

# How the West Invented Fertility Restriction

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# A peculiar institution

- Europeans (West of a line from St Petersburg to Trieste) limit fertility without infanticide (EMP)
  - Late marriage for women (often 25+) and men
  - High percentage never marrying
  - Low illegitimacy rates – no sex, given the state of biological knowledge
  - Nuptiality varies with economic conditions
  - No fertility control within marriage

Table 1: Age of marriage and marital fertility in seventeenth century Europe

	Average Age of Women at First Marriage	Cumulative Marital Fertility (20-44)
England	25	7.6
France	24.6	9
Belgium	25	8.9
Germany	26.4	8.1
Scandinavia	26.7	8.3
Switzerland	-	9.3

*Note:* Cumulative marital fertility = number of live births per married women married aged 20 to 44.

*Source:* Flinn (1981).

# Emergence of the EMP

- EMP non-existent in Roman times (age at marriage for women 12-15 for pagan girls, christian ~18)
- St. Augustin (350-430) declared that female consent was not necessary
- 866 – Pope Nicolas I insists on need for consent
- 1140 – Gratian: “mutual consent is decisive since where there is to be union of bodies there ought to be union of spirits”
- Contrast this with Chinese rules: Meng Tzu states that “marriage is a bond between surnames”
- Some scattered evidence of EMP’s emergence in medieval times (6C-14C)
  - St.Germain de Pres, 801-20: 16% unmarried
  - 9th century, Villeneuve-Saint-Georges: 11.5% never married
  - Lincolnshire Fenlands (Hallam 1985): women marry at 21 in the 12+13C – barely higher than in Roman times
- Full development after the Black Death in 1348, but to a (geographically) varying extent
  - Marriage ages trending towards 26 and higher for women
  - Up to 25% of women never marrying
  - Fully formed EMP in the 16th century (as wages fall again)

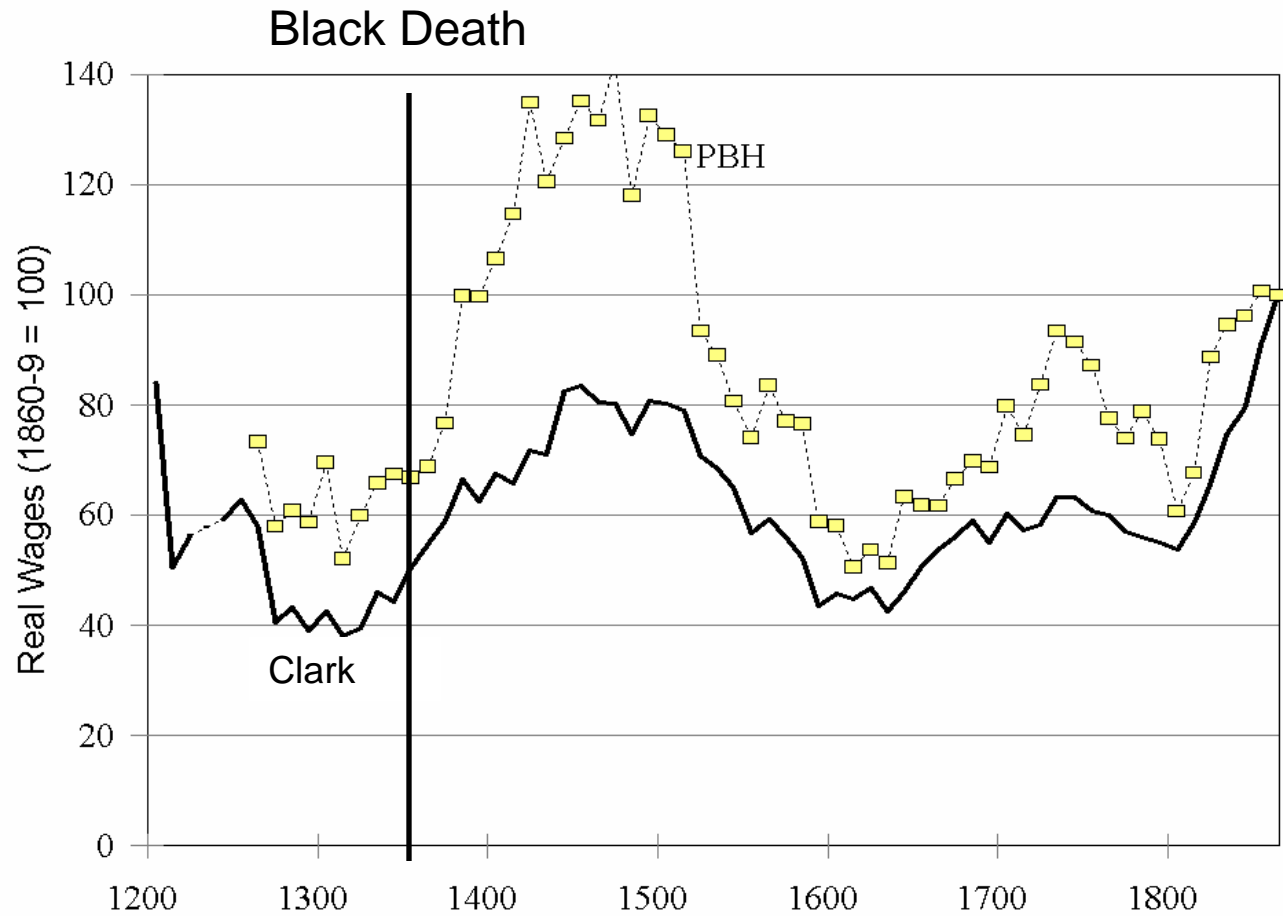
# Our story

- This paper offers an economic interpretation why Europe adopts this peculiar institution (and why China cannot).
  - EMP evolves after the Black Death
  - Response to shift in factor prices and the price of output
  - European exceptionalism a consequence of *low land productivity*
- What do women actually do before they get married?
  - Large share work as servants (domestic) and in agriculture (overwhelmingly in husbandry)
  - Economic role is huge
    - 13% of the English population are servants (1574-1821; overwhelmingly in husbandry)
    - approx. 60% of the population aged 15-24 works as servants

# Our story - 2

- Plague causes a large increase in real wages
- Workers consume more meat, more wool
- Large estates switch from arable to pastoral farming
  - Economizes on male labor (expensive)
  - Intensive use of land (cheap)
  - Allows the use of female labor
- Work as a servant in husbandry (milkmaid, shepherdess, etc.) involves living in the household of the landowner + an obligation not to marry

# Impact of the Plague



# Our story - 3

- Plague-induced switch from „corn to horn“ thus involves the creation of a class of women who postpone marriage in exchange for a chance to save for several years
- Creates an institution that allows marriage age to increase if times are hard, and to fall when they are good

# Contrast with China

“The country (China) is rather over-peopled ... and labour is, therefore, so abundant, that no pains are taken to abridge it. The consequence of this is, probably, the greatest production of food that the soil can possibly afford, for it will be generally observed, that processes for abridging labour, though they may enable a farmer to bring a certain quantity of grain cheaper to market, tend rather to diminish than increase the whole produce... “

Malthus 1798

- Chinese farms are small (between  $\frac{1}{4}$  and  $\frac{1}{150}$ )
- Very high labor input per unit of land
- Production per head about 80-90% of European output levels (optimistic interpretation, Allen 2007); or about 40% (Broadberry and Gupta (2005))
- Female wages in China 25% of male wages (vs. 50-63% in England)
- Land productivity (grain production) too high to ever switch to a English/European mode of pastoral production, using women

Table 3: Average farm size in England, China, and the Yangzi delta 1300-1850 (acres)

Year	1279	c.1400	c.1600	c.1700	1750	c.1800	1850
England	13.9		72	75		151	
China		4.2	3.4				2.5
Big Yangzi delta		3.75	1.875	1.875	1.25	1.16	1.04
Small Yangzi delta		2.89				1.04	

*Source:* Brenner and Isett (2002). English figures are from Allen (1992).

# A stylized model

- The Malthusian world
- Model overview and intuition
- Math
- Results
- Extensions

# Model ingredients (i)

## Marriage, work, and fertility

- Endowment 1 spent for labor ( $l_{Female}$ ) and marriage ( $1-l_{Female}$ )
- No sex before marriage  $\rightarrow$  no children
- No contraception technique during marriage
  - children arrive with probability  $p$
  - Number of offspring:  $b=(1-l_{Female})p$

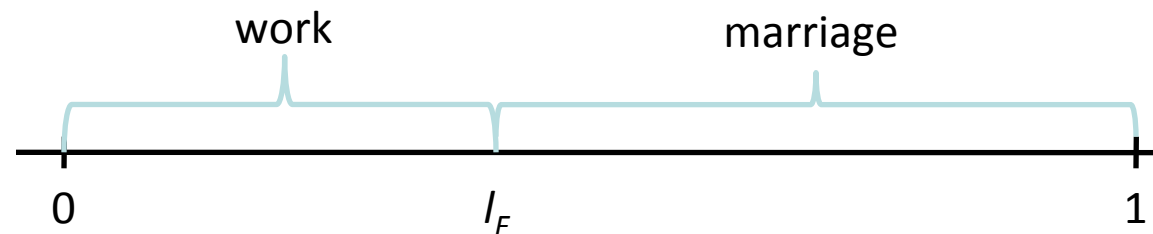
# Model ingredients (ii)

## Technology and female labor supply

- Two technologies: Grain and horn (livestock)
- Women can only work in horn production
  - Stay and work at landlord's location
  - Marriage not allowed
- For horn technology to be employed:
  - horn production profitable (need much land)
  - Demand for meat/wool (threshold  $\underline{c}$ )

# Households

- Population  $N$ ;  $N/2$  men and  $N/2$ women
  - Form couples, joint decisions
  - Infinite sequence, overlapping
- Time endowment: 1 unit per person
  - Men always work:  $l_M = 1$ ;  $L_M = N/2$
  - Women endogenously decide about  $l_F \in [0, 1]$



# Consumption

- If  $c_p < \underline{c}$ , peasants consume only grain
- If  $c_p \geq \underline{c}$ , grain ( $g$ ) and horn products ( $h$ ) become perfect substitutes  $\rightarrow p_g = p_h$
- Landlord has the same consumption shares as peasants
- Product market clearing:

$$Nc_p + c_k = \begin{cases} Y_g, & \text{if } Y_h = 0 \\ Y_g + Y_h, & \text{if } Y_h > 0 \end{cases}$$

# Technology

Two types of production; involve labor ( $L$ ) and land ( $T$ ):

- Grain (g)
  - highly intensive in physical labor → only men productive

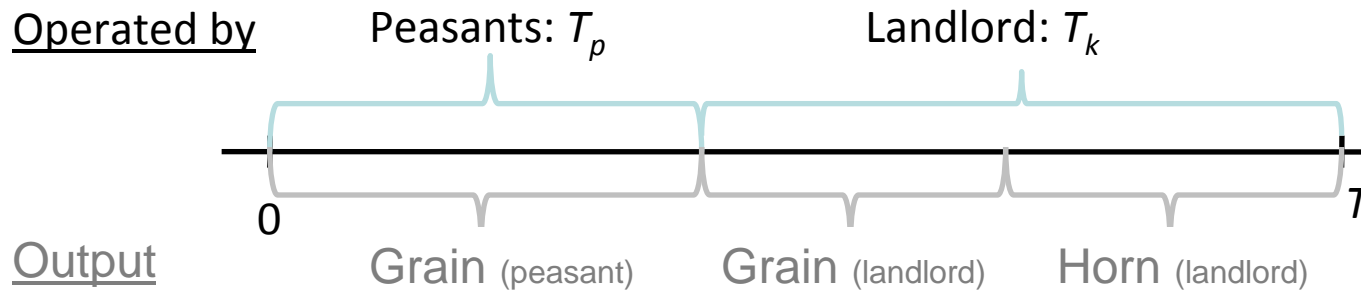
$$Y_g = A_g L_M^\alpha T_g^{1-\alpha}$$

- Horn (h)
  - less physical-labor intensive → only suitable for female labor (extreme assumption)
  - unproductive for small land-labor ratios, used only by landlord

$$Y_h = A_h L_F^\alpha T_h^{1-\alpha} - \rho L_F$$

# Land and labor allocation

- Landlords ( $k$ ) own all land  $T$ 
  - Rent land  $T_p$  to peasants, keep  $T_k = T - T_p$
- Peasant provide all labor:  $L_M + L_F$



# Equilibrium – wages and T/L ratios

- Male wage:

$$w_M = \alpha A_g \left( \frac{T_p}{L_{M,p}} \right)^{1-\alpha}$$

- Optimal allocation of labor and land
  - Wages of male peasants equal in own-land and landlord grain production
  - Land returns in grain ( $g$ ) and horn ( $h$ ) production equalize
- Obtain female wage as function of male peasant T/L-ratio:

$$w_F = \alpha A_h \left( \frac{A_h}{A_g} \right)^{\frac{1-\alpha}{\alpha}} \left( \frac{T_p}{L_{M,p}} \right)^{1-\alpha}$$

# Equilibrium – Fertility and female labor supply

- Peasant households draw utility from consumption  $c_p$  and offspring  $b$ . Maximize:

$$u(c_p, b) = (1 - \mu) \frac{(c_p - \underline{c})^{1-\phi}}{1 - \phi} + \mu \frac{b^{1-\eta}}{1 - \eta}$$

- s.t.  $c_p \leq w_M + w_F l_F$  and  $b = p(1 - l_F)$
- Birth rates are then given by:

$$b = \left( \frac{\mu}{1 - \mu} p \frac{(c_p - \underline{c})^\phi}{w_F} \right)^{\frac{1}{\eta}}$$

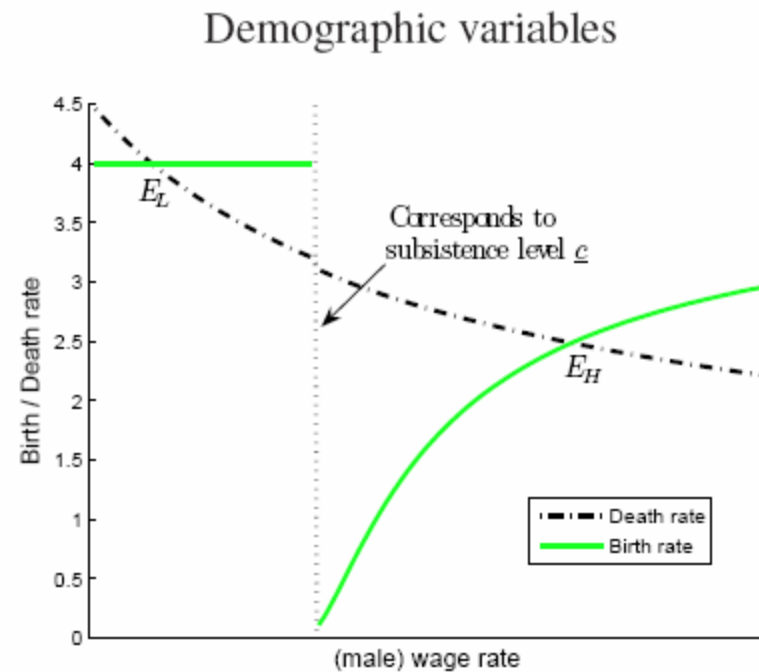
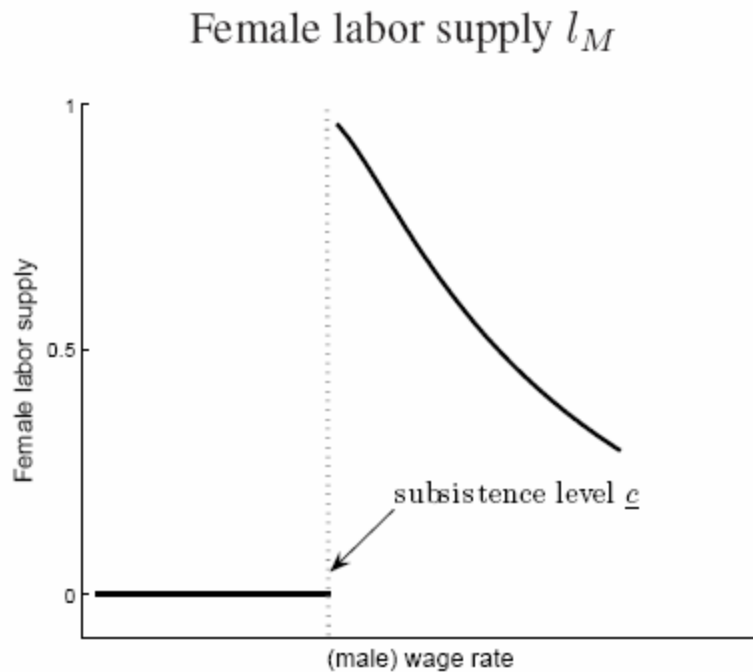
# Solution for female labor supply ( $l_F$ )

- We assume  $\phi = 1$  (income and substitution effect cancel each other)
- Then  $l_F$  is implicitly given by:

$$\frac{(1 - l_F)^\eta}{\frac{\mu}{1-\mu} p^{1-\eta}} - l_F = \frac{w_M - \underline{c}}{w_F}$$

# Long-run equilibria – Western Europe

- Horn technology profitable; used if there is demand for meat/wool



# Western Europe vs. China

- We assume: Grain has higher TFP in China

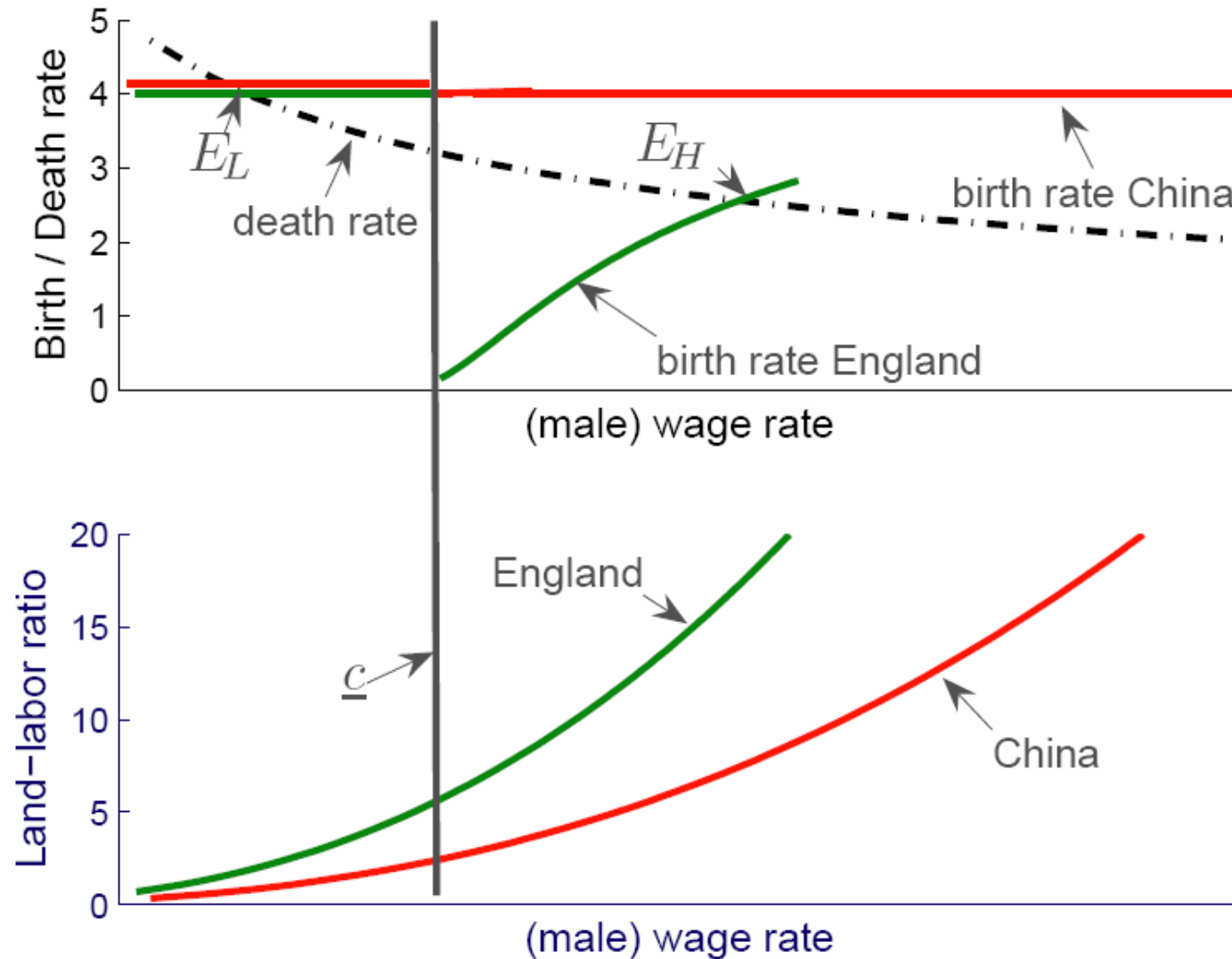
$$A_g^{\text{Europe}} < A_g^{\text{China}}, \text{ while } A_h^{\text{Europe}} = A_h^{\text{China}}$$

- In equilibrium:

$$\frac{T_h}{L_F} = \left( \frac{A_h}{A_g} \right)^{\frac{1}{\alpha}} \frac{T_p}{L_{M,p}}$$

- Thus: smaller  $T_h/L_F$  in China  $\rightarrow$  horn production not profitable ( $w_F < 0$ ), even if there is demand

# Equilibria in Western Europe vs. China



# Conclusions

- Simple model can explain salient features in W. Europe vs. China:

	<b>Western Europe</b>	<b>China</b>
Emergence of female labor outside the household	yes	no
Livestock production	vast	limited
Land-labor ratios	high	low
Marriage/fertility	late/lower	early/higher
Per capita incomes	higher	lower

**BACKUP**

# Extensions

- 2 CES production functions with male and female labor
- Stone-Geary preferences
- Role of inequality

# Backup – Female labor supply

- Peas

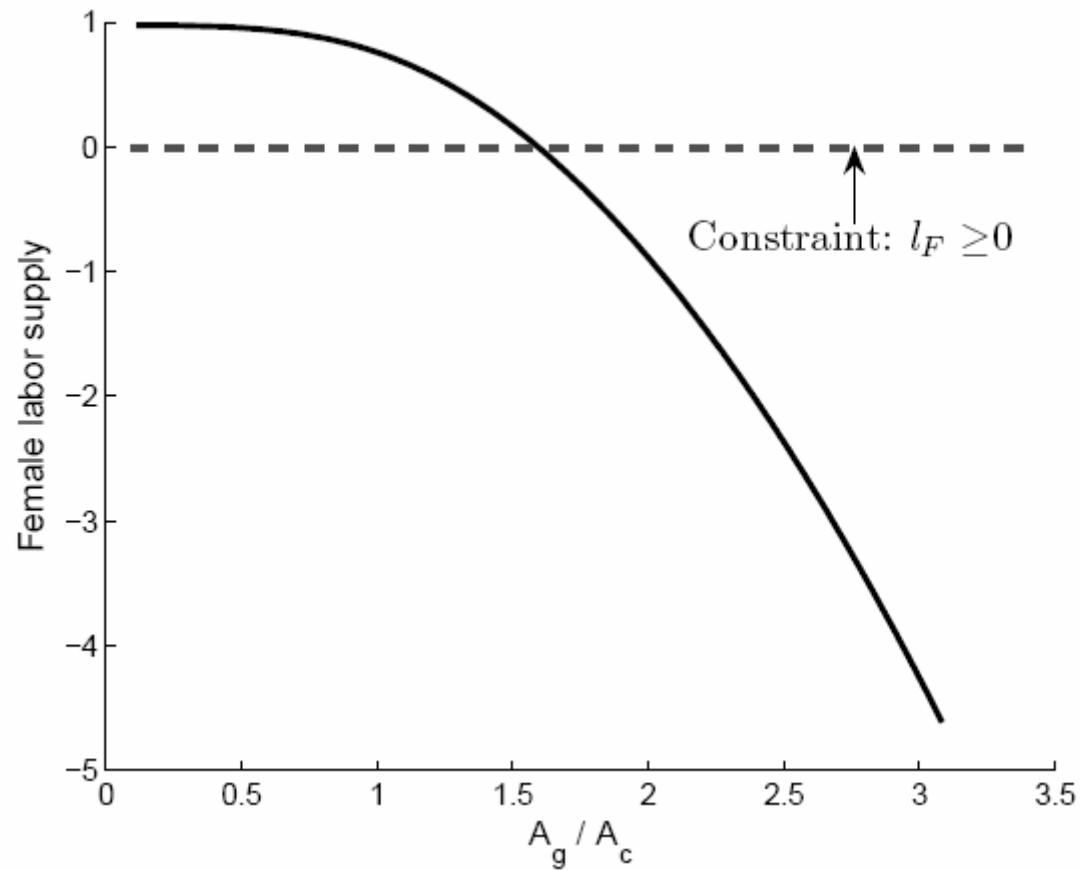


Table 2: Marital fertility rates (births per year and woman)

Age	Hutterite	Western Europe before 1800	China
20-24	0.55	0.45	0.27
25-29	0.502	0.43	0.25
30-34	0.447	0.37	0.22
35-39	0.406	0.3	0.18
40-44	0.222	0.18	0.12

*Source:* Clark (2007).