479703 |
| 2 | Grade 1-4 | 14050 | 8 | 1 year of college | 178274 |
| 3 | Grade 5-8 | 84243 | 9 | 2 years of college | 53428 |
| 4 | Grade 9 | 38121 | 10 | Bachelor degree | 99046 |
| 5 | Grade 10 | 57213 | 11 | Master degree | 56855 |
| 6 | Grade 11 | 49413 | 12 | Doctoral degree | 4612 |

Fact 1: fertility gap

When mothers, singles' fertility is lower by no more than one child compared to married



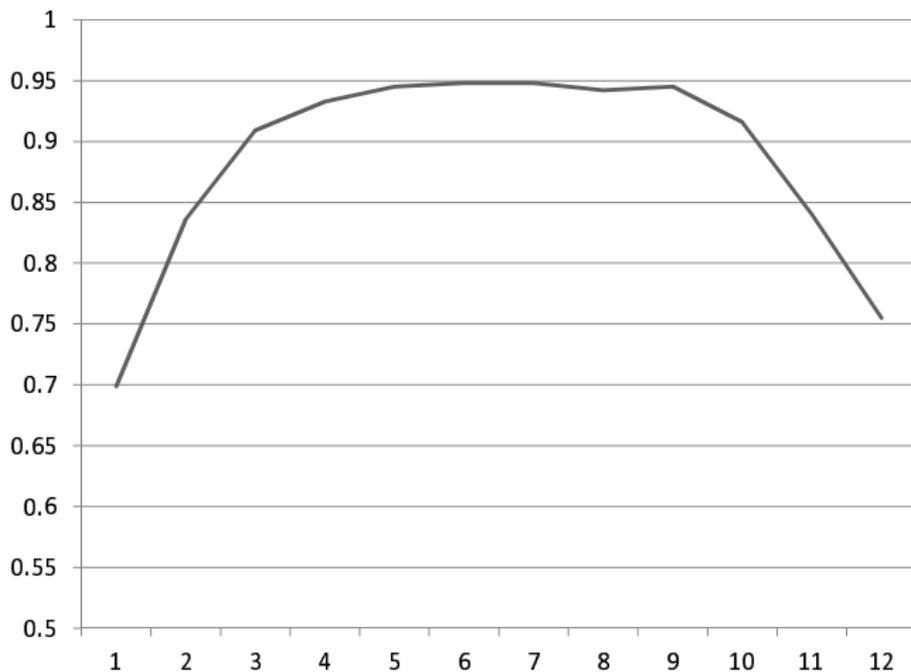
Fact 2: childlessness

Childlessness exhibits an U-Shaped relationship with education for both singles and married



Fact 3: marriage

There is a hump-shaped relationship between marriage rates and education levels



Main features of the model

Static model, 2 sexes ($i = \{f, m\}$), agents decide

- 1 to marry or not (random matching, once in life)
- 2 Consumption and fertility

Women can have children, married or not \neq Men should marry to have children

Exogenous potential income (education): w^i

+ heterogeneity in non labor income $a^i \perp w^i$

Preferences

Individuals:

$$u(c^i, n) = \ln c^i + \ln(n + \nu)$$

No gender differences in preferences

$\nu > 0$: Services from children are superior good

Couples:

$$\theta u(c^f, n) + (1 - \theta) u(c^m, n)$$

with

$$\theta \equiv \frac{1}{2} \underline{\theta} + (1 - \underline{\theta}) \frac{w^f}{w^f + w^m}, \quad \underline{\theta} \in (0, 1)$$

\Rightarrow although \exists marriage surplus, one spouse may refuse marriage if she/he is too low educated relatively (low $\theta / 1 - \theta$)

Marriage

Random matching, once in life

Gain to be married for a man: having children, potentially increasing consumption, household public good

Gain to be married for a woman: sharing childrearing costs, potentially increasing consumption, household public good

Cooperative bargaining: there is always a marriage surplus, but if power is too unequally distributed, better to stay single

Minimal consumption to be able to procreate: c^{\min}

$$n > 0 \Rightarrow c^f \geq c^{\min}$$

Why ? Mc Fall, (1979): Poor are more subject to diseases that can lead to subfecundity

- 1 Malnutrition
- 2 Poor use more drugs
- 3 Poor have less access to medical services: if they want to abort, they may be sterile after a medical mistake + no access to IVF
- 4 Poor live in more polluted areas: ↘ fecundity

Important: c^{\min} is a technological constraint and not a preference parameter.

Budget constraints

Single men:

$$\bar{c}^m = w^m + a^m - \mu$$

μ : cost of running a household

Single women:

$$c^f + \phi(1 + \eta(n)) w^f n = w^f + a^f - \mu$$

Couples:

$$c^f + c^m + \phi(1 + \eta(n)) \left(\alpha w^f + (1 - \alpha) w^m \right) n = w^m + w^f + a^m + a^f - \mu$$

$\alpha \in (\frac{1}{2}, 1)$ mother's share of child support

with fixed cost of having children:

$$\eta(n) = \begin{cases} \frac{\eta}{n} & \text{if } n > 0 \\ 0 & \text{if } n = 0 \end{cases}$$

Maximum fertility

Single women:

$$0 \leq n \leq \frac{1 - \phi\eta}{\phi} \equiv \bar{n}_M$$

Couples:

$$0 \leq n \leq \frac{1 - \alpha\phi\eta}{\alpha\phi} \equiv n_M$$

Regimes

Several constraints may bind: maximum fertility, minimum consumption to procreate

Conditionally on being married or not, \exists thresholds for wages and non-labor income separating different regimes.

11 regimes total.

5 pictures.

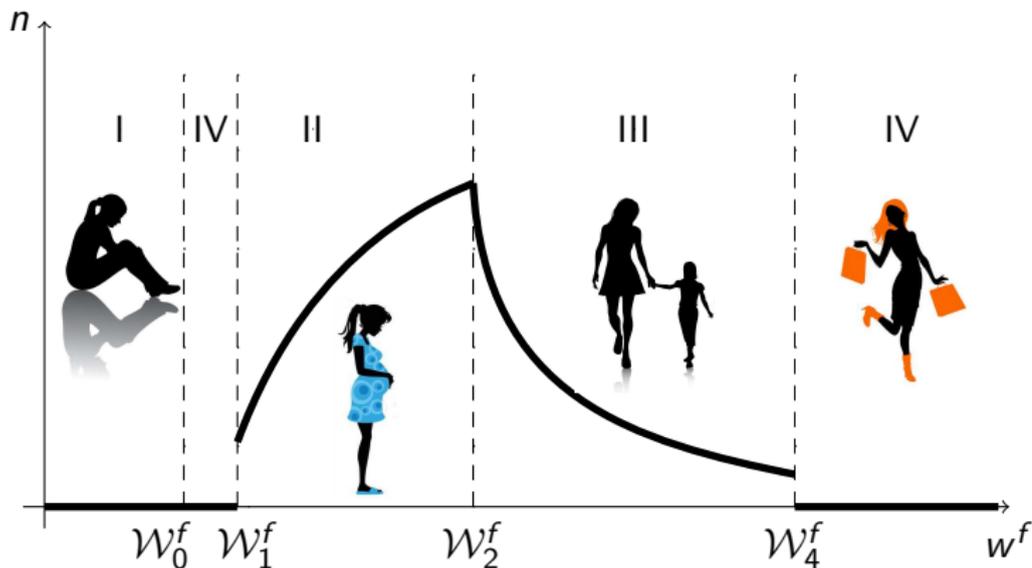
Fertility conditionally on being single when $a^f \in [\underline{a}, \bar{a}[$

I: Involuntary childlessness

II: "Get fit to procreate"

III: Interior solution

IV: Voluntary childlessness

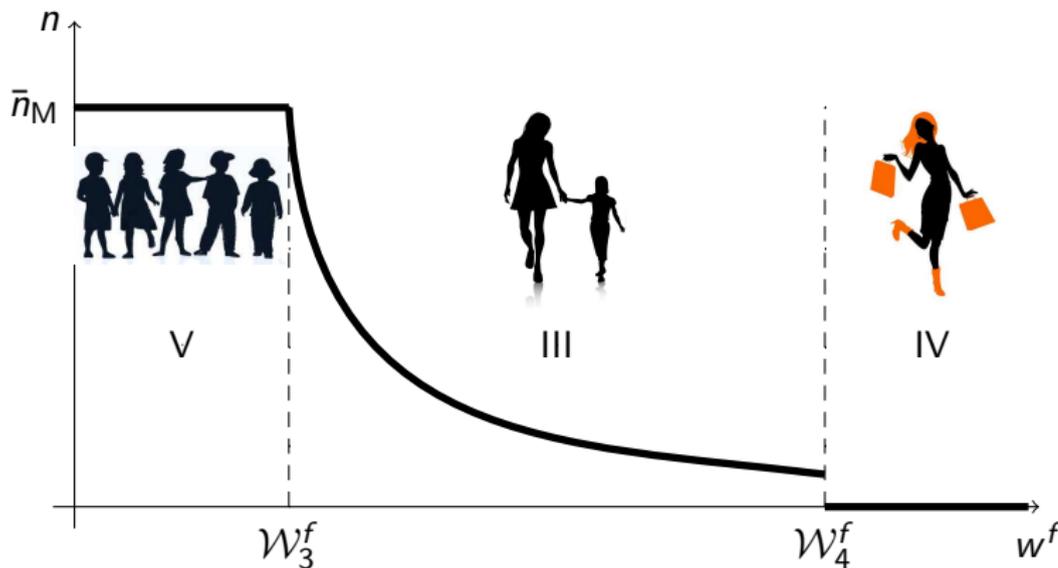


Fertility conditionally on being single when $a^f \geq \bar{a}$

V: Maximum fertility

III: Interior solution

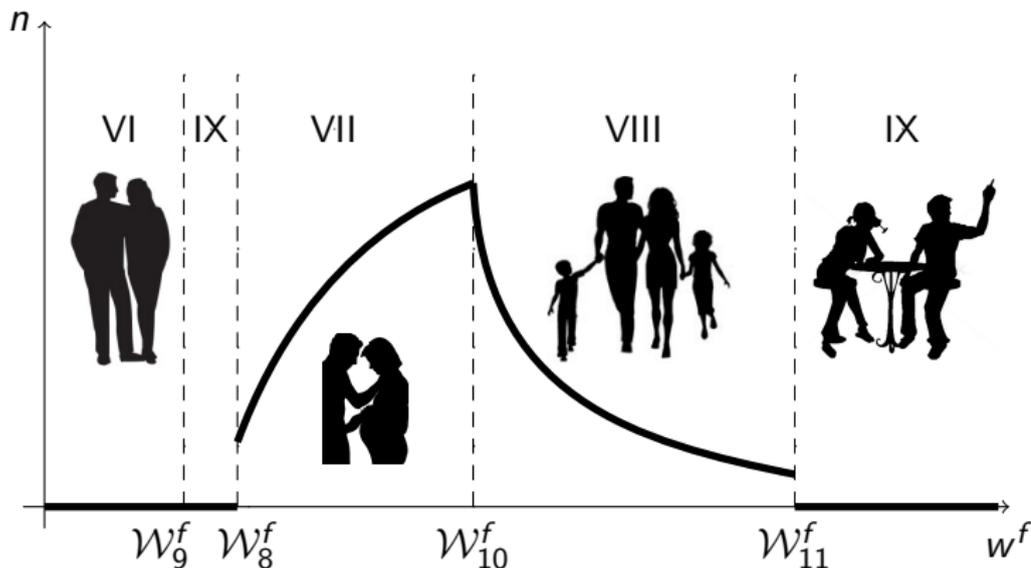
IV: Voluntary childlessness



Fertility conditionally on being married when $a^f \in [A_0, A_1[$

VI: Involuntary childlessness
IX: Voluntary childlessness

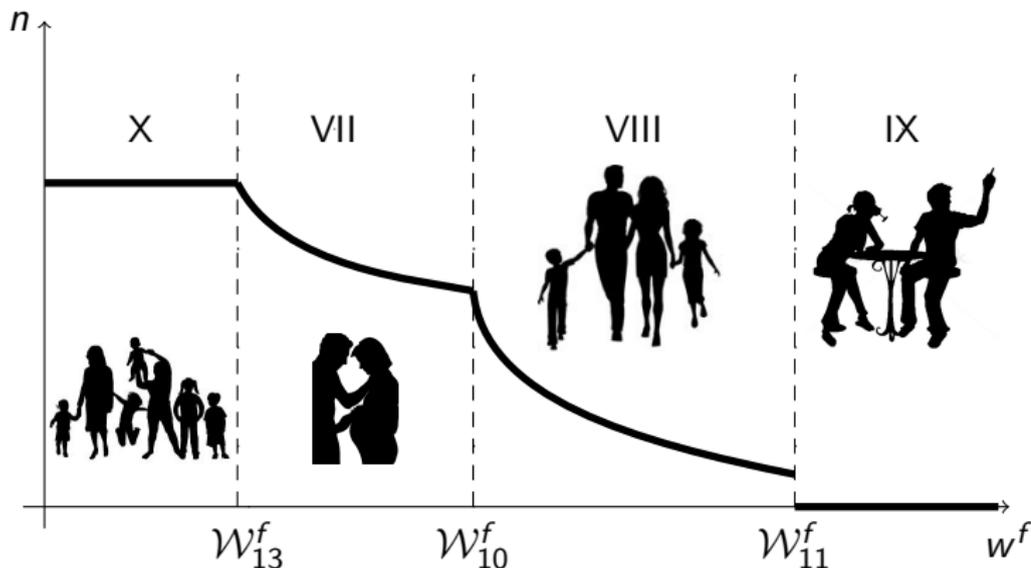
VII: "Eat and procreate"
VIII: Interior solution



Fertility conditionally on being married when $a^f \in [A_1, A_2[$

X: “Eat and procreate” a maximum
VII: “Eat and procreate”

IX: Voluntary childlessness
VIII: Interior solution

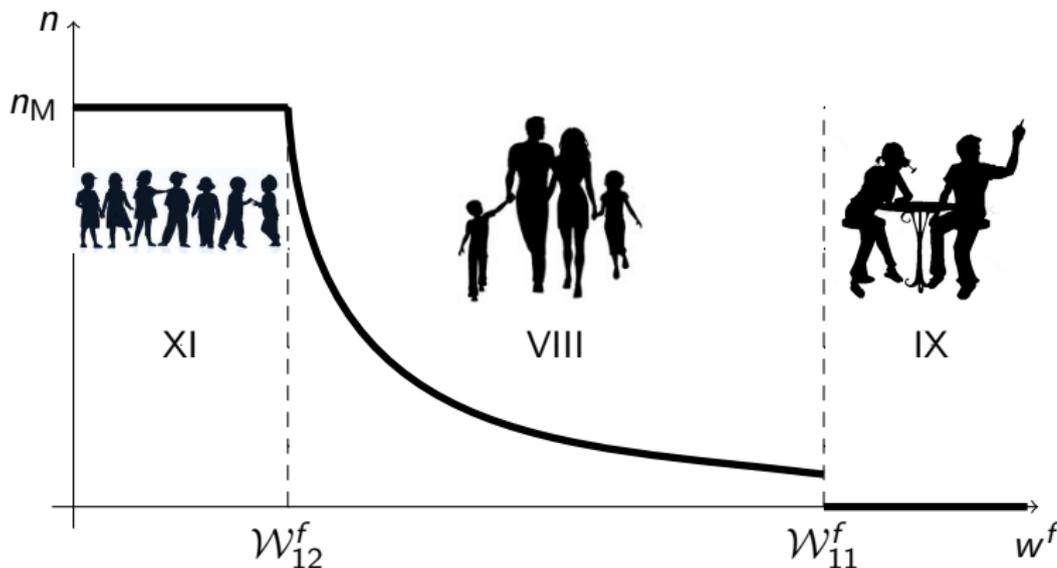


Fertility conditionally on being married when $a^f \geq A_2$

XI: Maximum fertility

VIII: Interior solution

IX: Voluntary childlessness



Identification of the Parameters

d , vector of 48 moments to match: fertility and childlessness rates for married and singles in 12 education categories

with p , vector of 9 parameters

We minimize

$$[d - s(p)] [W] [d - s(p)]'$$

where $s(p)$ is the vector of simulated moments.

W is the optimal weighting matrix.

To minimize the function, we implement in Fortran 90:

- 1 **PIKAIA** (genetic algorithm from Charbonneau (2002)) \Rightarrow finds the region where the global maximum lies
- 2 **UOBYQA** (quadratic approximation) \Rightarrow faster algorithm

How the simulated moments are computed

We consider a large number of hypothetical women, having a potential labor income depending on education

$$w_e = \gamma \exp\{0.1e\}, \quad \gamma = 0.9$$

For each woman we draw

- a non labor income from a log-normal distribution (mean and variance are parameters to be identified)
- a potential husband, with random education level and non-labor income

We compute whether each potential couple will marry, and what will be the optimal fertility of the woman

Simulated moments obtained by aggregating all individual choices

Identified parameters

| Description | Parameter | Value | Std. Error |
|---|------------|-------|------------|
| variance of the log normal distribution | σ_a | 0.319 | 0.006 |
| ratio of non labor income to labor income | m_a | 0.868 | 0.011 |
| preference parameter | ν | 6.848 | 0.112 |
| min consumption level to procreate | c^{\min} | 0.339 | 0.004 |
| good cost to be supported by a household | μ | 0.333 | 0.005 |
| bargaining parameter | θ | 0.568 | 0.009 |
| fraction of childrearing by women | α | 0.596 | 0.005 |
| time cost of having children | ϕ | 0.216 | 0.007 |
| fixed cost of children | η | 0.225 | 0.002 |

Comments on parameters

σ_a implies Gini on life-cycle income $w^f + a^f$ equal to 0.17.

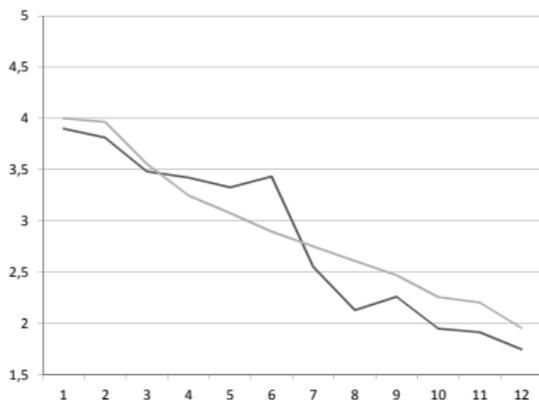
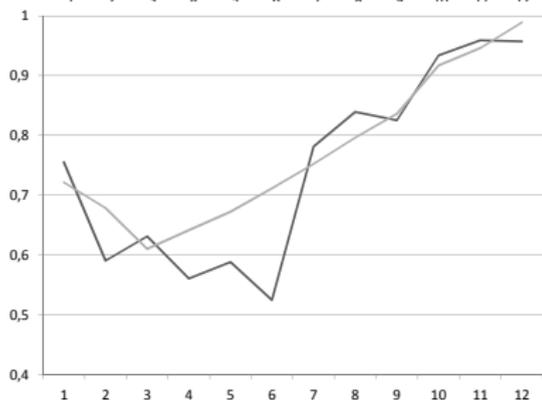
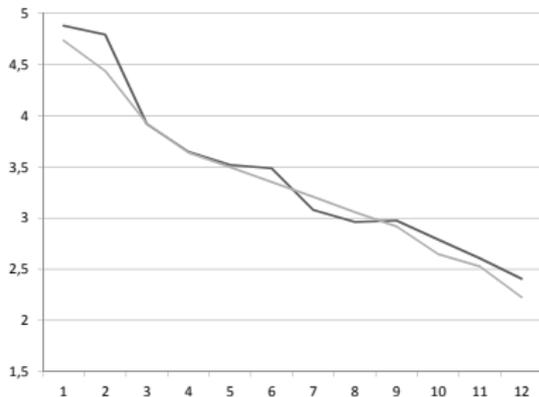
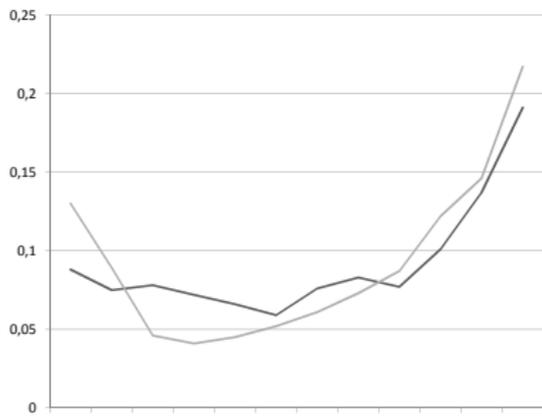
$\underline{\theta}$ implies minimal negotiation power of a spouse $\underline{\theta}/2 = 0.28$

$\eta, \phi, \alpha \rightarrow n_M = 7$, while $\bar{n}_M = 4$.

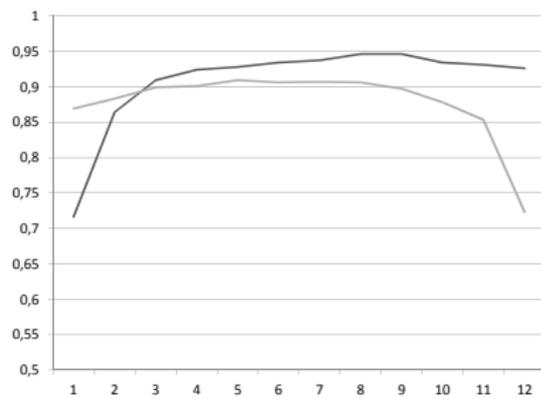
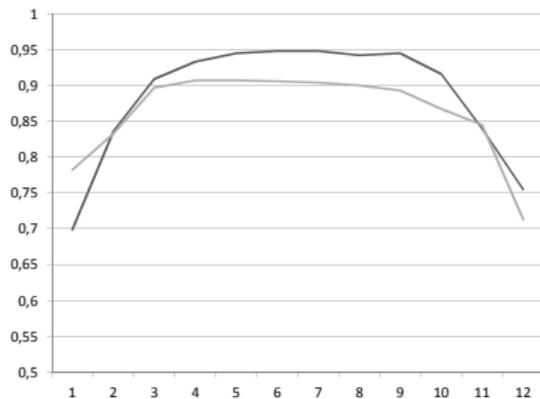
η means first child costs 22% more time than second

$\alpha = 0.598$ fathers do a lot. (or ex ante expectations?)

Matched moments: childlessness and mothers' fertility



Matched moments: marriage rates



NB: we did not use marriage rates to identify the parameters

% of women in each regime by education category

| | I | III | IV | V | VI | VII | VIII | IX | X | XI |
|-----|---|---|---|---|---|---|---|--|---|---|
| |  |  |  |  |  |  |  |  |  |  |
| 1 | 15.7 | 0.0 | 0.0 | 6.1 | 10.2 | 43.5 | 7.1 | 0.0 | 4.2 | 13.2 |
| 2 | 11.3 | 0.2 | 0.0 | 5.2 | 7.4 | 40.9 | 20.0 | 0.0 | 0.9 | 14.1 |
| 3 | 6.2 | 1.3 | 0.1 | 2.8 | 3.1 | 17.7 | 58.3 | 1.0 | 0.0 | 9.5 |
| 4 | 5.7 | 1.6 | 0.3 | 1.7 | 0.9 | 4.2 | 76.1 | 2.8 | 0.0 | 6.7 |
| 5 | 5.7 | 1.7 | 0.6 | 1.3 | 0.4 | 0.9 | 80.3 | 3.7 | 0.0 | 5.4 |
| 6 | 5.7 | 1.8 | 1.0 | 1.0 | 0.1 | 0.1 | 81.6 | 4.6 | 0.0 | 4.3 |
| 7 | 5.6 | 1.7 | 1.6 | 0.7 | 0.0 | 0.0 | 81.6 | 5.5 | 0.0 | 3.3 |
| 8 | 5.5 | 1.5 | 2.5 | 0.5 | 0.0 | 0.0 | 81.0 | 6.5 | 0.0 | 2.4 |
| 9 | 5.1 | 1.4 | 3.8 | 0.4 | 0.0 | 0.0 | 79.8 | 7.7 | 0.0 | 1.8 |
| 10 | 2.5 | 0.9 | 9.7 | 0.2 | 0.0 | 0.0 | 75.3 | 10.6 | 0.0 | 0.8 |
| 11 | 1.0 | 0.7 | 13.7 | 0.1 | 0.0 | 0.0 | 71.7 | 12.3 | 0.0 | 0.5 |
| 12 | 0.0 | 0.3 | 28.4 | 0.0 | 0.0 | 0.0 | 55.7 | 15.5 | 0.0 | 0.1 |
| all | 5.3 | 1.5 | 3.1 | 0.9 | 0.5 | 2.5 | 76.7 | 5.9 | 0.1 | 3.6 |

Involuntary childlessness

| | I | III | IV | V | VI | VII | VIII | IX | X | XI |
|-----|---|-----|------|-----|---|------|------|------|-----|------|
| |  | | | |  | | | | | |
| 1 | 15.7 | 0.0 | 0.0 | 6.1 | 10.2 | 43.5 | 7.1 | 0.0 | 4.2 | 13.2 |
| 2 | 11.3 | 0.2 | 0.0 | 5.2 | 7.4 | 40.9 | 20.0 | 0.0 | 0.9 | 14.1 |
| 3 | 6.2 | 1.3 | 0.1 | 2.8 | 3.1 | 17.7 | 58.3 | 1.0 | 0.0 | 9.5 |
| 4 | 5.7 | 1.6 | 0.3 | 1.7 | 0.9 | 4.2 | 76.1 | 2.8 | 0.0 | 6.7 |
| 5 | 5.7 | 1.7 | 0.6 | 1.3 | 0.4 | 0.9 | 80.3 | 3.7 | 0.0 | 5.4 |
| 6 | 5.7 | 1.8 | 1.0 | 1.0 | 0.1 | 0.1 | 81.6 | 4.6 | 0.0 | 4.3 |
| 7 | 5.6 | 1.7 | 1.6 | 0.7 | 0.0 | 0.0 | 81.6 | 5.5 | 0.0 | 3.3 |
| 8 | 5.5 | 1.5 | 2.5 | 0.5 | 0.0 | 0.0 | 81.0 | 6.5 | 0.0 | 2.4 |
| 9 | 5.1 | 1.4 | 3.8 | 0.4 | 0.0 | 0.0 | 79.8 | 7.7 | 0.0 | 1.8 |
| 10 | 2.5 | 0.9 | 9.7 | 0.2 | 0.0 | 0.0 | 75.3 | 10.6 | 0.0 | 0.8 |
| 11 | 1.0 | 0.7 | 13.7 | 0.1 | 0.0 | 0.0 | 71.7 | 12.3 | 0.0 | 0.5 |
| 12 | 0.0 | 0.3 | 28.4 | 0.0 | 0.0 | 0.0 | 55.7 | 15.5 | 0.0 | 0.1 |
| all | 5.3 | 1.5 | 3.1 | 0.9 | 0.5 | 2.5 | 76.7 | 5.9 | 0.1 | 3.6 |

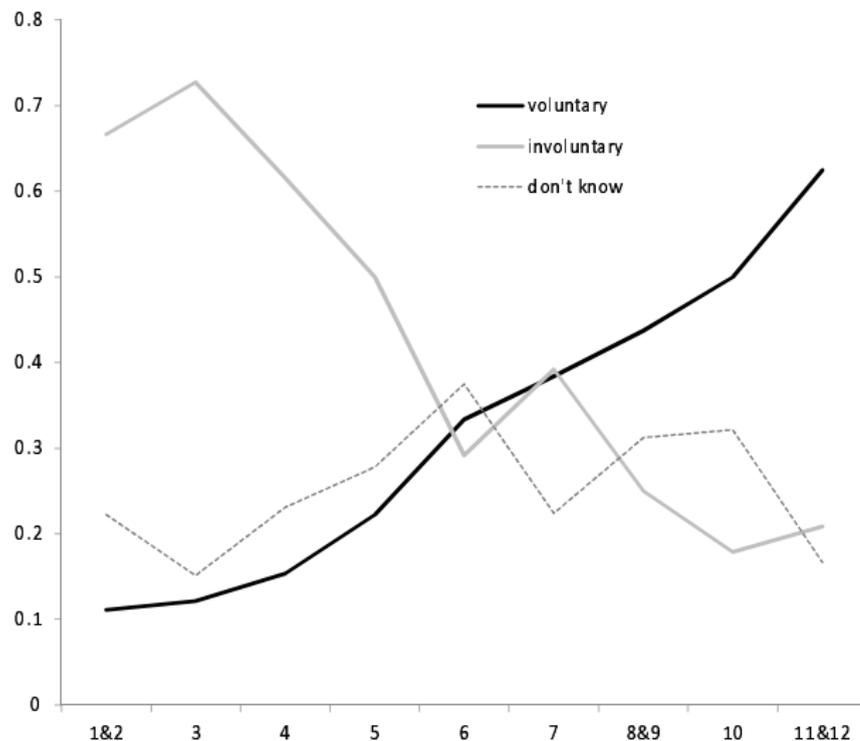
Marriage helps to escape poverty

| | I | III | IV | V | VI | VII | VIII | IX | X | XI |
|-----|------|-----|------|-----|------|---|------|------|---|------|
| | | | | | |  | | |  | |
| 1 | 15.7 | 0.0 | 0.0 | 6.1 | 10.2 | 43.5 | 7.1 | 0.0 | 4.2 | 13.2 |
| 2 | 11.3 | 0.2 | 0.0 | 5.2 | 7.4 | 40.9 | 20.0 | 0.0 | 0.9 | 14.1 |
| 3 | 6.2 | 1.3 | 0.1 | 2.8 | 3.1 | 17.7 | 58.3 | 1.0 | 0.0 | 9.5 |
| 4 | 5.7 | 1.6 | 0.3 | 1.7 | 0.9 | 4.2 | 76.1 | 2.8 | 0.0 | 6.7 |
| 5 | 5.7 | 1.7 | 0.6 | 1.3 | 0.4 | 0.9 | 80.3 | 3.7 | 0.0 | 5.4 |
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| 7 | 5.6 | 1.7 | 1.6 | 0.7 | 0.0 | 0.0 | 81.6 | 5.5 | 0.0 | 3.3 |
| 8 | 5.5 | 1.5 | 2.5 | 0.5 | 0.0 | 0.0 | 81.0 | 6.5 | 0.0 | 2.4 |
| 9 | 5.1 | 1.4 | 3.8 | 0.4 | 0.0 | 0.0 | 79.8 | 7.7 | 0.0 | 1.8 |
| 10 | 2.5 | 0.9 | 9.7 | 0.2 | 0.0 | 0.0 | 75.3 | 10.6 | 0.0 | 0.8 |
| 11 | 1.0 | 0.7 | 13.7 | 0.1 | 0.0 | 0.0 | 71.7 | 12.3 | 0.0 | 0.5 |
| 12 | 0.0 | 0.3 | 28.4 | 0.0 | 0.0 | 0.0 | 55.7 | 15.5 | 0.0 | 0.1 |
| all | 5.3 | 1.5 | 3.1 | 0.9 | 0.5 | 2.5 | 76.7 | 5.9 | 0.1 | 3.6 |

Voluntary childlessness

| | I | III | IV | V | VI | VII | VIII | IX | X | XI |
|-----|------|-----|---|-----|------|------|------|--|-----|------|
| | | |  | | | | |  | | |
| 1 | 15.7 | 0.0 | 0.0 | 6.1 | 10.2 | 43.5 | 7.1 | 0.0 | 4.2 | 13.2 |
| 2 | 11.3 | 0.2 | 0.0 | 5.2 | 7.4 | 40.9 | 20.0 | 0.0 | 0.9 | 14.1 |
| 3 | 6.2 | 1.3 | 0.1 | 2.8 | 3.1 | 17.7 | 58.3 | 1.0 | 0.0 | 9.5 |
| 4 | 5.7 | 1.6 | 0.3 | 1.7 | 0.9 | 4.2 | 76.1 | 2.8 | 0.0 | 6.7 |
| 5 | 5.7 | 1.7 | 0.6 | 1.3 | 0.4 | 0.9 | 80.3 | 3.7 | 0.0 | 5.4 |
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| 7 | 5.6 | 1.7 | 1.6 | 0.7 | 0.0 | 0.0 | 81.6 | 5.5 | 0.0 | 3.3 |
| 8 | 5.5 | 1.5 | 2.5 | 0.5 | 0.0 | 0.0 | 81.0 | 6.5 | 0.0 | 2.4 |
| 9 | 5.1 | 1.4 | 3.8 | 0.4 | 0.0 | 0.0 | 79.8 | 7.7 | 0.0 | 1.8 |
| 10 | 2.5 | 0.9 | 9.7 | 0.2 | 0.0 | 0.0 | 75.3 | 10.6 | 0.0 | 0.8 |
| 11 | 1.0 | 0.7 | 13.7 | 0.1 | 0.0 | 0.0 | 71.7 | 12.3 | 0.0 | 0.5 |
| 12 | 0.0 | 0.3 | 28.4 | 0.0 | 0.0 | 0.0 | 55.7 | 15.5 | 0.0 | 0.1 |
| all | 5.3 | 1.5 | 3.1 | 0.9 | 0.5 | 2.5 | 76.7 | 5.9 | 0.1 | 3.6 |

NSFG data: 1973 & 1976



Very detailed survey on fertility, but few observations

Historical experiment

1960-1990: rise in the education of both women and men

Predictions of the model are:

- A. drop in marriage rates for unskilled women, rise for skilled.
- B. a drop in childlessness for all education categories.
- C. drop in fertility (opportunity cost effect dominates).

A and B are in the data. C is not because of baby boom.

α

Imposing $\alpha = 1$, the model becomes unable to reproduce

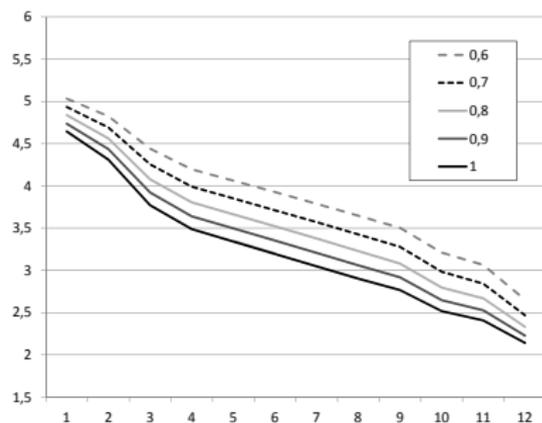
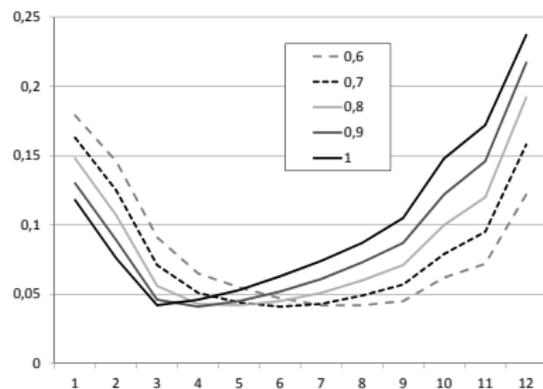
(a) a reasonable marriage rate (especially for highly educated women who have lost their incentive to marry),

(b) the U-shaped relationship between education and childlessness for married women,

(c) the gap between fertility of the married mothers and fertility of the single mothers, who now face the same opportunity cost.

Hence, allowing $\alpha < 1$ is pretty important.

Closing the gender wage gap γ



Usual opportunity cost effect on fertility.

Drop in Involuntary Childlessness and rise in Voluntary Childlessness

Conclusion (1)

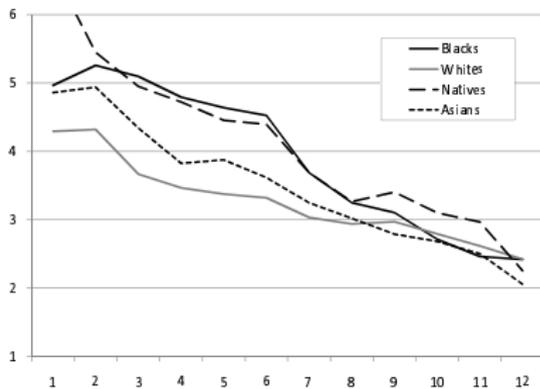
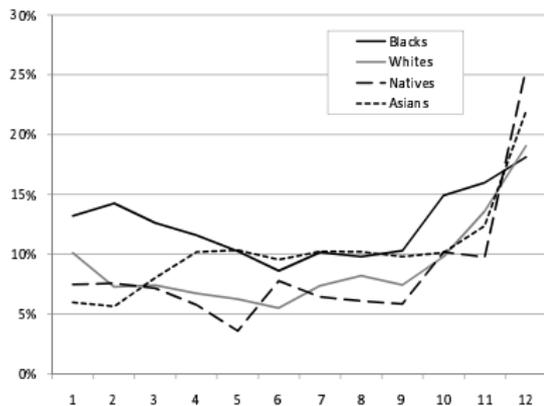
Distinguish the decision to have children or not from the choice of the number of children \Rightarrow highlighting, both in terms of data and theory.

- 3 stylized facts \Rightarrow the model is relevant to explain them
- New “regimes” of fertility which are relevant in the data:
 - 5.8% of American women are involuntarily childless in 1990
 - 9% are voluntarily childless
- Co-existence of voluntary and involuntary childlessness explains U-shaped relationship between childlessness and education (for both married and single women)

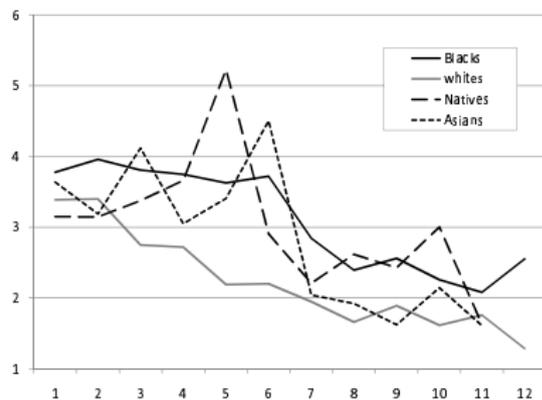
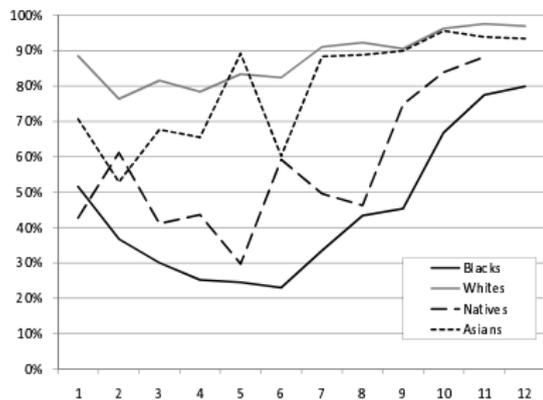
Conclusion (2)

- Marriage interacts in two ways with childlessness:
 - for poor woman \Rightarrow an opportunity to get enough resources to be able to have children \Rightarrow reduces involuntary childlessness.
 - for rich women, marriage reduces the opportunity cost of having children \Rightarrow reduces voluntary childlessness.
- The model helps to understand the impact of education on marriage, fertility and childlessness between 1960 and 1990

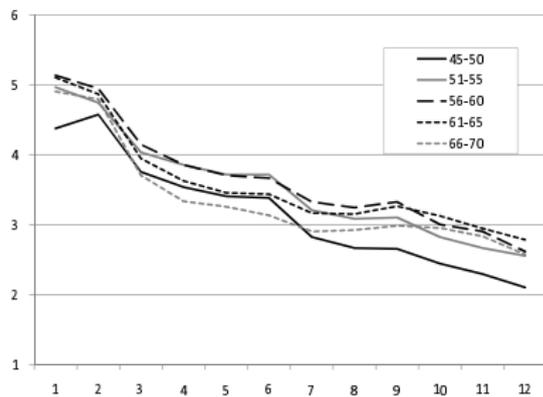
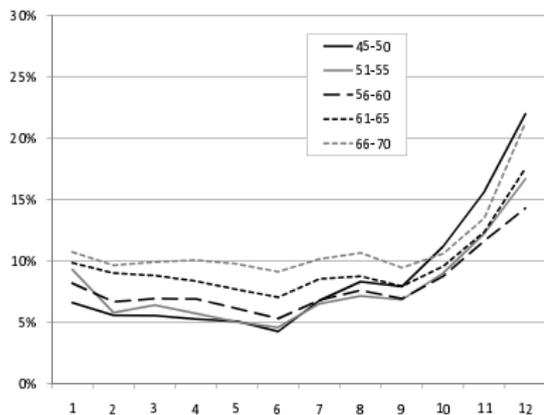
Childlessness and fertility of mothers (married)



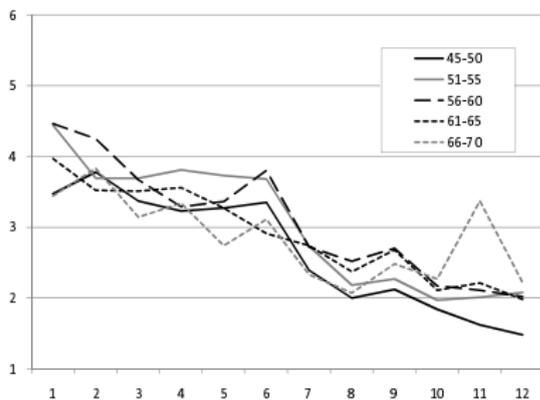
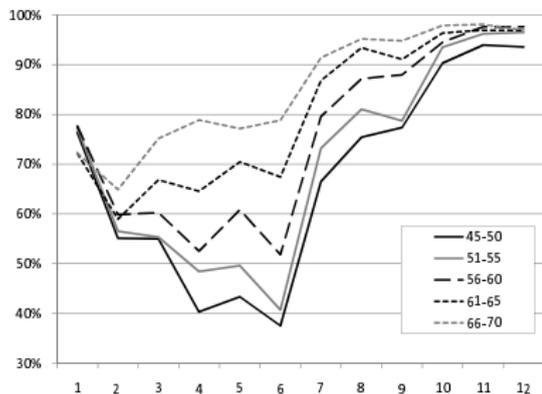
Childlessness and fertility of mothers (single)



Childlessness and fertility of mothers (married)



Childlessness and fertility of mothers (single)



Percentage of single mothers, aged 45-70, with an unmarried partner

| Cat. | % | Cat. | % |
|------|-----|------|-----|
| 1 | 3.8 | 7 | 3.6 |
| 2 | 4.8 | 8 | 2.8 |
| 3 | 4.0 | 9 | 3.8 |
| 4 | 3.6 | 10 | 3.0 |
| 5 | 3.8 | 11 | 2.8 |
| 6 | 4.0 | 12 | 8.2 |