Online Appendix

How the West 'Invented' Fertility Restriction

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A Technical Appendix

A. *Proof of Proposition 2*

This section provides the proof for proposition 2 for women of a given strength ρ_i. By definition, EMP requires for strength-type i: (i) $b_i < \bar{b}$ and (ii), b_i to be increasing over some range of $t = T/N$. We show that the first condition holds when horn becomes viable for women of type i ($T/N > \frac{T}{N}\big|_{w_h = w_{i,Fg}}$), irrespective of whether or not income exceeds subsistence at this point. The crucial part of the proof is thus condition (ii), which requires that $l_{i,h}$ in equation (19) be decreasing in female income over some range of $t = T/N$, such that birth rates are increasing. We focus on the third regime in (19), because $l_{i,h}$ and b_i are constant in the other two regimes. As a first step, we re-arrange the third line of (19):[1]

$$l_{i,h} = (1-\mu)\bar{l}_h - \mu \underbrace{\frac{1 - \frac{\underline{c}}{w_{i,Fg}(t)}}{\frac{w_h(t)}{w_{i,Fg}(t)} - 1}}_{\equiv Z_i(t)} \tag{A.1}$$

Using $b_i = \pi(1 - l_{i,h})$ we obtain:

$$b_i = \underline{b} + \mu(Z_i(t) + \bar{l}_h) \tag{A.2}$$

EMP therefore requires $Z_i(t)$ to be increasing in t over some range.[2] Throughout the proof, we thus focus on the derivative of Z_i with respect to t:

$$\frac{dZ_i}{dt} = \frac{\frac{\underline{c}}{w_{i,Fg}^2}\left(\frac{w_h}{w_{i,Fg}} - 1\right)\cdot\frac{dw_{i,Fg}}{dt} - \left(1 - \frac{\underline{c}}{w_{i,Fg}}\right)\cdot\frac{d}{dt}\left(\frac{w_h}{w_{i,Fg}}\right)}{\left(\frac{w_h}{w_{i,Fg}} - 1\right)^2} \tag{A.3}$$

[1] For simplicity, but without loss of generality, we ignore the small positive parameter ϵ. Leaving ϵ in the equation and considering the case $\epsilon \to 0$ yields identical results.

[2] Female income grows hand-in-hand with t over the range where horn is economically viable ($w_h > w_{i,Fg}$).

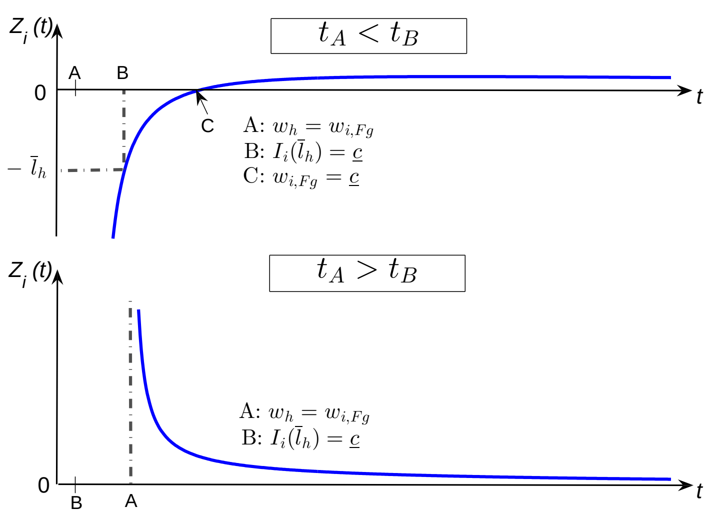
In order to analyze this expression, we obtain $dw_{i,Fg}/dt$ from $w_{i,Fg} = \rho_i w_{Mg}$ and (16), and $d(w_h/w_{i,Fg})/dt$ from (17).

$$\begin{aligned} \frac{dw_{i,Fg}}{dt} &= (1-\alpha_g)\frac{\alpha_h}{\alpha_g}\frac{l_h}{t_h} w_{i,Fg} \cdot \frac{d}{dt}\left(\frac{t_h}{l_h}\right) > 0 \\ \frac{d}{dt}\left(\frac{w_h}{w_{i,Fg}}\right) &= \frac{\alpha_g - \alpha_h}{\alpha_g}\frac{l_h}{t_h}\frac{w_h}{w_{i,Fg}} \cdot \frac{d}{dt}\left(\frac{t_h}{l_h}\right) > 0 \end{aligned} \tag{A.4}$$

Both derivatives are positive because of Proposition 1 and Corollary 1. Throughout the proof, we use the notation $t_{i,A} \equiv \frac{T}{N}\big|_{w_h = w_{i,Fg}}$ (T/N at which horn becomes viable for strength-type i) and $t_{i,B} \equiv \frac{T}{N}\big|_{I_i(\bar{l}_h) = \underline{c}}$ (T/N at which consumption exceeds subsistence). Because the horn technology is not viable for strength-type i below $t_{i,A}$, it is sufficient to focus on $t \geq t_{i,A}$.

We now turn to the first part of the proof – the "if" part of the proposition, showing that $Z_i(t)$ is increasing over some range of t if $t_{i,A} < t_{i,B}$, and that b_i is below its maximum level. Before turning to the formal proof, the upper panel of Figure A.1 illustrates the underlying intuition: We show that $Z_i(t) = -\bar{l}_h$ in point B, is increasing for all t up to (and beyond) point C, and that $Z_i(t)$ eventually becomes decreasing (albeit marginally so) and converges to zero as $t \to \infty$.[3] Following (A.2), this means that $b = \underline{b}$ in B, and then b increases over some range (beyond C) – this increasing part reflects EMP. Eventually, b becomes decreasing in t and converges to $\underline{b} + \mu\bar{l}_h$.

Figure A.1: Functional form of $Z(t)$ in the proof of Proposition 1



We now show this line of argument formally. In point B, we have $I_i(\bar{l}_h) = w_{i,Fg} + \bar{l}_h(w_h - w_{i,Fg}) = \underline{c}$. Re-arranging this expression yields $Z_i(t_{i,B}) = -\bar{l}_h$. For land-labor ratios up to point C, $w_{i,Fg} \leq \underline{c}$.

[3]Note that B lies to the left of C because $I_i(\bar{l}_h) = w_{i,Fg} + \bar{l}_h(w_h - w_{i,Fg}) > w_{i,Fg}$ for all $t > t_{i,A}$.

Therefore, $\left(1-\frac{\underline{c}}{w_{i,Fg}}\right)\cdot\frac{d}{dt}\left(\frac{w_h}{w_{i,Fg}}\right)\leq 0$ in (A.3). The remaining term in the denominator in (A.3) is positive because $t_{i,B}>t_{i,A}$. Consequently, Z_i is strictly increasing in t for $t\leq t_{i,C}$. In addition, since $Z_i(t)$ and $Z_i'(t)$ are continuous, and since $Z_i'(t_{i,C})>0$, there exists a $\delta>0$ s.t. $\forall\tilde{t}\in(t_{i,C},t_{i,C}+\delta)$, $Z_i(\tilde{t})>0$ and $Z_i'(\tilde{t})>0$. That is, $Z_i(t)$ is positive and increasing over some range to the right of C. Next, we show that $Z_i'(t)$ becomes negative, and $Z_i(t)$ converges to zero for large t. Substituting (A.4) into (A.3) and re-arranging yields:

$$\frac{dZ_i}{dt}=\frac{(1-\alpha_h)\underline{c}\;-\;(1-\alpha_g)\frac{\alpha_h}{\alpha_g}\frac{w_{i,Fg}}{w_h}\underline{c}\;-\;\frac{\alpha_g-\alpha_h}{\alpha_g}w_{i,Fg}}{w_{i,Fg}\frac{w_{i,Fg}}{w_h}\left(\frac{w_h}{w_{i,Fg}}-1\right)^2}\cdot\frac{l_h}{t_h}\cdot\frac{d}{dt}\left(\frac{t_h}{l_h}\right)\tag{A.5}$$

The denominator of this expression is positive, and so is $d(t_h/l_h)/dt$ by Proposition 1. Thus, we can focus on the sign of the numerator in (A.5). The first term in the numerator is constant, the second term converges to zero as t grows large, and the third term increases, following (A.4). Thus, for large enough t the numerator becomes negative such that $Z_i'<0$.[4] Finally, we show that $\lim_{t\to\infty}(Z_i(t))=0$. This follows from (A.1): As $t\to\infty$, the denominator of Z_i becomes large while $\underline{c}/w_{i,Fg}$ goes to zero (both because of (A.4)). Altogether, this delivers the shape of $Z_i(t)$ shown in the upper panel of Figure A.1, which establishes property (ii) of EMP over some range of T/N.

Finally, we show that $b_i<\bar{b}$ over some range that also involves $b_i'(t)>0$ (that is, there exists a range of t over which both criteria for EMP are fulfilled). The latter holds unambiguously for $t_{i,B}\leq t\leq t_{i,C}$. In addition, in the vicinity of point B, birth rates b_i are close to $\underline{b}<\pi=\bar{b}$, such that $b_i<\bar{b}$. Formally, $\exists\,\epsilon>0$ s.t. $\forall t_{i,B}\leq\tilde{t}<t_{i,B}+\epsilon:\;b_i<\pi$. This establishes property (i) of EMP and completes the "if" part of the proof.

We now turn to the "only if" part of the proof. It suffices to show that for all $t_{i,A}>t_{i,B}$, $Z_i'(t)<0,\forall t>t_{i,A}$, such that birth rates b_i are never upward sloping in t, i.e., EMP never emerges. The lower panel of Figure A.1 illustrates the functional form of Z_i for the case $t_{i,A}>t_{i,B}$. We begin by showing that $Z_i'(t)$ becomes large and negative as t converges to $t_{i,A}$ from above. If $t\downarrow t_{i,A}$, $w_h\downarrow w_{i,Fg}$. Since $w_{i,Fg}/w_h\to 1$, (A.5) simplifies and we can derive the limit of $Z_i'(t)$:

$$\lim_{w_h\downarrow w_{i,Fg}}\left(\frac{dZ_i}{dt}\right)=\lim_{w_h\downarrow w_{i,Fg}}\frac{-\frac{\alpha_g-\alpha_h}{\alpha_g}\left(w_{i,Fg}-\underline{c}\right)}{w_{i,Fg}\cdot 1\cdot\left(\frac{w_h}{w_{i,Fg}}-1\right)^2}\cdot\frac{l_h}{t_h}\cdot\frac{d}{dt}\left(\frac{t_h}{l_h}\right)=-\infty\tag{A.6}$$

This result follows because (i) the numerator in (A.6) is negative and finite. To see this, note that $\alpha_g>\alpha_h$

[4] Taking the limit of each term divided by the denominator, it is straightforward to show that $Z_i'(t)$ converges to zero from below as $t\to\infty$. For this step, note that $\frac{d}{dt}\left(\frac{t_h}{l_h}\right)$ is positive and finite. To show this we use the fact that for very large t, the expenditure share for horn converges to a constant (see our Stone-Geary setting in Section F.), so that p_h is constant in t. Then Proposition 1 implies that rising t leads to increasing land-labor ratios in both sectors. Thus: $\frac{d}{dt}\left(\frac{t_h}{l_h}\right)<\frac{d}{dt}\left(\frac{t}{l_h}\right)=\frac{1}{l_h}-\frac{t}{l_h^2}\frac{dl_h}{dt}<\frac{1}{l_h}$. The last inequality follows because $Z_i'<0$ for large t, such that (A.1) implies $dl_h/dt>0$. Finally, $1/l_h$ is finite: As we show below, $\lim_{t\to\infty}(Z_i(t))=0$, such that following (A.1), $\lim_{t\to\infty}(l_{i,h}(t))=(1-\mu)\bar{l}_h>0$. Since the individual $l_{i,h}$ are finite, so must be the average l_h.

and $w_{i,Fg} > \underline{c}$.[5] Using the latter in (A.1) also implies that $\lim_{w_h \downarrow w_{i,Fg}} Z_i(t) = \infty$, as shown in the lower panel of Figure A.1. (ii) The denominator converges to zero from above, and (iii), l_h/t_h and $d(t_h/l_h)/dt$ are both positive and finite (see footnote 4 for the latter).

Next, we show that $Z_i'(t)$ is negative for all $t > t_{i,A}$ (and thus $w_h > w_{i,Fg}$). Since the denominator in (A.5) is positive and finite ($t > t_{i,A} \Rightarrow w_h > w_{i,Fg}$), it is sufficient to show that the numerator remains negative as t increases beyond $t_{i,A}$. To demonstrate this, we label the numerator in (A.5) $NUM_i(t)$ and show that $NUM_i'(t) < 0$, $\forall t > t_{i,A}$. In other words, the numerator becomes more negative as t increases. Using (A.4) and taking into account that $d(w_{i,Fg}/w_h)/dt = -(w_{i,Fg}/w_h)^2\, d(w_h/w_{i,Fg})/dt$, we obtain:

$$\frac{dNUM_i}{dt} = -\frac{\alpha_g - \alpha_h}{\alpha_g}(1-\alpha_g)\frac{\alpha_h}{\alpha_g}\left(w_{i,Fg} - \frac{w_{i,Fg}}{w_h}\underline{c}\right) \cdot \frac{l_h}{t_h} \cdot \frac{d}{dt}\left(\frac{t_h}{l_h}\right) < 0 \tag{A.7}$$

The inequality holds because $d(t_h/l_h)/dt > 0$ and $w_{i,Fg} > \underline{c} > (w_{i,Fg}/w_h)\underline{c}$ for all $t > t_{i,A}$.[6] Finally, we have already shown that $\lim_{t\to\infty}(Z_i(t)) = 0$ (this holds irrespective of $t_{i,A} \lesseqgtr t_{i,B}$). Altogether, the second part of the proof shows that Z_i' is negative and large for $t \downarrow t_{i,A}$, remains negative for all $t > t_{i,A}$, and converges to zero from below as $t \to \infty$. $\square$

B. *Proof of Corollary 2*

Point A in Figure 2 lies to the left of B if $(I_i(\bar{l}_h)/\underline{c})\big|_{t=t_{i,A}} < 1$, i.e., if $I_i(\bar{l}_h) < \underline{c}$ in point A. Horn becomes viable for women of strength ρ_i at point A: $w_h = w_{i,Fg}$. Using this in (17), we can solve for the land-labor ratio in horn: $\frac{t_h}{l_h} = \left[\rho_i \frac{\alpha_g}{\alpha_h}\left(\frac{A_g}{p_h A_h}\right)^{\frac{1}{\alpha_g}}\left(\frac{1-\alpha_g}{1-\alpha_h}\right)^{\frac{1-\alpha_g}{\alpha_g}}\right]^{\frac{\alpha_g}{\alpha_g-\alpha_h}}$, where $\alpha_g > \alpha_h$. Next, (3) simplifies to $I_i = w_{i,Fg}$ at point A. Using $w_{i,Fg} = \rho_i w_{Mg}$ and (16) yields: $I_i = \rho_i \alpha_g A_g \left(\frac{A_g}{p_h A_h}\,\frac{1-\alpha_g}{1-\alpha_h}\right)^{\frac{1-\alpha_g}{\alpha_g}}\left(\frac{t_h}{l_h}\right)^{\frac{\alpha_h}{\alpha_g}(1-\alpha_g)}$. Consequently, $I_i = \rho_i \alpha_g A_g \left[\left(\rho_i \frac{\alpha_g}{\alpha_h}\right)^{\alpha_h}\left(\frac{1-\alpha_g}{1-\alpha_h}\right)^{1-\alpha_h}\left(\frac{A_g}{p_h A_h}\right)\right]^{\frac{1-\alpha_g}{\alpha_g-\alpha_h}}$ at point A, which is increasing in ρ_i and A_g, and is decreasing in p_h and A_h. Therefore, conditions (i)-(iv) make $(I_i(\bar{l}_h)/\underline{c})\big|_{t=t_{i,A}} < 1$ more likely to hold. $\square$

C. *Strength-Dependent Female Labor in Horn $l_{i,h}$*

This section shows how women across all strength types choose their labor supply in horn in response to changing land-labor ratios. This illustrates in detail the mechanism behind the aggregate labor supply shown in Figure 4. Throughout, we use the notation of points A and B introduced in Figure 2 (at the former, horn begins to offer a wage premium; at the latter, female income exceeds the threshold $\underline{c}$). We also take the price of horn p_h as given for now, and discuss implications of changing p_h at the end of this section. For ease of exposition, we refer to the line $w_h/w_{i,Fg}$ as "line A", and to $I_i(\bar{l}_h)/\underline{c}$ as "line B" – both as functions of the

[5] The latter holds because for all $t > t_{i,B}$: $I_i(\bar{l}_h) > \underline{c}$, and $\lim_{w_h \downarrow w_{i,Fg}} I_i(\bar{l}_h) = \lim_{w_h \downarrow w_{i,Fg}} w_{i,Fg} + \bar{l}_h(w_h - w_{i,Fg}) = w_{i,Fg}$.

[6] From footnote 5 we know that $w_{i,Fg} > \underline{c}$ at $t = t_{i,A}$, and (A.4) shows that $w_{i,Fg}$ is increasing in t. In addition, for $t > t_{i,A}$, $w_{i,Fg}/w_h < 1$.

land-labor ratio in horn t_h/l_h. Line A is defined by (17); it shifts downward if ρ_i increases. In contrast, line B is shifted upward for larger ρ_i (remember the definition $I_i(\bar{l}_h) = \rho_i w_{Mg}(1-\bar{l}_h) + w_h\bar{l}_h$). Consequently, increasing ρ_i moves point A to the right and point B to the left.

Next, we derive the strength $\rho_{A=B}$ at which points A and B coincide. First, at point A, $w_{i,Fg} = w_h$, so that we obtain for point B (if it is identical to A): $I_i(\bar{l}_h) = w_{i,Fg} = w_h = \underline{c}$. Therefore, we can use (12) to derive the land-labor ratio at which points A and B coincide:

$$\left.\frac{t_h}{l_h}\right|_{A=B} = \left(\frac{\underline{c}}{\alpha_h p_h A_h}\right)^{\frac{1}{1-\alpha_h}} . \tag{A.8}$$

Second, because $w_{i,Fg} = \rho_i w_{Mg} = \underline{c}$, we can use (16) and (A.8) to obtain the strength ρ_i at which A and B are identical:

$$\rho_{A=B} = \underline{c} \Bigg/ \alpha_g A_g \left(\frac{A_g}{p_h A_h}\,\frac{1-\alpha_g}{1-\alpha_h}\right)^{\frac{1-\alpha_g}{\alpha_g}} \left(\left.\frac{t_h}{l_h}\right|_{A=B}\right)^{\frac{\alpha_h}{\alpha_g}(1-\alpha_g)} . \tag{A.9}$$

For the following discussion, it is also useful to derive two more cutoffs: First, the maximum strength at which horn is still viable, ρ_A^{max}. For any given land-labor ratio, this is the strength at which $w_{i,Fg} = w_h$. Using (17), this is given by:

$$\rho_A^{\text{max}} = \frac{w_h}{w_{Mg}} = \frac{\alpha_h}{\alpha_g} \left(\frac{p_h A_h}{A_g}\right)^{\frac{1}{\alpha_g}} \left(\frac{1-\alpha_h}{1-\alpha_g}\right)^{\frac{1-\alpha_g}{\alpha_g}} \left(\frac{t_h}{l_h}\right)^{\frac{\alpha_g-\alpha_h}{\alpha_g}} . \tag{A.10}$$

Note that ρ_A^{max} is increasing in the land-labor ratio. This is because $w_h/w_{i,Fg}$ grows with land abundance (Corollary 1), so that horn offers a wage premium for ever stronger women. Second, the cutoff ρ_B^{min} is the minimum strength at which female income exceeds the reference level $\underline{c}$. This is given by

$$\rho_B^{\text{min}} = \frac{\underline{c} - w_h\bar{l}_h}{w_{Mg}(1-\bar{l}_h)} \tag{A.11}$$

The cutoff strength ρ_B^{min} is decreasing in the land-labor ratio. Intuitively, ever weaker women can reach the consumption cutoff level $\underline{c}$ if land becomes more abundant so that wages surge.

Figure A.2 illustrates the female labor supply across all strength types, together with the probability density function $f(\rho)$, which is given by a beta distribution with both parameters equal to 2. In the first panel, we use a low land-labor ratio. In this setting, only a few low-strength women work in horn (to the left of ρ_A^{max}). For the remainder, horn wages do not offer a wage premium. At the same time, ρ_B^{min} is to the right of ρ_A^{max}, so that all women who can earn a wages premium in horn have consumption below the reference level $\underline{c}$, and thus work the maximum amount $\bar{l}_h$. If the land-labor ratio increases, ρ_A^{max} rises while ρ_B^{min} declines. Consequently, there must be an l_h/t_h such that both coincide. This is exactly the ratio given by (A.8), and the corresponding strength is $\rho_{A=B}$. We use this land-labor ratio in the second panel of Figure A.2. The point $\rho_{A=B}$ corresponds to the kink in the aggregate horn labor supply, as shown in Figure 4 in the paper. It is the highest strength at which women behave according to EMP.[7] When this point coincides with $\rho_A^{\max}$ and $\rho_B^{\min}$, women with strength $\rho_i < \rho_{A=B}$ work the maximum time $\bar{l}_h$ in horn, and women with strength $\rho_i > \rho_{A=B}$ do not work in horn, at all.

If the land-labor ratio increases further (third panel in Figure A.2), $\rho_A^{\max}$ moves to the right of $\rho_B^{\min}$. Women with strength between $\rho_{A=B}$ and $\rho_A^{\max}$ do not work in horn because their income is well above the reference level $\underline{c}$, while the wage premium they would earn in horn is relatively small.[8] For women with strength between $\rho_B^{\min}$ and $\rho_{A=B}$, income now exceeds the threshold level, and the income effect implies that they provide relatively less labor in horn in order to have more children. Finally, for women the the left of $\rho_B^{\min}$ income is below $\underline{c}$, so that they work the maximum possible time in horn.

In sum, an increase in the land-labor ratio from just-below $\rho_{A=B}$ to just-above this point implies that a) no additional women are drawn into the horn sector; and b) the strongest among those who do work in horn now work less. This explains the kink in aggregate labor supply (Figure 4).

What if we take into account a demand effect such that p_h increases with the land-labor ratio (as with the non-homothetic demand in Section F.)? This effect unambiguously strengthens the emergence of EMP. First, according to (A.8) and (A.9), $\rho_{A=B}$ increases with p_h. Therefore, a larger fraction of women can earn a wage premium in horn. Second, following (A.10), $\rho_A^{\max}$ increases in p_h, which also results in higher female labor in horn (see the first panel in Figure A.2). Because of these two effects, the initial increase in aggregate horn labor supply (and thus the drop in fertility – see Figure 4) is steeper. Finally, (A.11) implies that $\rho_B^{\min}$ is falling in p_h (because the latter raises w_h). This becomes important for relatively high land-labor ratios, when $\rho_B^{\min} < \rho_A^{\max}$. As illustrated in the third panel of Figure A.2, a decline in $\rho_B^{\min}$ means that more women reduce their working time in horn in response to growing income. Thus, birth rates are more responsive to income. To sum up, if horn is a luxury product, the initial drop in fertility is steeper, and the subsequent positive response of birth rates to income is also more pronounced.

D. Stone-Geary Preferences

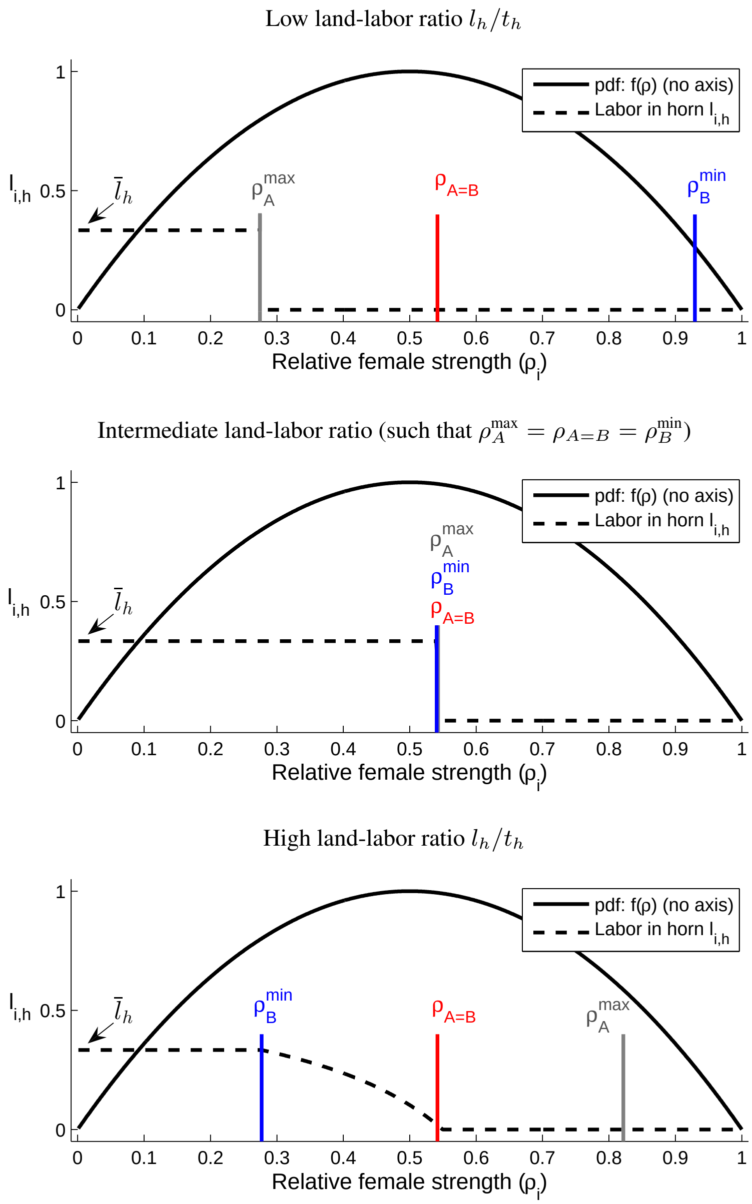
This section discusses our Stone-Geary consumption preferences in detail and shows that they imply an indirect utility in line with equation (2) in the paper. Before individuals buy the 'luxury' horn products, they need to satisfy their basic nutritional requirement $\underline{c}$ with grain consumption. Below this reference level, any increase in income is spent on grain. Preferences take the Stone-Geary form:

$$h(c_{i,g}, c_{i,h}) = \begin{cases} \ln\left((c_{i,g} - \underline{c} + \epsilon)^{\phi} c_{i,h}^{1-\phi}\right), & \text{if } c_{i,g} > \underline{c} \\ (c_{i,g} - \underline{c})/\epsilon + \ln(\epsilon), & \text{if } c_{i,g} \leq \underline{c} \end{cases} \tag{A.12}$$

[7] For large land-labor ratios, women with strength close to but above $\rho_{A=B}$ also work in horn (albeit very little – see the proof in appendix A.1). However, their fertility is *decreasing* in the land-labor ratio and is thus incompatible with feature (ii) of EMP. Thus, the relevant strength range for EMP is to the left of $\rho_{A=B}$.

[8] The (opportunity) cost of children is so low for these women, that they would like to give up consumption in order to 'buy time' and have more children. This is the case explained in footnote 33 in the paper.

Figure A.2: Female labor in horn $l_{i,h}$ as a function of strength ρ_i, for low, middle, and high land-labor ratios



Notes: ρ_A^{max} is the maximum strength at which horn is still viable (i.e., offers a wage premium), given the land-labor ratio l_h/t_h. ρ_B^{min} is the minimum strength at which female income exceeds the reference level $\underline{c}$, given the land-labor ratio. $\rho_{A=B}$ is the strength at which points A and B coincide (see equation (A.9)).

where $\phi > 0$ is a constant and ϵ is infinitesimal. Given income I_i (for women) or w_{Mg} (for men), consumers maximize (A.12) subject to their budget constraint $c_{i,g} + p_h c_{i,h} \leq I_i$.[9] When $I_i \leq \underline{c}$, the (trivial) solution is $c_{i,g} = I_i$. For $I_i > \underline{c}$, optimization yields the expenditure shares given by (20), when ignoring the infinitesimal ϵ. Re-arranging the expenditure shares and substituting in the first line of (A.12) we obtain the indirect utility:

$$\widetilde{h}(I_i, p_h) = \begin{cases} \ln\left(I_i - \underline{c} + \epsilon\right) + \ln\left(\phi^{\phi}\left(\frac{1-\phi}{p_h}\right)^{1-\phi}\right), & \text{if } I_i > \underline{c} \\ (I_i - \underline{c})/\epsilon + \ln(\epsilon), & \text{if } I_i \leq \underline{c} \end{cases} \tag{A.13}$$

Individual female and male peasants take the price of horn as given; they also spend all their income on consumption, so that p_h does not affect intertemporal allocation. Therefore, the second term in parentheses for the case $I_i > \underline{c}$ in (A.13) does not affect individual decision making (i.e., it does not influence the *marginal* utility of consumption). Consequently, the indirect utility given by (A.13) implies the same optimal choices of consumption and fertility as the form given by (2) in the paper.

E. Solving the Model

In this section, we describe how we solve our model in general equilibrium. We begin by solving the model for wages, labor supply, and birth rates for *given* land-labor ratios $t = T/N$. The steady state level of t (or more precisely, N, because T is fixed) is then determined by the intersection of birth and death rates, as shown in Figure.

Before describing the solution algorithm, we explain the equations that it uses. Consumption of an *average* peasant household over the adult period is given by

$$\begin{aligned} c_g^p &= c_{Mg} + \int_0^1 \rho_i \cdot c_{i,g}(\rho_i) f(\rho_i) d\rho_i \\ c_h^p &= c_{Mh} + \int_0^1 \rho_i \cdot c_{i,h}(\rho_i) f(\rho_i) d\rho_i \ , \end{aligned} \tag{A.14}$$

where c_{Mg} and c_{Mh} are male grain and horn consumption, respectively, as given by (20) for the male wage w_{Mg}. Multiplying these by N yields aggregate peasant consumption.

Next, we derive a system of three equations that solves for the three unknowns w_{Mg}, w_h, and t_h. This involves market clearing. Because the landlord spends his income on non-agricultural items (such as warfare), the relevant market clearing condition refers to the peasant part of consumption and production only.[10]

$$N(\widehat{l_g} w_{Mg} + l_h w_h) = \alpha Y_g + \alpha_h p_h Y_h \ . \tag{A.15}$$

[9] We model the female optimization only. All results also hold for male peasants, where the index i is not needed because men are homogeneous.

[10] One can use an alternative setup with equivalent implications: That the landlord has the same consumption preferences as peasants. Historically, this alternative assumption is reasonable: While land-owners themselves did not consume goods in the same proportions as peasants, the staff they employed in large numbers, or the armies they maintained, did. In this alternative setting, (A.15) is given by $N(\widehat{l_g} w_{Mg} + l_h w_h) + rT = Y_g + p_h Y_h$. This yields identical results.

Dividing by N and using (8), (9), and $t_g = t - t_h$ yields:

$$\widehat{l}_g w_{Mg} + l_h w_h = \alpha A_g \widehat{l}_g^{\alpha_g} (t - t_h)^{1-\alpha_g} + \alpha_h p_h A_h l_h^{\alpha_h} t_h^{1-\alpha_h} \,. \tag{A.16}$$

This is the first equation in our system of three. The remaining two are (12) and (13). For a given price of horn p_h and land per household t, as well as labor supply l_h and $\widehat{l}_g$, we can solve this system of equations to obtain w_{Mg}, w_h, and t_h. This solution is for the case where the horn sector operates, i.e., where $l_h > 0$ and $c_h^p > 0$. If the horn sector does not operate, equation (A.16) is replaced by $t_h = 0$. This also yields $w_h = 0$ in (12), and (13) then uses $t_g = t$.

We have now specified all equations that we need to solve for the general equilibrium. Starting from initial guesses for w_h, w_{Mg}, p_h, and t_h, our algorithm to solve the model then follows the steps:

1. Obtain individual birth rates b_i and individual female labor supply $l_{i,h}$ for *given* wages and p_h from (18) and (19).

2. Use (20) to calculate individual demand, given p_h and I_i (the latter is obtain from (3) for given wages)

3. Aggregate across all strength types to obtain $\widehat{l}_g$ from (11), $l_h = \int_0^1 l_{i,h}(\rho_i) f(\rho_i) d\rho_i$, as well as aggregate peasant consumption $C_g^p = N c_g^p$ and $C_h^p = N c_h^p$ from (A.14)

4. For the derived $\widehat{l}_g$ and l_h (and given t_h), calculate the aggregate output of horn, Y_h from (8) and grain, Y_g, from (9). Derive the part of production that goes to peasants as $Y_h^p = \alpha_h p_h Y_h$ and $Y_g^p = \alpha_g Y_g$.

5. Update the price to p_h': If $Y_h^p > C_h^p$, then $p_h' < p_h$, and vice versa.

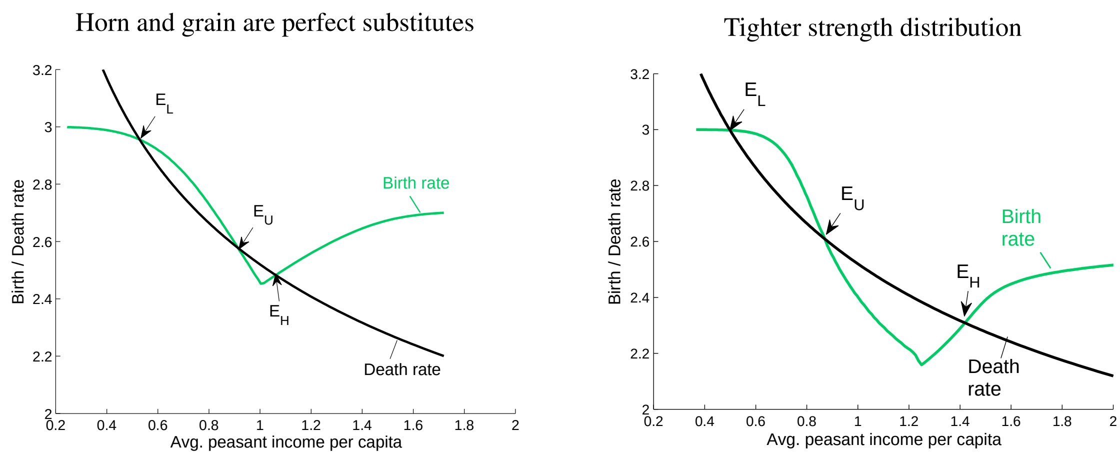
6. Solve the system of three equations (12), (13), and (A.15) for given p_h', This delivers updated wages w_h' and w_{Mg}', as well as the land per household in horn t_h'.

We run this loop until the maximum absolute deviation between the four original and updated values is below a small positive number. Note that birth rates are not needed in the solution algorithm, because it solves the model for a given land per household t. However, aggregate (average) fertility determines the Malthusian equilibria as in Figure 5, and thus t. It is derived from individual birth rates (see step 1) by integrating across all types: $b = \int_0^1 b_i(\rho_i) f(\rho_i) d\rho_i$. Similarly, the death rate follows from average peasant consumption $\bar{c}^p$ and is given by equation (6). We calculate $\bar{c}^p = \int_0^1 c_i^p(\rho_i) f(\rho_i) d\rho_i$, where $c_i^p = \bar{p}_h c_{i,h} + c_{i,g}$, is a measure of real income, with the price of horn held constant at the level $\bar{p}_h$, measured in the equilibrium E_L (see the left panel of 5).

F. Robustness Checks of the Model

In this section, we analyze the robustness of our model to alternative parameter choices. The left panel of Figure A.3 shows the simulation results without the demand effect for ’luxury’ horn products. Here, we model the case where horn and grain are perfect substitutes, normalizing $p_h = 1$. We use the same parameters as in the baseline model.[11] As the figure shows, the emergence of EMP is slightly dampened: The drop in fertility rate is now smaller than in the baseline model (Figure 5 in the paper). However, we still obtain the two stable steady states E_L and E_H. In the right panel of Figure A.3, we show that our results are robust to using a tighter distribution. Here, we use a beta distribution with both parameters equal to 5, so that the mean is still 0.5, but the standard deviation is now 0.15 (instead of 0.22). The results are very similar to those obtained in our baseline model.

Figure A.3: Model Robustness – Perfect Substitutes and Strength Distribution



Note: In the left panel, we assume that horn and grain products are perfectly substitutable, so that $p_h = 1$. In the right panel, we use a tighter strength beta distribution $f(\rho)$, with both parameters set equal to 5 (instead of 2).

While the slope of the death schedule (the strength of the "positive Malthusian check") does not affect our main mechanism, it influences the location (and existence) of the high-income steady state E_H. In our baseline simulation, we use an elasticity of death rates with respect to income of -0.25. This is the average estimate for England between 1600 and 1800 by Kelly and Ó Grada (2010). Kelly and Ó Grada argue that in early modern England, the positive check may have been dampened by the Old Poor Law. When we use an elasticity of -0.5 instead, we still obtain both steady states, but yet more negative elasticities result in a unique steady state E_L. Nevertheless, warfare and epidemics after 1400 arguably shifted the death schedule upward (Voigtländer and Voth, 2013). Once we account for this *shift* in the death rate, even elasticities below -0.5 deliver multiple steady states. At the other extreme, Anderson and Lee (2002) document elasticities of mortality between -0.076 and -0.16 for 16C–19C England and Europe. When using these values, we always obtain multiple steady states with larger income levels in E_H, thus strengthening the impact of EMP.

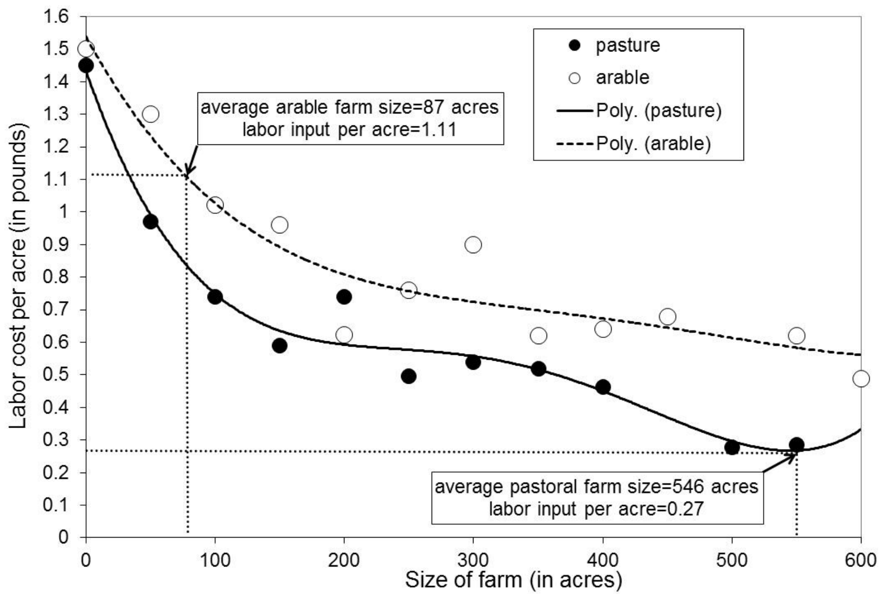
[11] There is one exception: A_h now has double its original value. This compensates for the fact that in the baseline simulation p_h was approximately 2 in the equilibrium E_H.

B Empirical Appendix

A. Labor Cost and Female Labor in Pastoral and Arable Farming

Allen (1988) calculates labor cost per acre for pastoral and arable farms (tables 8 and 9). We plot his data in figure B.1. The average farm size is calculated from Allen (1988, Table 4). The size distribution of farms is from Table 4 in Allen (1988). Conservatively, we assume that farms listed as having 1,000+ acres (which are all pastoral) had an average size of 1,000 acres. This means that the estimated average size for pastoral farms is a lower bound of the true value.

Figure B.1: Arable and pastoral labor cost per acre, by farms size



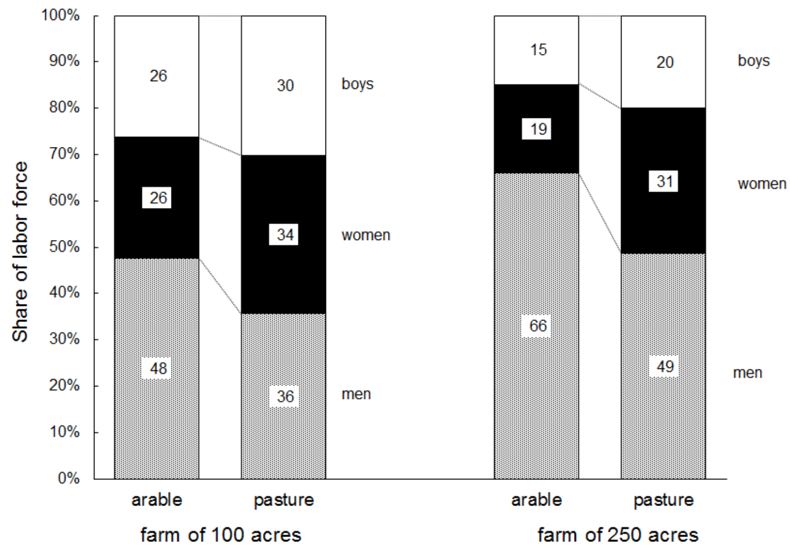
Notes: Data source: Allen (1988). The figure shows individual observations and a fourth-degree polynomial for each farm type.

Figure B.2 shows that switching from arable to pastoral farming resulted in a more important role for female labor.

B. Sexual Division of Labor – Anthropological Evidence

Does the anthropological literature on work patterns support the notion that pastoral activities are more compatible with female labor? To answer this question, we examine the data on 185 societies compiled by Murdock and Provost (1973). They classify each activity according to the extent to which it uses male or female labor. To take one example, the hunting of large aquatic animals is classified as an exclusively male activity in the 48 tribes where it is observed. At the opposite end of the spectrum, in 174 societies where there is information on the preparation of vegetal foods, fully 145 (83%) only used female labor for

Figure B.2: Labor Usage on Arable and Pastoral Farms, by Size of Farm

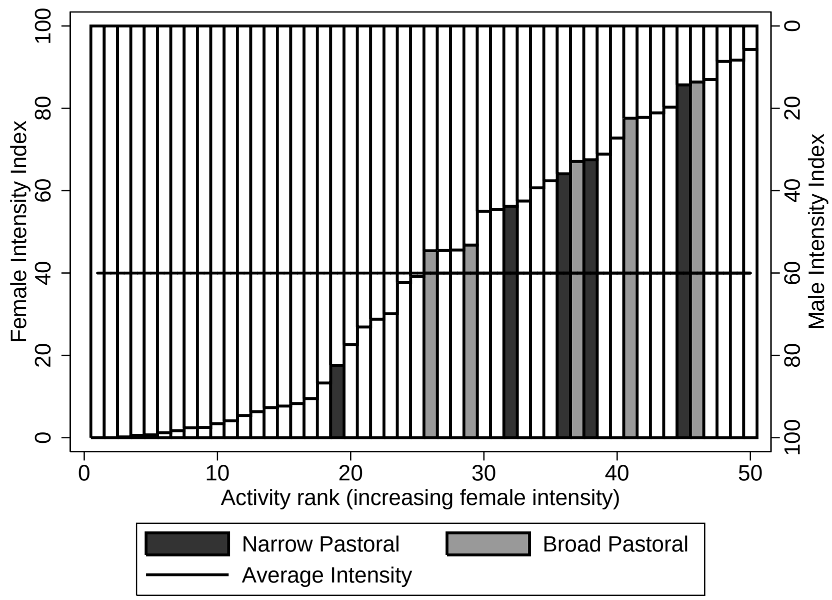


Data source: Allen (1991, Table 9.4).

the purpose. Most activities fall between these two extremes. Murdock and Provost assign a letter for each tribe and activity: M – exclusively male; N – dominantly male; E – equal participation; G – dominantly (but not exclusively) female; F – exclusively female. They then compile an index of male labor intensity, which takes values between 0 and 100, using weights of $M = 1$; $N = 0.8$; $E = 0.5$; $G = 0.2$; $F = 0$. We invert it by taking the female activity index as 100–male activity index. The result is plotted in Figure B.3. The most male activities are on the left; the most female-labor intensive tasks are on the right of the spectrum. Pastoral activities such as looking after small and large animals, milking, etc. are highlighted in black ('Narrow Pastoral'); pasture-related activities are grey ('Broad Pastoral'). As is readily apparent, pastoral activities use ample female labor – they are far to the right in the distribution. All of them except one use female labor more intensively than the average activity sampled by ethnographers.

Next, we perform regression analysis, using both the female activity index and the ranking of activities as dependent variables. As explanatory variables, we first use a dummy for the broader set of pastoral and pastoral-related activities ($Pastoral^{\text{broad}}$). In addition, we restrict the analysis to strictly pastoral activities ($Pastoral^{\text{narrow}}$). Table B.1 gives the results. We find strongly significant relationships for most combinations of dependent and explanatory variables. For example, the result in column 1 suggests that on a scale from 0–100, pastoral activities score on average 64.7; non-pastoral activities have an average score of 37.3, a difference of 27.4. If we exclude the pastoral-related activities (column 2), the coefficient drops to 20.3, but is still significant at the 10% level. When we use the rank as the dependent variable (columns 3-4), the result is the same – pastoral activities score much higher than non-pastoral activities in their intensity of using female labor.

Figure B.3: Intensity of female labor usage, by activity



Notes: Data source: Murdock and Provost (1973). Pastoral activities (narrowly defined) include 'tending large animals', 'milking', 'care of small animals', 'loom weaving', and 'dairy production'. Pastoral activities (broadly defined) additionally include 'preparation of skins', 'manufacture of leather products', 'preservation of meat and fish', 'manufacture of clothing', and 'spinning'.

Table B.1: Anthropological evidence: Female labor intensity of pastoral activities

	(1)	(2)	(3)	(4)
Dep. Var.:	Female Intensity Index		Female Intensity Rank	
$Pastoral^{\text{broad}}$	27.41***		11.44***	
	(8.926)		(4.045)	
$Pastoral^{\text{narrow}}$		20.26*		9.444**
		(11.38)		(4.514)
Constant	37.25***	37.96***	24.36***	24.56***
	(4.899)	(4.917)	(2.216)	
R^2	.066	.036	.057	.039
Observations	50	50	50	50

Notes: Robust standard errors in parentheses. Key: *** significant at 1%; ** 5%; * 10%. Data from Murdock and Provost (1973). $Pastoral^{\text{broad}}$ and $Pastoral^{\text{narrow}}$ are dummies for broad and narrowly defined pastoral activities, respectively. See the note to Figure B.3 for a list of these activities.

In combination, these results strongly suggest that pastoral agriculture is more intensive in the use of female labor than other farming activities. A similar conclusion emerges if we use information on patterns of time-use in different farming activities. Minge-Klevana (1980) collect evidence on working hours in 15 agricultural societies. Where pastoralism is mentioned as at least one of the forms of cultivation (5 societies), working hours for women are markedly longer – 11 hours per day, vs 8.4 hours in the rest of the sample (the difference is statistically significant at the 10% level).

C. *Background on Demography and Agriculture in China*

The extent to which Chinese demography resulted in higher fertility and greater pressure on living standards is debated. As Lee and Feng (1999) and Feng, Lee, and Campbell (1995) have argued, infanticide and lower fertility limitation within marriage reduced population growth rates. However, what matters for population pressure is the total fertility rate – the combined effect of marriage rates and fertility within marriage. There is no question that this rate was markedly higher in China than in Europe – by 20-40% (Smith, 2011). In line with this, Chinese population size increased by a factor of over 5 between 1400 and 1820, while Europe only grew by a factor of 3.2 – annual population growth rates were 0.4% and 0.28%, respectively (Maddison, 2001). In other words, Chinese population growth was approximately one third faster than in Europe.

Grain production in China was approximately 4 times more efficient than in England. We use the figures by Allen (2009) on output per acre and output per day, weighting them with a labor share of 0.5.[12] Chinese land productivity was 700% of English land productivity in grain, and labor productivity was 86%. This implies a factor-weighted average of 392%. The main reason for high land productivity was the limited size of plots: Chinese farms were markedly smaller, and labor input per acre much higher, than in England. Continuous population pressure led to increasing subdivision of farms. Table B.2 compares farm sizes in the most advanced areas – England and the Yangtze Delta. At the dawn of the nineteenth century, English farms were thus, on average, 150 times larger than Yangtze ones.

Table B.2: 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).

Chinese grain production was efficient because it used various techniques to raise output per unit of land. All of them required the use of more labor – rice paddy cultivation, the use of bean cake as fertilizer,

[12]From his figures, we derive an estimate of output per acre in arable farming in the midlands of 3.5 pounds per acre.

and intercropping with wheat (Goldstone, 2003; Brenner and Isett, 2002). The relatively low productivity of grain agriculture in England is reflected in its low share in land use. Arable production accounted for only 39-43% of acreage in England, according to Broadberry, Campbell, and van Leeuwen (2011, Table 3). In contrast, rice and grain accounted for almost all of China's land use.

Chinese farms used all means available to raise output per unit of land; the same is not true of output per worker. Ever fewer draft animals were in use. While Chinese 16th century writers observed that "the labor of ten men equals that of one ox,"[13] the use of draft animals declined in the Ming (1368-1644) and Qing (1644-1911) period. By the mid-Qing period, animal use had disappeared almost entirely, except for the most arduous tasks.[14] The land needed to feed an ox was dear, and farms were typically too small for keeping an ox.

Ever smaller farm sizes in China also meant that there was less scope for female employment in agriculture. Labor requirements could be satisfied by the existing male labor force on small plots. As Li (1998) has argued, women were increasingly rendered superfluous for agricultural tasks, which were also less and less well-matched to their comparative advantages. They consequently sought employment outside agriculture, in home production of textiles through spinning and weaving.

Overall, the market value of female labor declined during the Ming and Qing periods, as a result of falling labor productivity combined with changes in the pattern of production arising from growing 'agricultural involution' (Berkeley, 1963). Even authors skeptical of the involution hypothesis conclude that female market wages were only 25% of male wages in 1820s China, whereas English women's market wages were equivalent to 50-63% of English male wages (Kussmaul, 1981; Allen, 2009).[15] This offers important empirical support for the predictions of our model - in Europe, female labor was relatively more valuable, partly because technology, soil, and climate favored the pastoralism, where women could make more of a contribution.

D. Comparison of Marital Fertility Rates

This section compares fertility within marriage for Hutterites, Western Europe before 1800, and China. Table B.3 shows that European marital fertility was only slightly below contemporaneous levels of Hutterites and therefore probably close to the biological maximum.[16]

E. Measures for Pastoral Production and Instrumental Variables

In this section we check the consistency of our measure for pastoral production at the English county level in 1290, and describe the construction of our instrumental variable, the days of the year during which grass grows.

[13] Cited after Brenner and Isett (2002).

[14] The view is controversial. Wider availability of bean cake may have helped the increased use of oxen after 1620 (Allen, 2009).

[15] In our model, female market wages are represented by w_h. Low w_h/w_{Mg} is thus an indicator for relatively high productivity in grain (i.e., small A_h/A_g in China).

[16] The remaining minor difference is at least partially explained by the better nutrition and general health of Hutterites.

Table B.3: Marital fertility rates (births per year and woman)

Age	Hutterites	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).

Arable Acreage in 1290

Because the share of pastoral land is not available for medieval times, we use the proxy $Pastoral^{1290}$ = 1–share of arable land in 1290. We take the share of arable land in 1290 from Table 7 in Broadberry et al. (2011). In the following we show that this proxy performs well. We first construct the same variable for 1836 – when more detailed data on land use are available – and compare it to the actual share of pastoral land. Kain (1986) reports four categories: arable land, woodland, grassland, commons, for 28 counties in 1836. In an average county, these account for 97.8% of county acreage. Grassland and commons (which were mostly pastures) reflect pastoral land. We plot this against 1–share of arable land in 1836 in the left panel of Figure B.4. The fit is very good, and, importantly, there is no systematic bias (deviation from the 45-degree line) in our proxy.

Next, we analyze how strongly our main explanatory variable $Pastoral^{1290}$ itself is correlated with the share of pastoral land in 1836. The right panel of Figure B.4 shows the relationship. The correlation coefficient is .58, significant at the 1% level.

Finally, we verify that more pastoral *land* in a county also implies more pastoral *production*.[17] Data on livestock at the county level in 1867 from Mingay and Thirsk (2011) suggest a strong positive relationship (Figure B.5).

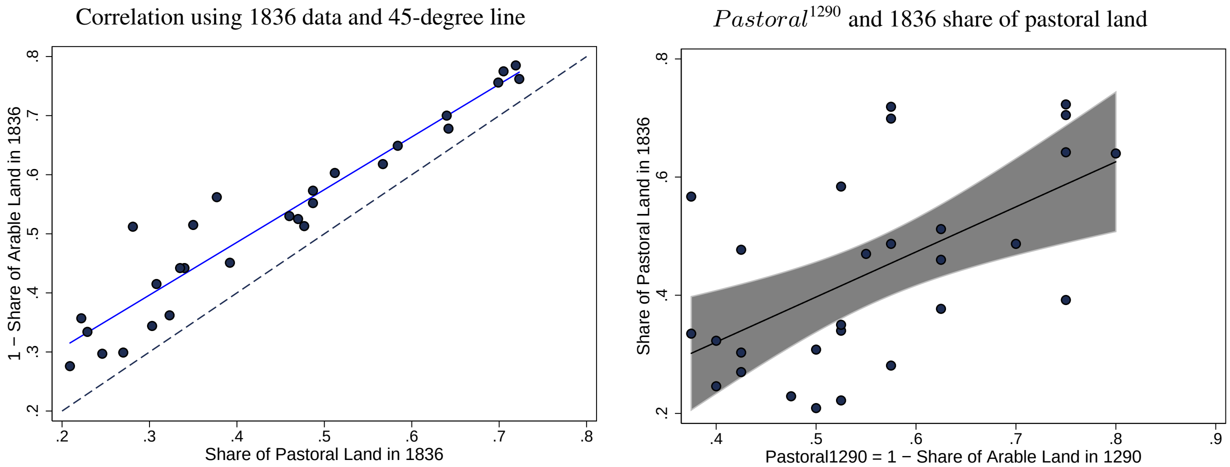
Grass growing days

We use days of grass growth ($daysgrass$) from Down, Jollans, Lazenby, and Wilkins (1981) to instrument for the suitability for pastoral agriculture. Grass growing days are derived based on suitable soil temperature (above 6 degrees Celsius), adjusted for a drought factor and altitude. Figure B.6 plots the number of days of grass growth in a typical year in the British Isles. While the broad pattern is of higher suitability to the West, there is substantial variation even at relatively low levels of aggregation.

In Figure B.7 we show that $\ln(daysgrass)$ is a strong predictor of the share of pastoral land in 1290. The left panel of the figure depicts the raw correlation, while the right panel shows a partial scatterplot, after controlling for general crop suitability for agriculture. The latter is calculated following Alesina, Giuliano,

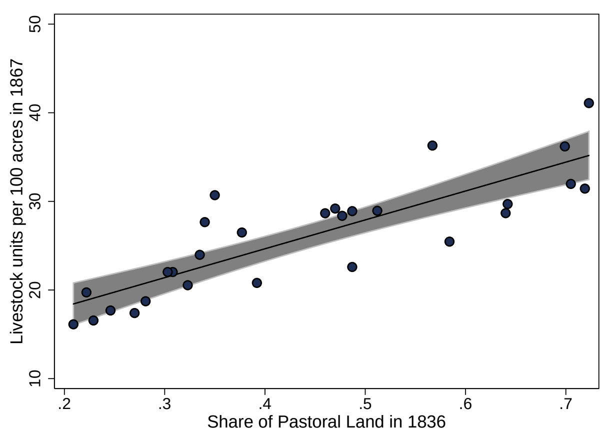
[17] One concern is that grassland and commons may merely reflect fallow land.

Figure B.4: Consistency check of the variable $Pastoral^{1290}$



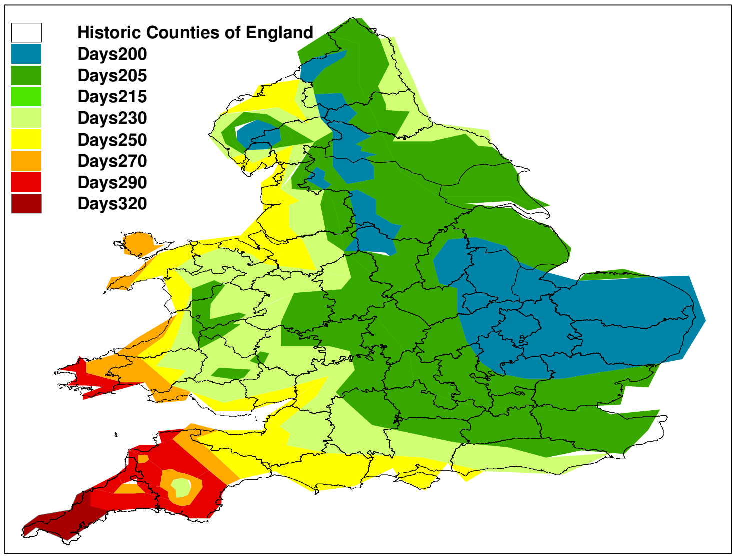
Source: County level data for 1836 are from Kain (1986), who reports four categories: arable land, grassland, commons, and woodland. We use the combined share of grassland and commons as the share of pastoral land in 1836. County-level arable acreage in 1290 is calculated as 1–share of arable land in 1290, which is from Broadberry et al. (2011).

Figure B.5: Regions with more Grass and Commons have more Livestock



Source: Data on livestock at the county level in 1867 is from The Agrarian History of England and Wales, vol. VI (Mingay and Thirsk, 2011), Table III.10. One unit of livestock reflects 1 cow/ox, or 7 sheep. See note to Table B.4 for the share of pastoral land in 1836.

Figure B.6: Days of Grass Growth



Source: Data from Down et al. (1981).

and Nunn (2011). We first define land as "suitable" for a crop (wheat, barley, or rye) if it reaches a yield/ha at least 40% of the maximum observed yield.[18] We then calculate county-level crop suitability as the share of each county's land area that is "suitable" for at least one crop according to the 40% cutoff.

Table B.4 shows the corresponding first-stage regressions for both $Pastoral^{1290}$ and $Pastoral^{1836}$ as dependent variable. Our instrument $\ln(daysgrass)$ is a strong and robust predictor of pastoral land shares. As one should expect, general crop suitability is negatively correlated with pastoral land use. None of our IV results depends on whether we control for general grain feasibility. All results presented in the paper use only $\ln(daysgrass)$. This is shown in Table B.5, which replicates the estimates from the paper, including general crop suitability in the first stage.

F. Evidence from the 1377 and 1381 Poll Tax: Sampling Procedure and Results

This section describes our use of the poll tax returns of 1377-81 as an indicator of the number of unmarried women. We begin by explaining our sampling procedure and then turn to the empirical approach and results.

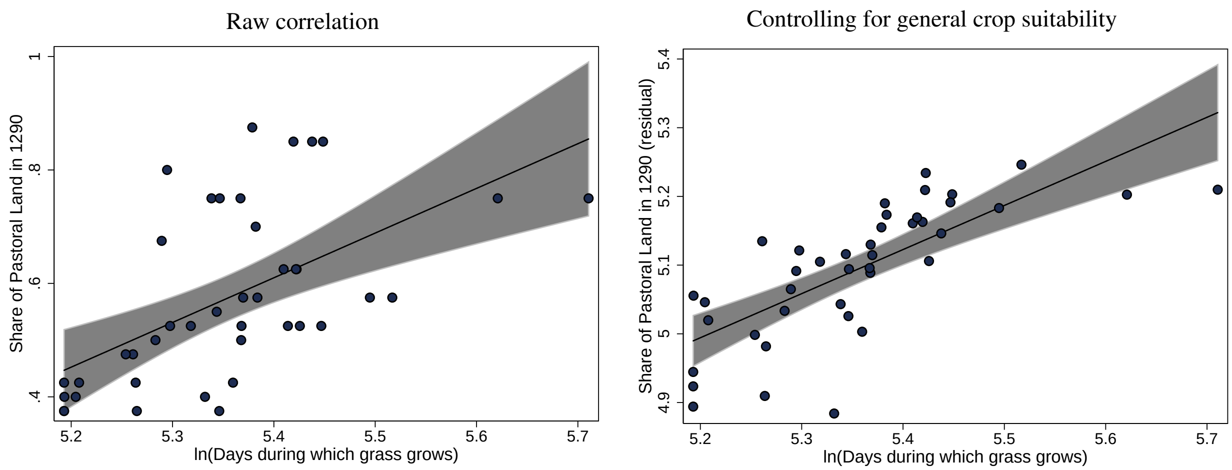
Sampling Procedure

Ideally, we would like to have direct information on the number of unmarried women in 1377 and 1381. For 1377, the surviving rolls are not complete enough to determine this for a country-wide sample.[19] Instead, we do two things. First, we calculate the drop in the number of taxpayers between 1377 (when evasion

[18] Soil suitability for each crop is from Gaez 3.0 (FAO/IIASA, 2010), derived for low inputs (traditional farming technology) and rain-fed agriculture (no irrigation). This best reflects the conditions of early modern agriculture.

[19] Only seven counties have surviving nominative rolls in 1377, and these contain little information.

Figure B.7: First stage using days of grass growth as IV for pastoral land



Source: The number of days during which grass grows is from Down et al. (1981). County-level arable acreage in 1290 is from Broadberry et al. (2011). General crop suitability is derived from FAO/IIASA (2010), following Alesina et al. (2011).

Table B.4: First stage regressions

	(1)	(2)	(3)	(4)
Dep. Var.:	$Pastoral^{1290}$		$Pastoral^{1836}$	
$\ln(daysgrass)$	.788***	.545***	.808***	.652**
	(.135)	(.163)	(.185)	(.252)
General Crop Suitability		-.279***		-.189*
		(.067)		(.108)
R^2	.328	.569	.344	.422
Observations	41	41	28	28

Notes: Robust standard errors in parentheses. Key: *** significant at 1%; ** 5%; * 10%. The number of days during which grass grows is from Down et al. (1981). County-level arable acreage in 1290 is from Broadberry et al. (2011). General crop suitability is derived from FAO/IIASA (2010) as described in the text.

Table B.5: Main IV results, using general crop suitability as additional instrument

	(1)	(2)	(3)	(4)	(5)
Table (T.), Column (col.):	T.3, col.4	T.4, col.3	T.4, col.6	T.5, col.3	T.5, col.4
$Pastoral^{1290}$	1.045***	5.130**	4.985**		
	(0.147)	(2.252)	(2.508)		
DMV		6.813**	7.098**		
		(2.684)	(3.125)		
$PastoralMarriage$				7.321***	7.130***
				(1.765)	(1.909)
Period FE	-	yes	yes	yes	yes
Observations	38	112	66	112	66
First Stage F-Statistic#	18.9	33.2	30.6	41.6	16.5

Notes: The table replicates the IV regressions reported in the paper, using 2 instruments: 1) The number of days during which grass grows (from Down et al. (1981)), and 2) general crop suitability (derived from FAO/IIASA (2010) as described in the text). The second row in this table indicates which regression from the paper is replicated. Robust standard errors in parentheses (in columns 2-5 clustered at the county level). Key: *** significant at 1%; ** 5%; * 10%.
Kleibergen-Paap rK Wald F statistic.

was minimal) and 1381 (when it was massive). The 1381 rolls are more complete, and we collect direct information on marital status of the assessed population for this year. This procedure shows that in those areas where there are many "missing women" in the 1381 tax returns, relative to 1377, there is also a suspiciously high number of unmarried men relative to unmarried women.

Medieval England was subdivided into either hundreds, wapentakes, or liberties, depending on the local naming convention. Below this level, the parish or vill formed the smallest administrative unit. The Exchequer named county-level commissions, which in turn appointed local collectors in charge of assessing and collecting the tax dues in a given area (usually a small number of vills or parishes).

The collectors would then turn over proceeds and tax rolls to the county commission. Tax rolls contain the names of each taxpayer, the amount taxed, and the parish or vill where the taxpayer was assessed. Marital status and occupation were recorded at the discretion of the individual tax collector.

These tax rolls (also called nominative rolls) were checked and aggregated at the county level, with extracts (particulars of account) sent to London along with the proceeds of the collection. These generally included a list of all settlements in the county with their respective number of taxpayers and taxed amount. Sometimes the aggregation was conducted at the hundred level, rather than that of the individual vill or parish.

Surviving data on the Poll Taxes either comes from the nominative rolls or the particulars of account (Fenwick, 1998, 2001, 2005). In the former case, information on sex and marital status might be available. The latter only contain aggregate information on the number of taxpayers and amounts collected. In 1381, no account particulars were compiled.

The sampling was performed by first eliminating all counties for which no nominative rolls remained for the 1381 Poll Tax. Then, the number of settlements in each county with usable data was determined. A settlement was included in the sampling pool if it satisfied the following criteria: 1. It showed the presence of at least one married couple (thus eliminating records where marital status was not recorded). 2. It was complete, or, only a few centimeters of the medieval tax roll was missing, with no discernible pattern in the sequence of entries for married and unmarried people (i.e., missing individuals would not skew the sampling).

From the remaining settlements, a maximum of ten settlements were picked at random for each county (using the Excel random number generator). For counties where records from fewer than ten settlements survived, all available settlements were sampled. The sex was determined from either the name, or from the occupation (in the case of individuals with faded first names), when it unambiguously indicates gender (e.g., "milkmaid").

The nominative rolls used two different conventions for recording marital status. In the first, the names of all men, and only unmarried women were recorded. The wives present were tallied by adding "ux." next to the name of their husband [from Latin uxor, wife]. In other rolls, names for all taxpayers are recorded, with each wife listed after their husband, followed by "Ux. Eius" ["His wife"]. In each of these cases, the number of married couples and of unmarried men and women can easily be calculated.

The Cities of London and York were not considered part of any county for taxation purposes. Where the records for a county included one or more cities, at least one was sampled in each case in addition to the ten rural settlements. For Canterbury, a large city (2,200 taxpayers) with no division into parishes, ten randomly selected blocks of 45 people were sampled.

The end result is a dataset of 193 vill/parish records from 22 counties. Table B.9 at the end of this appendix shows the list of sampled settlements and the sample number of people living in each settlement. There are 17 counties with the full complement of ten sampled settlements. Somerset has only nine, Northamptonshire has seven, and Kent, Worcestershire and Sussex only have records for one city each (Canterbury, Worcester and Chichester respectively).

Empirical Approach and Results

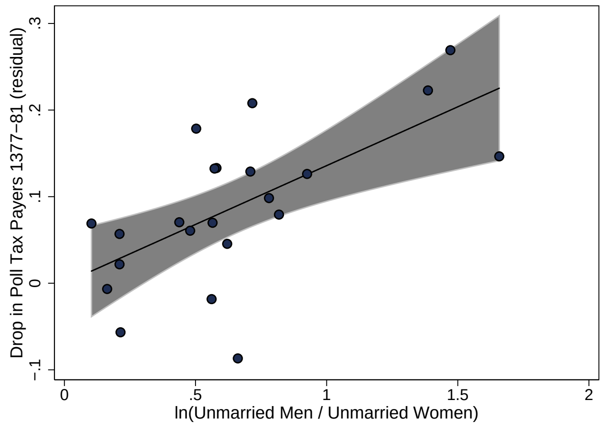
We construct two variables from the poll tax returns of 1377 and 1381. Fenwick (1998, 2001, 2005) provides transcriptions of the names and assessed amounts of tax payers for each sub-county ("hundred", where they survived), as well as county totals (of which a substantially larger number is available). The drop in the number of taxpayers is calculated from changes in the total number of assessed individuals in 1377 and 1381. For example, in south-east Lincolnshire, the sub-division of Holland returned 18,592 taxpayers in 1377. In 1381, only 13,519 appear as taxed, equivalent to a drop of 27 percent (Fenwick, 2001, p. 3). We construct the percentage drop in tax payers between 1377–81 ($\%TaxDrop$) for 38 English counties.[20]

To verify that 'missing women' are indeed an explanation for the drop in tax payers, we use our sample of 193 settlements from 22 counties where individual tax records survived, as explained above (Fenwick,

[20]Unfortunately, directly counting the number of unmarried women in 1377 – when tax evasion was low – is not an option. Only a handful of counties have surviving information at the settlement level that could be used.

1998, 2001, 2005). We count the number of unmarried men (M_{single}) and women (W_{single}). This allows us to construct a measure for 'missing single women' (following Oman, 1906): $\ln\left(M_{\text{single}}/W_{\text{single}}\right)$. This variable equals zero when there are no missing single women; its mean is .25, and it ranges from .06 to .39, and it can be constructed for 22 counties. Next, we examine the link between the measure with broader coverage – $\%TaxDrop$ – and $\ln\left(M_{\text{single}}/W_{\text{single}}\right)$. Figure B.8 shows that these measures are strongly positively correlated.

Figure B.8: Excess Single Men and Drop in 1381 Poll Tax Payers



Notes: The y-axis plots the residual variation (after controlling for population density in 1290) in the county-level drop in tax payers between the 1377 and 1381 poll tax. County-level poll tax data for 1377 and 1381 are from Fenwick (1998, 2001, 2005). To obtain gender and marital status, we sample 193 settlements, as described in detail in Section F. and Table B.9.

In Table B.6, Columns 1-3 show that missing single women are strongly associated with the drop in tax revenues. Our proxy itself accounts for 27% of the variation in tax payer reduction (column 1), and together with county population density it can explain 47% of the variation (column 2). The coefficient on population density is negative – as expected if it is easier to evade tax collection in more remote areas. Column 3 shows that this finding is robust to controlling for regional fixed effects. The remainder of Table B.6 shows that the results are driven by a low proportion of unmarried women (columns 4-6), but not by unmarried men (columns 7-9).

How important was pastoralism for late marriage or celibacy in the 14th century? To gauge magnitudes, we need the proportion of unmarried women. However, we cannot construct this direct measure because single women are underreported in the poll tax data. Instead, we use the proportion of unmarried *men* as a proxy. As before, this variable can be constructed for the 22 counties with detailed tax records. Figure B.9 shows that it correlates strongly with the share of pastoral land in 1290. After controlling for population density, the coefficient is .244 with a standard error of .086.[21] Thus, a one-standard deviation increase in $Pastoral^{1290}$ (.15) is associated with an increase of 3.7% in the share of unmarried men.[22]

[21]The coefficient is almost identical but marginally insignificant when we additionally include regional fixed effects.

[22]This figure has to be interpreted with caution. The share of unmarried men in the observed population is mechanically higher

Table B.6: 'Missing' unmarried women and the drop in poll tax payers, 1377-81

Dependent Variable: Drop in Tax Payers at the County Level, 1377-1381

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\ln(M_{\text{single}}/W_{\text{single}})$	.111**	.119***	.132***						
	(.044)	(.037)	(.026)						
$W_{\text{single}}/N_{\text{sample}}$				-1.389**	-1.308***	-2.053***			
				(.523)	0.413	0.315			
$M_{\text{single}}/N_{\text{sample}}$							.141	.714	.499
							(.430)	(.527)	(.673)
$\ln(popdensity^{1290})$		-.110**	-.286***		-.0885	-.346***		-.126*	-.245*
		(.049)	(.081)		(.059)	(.058)		(.071)	(.121)
Region FE	no	no	yes	no	no	yes	no	no	yes
R^2	.273	.473	.683	.262	.392	.746	.003	.222	.368
Observations	22	22	22	22	22	22	22	22	22

Notes: Robust standard errors in parentheses. Key: *** significant at 1%; ** 5%; * 10%. The dataset consists of 22 counties for which detailed records from the 1381 English poll tax has survived. M_{single} and W_{single} reflect the number of unmarried men and women, respectively. These are derived based on sampling 193 hundreds (sub-parish level), where N_{sample} denotes the total number of sampled tax payers at the county level (ranging 316–1,963 with a mean of 776); this variable is used as analytical regression weight. $popdensity$ is the population per square mile at the county level in 1290 from Broadberry et al. (2011).

Drop in Tax Payers at the County Level

While tax rolls listing individual names and marital status survived for only 22 counties, the overall number of tax payers in 1377 and 1381 is available for 38 English counties. We use these data in the paper. Figure B.10 shows that tax evasion in 1381 was a broad phenomenon across all regions in England.

G. *Female Marriage Age and Patterns of Land Use*

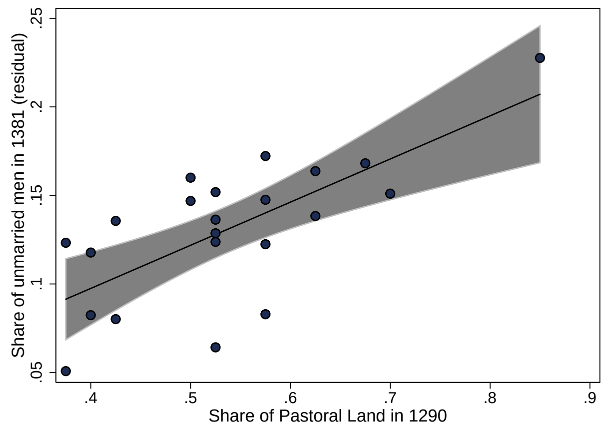
In this appendix, we provide additional information on the relationship between deserted medieval villages, pastoral marriage patterns, and the female age at first marriage.

Age at Marriage, Pastoral Production, and Farm Service

We begin by showing that our results in Tables 4 and 5 in the paper are not driven by outliers. The left panel of Figure B.11 shows the (partial) scatterplot for the first regression in Table 4. There, we estimate a panel structure based on 26 parishes in 15 counties over 5 periods. Our estimates control for period fixed effects, and standard errors are clustered at the county level. Thus, we exploit the cross-county variation. To provide a complete overview of the underlying data, we plot all data points used in the regression. The right panel of Figure B.11 shows the scatterplot corresponding to the first regression in Table 5. This specification exploits both time-series and cross-sectional variation in the spring marriage pattern and the female age at first marriage. It uses the number of parishes in each county for which the pastoral marriage pattern is reported in Kussmaul (1990) as analytical weights. The size of the dots in the figure is proportional to these

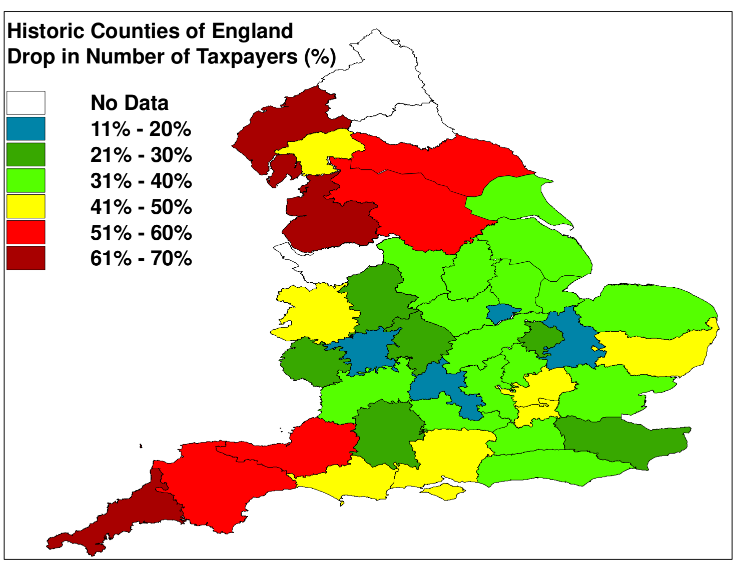
where many unmarried women evaded the poll tax, because then the denominator is lower.

Figure B.9: Unmarried men in the 1381 Poll Tax (partial scatterplot)



Notes: The y-axis plots the residual variation in unmarried men relative to total population, after controlling for county-level population density in 1290. To obtain gender and marital status, we sample 193 settlements from Fenwick (1998, 2001, 2005), as described in detail in Appendix F. and Table B.9. See note to Figure B.4 for share of pastoral land in 1290.

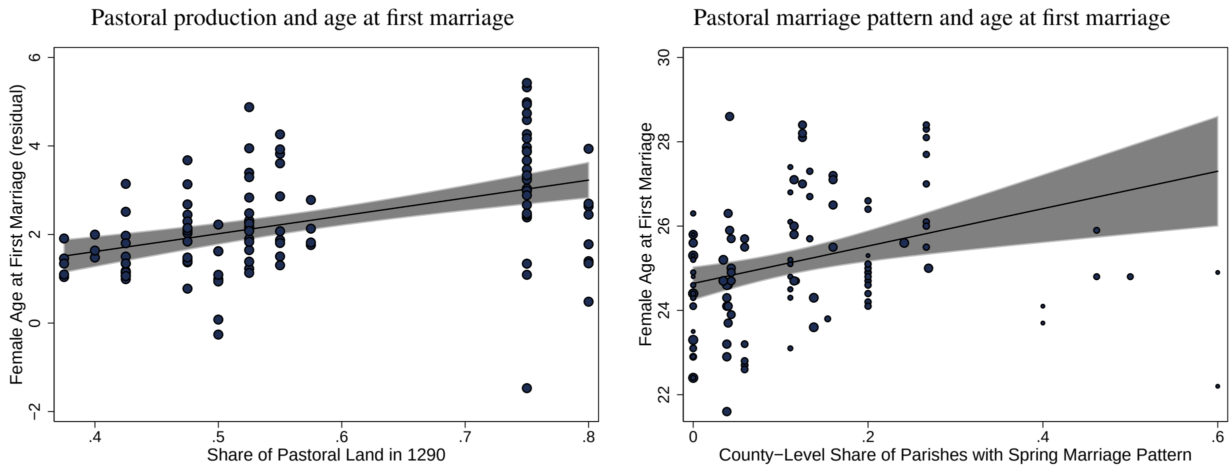
Figure B.10: Spatial distribution of drop in poll tax payers 1377-81



Notes: The figure shows the percentage drop of the number of tax payers in each county between 1377 and 1381. The data is from Fenwick (1998, 2001, 2005).

weights.

Figure B.11: Scatterplots Corresponding to Tables 4 and 5 in the Paper



Notes: The left panel shows the partial scatterplot corresponding to the first regression in Table 4. The y-axis plots the residual variation in the age at first marriage, after controlling for DMV (Deserted Medieval Villages) and period fixed effects. The right panel shows the scatterplot for the first regression in Table 5 (panel A). All regressions in this table are weighted by the number of parishes in each county for which the pastoral marriage pattern is reported in Kussmaul (1990). The size of the dots in the figure is proportional to these weights. See the notes to Tables 4 and 5 in the paper for further descriptions.

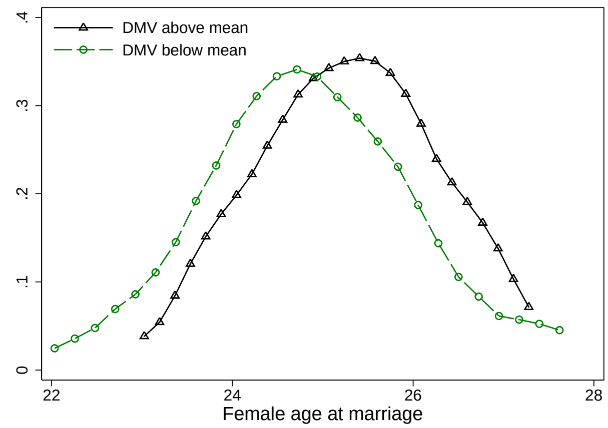
Deserted Medieval Villages and Age at Marriage

We use data on abandoned medieval villages to capture agricultural change after the Black Death (Beresford, 1989). This information has been widely used as an indicator of agricultural change after the Black Death. For example, Broadberry et al. (2011) conclude that:

> One guide to the scale and geographical extent of this shift is provided by a simple count of the numbers of deserted medieval villages (DMVs) in each county...in a band of counties stretching north-east to south-west through the heart of the midlands, potentially at least 1/2 million acres of land which had been in arable production before the Black Death may have been converted to permanent grassland thereafter and much of it, even at the height of the ploughing-up campaign of the Napoleonic Wars, was never converted back.

From the CAMPOP dataset, we take the average age of first marriage for women in each parish. The number of deserted villages per 100,000 acres in each county is our indicator for the extent to which the switch from "corn to horn" occurred after 1350. In Figure B.12, we plot the kernel density of marriage ages, conditional on the share of deserted villages being above or below the median. The distribution is clearly shifted to the right, with a difference in modes of one year.

Figure B.12: Deserted medieval villages and female age at marriage (kernel density)



Notes: Mean age at first marriage is from CAMPOP Wrigley, Davies, Oeppen, and Schofield (1997); we use the parish-level average over all five CAMPOP periods between 1600 and 1837. Deserted medieval villages per 100,000 acres (DMV) are from Broadberry et al. (2011). DMV serve as a proxy for the shift from arable to pastoral production after the Black Death.

Pastoral Production and Age at Marriage

In Table B.7 we show that a higher share of pastoral land use in 1836 (when the measure is available directly from the tithe records) has a similar effect as our variable for 1290. This underlines the long-run stability of effects shown in Table 4 in the paper.[23]

Pastoral Marriage Pattern

As mentioned in the text, Kussmaul (1990) provides data on the pastoral (spring) marriage pattern for 542 parishes over 3 periods: 1561-1640, 1641-1740, and 1741-1820. We match these as follows to the five periods in CAMPOP (Wrigley et al., 1997): 1561-1640 –> 1600-40; 1641-1740 –> 1650-99 and 1700-49; 1741-1820 –> 1750-99 and 1800-37.

Figure B.13 shows the relationship between the share of pastoral land in 1290 and our proxy for pastoral service ($PastoralMarriage$) for a cross-section of 40 counties. The corresponding regression (weighted by the number of Kussmaul parishes in each county) has a coefficient of 0.389 (0.139) and is significant at the 1% level.

H. Evidence from the 1851 Census

Although our main focus of analysis is the period before 1800, we can exploit the detailed data available in mid-19th century censuses to illustrate the main mechanism that linked farm service for women and delayed marriage. Farming was a declining part of the English economy. Nonetheless, areas that employed servants in agricultural production still saw markedly later marriage ages. In the following, we describe the data in

[23] $Pastoral^{1836}$ is available for 28 counties only. In specifications with $Pastoral^{1836}$ we do not include DMV, because the variable should already reflect the post-plague shift "from corn to horn."

Table B.7: Pastoral Production and Age at First Marriage (Parish-Level Panel)

Dependent Variable: Female Age at First Marriage

	(1) OLS	(2) OLS	(3) IV	(4) OLS	(5) OLS	(6) IV
Period		1600-1837			1600-1749	
$Pastoral^{1836}$	3.622***	7.580**	4.502***	4.177***	7.842	4.812***
	(.804)	(3.293)	(.706)	(.867)	(5.101)	(.703)
Period FE	yes	yes	yes	yes	yes	yes
Region FE	no	yes	no	no	yes	no
R^2	.577	.715	-	.417	.591	-
Observations	83	83	83	49	49	49
Instrument			$\ln(daysgrass)$			$\ln(daysgrass)$
First Stage F-Statistic#			47.0			51.7

Notes: The panel comprises 26 parishes (located in 15 counties) over 5 periods. All explanatory variables and the instrument are measured at the county level, while the dependent variable is observed at the parish level. Robust standard errors in parentheses (clustered at the county level). Key: *** significant at 1%; ** 5%; * 10%. $Pastoral^{1836}$ is the fraction of grass and commons in the total county area in 1836, and $daysgrass$ denotes the days per year during which grass grows at the county level (see Appendix E. for detail).

Kleibergen-Paap rK Wald F statistic (cluster-robust). The corresponding Stock-Yogo value for 10% maximal IV bias is 16.4 in both columns 3 and 6.

detail and then present our empirical results.

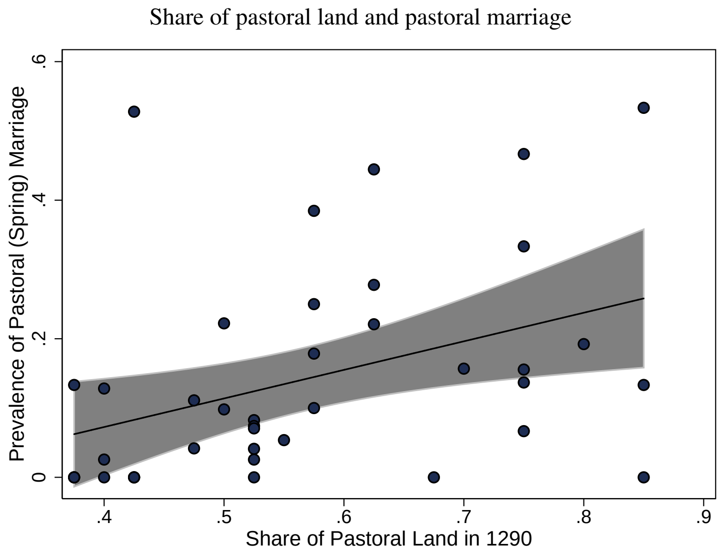
Variables from the 1851 Census

We collect county-level information on civil condition and occupations from the 1851 British Census, Volume I (Eyre and Spottiswoode, 1854). Civil conditions comprise bachelors, spinsters, husbands, wives, widowers, and widows, all aged 20 or older. We calculate the share of unmarried women as spinsters, divided by the sum of wives, spinsters, and widows. Thus, our measure reflects women who have never been married – the relevant group for our argument. The census also lists detailed occupations in agriculture (for both male and female workers), including farmers, graziers, agricultural labourers, shepherds, cowkeepers/milksellers, and farm servants. We define the variable $\%AgServants$ as the number of farm servants, divided by all listed occupational categories in agriculture. In addition, we define the more specific category $\%AgServants_{\text{female}}$, which includes only female servants in the numerator. Finally, we extract the number of employees in 'chief manufactures and products,' and divide it by the total population aged 20 and above to obtain the variable $\%ManufEmp$.

Empirical Results

In Table B.8, we investigate the link between pastoral employment in agriculture and marriage probabilities. The dependent variable is the ratio of spinsters (unmarried, but not widowed) to all women aged 20 or older, in each county. Where many females remained unmarried until late in life, average age at first marriage must

Figure B.13: Pastoral Land, and Spring Marriage



Source: County-level arable acreage in 1290 is from Broadberry et al. (2011). To obtain the prevalence of pastoral marriage, we take the county-level average across all parishes reported by Kussmaul (1990) that are located in the respective county.

have been high. The ratio of single women has a mean of .28 and a standard deviation of .027 across 41 counties. We use two explanatory variables. First, the share of female agricultural servants in total agricultural employment ($\%AgServants_{\text{female}}$) captures the demand for *women* as servants in agriculture. Second, we use the share of *all* agricultural servants in total agricultural employment ($\%AgServants$). This reflects the strength of hiring labor year-long in agriculture in general; it is also the explanatory variable used by Kussmaul (1981). Columns 1 and 2 show a positive correlation between $\%AgServants_{\text{female}}$ and the proportion of single women. The statistical significance of this result increases when we use $\%AgServants$ instead (columns 4 and 5). The number of agricultural servants reported in the census does not differentiate between arable and pastoral farms. One way to address this issue is by instrumenting with pastoral land suitability (days of grass-growing). Because our story relies on animal husbandry, we expect the coefficients to increase when we isolate this channel by IV estimation. Columns 4 and 6 show that, for both explanatory variables, results are stronger when we instrument. According to these estimates, farm service was powerfully associated with a higher proportion of unmarried females. A one standard deviation increase in $\%AgServants_{\text{female}}$ pushes up the the proportion of single women by up to 3.5 percentage points. The same proportional increase of $\%AgServants$ raises the dependent variable by 3.9 percentage points. In levels (using the means of the explanatory variables), pastoral farm service raises the proportion of single women by 5.6–6.8 percentage points. Interestingly, we also find a negative effect of the share of manufacturing employment. This suggests that as industrial employment opportunities increased, the European Marriage Pattern declined.

Table B.8: Celibacy and Service Employment in Agriculture in the 1851 British Census

Dependent Variable: Proportion of Unmarried Women in Female Population over 20

	(1) OLS	(2) OLS	(3) IV	(4) OLS	(5) OLS	(6) IV
$\%AgServants_{\text{female}}$	.335	.387*	1.766**			
	(.229)	(.210)	(.773)			
$\%AgServants$				.141*	.186***	.681***
				(.073)	(.062)	(.214)
$\%Manuf$		-.0626*	-.0969**		-.0781**	-.145***
		(.034)	(.049)		(.032)	(.053)
R^2	.06	.14	-	.09	.20	-
Observations	41	41	41	41	41	41
Instrument			$\ln(daysgrass)$			$\ln(daysgrass)$
First Stage F-Statistic#			15.8			13.4

Notes: Robust standard errors in parentheses. Key: *** significant at 1%; ** 5%; * 10%. The dependent variable is defined as the share of spinsters (unmarried, but not widowed) in the population over 20 years old. $\%AgServants_{\text{female}}$ and $\%AgServants$ are, respectively, the shares of female and all agricultural servants in total agricultural employment. $\%Manuf$ is the employment share in manufacturing.
Kleibergen-Paap rK Wald F statistic (cluster-robust). The corresponding Stock-Yogo value for 10% maximal IV bias is 16.4 in both columns 5 and 6.

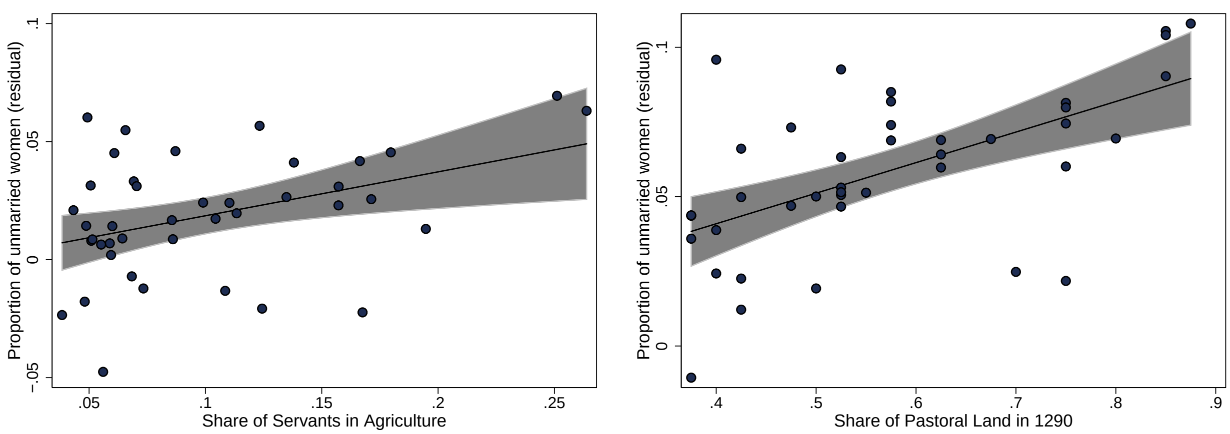
Figure B.14 complements the evidence provided above. The left panel shows the relationship between agricultural service and the proportion of single women, after controlling for manufacturing employment (this corresponds to column 5 in Table B.8). The right panel performs an additional analysis, regressing the fraction of single women directly on the historical share of pastoral land (again, after controlling for $\%ManufEmp$. The coefficient on $Pastoral^{1290}$ is .102 (.023). Given that the average of $Pastoral^{1290}$ is .57, this estimate implies that pastoral production raises the share of unmarried women by about 5.7 percentage points countrywide.

I. *Additional Historical Evidence*

On the use of poll tax data as an indicator of the share of unmarried women (Oman, 1906):

> The result was that *every shire of England returned an incredibly small number of adult inhabitants liable to the impost*. This can be proved with absolute certainty by comparing the returns of the earlier...Poll-tax of 1377 with those of this...Poll-tax of 1381. ...*The adult population of the realm had ostensibly fallen from 1,355,201 to 896,481 persons. These figures were monstrous and incredible* – in five years, during which the realm, though far from being in a flourishing condition, had yet been visited neither by pestilence, famine, nor foreign invasion, the ministers were invited to believe that its population had fallen off in some districts more than 50 per cent, in none less than 20 per cent...

Figure B.14: Pastoral Land, Servants in Agriculture, and Celibacy in 1851 (partial scatterplots)



Notes: The y-axis plots the residual variation in the share of unmarried women (in population aged above 20), after controlling for the employment share in manufacturing. Employment shares and civil conditions are from the 1851 British Census (Eyre and Spottiswoode, 1854). See note to Figure B.4 for share of pastoral land in 1290.

A glance at the details of the township-returns...reveals the simple form of evasion which the villagers had practised when sending in their schedules. They had suppressed the existence of their unmarried female dependants, ... The result is that most villages show an enormous and impossible predominance of males in their population, and an equally *incredible want of unmarried females*. When therefore we find Essex or Suffolk or Staffordshire townships returning, one after another, a population working out in the proportion of five or four males to four or three females, we know what to conclude. [our emphasis]

Table B.9: List of Sampled Settlements from the 1381 Poll Tax

	County	# Settlem. per county	Name of Settlement	Type of Settlement	# of People in Sample
1	Berkshire	10	Shaw	rural	16
2	Berkshire	10	Faringdon	rural	195
3	Berkshire	10	Bercote	rural	35
4	Berkshire	10	Enborne	rural	73

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Table B.9 – continued from previous page

	County	# Settlem. per county	Name of Settlement	Type of Settlement	# of People in Sample
5	Berkshire	10	East Hanney	rural	41
6	Berkshire	10	Burghfield	rural	25
7	Berkshire	10	Idstone	rural	46
8	Berkshire	10	Balking	rural	18
9	Berkshire	10	Steventon	rural	171
10	Berkshire	10	Grove	rural	117
11	Derbyshire	10	Youlgrave	rural	231
12	Derbyshire	10	Darley	rural	246
13	Derbyshire	10	Tideswell	rural	165
14	Derbyshire	10	Wormhill	rural	331
15	Derbyshire	10	Bakewell	rural	166
16	Derbyshire	10	Buxton	rural	126
17	Derbyshire	10	Baslow	rural	292
18	Derbyshire	10	Glossop	rural	118
19	Derbyshire	10	Blackwell	rural	26
20	Derbyshire	10	Castleton	rural	262
21	Dorset	10	Wareham	rural	150
22	Dorset	10	Radipole	rural	33
23	Dorset	10	Tyneham	rural	5
24	Dorset	10	Hanford	rural	19
25	Dorset	10	Afflington	rural	22
26	Dorset	10	[name unknown]	rural	4
27	Dorset	10	Bishop's Candle	rural	15
28	Dorset	10	Kyngeston	rural	22
29	Dorset	10	Chartlon and Herrington	rural	17
30	Dorset	10	W[...]	rural	29
31	Essex	10	West Ham	rural	239
32	Essex	10	Broomfield	rural	34
33	Essex	10	Leaden Roding	rural	39
34	Essex	10	Foxearth	rural	63
35	Essex	10	Lamarsh	rural	43
36	Essex	10	Bobbingworth	rural	48
37	Essex	10	Chigwell	rural	123
38	Essex	10	LittkeBentley	rural	46
39	Essex	10	GreatTotham	rural	71
40	Essex	10	Witham	rural	58
41	Gloucestershire	10	Frampton Mansell	rural	19
42	Gloucestershire	10	Hampnett	rural	19
43	Gloucestershire	10	Hatherop	rural	50
44	Gloucestershire	10	Bagendon	rural	7
45	Gloucestershire	10	Postlip	rural	23
46	Gloucestershire	10	Admington	rural	72
47	Gloucestershire	10	Rodborough	rural	62
48	Gloucestershire	10	North Cerney	rural	26
49	Gloucestershire	10	Lower Swell	rural	44
50	Gloucestershire	10	Ashton Under Hill	rural	65
51	Hampshire	10	Amport	rural	18

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Table B.9 – continued from previous page

	County	# Settlem. per county	Name of Settlement	Type of Settlement	# of People in Sample
52	Hampshire	10	Quarley	rural	106
53	Hampshire	10	[...]ute	rural	61
54	Hampshire	10	Pokesole	rural	31
55	Hampshire	10	North Fareham	rural	12
56	Hampshire	10	Hambledon	rural	49
57	Hampshire	10	Chilworth	rural	18
58	Hampshire	10	Portsea	rural	32
59	Hampshire	10	[name unknown]	rural	86
60	Hampshire	10	[name unknown]	rural	8
61	Kent	1	Canterbury	urban	445
62	Lancashire	10	Salford	rural	35
63	Lancashire	10	Bolton	rural	35
64	Lancashire	10	Heaton Norris	rural	29
65	Lancashire	10	Castleton	rural	20
66	Lancashire	10	Chortlong Upon Medlock	rural	12
67	Lancashire	10	Hale	rural	73
68	Lancashire	10	Aughton	rural	65
69	Lancashire	10	Sutton	rural	43
70	Lancashire	10	Abram	rural	17
71	Lancashire	10	Much Woolton	rural	20
72	Leicestershire	10	Wyfordby	rural	37
73	Leicestershire	10	Bottesford	rural	156
74	Leicestershire	10	Croxton Kerrial	rural	67
75	Leicestershire	10	Stockerston	rural	37
76	Leicestershire	10	Great Glen	rural	110
77	Leicestershire	10	Queninborough	rural	107
78	Leicestershire	10	Barrow Upon Soar	rural	67
79	Leicestershire	10	Loddington with Launde	rural	117
80	Leicestershire	10	Braunstone	rural	79
81	Leicestershire	10	Shenton	rural	110
82	Lincolnshire	10	Whaplode	rural	725
83	Lincolnshire	10	Holbeach	rural	399
84	Lincolnshire	10	Benington	rural	126
85	Lincolnshire	10	Butterwick	rural	118
86	Lincolnshire	10	Fishtoft	rural	193
87	Lincolnshire	10	Skirbeck	rural	140
88	Lincolnshire	10	Swarby	rural	27
89	Lincolnshire	10	Totill and South Reston	rural	59
90	Lincolnshire	10	Mablethorpe	rural	57
91	Lincolnshire	10	Belleau and Aby	rural	60
92	Norfolk	10	Wereham	rural	51
93	Norfolk	10	StowBardolph with Wimbotsham	rural	113
94	Norfolk	10	Denver	rural	66
95	Norfolk	10	Beetley	rural	74
96	Norfolk	10	Colkirk	rural	50
97	Norfolk	10	East Brandenham	rural	32
98	Norfolk	10	HolmeHale	rural	35
99	Norfolk	10	Ridlington	rural	71

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Table B.9 – continued from previous page

	County	# Settlem. per county	Name of Settlement	Type of Settlement	# of People in Sample
100	Norfolk	10	NorthWalsham	rural	153
101	Norfolk	10	Crostwight	rural	44
102	Northamptonshire	7	Wellingborough	rural	142
103	Northamptonshire	7	EastonMaudit	rural	49
104	Northamptonshire	7	KingsCliffe	rural	147
105	Northamptonshire	7	Southwick	rural	32
106	Northamptonshire	7	Fotheringhay	rural	74
107	Northamptonshire	7	Duddington	rural	66
108	Northamptonshire	7	[name unknown]	rural	55
109	Oxfordshire	12	Banbury	rural	52
110	Oxfordshire	12	Neithrop and Calthorpe	rural	44
111	Oxfordshire	12	Adderbury	rural	85
112	Oxfordshire	12	Arncott	rural	33
113	Oxfordshire	12	Radford	rural	30
114	Oxfordshire	12	Fifield	rural	40
115	Oxfordshire	12	Mongewell Cadwell and Huntercombe	rural	27
116	Oxfordshire	12	Warborough and Ganglesdown	rural	124
117	Oxfordshire	12	StMary Magdalen	urban	156
118	Oxfordshire	12	StGiles	urban	60
119	Oxfordshire	12	Attington	rural	26
120	Oxfordshire	12	Waterstock	rural	50
121	Shropshire	10	Fauls Willaston and Adderley	rural	51
122	Shropshire	10	Halesowen	rural	95
123	Shropshire	10	Waltone	rural	23
124	Shropshire	10	Marrington and Walcot	rural	62
125	Shropshire	10	CondoverwithParcels	rural	50
126	Shropshire	10	Rowton with Parcels	rural	40
127	Shropshire	10	Minsterley	rural	44
128	Shropshire	10	Coleham	rural	33
129	Shropshire	10	Alveley	rural	78
130	Shropshire	10	Wrickton and Walkerslow	rural	28
131	Somerset	9	Bath	urban	295
132	Somerset	9	Hardington Mandeville	rural	22
133	Somerset	9	Sutton Bingham	rural	13
134	Somerset	9	Closworth	rural	44
135	Somerset	9	WestCoker	rural	56
136	Somerset	9	Hardington Marsh	rural	10
137	Somerset	9	Chilton Cantelo	rural	21
138	Somerset	9	Pendomer	rural	8
139	Somerset	9	EastCoker	rural	8
140	Staffordshire	11	Moreton and Wilbrighton	rural	47
141	Staffordshire	11	High Onn	rural	33
142	Staffordshire	11	Rugeley	rural	156
143	Staffordshire	11	Gnosall	rural	61
144	Staffordshire	11	Essington Coven and Stretton	rural	73
145	Staffordshire	11	Lichfield	urban	667
146	Staffordshire	11	Curborough and Elmhurst	rural	50

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Table B.9 – continued from previous page

	County	# Settlem. per county	Name of Settlement	Type of Settlement	# of People in Sample
147	Staffordshire	11	Norton Canes and Little Wirley	rural	37
148	Staffordshire	11	Pipe Ridware and Packington	rural	48
149	Staffordshire	11	Mavesyn Ridware	rural	99
150	Staffordshire	11	West Bromwich	rural	60
151	Suffolk	10	Langham	rural	89
152	Suffolk	10	Buxlow	rural	28
153	Suffolk	10	Bulcamp	rural	31
154	Suffolk	10	Hadleigh	rural	312
155	Suffolk	10	Thwaite	rural	46
156	Suffolk	10	Mildenhall	rural	396
157	Suffolk	10	Flixton	rural	116
158	Suffolk	10	[name unknown]	rural	127
159	Suffolk	10	Gipping	rural	43
160	Suffolk	10	Chevington	rural	63
161	Surrey	10	Wotton	rural	67
162	Surrey	10	Dorking	rural	279
163	Surrey	10	Abinger	rural	20
164	Surrey	10	Shere	rural	166
165	Surrey	10	Westcott	rural	59
166	Surrey	10	Godalming	rural	238
167	Surrey	10	Farncombe	rural	56
168	Surrey	10	Chiddingfold	rural	176
169	Surrey	10	Hurtmore	rural	13
170	Surrey	10	Hambledon	rural	23
171	Sussex	1	Chichester	urban	474
172	Wiltshire	11	Throope	rural	33
173	Wiltshire	11	Croucheston	rural	72
174	Wiltshire	11	Bishopstone	rural	46
175	Wiltshire	11	Wick	rural	26
176	Wiltshire	11	Stourton	rural	53
177	Wiltshire	11	Mere	rural	144
178	Wiltshire	11	Charnage	rural	33
179	Wiltshire	11	WestKnoyle	rural	50
180	Wiltshire	11	Zeals	rural	131
181	Wiltshire	11	Salisbury	urban	304
182	Wiltshire	11	Netton	rural	40
183	Worcestershire	1	Worcester	urban	410
184	YorkshireER	10	Thornthorpe	rural	14
185	YorkshireER	10	Fimber	rural	45
186	YorkshireER	10	Westow	rural	54
187	YorkshireER	10	Acklam with Leavening	rural	34
188	YorkshireER	10	Holme on the Woods	rural	64
189	YorkshireER	10	Hayton	rural	69
190	YorkshireER	10	Lomdesborough	rural	32
191	YorkshireER	10	Naburn	rural	47
192	YorkshireER	10	Fulford	rural	47

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Table B.9 – continued from previous page

	County	# Settlem. per county	Name of Settlement	Type of Settlement	# of People in Sample
193	YorkshireER	10	Cottyngwyth	rural	44

Notes: The sampling procedure is described in Section F.. Underlying settlement data for the 1381 poll tax are from Fenwick (1998, 2001, 2005).

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