Ronald Lee's research on economic-demographic interactions in historical perspective

IUSSP Laureate Ceremony

David Lam, University of Michigan

March 30, 2016

Washington, DC

International Union for the Scientific Study of Population
Union internationale pour l'étude scientifique de la population

Historical perspective on Ron's whereabouts

- Harvard University, Ph.D. 1971: Dissertation: "Econometric Studies of Topics in Demographic History"
- INED, Postdoc, 1970-71
- University of Michigan, Assistant Professor to Professor of Economics and Research Associate, Population Studies Center, 1971-79
- University of California, Berkeley, Professor of Demography and Economics, 1979 -

How to get your career started

- Ronald Lee (1973) “Population in Preindustrial England: An Econometric Analysis,” *Quarterly Journal of Economics* 87, n. 4 (November 1973).
- Ronald Lee (1974) “Forecasting Births in Post-Transition Populations: Stochastic Renewal with Serially Correlated Fertility,” *Journal of the American Statistical Association* 69, n. 247 (September 1974).
- Ronald Lee (1974) “Estimating Series of Vital Rates and Age Structures from Baptisms and Burials: A New Technique, with Applications to Preindustrial England,” *Population Studies* 28, n. 3 (November 1974).
- Ronald Lee (1974) “The Formal Dynamics of Controlled Populations and the Echo, the Boom and the Bust,” *Demography* 11, n.4 (November 1974).
- Ronald Lee (1975) “Natural Fertility, Population Cycles, and the Spectral Analysis of Births and Marriages,” *Journal of the American Statistical Association*, 70, n.350 (June 1975).
- Ronald Lee (1976) “Demographic Forecasting and the Easterlin Hypothesis,” *Population and Development Review* (September/December, 1976).

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Themes

- Topics are grand
  - History of population dynamics over many centuries
  - Links between macro and micro
  - How do demography and economics interact
- The demography is interesting, creative, and illuminating
  - Great attention to detail in historical data (births, deaths, population, etc.)
  - Understanding the big picture requires focusing carefully on the small details
  - Creative use of mathematical demography to fill in gaps
- The economics is even more interesting, creative, and illuminating
  - Careful use of detailed historical data (prices, wages, rents, etc.)
  - Clever and creative econometric analysis
- The demography and economics are connected theoretically and empirically

Inverse Projection

- Ronald Lee (1974) "Estimating Series of Vital Rates and Age Structures from Baptisms and Burials: A New Technique, with Applications to Preindustrial England," *Population Studies* 28, n. 3 (November 1974).

As the name 'inverse projection' suggests, this method uses the techniques of population projection in an inverted form. However, the inversion is logical, not temporal. Like projection, the method is recursive and can be used either forward or backward in time. But, rather than using a given sequence of vital rates to project sequences of births, deaths and age distributions, this method uses a given sequence of births and deaths to derive sequences of vital rates and age distributions. The inputs and outputs of the method are shown below:

Inverse Projection

Given	Find
Births and deaths at each time t over the period T_1 to T_2	Population size, age distribution, mortality (e_0) and fertility (GRR) at each time t over the period T_1 to T_2
Population size and age distribution at any *single* time t^* in the period T_1 to T_2	

TABLE 1. *Inverse projection estimates for Colyton, 1545–1834*

Date*	Baptisms	Burials	Population†	Gross reproduction rate	Period life expectancy	'Cohort' life expectancy
1545–49	176	116	850	2·77	38·6	39·1
1550–54	191	136	910	2·89	35·6	34·8
1555–59	127	203	965	1·90	19·0	31·4
1560–64	127	42	889	1·81	66·2	50·3
1565–69	147	94	974	1·90	46·5	44·3
1570–74	177	103	1027	2·10	46·6	44·8
1575–79	214	100	1101	2·43	50·8	44·8
1580–84	251	153	1215	2·86	41·0	40·8
1585–89	220	166	1313	2·51	38·3	37·2
1590–94	219	227	1367	2·41	28·2	32·1
1595–99	230	169	1359	2·31	38·4	39·8
1600–04	227	141	1420	1·99	46·0	41·8
1605–09	279	181	1506	2·22	41·3	41·6
1610–14	296	129	1604	2·27	52·8	43·1
1615–19	318	195	1771	2·42	43·0	39·1
1620–24	328	201	1894	2·45	43·5	39·0
1625–29	353	206	2021	2·48	45·1	40·4
1630–34	381	242	2168	2·43	42·7	39·4
1635–39	379	267	2307	2·18	41·1	37·0
1640–44	349	378	2419	1·88	29·3	27·2
1645–49	144	579	2390	0·78	8·6	17·5

Ronald Lee, "Estimating Series of Vital Rates and Age Structures from Baptisms and Burials: A New Technique, with Applications to Preindustrial England," *Population Studies* 1974.

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Population

GRR

Life expectancy

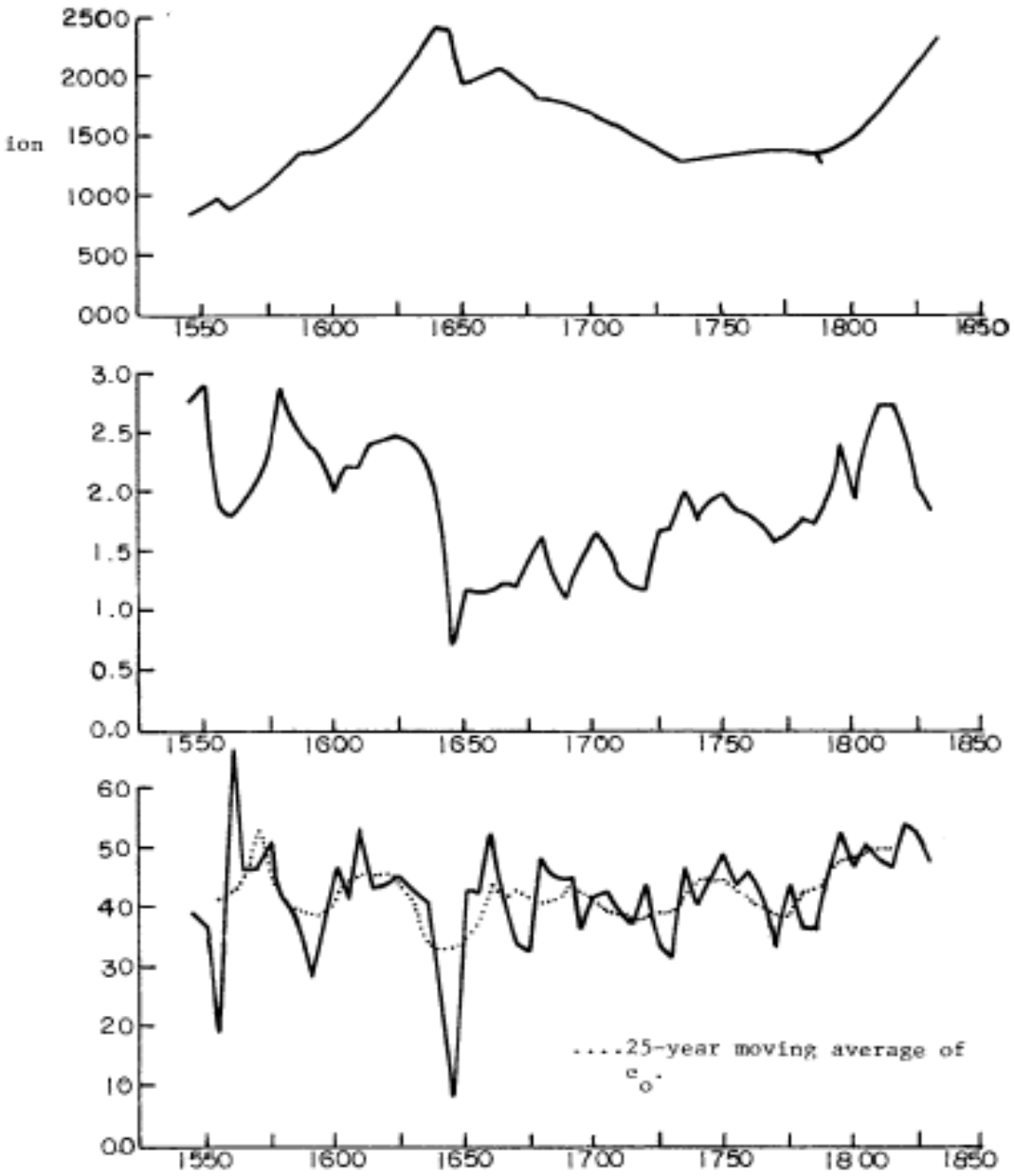


FIGURE 1. Estimated population, gross reproduction rate, and life expectancy in Colyton, 1545–1834
Source: see Table 1.

Inverse projection applied to Colyton, 1545-1843

Ronald Lee, "Estimating Series of Vital Rates and Age Structures from Baptisms and Burials: A New Technique, with Applications to Preindustrial England," *Population Studies* 1974.

Inverse projection applied to England, 1701-1840

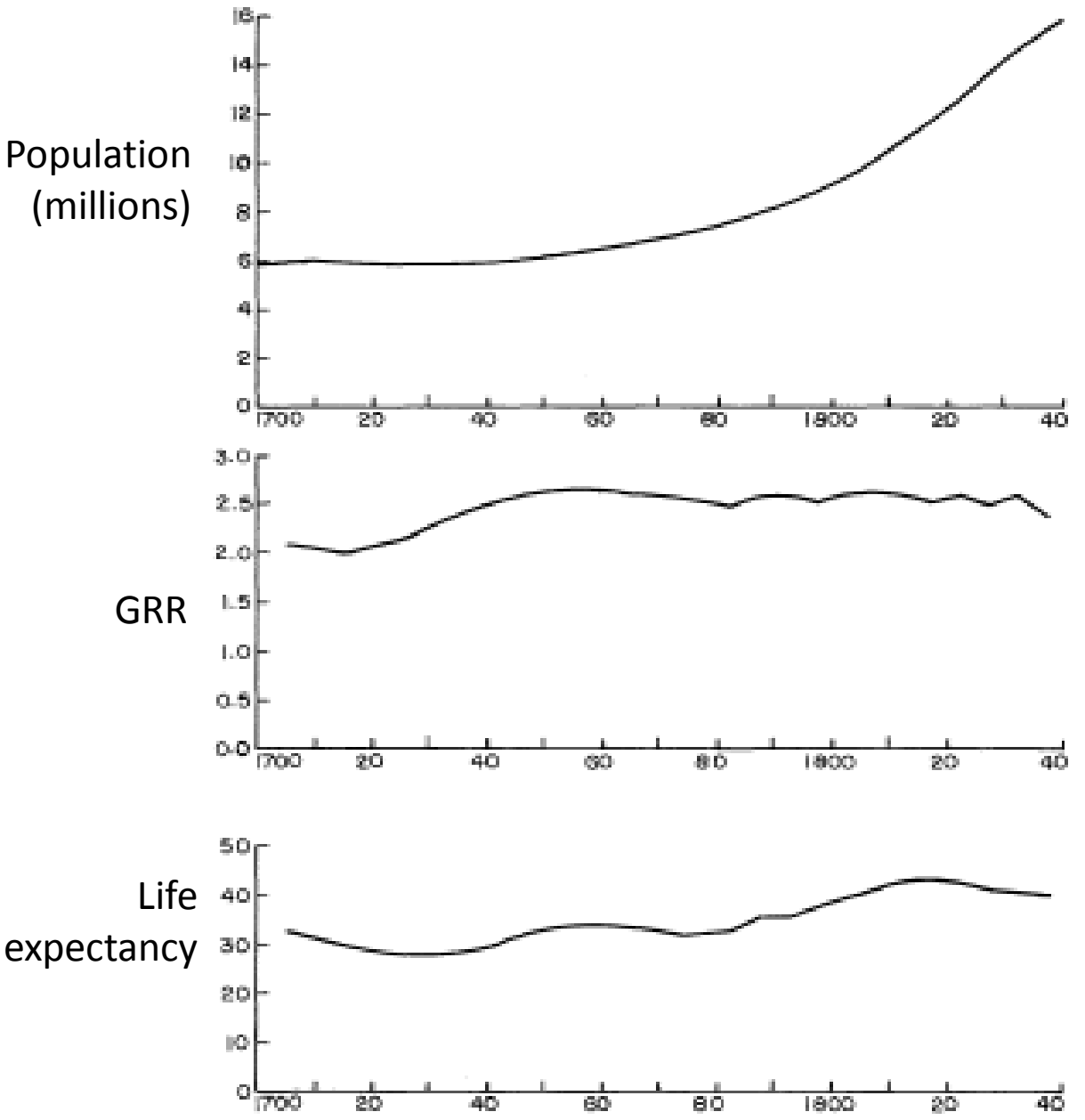


FIGURE 4. Inverse projection estimates of population, gross reproduction rates and life expectancy for England 1701–1840

Ronald Lee, "Estimating Series of Vital Rates and Age Structures from Baptisms and Burials: A New Technique, with Applications to Preindustrial England," *Population Studies* 1974.

Linking to Economics

- Ronald Lee (1973) “Population in Preindustrial England: An Econometric Analysis,” *Quarterly Journal of Economics* 87, n. 4 (November 1973).

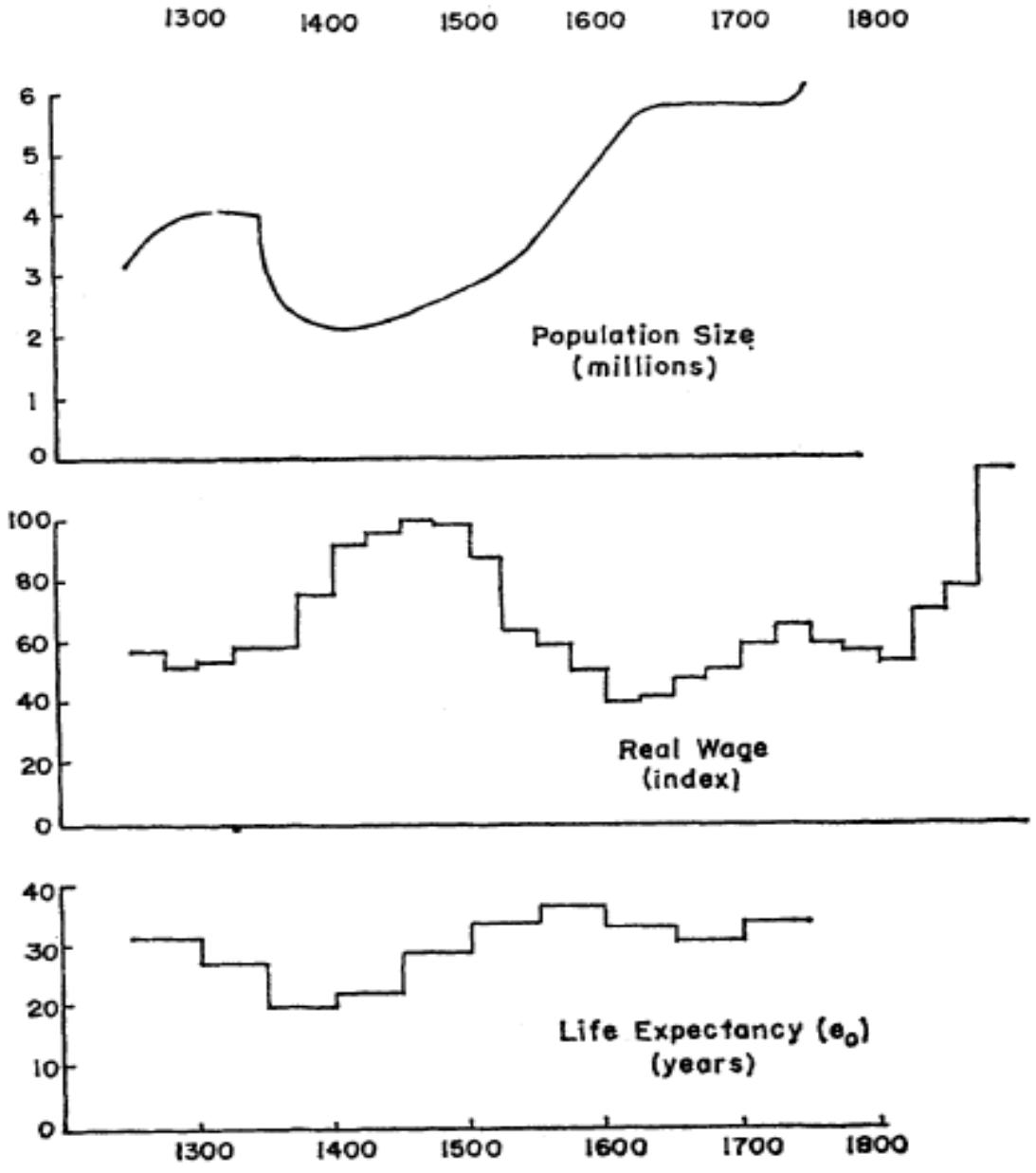


FIGURE I
Data Series

Population size, real wage, and life expectancy, England 1250-1750

Ronald Lee (1973) "Population in Preindustrial England: An Econometric Analysis," *Quarterly Journal of Economics* 87, n. 4 (November 1973).

Clear negative relationship between population (driven mainly by exogenous mortality) and wages, but relationship seems to change after 1700.

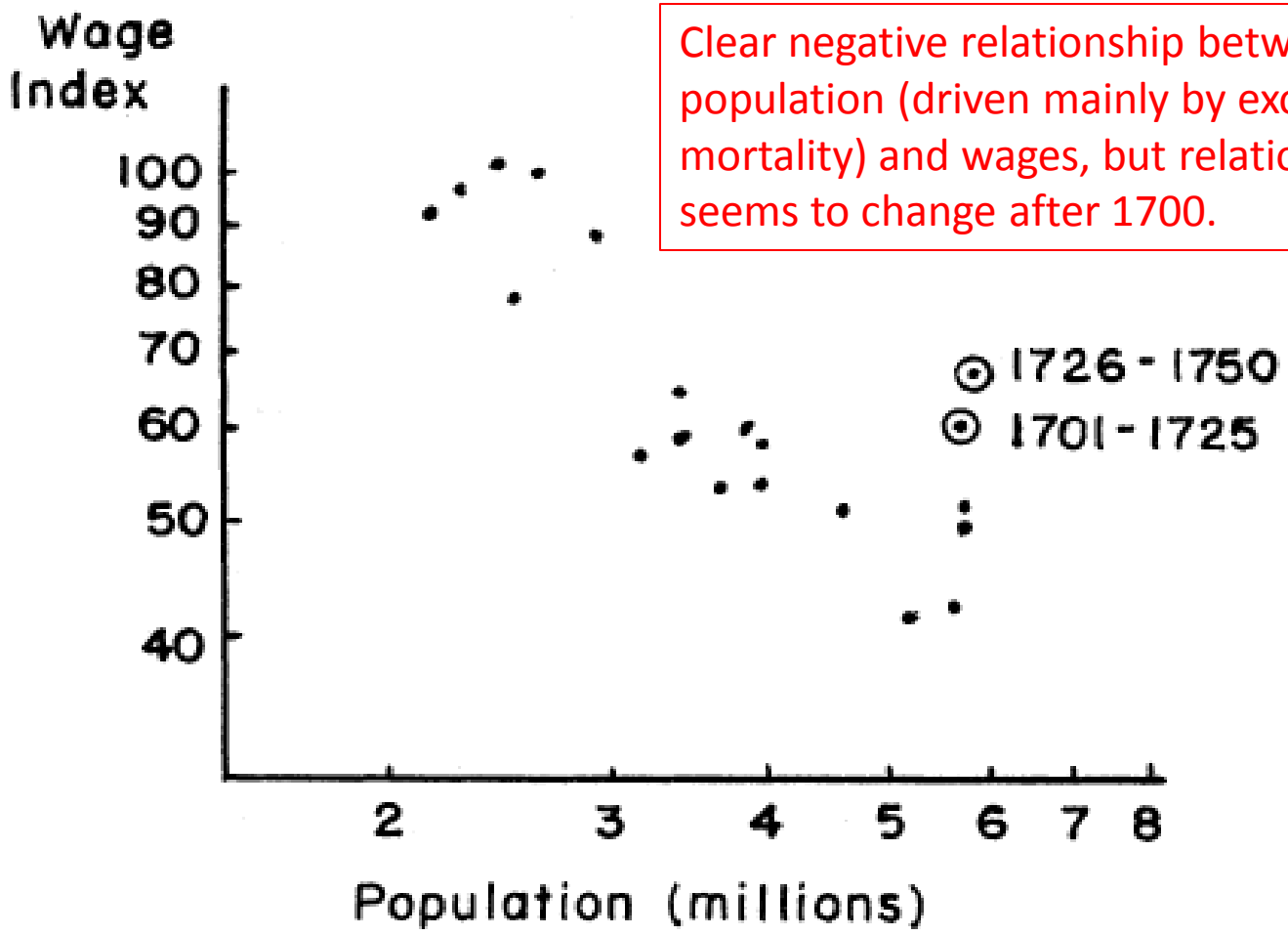


FIGURE IIA

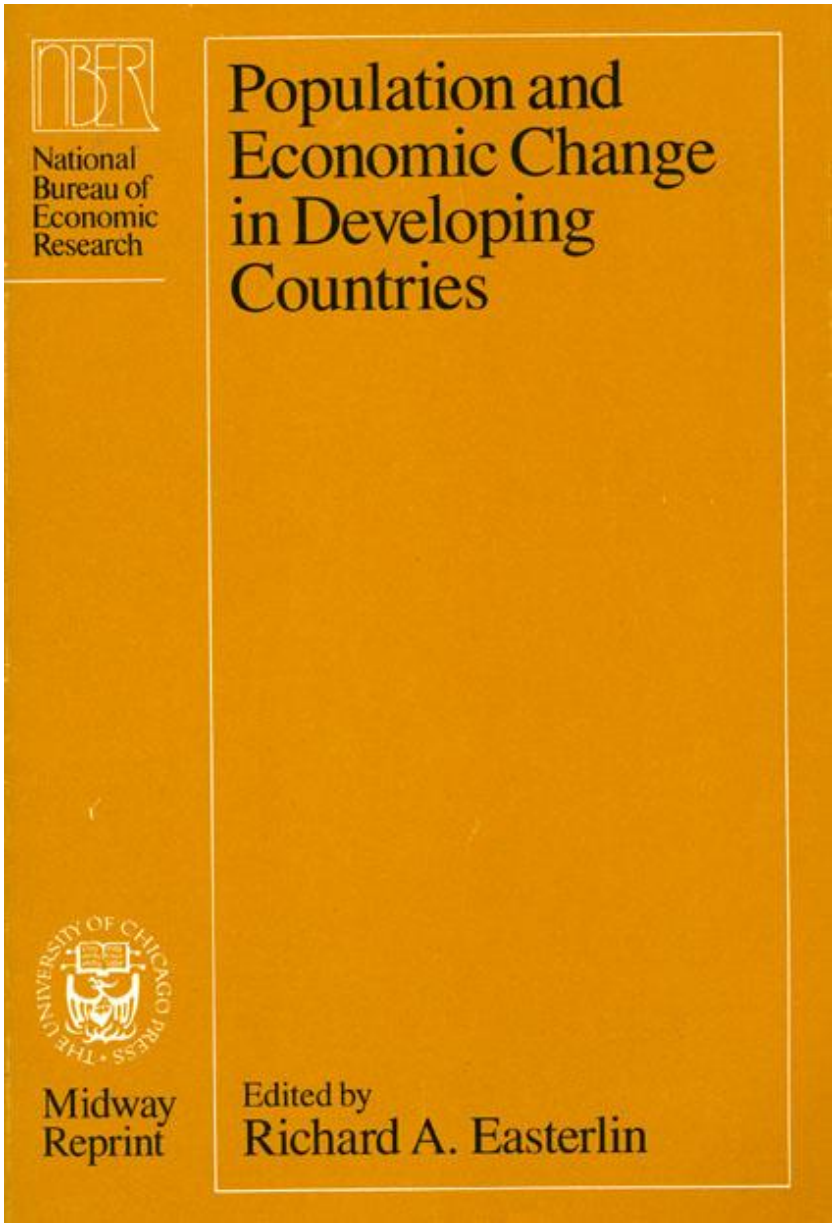
Effects of Population Change: Real Wages × Population (twenty-five-year averages, 1250–1750)

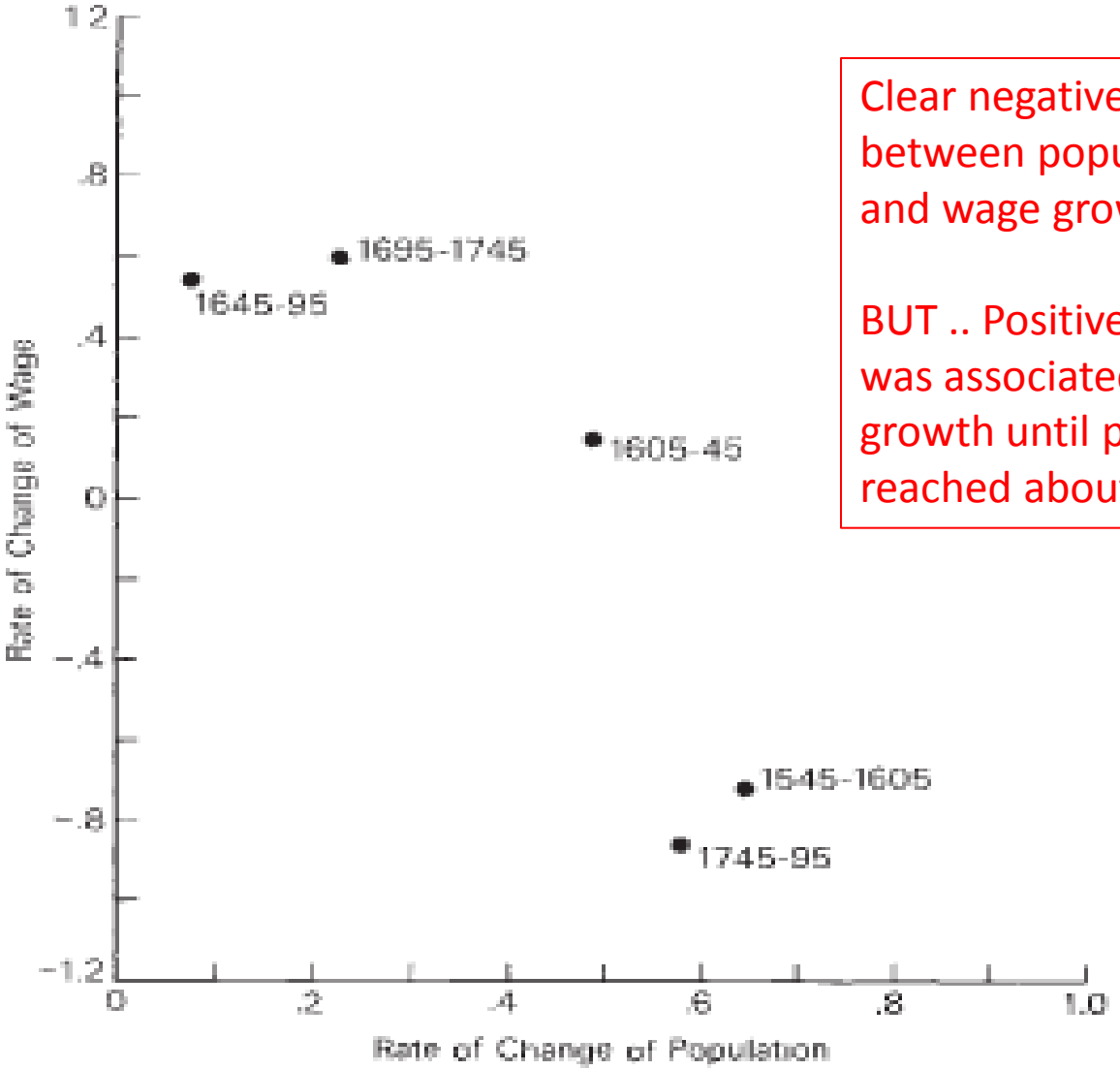
Source: See text.
Note: All axes are logarithmic scale.

Ronald Lee (1973) "Population in Preindustrial England: An Econometric Analysis," *Quarterly Journal of Economics* 87, n. 4 (November 1973).

Lessons for developing countries

- Ronald Lee (1980) "A Historical Perspective on Economic Aspects of the Population Explosion: the Case of Preindustrial England," R. Easterlin, ed., *Population and Economic Change in Developing Countries*: a conference report of the Universities-National Bureau Committee for Economic Research.
- Expanded previous work on preindustrial England and discussed its implications for links between population growth and economic development in developing countries.





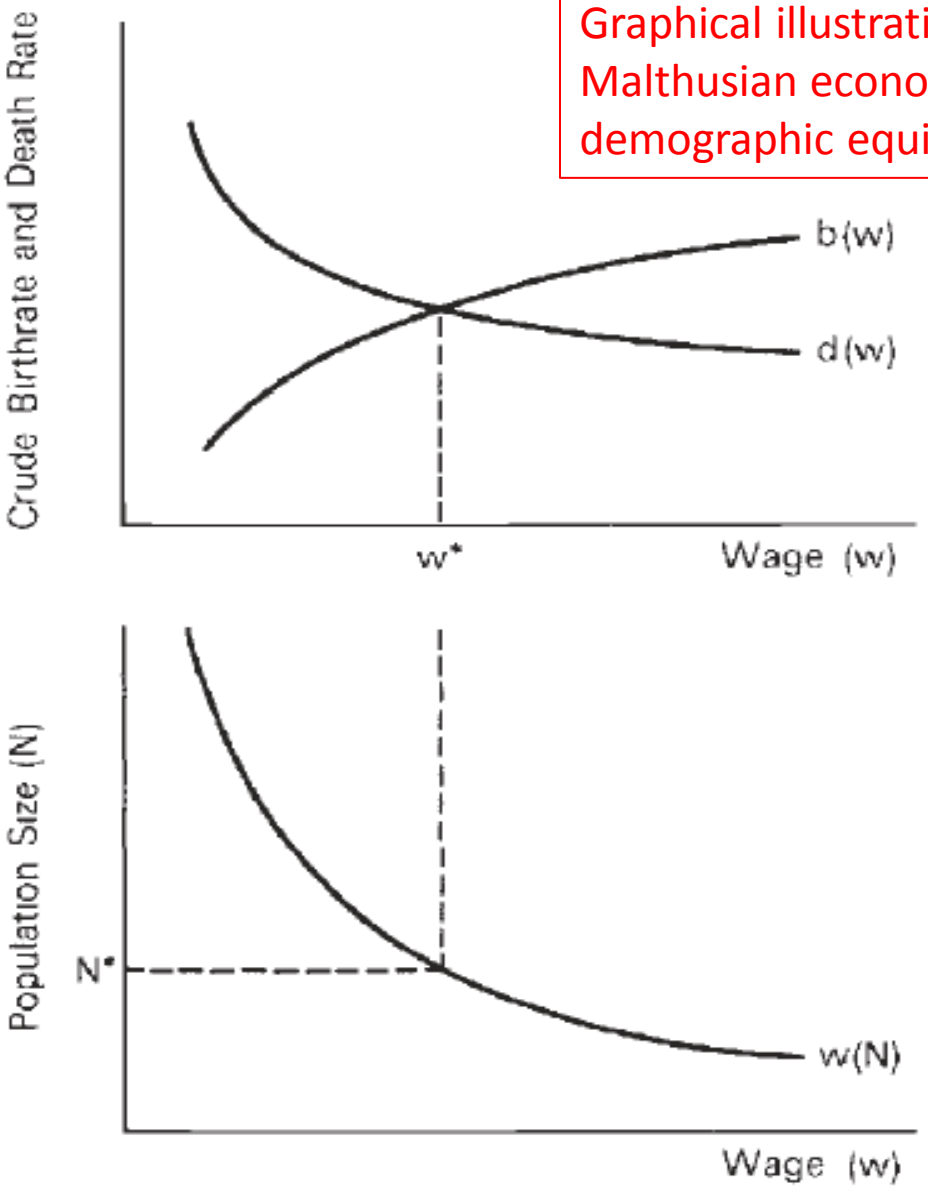
Clear negative relationship between population growth rate and wage growth rate.

BUT .. Positive population growth was associated with positive wage growth until population growth reached about 0.4% per year.

Ronald Lee (1980) "A Historical Perspective on Economic Aspects of the Population Explosion: the Case of Preindustrial England," R. Easterlin, ed., *Population and Economic Change in Developing Countries.*

Rates of change for population and wages in England, 1540–1800. Rates are given in percentage per year. Rates of change of wages are calculated from centered thirty-year averages of wages, except for 1795.

Graphical illustration of Malthusian economic-demographic equilibrium



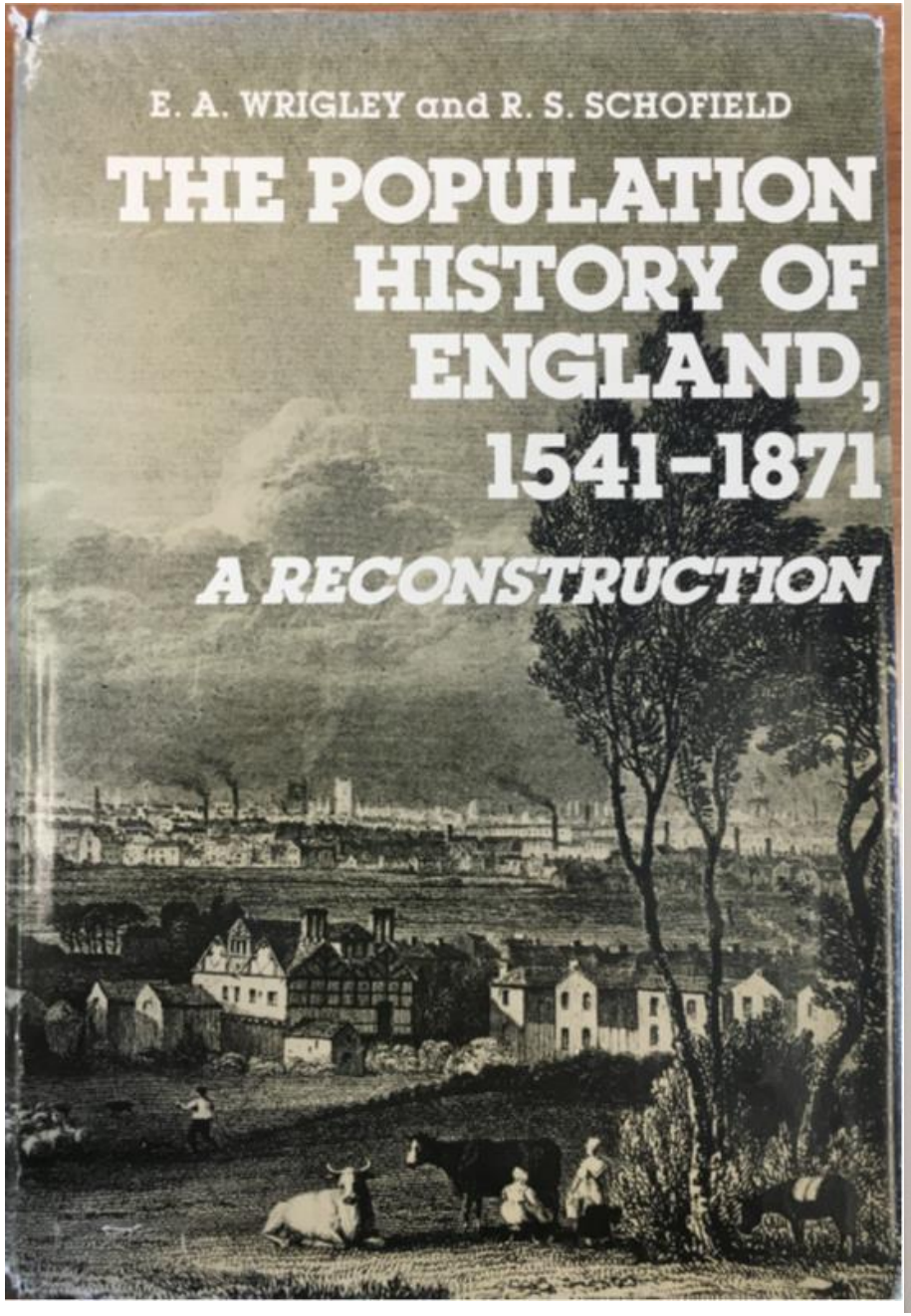
Ronald Lee (1980) "A Historical Perspective on Economic Aspects of the Population Explosion: the Case of Preindustrial England," R. Easterlin, ed., *Population and Economic Change in Developing Countries.*

Fig. 9.8 Economic-demographic equilibrium.

Ronald Lee (1980) "A Historical Perspective on Economic Aspects of the Population Explosion: the Case of Preindustrial England," R. Easterlin, ed., *Population and Economic Change in Developing Countries.*

9.5 Summary and Conclusions

For today's LDCs there is little empirical evidence on the economic effects of population change. For the economy of preindustrial England and perhaps Europe, on the other hand, population emerges clearly as the dominant cause of long-run change in wages, rents, industrial prices, and income distribution. The economy could absorb population growth at about 0.4% per year with little effect; deviations of population size above or below this trend line, however, had dramatic consequences. And perhaps more striking than the existence of these effects is the extreme sensitivity of the economy's reaction: reckoning in terms of agricultural goods, a 10% increase in population depressed wages by 22%; raised rents by 19%; lowered industrial prices relative to agricultural prices by 17%; raised the ratio of industrial to agricultural production by 13%; and lowered labor's share of national income by 14%.



The Population History of England 1541–1871

A reconstruction

E. A. Wrigley and R. S. Schofield
with contributions by Ronald Lee and Jim Oeppen

Ronald Lee (1981) "Short-term variation: vital rates, prices, and weather,," Chapter 9 of E.A. Wrigley and Roger Schofield, *The Population History of England 1541-1871: A Reconstruction* (Edward Arnold and Harvard University).

Harvard University Press
Cambridge, Massachusetts
1981

Short-term variation in prices and fertility

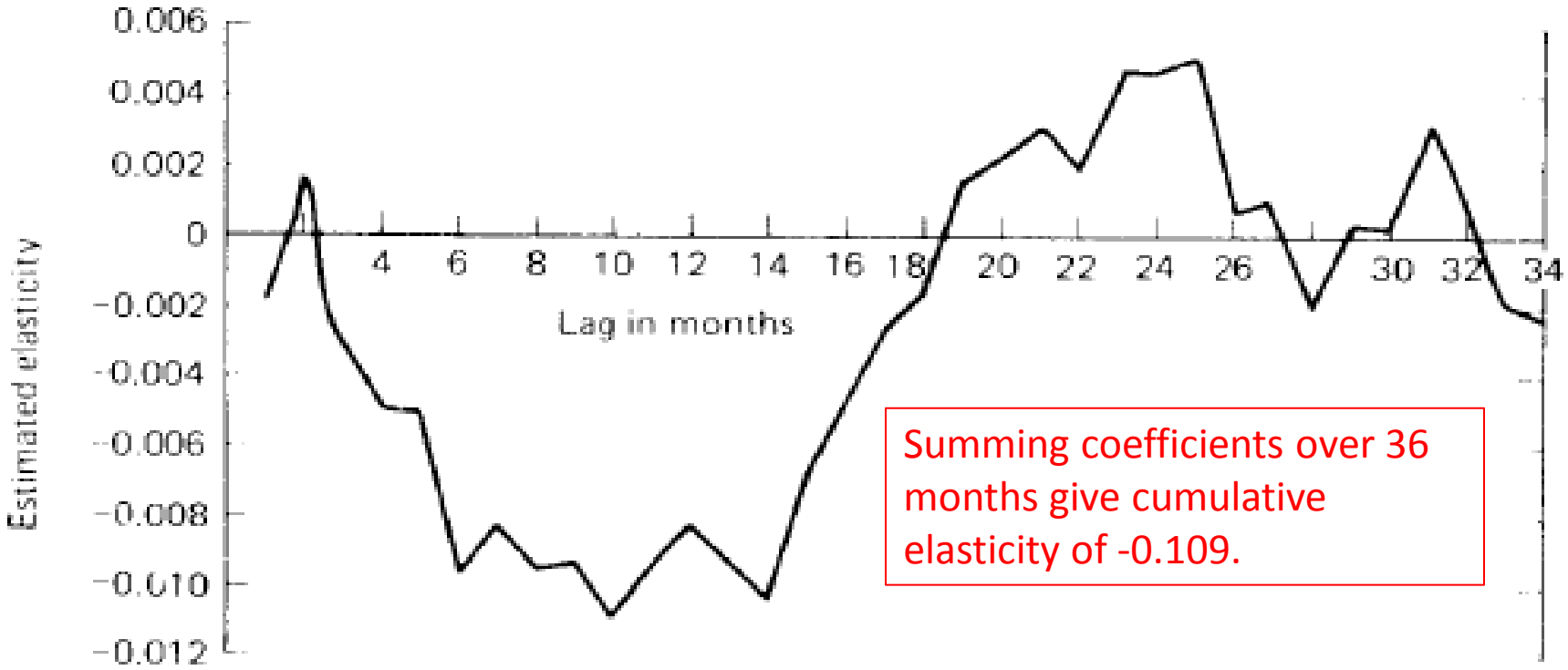
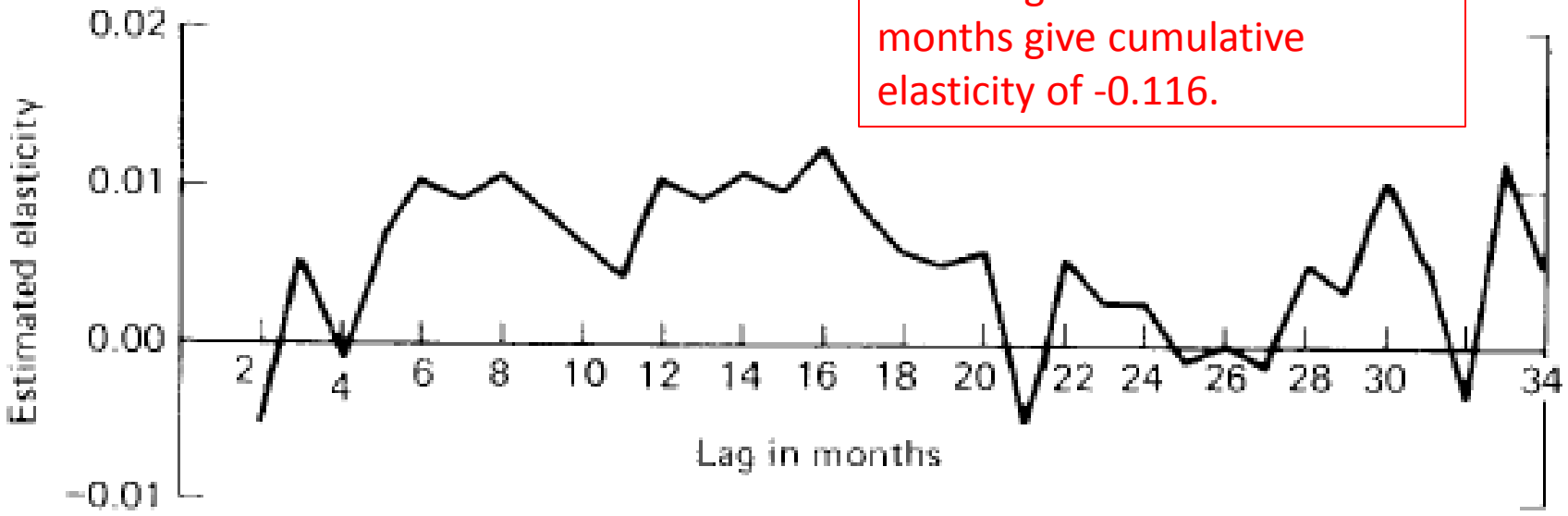


Figure 9.5: The reaction of fertility following a variation in wheat prices, by elapsed months (estimated from monthly data 1691–1834)

Ronald Lee (1981) "Short-term variation: vital rates, prices, and weather,," Chapter 9 of E.A. Wrigley and Roger Schofield, *The Population History of England 1541-1871: A Reconstruction* (Edward Arnold and Harvard University)

Short-term variation in prices and mortality

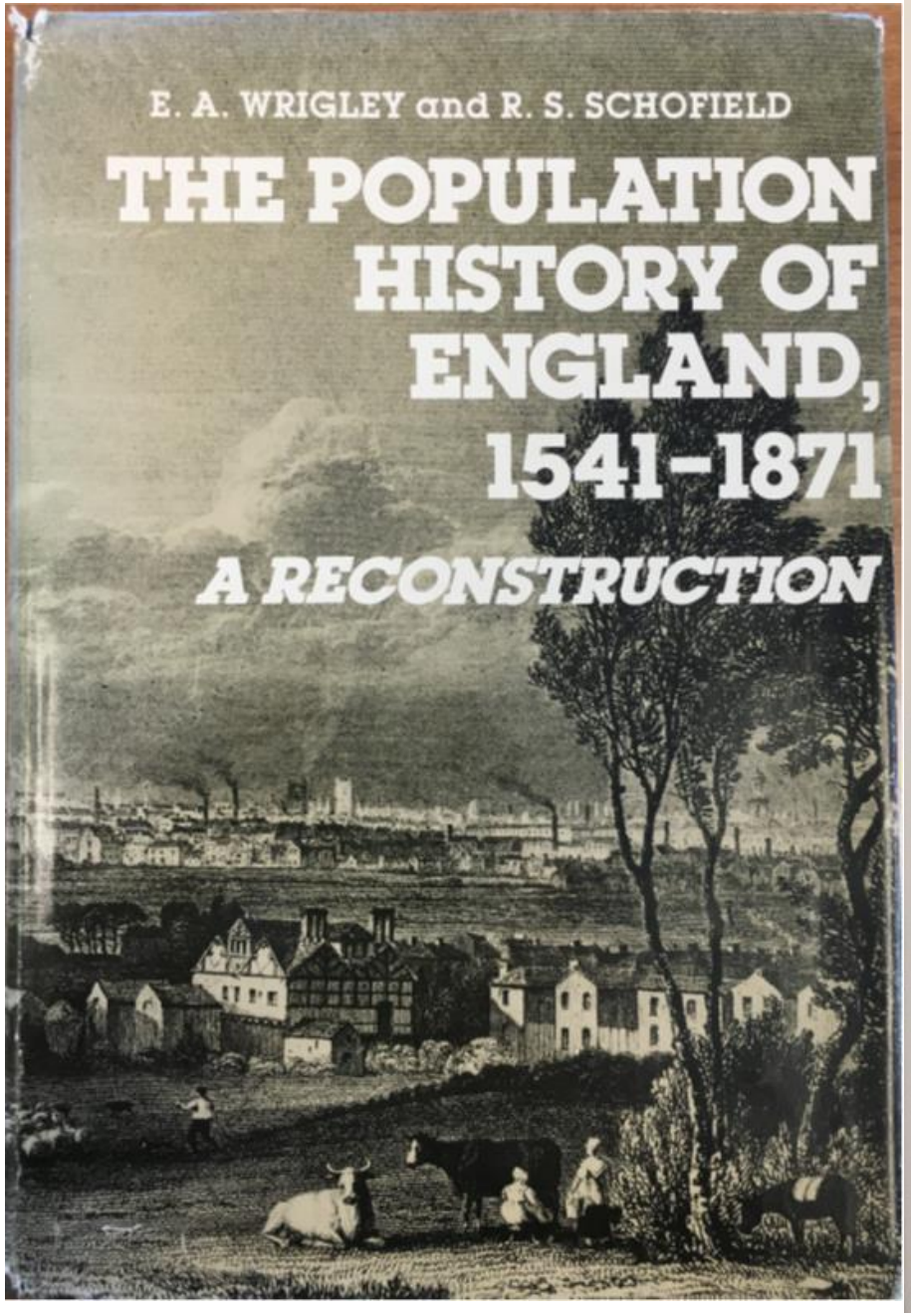
Summing coefficients over 36 months give cumulative elasticity of -0.116.



ty of the unsmoothed estimates. If we cumulate the coefficients over the 36
e find 0.116, a somewhat higher figure than the cumulated sum of 0.098 for
ee years of the annual estimates averaged for the last two periods (see table

g a variation in wheat
ited from monthly data

Ronald Lee (1981) "Short-term variation: vital rates, prices, and weather,," Chapter 9 of E.A. Wrigley and Roger Schofield, *The Population History of England 1541-1871: A Reconstruction* (Edward Arnold and Harvard University)



The Population History of England 1541–1871

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Conference at Asilomar, California, March 1982

Population Studies, **37** (1983), 445–464
With 6 text-figures
Printed in Great Britain

Age Distribution Adjustments for English Censuses, 1821 to 1931*

R. LEE AND D. LAM†

I. INTRODUCTION

This paper has four purposes: to study age distortion in English censuses; to apply Demeny and Shorter's method and some modest extensions of it to historical data; to compare the resulting estimates with those from existing nominal linkage studies; and to assess the age adjustments made by Wrigley and Schofield in their recent and important book, *The Population History of England, 1541–1871*.[1]

* An earlier draft of this paper was presented at the Conference on British Demographic History, held at Asilomar, California, March 1982. The research on which this paper is based was funded by a grant from NICHD, R01-HD14656.

Economic-Demographic Interactions and Population Homestasis

- Ronald Lee (1985) “Population Homeostasis and English Demographic History,” *Journal of Interdisciplinary History*, XV:4 (Spring 1985).
- Ronald Lee (1987) “Population Dynamics of Humans and Other Animals”, Presidential Address to the Population Association of America, *Demography*.

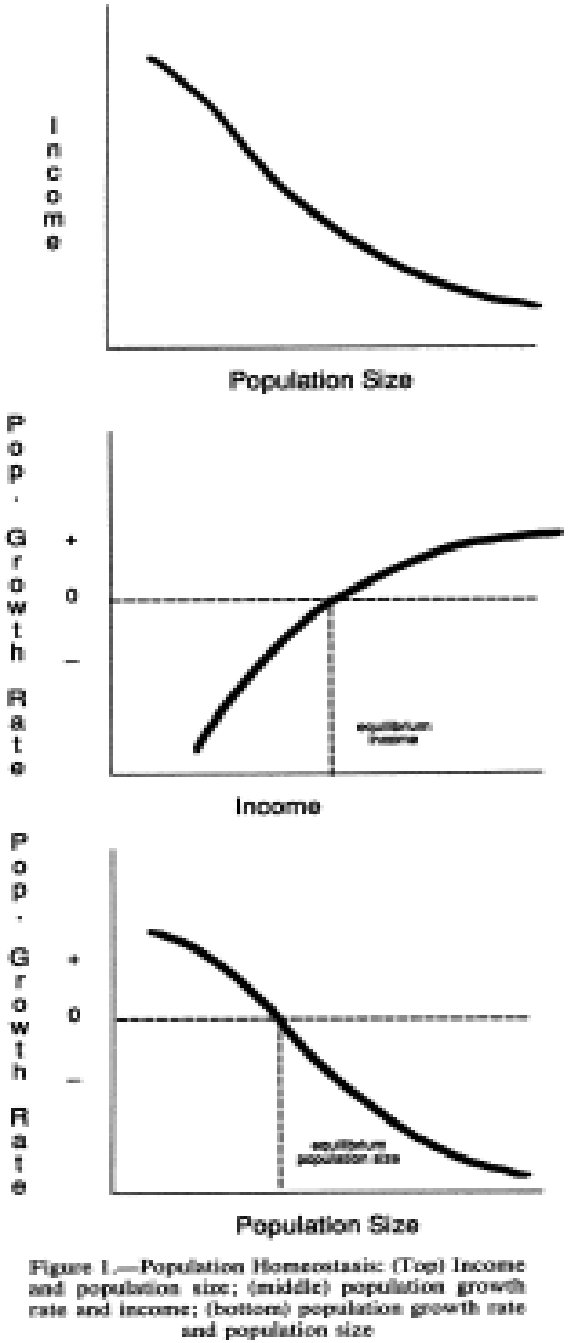


Figure 1.—Population Homeostasis: (Top) Income and population size; (middle) population growth rate and income; (bottom) population growth rate and population size

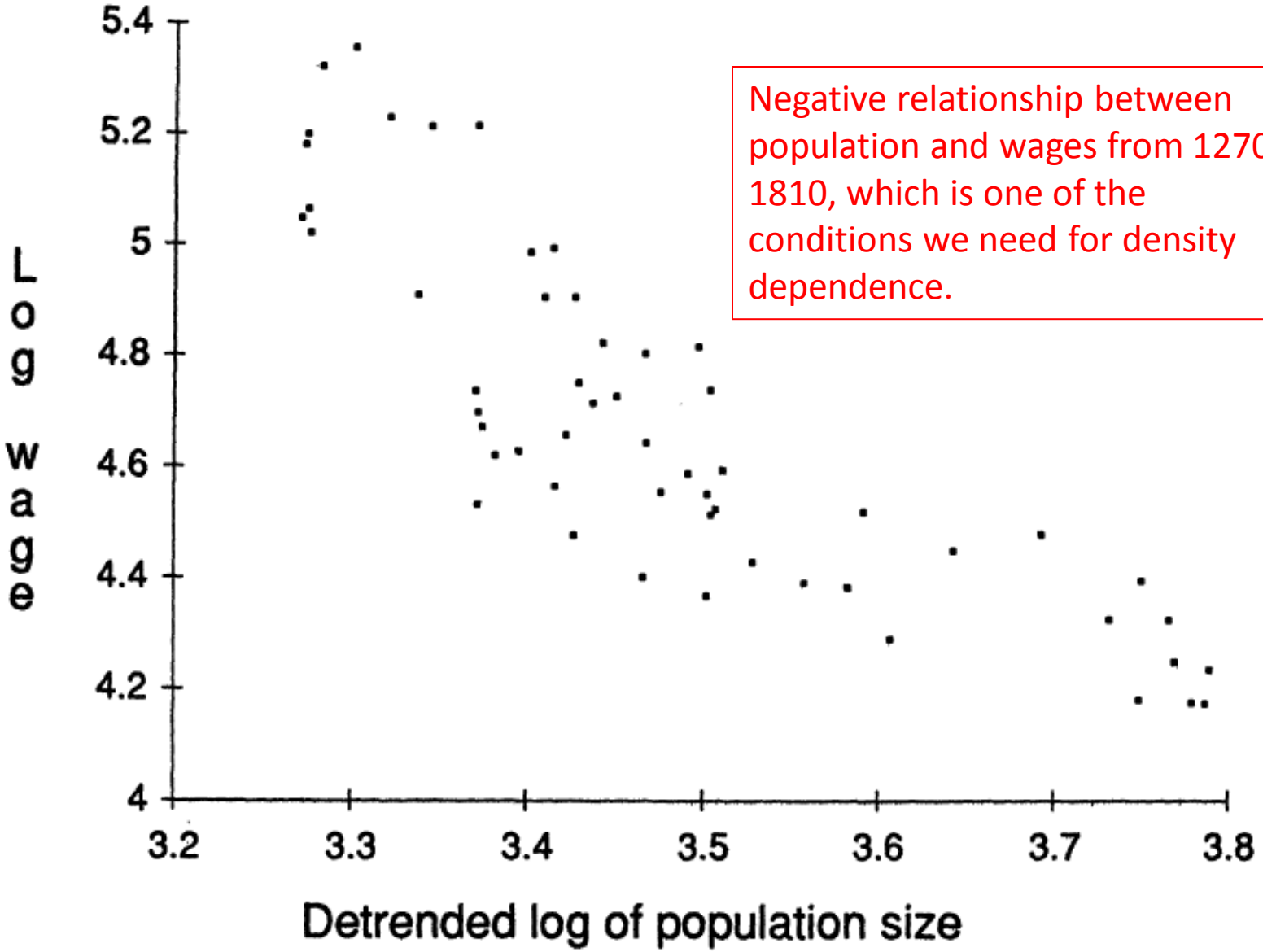
Model of population homeostasis (density dependence) working through relationship between income and population.

We need two things to be true to have density dependence through this mechanism:

1. Larger populations imply lower incomes.
2. Higher incomes imply higher population growth (through higher fertility and/or lower mortality)

These conditions imply a negative relationship between population size (density) and population growth.

Ronald Lee (1987) "Population Dynamics of Humans and Other Animals", Presidential Address to the Population Association of America, *Demography*



Negative relationship between population and wages from 1270-1810, which is one of the conditions we need for density dependence.

Figure 3.—Scatter Plot of Real Wages and Detrended Population Size (Europe, logs of decadal data, 1270–1810)

Ronald Lee (1987) "Population Dynamics of Humans and Other Animals", Presidential Address to the Population Association of America, *Demography*

Table 1.—European Wage–Population Elasticities

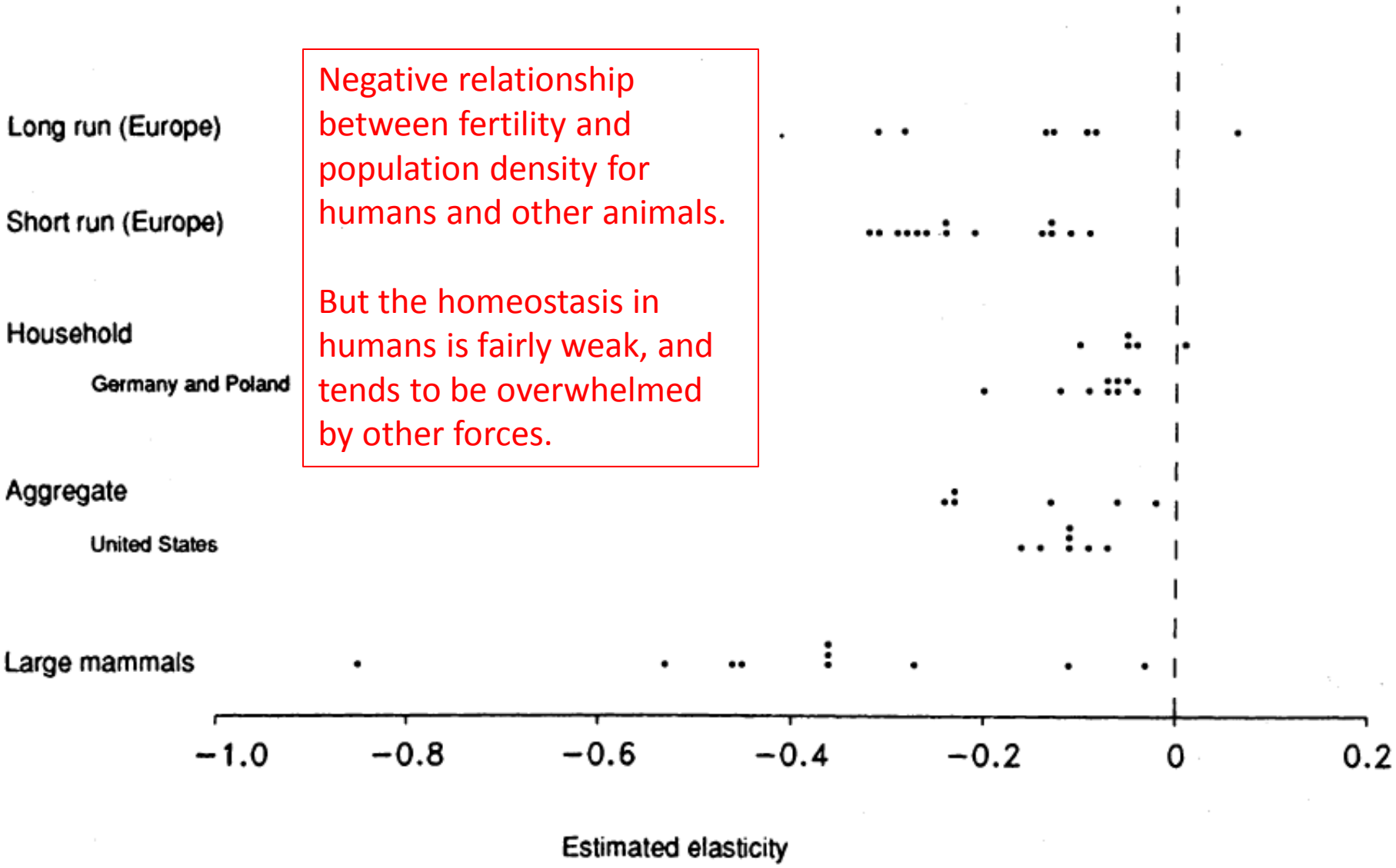
Area	Date	Elasticity
England	1260–1840	−1.2**
France	1270–1840	−2.2**
Italy	1360–1790	−1.0*
Germany	1500–1750	−2.4**
Austria	1520–1760	−2.5**
Poland	1530–1800	−0.9
Spain	1410–1610	−2.4**
Europe	1260–1840	−1.6**

Note: These come from regressions of the log of real wages on a constant, time, time-squared, inflation, and the log of population size (for the rationale, see Lee, 1985). The data are 10-year averages of real wages, centered on points of population size. All are adjusted for up to second-degree autoregressive residuals, as appropriate. The Spain regression did not include any time variables, as they were insignificant, or inflation.

* Significant at least at 0.05 level.

** Significant at least at 0.01 level.

Ronald Lee (1987) "Population Dynamics of Humans and Other Animals", Presidential Address to the Population Association of America, *Demography*



Negative relationship between fertility and population density for humans and other animals.

But the homeostasis in humans is fairly weak, and tends to be overwhelmed by other forces.

Figure 4.—Estimated Elasticities of Fertility With Respect to Density (various populations, time periods, and methods). Each line shows the distribution of the estimated elasticities for the populations indicated by the line headings.

Ronald Lee (1987) "Population Dynamics of Humans and Other Animals", Presidential Address to the Population Association of America, *Demography*

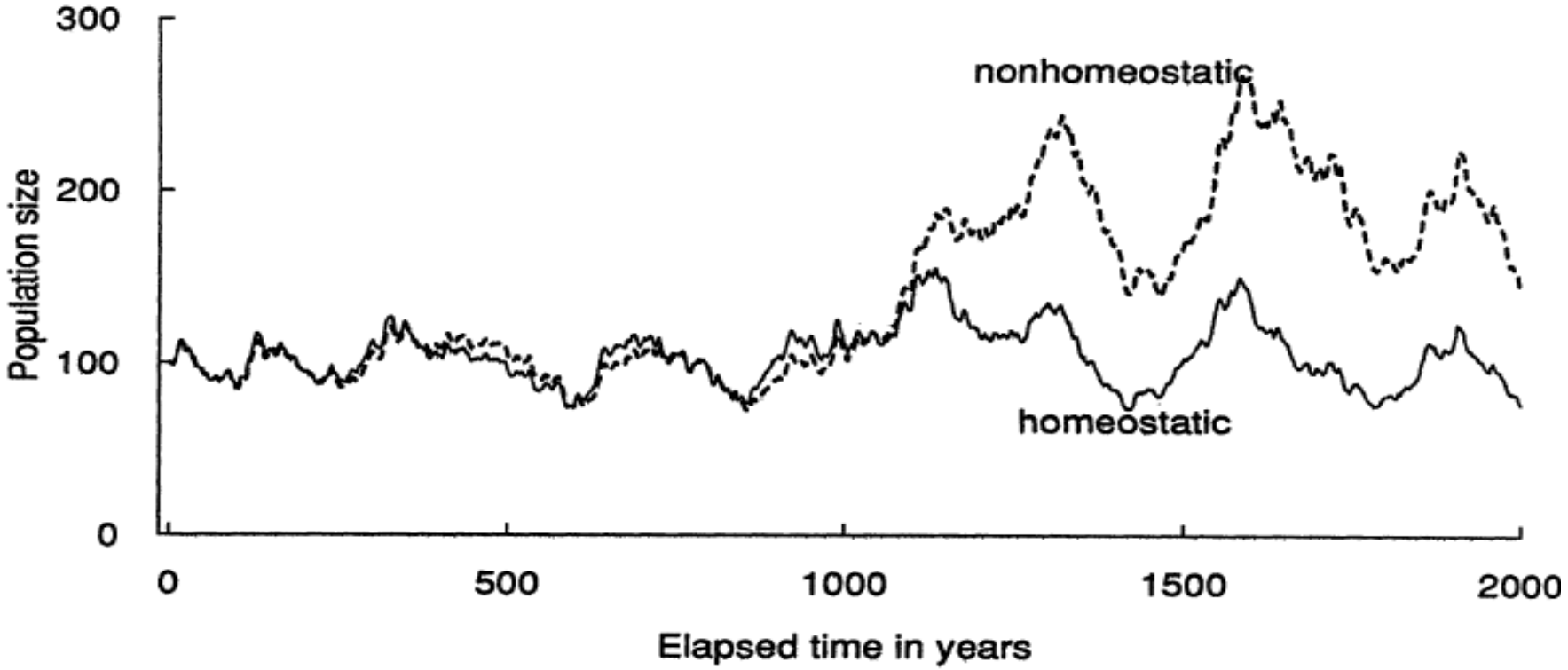


Figure 5.—Stochastic Simulation of Population Size With and Without Homeostasis (2,000 years). For details of the simulation, see text and note 24.

Visually, there is scarcely a discernible difference between the two for the first few centuries; the lines remain very close. Both drift around and appear largely random. These simulations show that homeostasis need not make much difference over the course of a few centuries, making it hard to recognize and limiting its importance as a force within historical periods of moderate length.[25] Many historians would disagree, but elasticities would have to be considerably higher for this result to be altered. Yet it would be misleading to leave the matter here, for the gentle nudge of homeostasis becomes a dominant force in the longer run. Eventually the two population trajectories come to differ by a great deal, and the greater stability of the homeostatic population becomes obvious.