

# Lectures on Fertility, Education, Growth, and Sustainability

## 1c. Forerunners in fertility decline

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## Question

Understanding the evolution of fertility by social class **before the industrial revolution** can shed light on the changes that led to declining total fertility rates.

Look at the forerunners in fertility decline

What we do:

- data on changes in differential fertility in Rouen and Geneva 1670-1792.
- use a quantity-quality fertility model to identify exogenous variables that can be responsible for observed changes.

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## Data for Rouen (Bardet)

	notables	merchants	craftsmen	workmen
<i>income</i>				
rental value - 1773	488.00	266.00	202.00	77.00
poll tax - 1728	26.80	12.10	9.40	1.22
<i>Literacy rate</i>				
1670-99	91.99	76.00	60.50	29.50
1700-29	97.42	79.00	71.50	34.00
1730-59	96.11	83.50	77.00	42.50
1760-92	95.70	90.50	82.50	47.50
<i>Fertility per women</i>				
1670-99	6.23	6.53	7.19	7.21
1700-29	4.87	5.51	6.29	6.06
1730-59	4.84	4.81	5.48	5.67
1760-92	3.77	3.28	4.84	4.84
<i>Survival probability</i>				
15 → 30	0.865	0.875	0.875	0.857
0 → 15	0.521	0.474	0.474	0.408

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## Data for Geneva (Perrenoud)

	notables	craftmen	workmen
<i>income</i>			
dowry 1700-4	20160.00	3189.00	1251.00
dowry 1741-5	25092.00	5057.00	2173.00
dowry 1770-4	33730.00	2489.00	2311.00
<i>Literacy rate</i>			
1700-4	86.00	54.50	12.50
1741-5	96.50	83.50	33.50
1770-4	98.50	87.50	58.00
<i>Fertility per women</i>			
1675-96	6.70	7.10	6.20
1700-4	6.70	7.30	5.50
1741-5	4.70	5.70	4.20
1770-4	2.80	5.20	4.70
<i>Survival probability</i>			
15 → 30	0.89	0.84	0.80
0 → 15	0.61	0.452	0.338

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## Model - utility

Two periods of adulthood:

$$u_t^t + \beta \pi_t^A u_{t+1}^t,$$

$\pi_t^A$  is the probability of surviving into the second period

$$u_{t+i}^t = \log c_{t+i}^t + \gamma \log (\pi_{t+i}^C n_{t+i}^t q_{t+i}^t). \quad i = 0, 1$$

$$q_{t+i}^t = (\theta + e_{t+i}^t)^\eta$$

$\pi_{t+i}^C$ : child mortality

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## Model - Budget constraints

$$\begin{aligned} c_t^t + s_t + e_t^t n_t^t \pi_t^C + \nu n_t^t \pi_t^C &= w(1 - \phi n_t^t - \psi n_t^t \pi_t^C) \\ c_{t+1}^t + e_{t+1}^t n_{t+1}^t \pi_{t+1}^C + \nu n_{t+1}^t \pi_{t+1}^C &= s_t \tilde{R}_{t+1} \\ &+ w(1 - \phi n_{t+1}^t - \psi n_{t+1}^t \pi_{t+1}^C) \end{aligned}$$

$\nu$ : good cost of having children

$\phi + \psi$ : time cost associated to surviving children

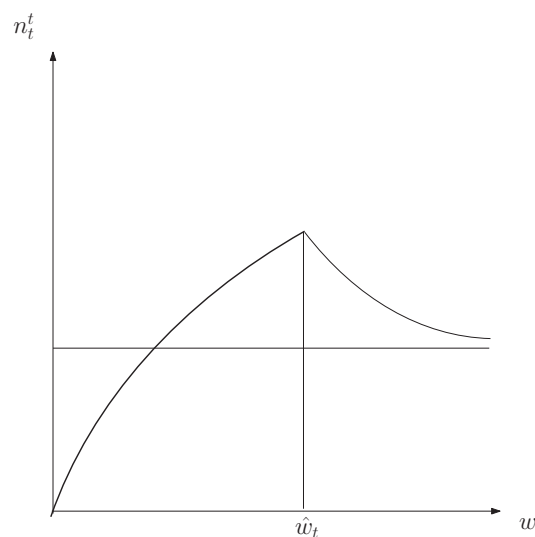
$\phi$ : time cost associated to non-surviving children

Annuity markets:

$$\tilde{R}_{t+1} = R_{t+1} / \pi_t^A.$$

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## Fertility as a Function of Human Capital when $\theta > \nu > 0$



In the corner regime, fertility is increasing in income because of the good cost of having children

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## Main assumptions

One period lasts 15 years.

A first set of parameters is fixed a priori. The time costs parameters are set to have  $\phi + \psi = 0.15$  (Chapter 2) and  $(\phi + \psi) / \phi = 4$ .

$$\beta = 0.99^{60} \text{ and } R = 1.01^{60}.$$

For wages and survival probabilities: data. Do not change over the period.

For the remaining parameters,  $\theta$ ,  $\nu$ ,  $\gamma$ , and  $\eta$ : same in both cities. Overall level of wages to differ across cities by a factor  $z$ .

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## Results

We calibrate those five parameters so as to match as best as possible the fertility pattern in 1670.

Total fertility of a group is the sum of fertility rates conditionally on being alive:

$$2(n_t^t + n_{t+1}^t) \quad (1)$$

$\theta$	fixed factor in education	0.253
$\nu$	goods cost of one child	0.234
$\gamma$	taste for children	0.401
$\eta$	return on education	0.453
$z$	relative wage: Rouen/Geneva	1.251

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## Matching education levels

The parameters have not been chosen to match education data.

Compare implied investment in education  $\theta + e$  with the literacy data.

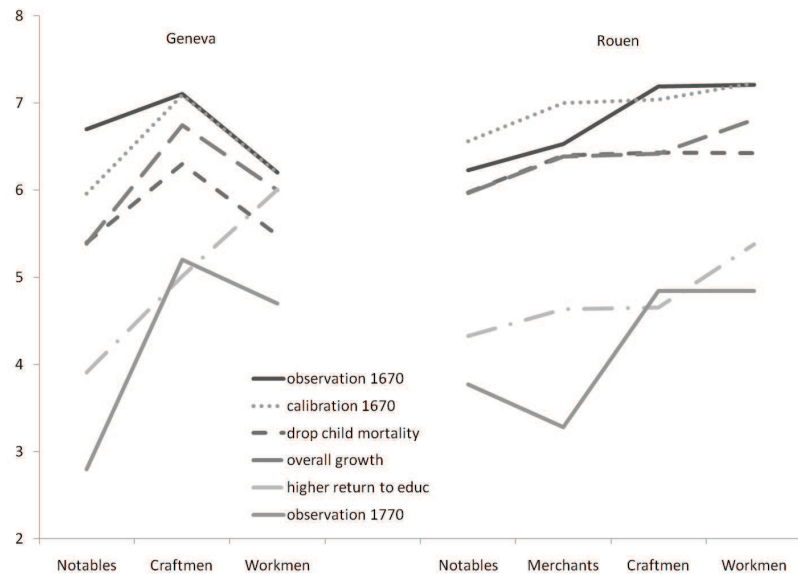
Need to scale literacy data to make them of same magnitude as education in the model. Assume the following relationship:

$$\theta + e = \sigma_0 \text{literacy}^{\sigma_1}$$

Calibrate the four  $\sigma$ 's by minimizing the squared deviation from predicted literacy and observed ones in 1670 (1700 for Geneva).

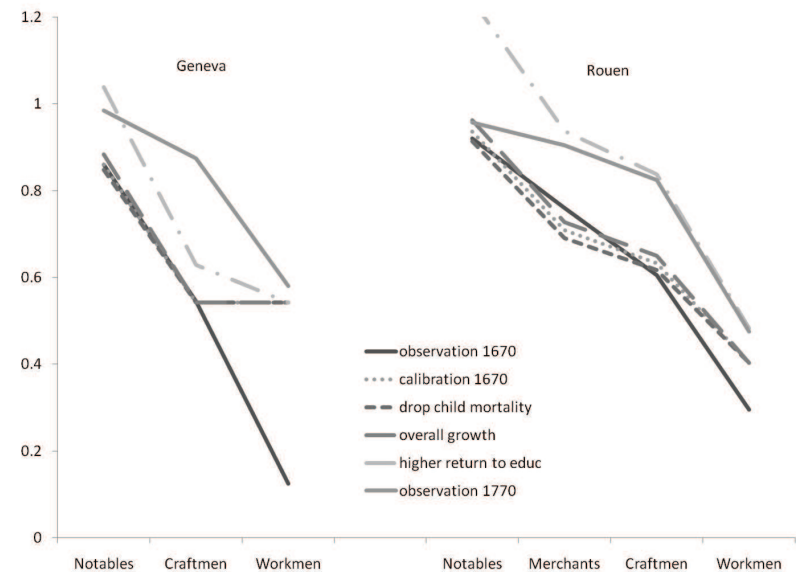
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## Fertility Rates: Calibration and Simulation



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## Literacy Rates: Calibration and Simulation



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## Conclusion

Differences in wages and mortality rates are important determinants of fertility differentials between social groups before the onset of the demographic transition.

Only changes in the return on education, however, are a successful explanation for the beginning of the fertility decline.