Urbanization, Health and Income in Malthusian Europe

Gregory Clark, University of California, Davis

Introduction

A Farewell to Alms argued that pre-industrial England in particular, and Europe in general, had a distinctive demographic regime, "survival of the richest." In this regime the wealthy and the educated produced many more surviving children than the poor. Consequently there must have been substantial downward mobility. This provided a dynamic favoring the culture, and perhaps even the genes, of those oriented towards economic success for centuries before the Industrial Revolution.

Would the existence, however, of substantial urban areas in northern Europe by the seventeenth century have reversed this process, and ensured instead survival of the poorest and least educated? Jan de Vries, for example, cites "the dismal reproductive success of Londoners and other urban residents" as refutation of "survival of the richest."[1] In pre-industrial Europe those who would triumph demographically in the long run would be the products of "the idiocy of rural life": ill-educated and socially conservative.[2] Table 1, for example, shows that in England between 1500 and 1800 literate male will makers were concentrated in London and smaller towns. The table also shows the numbers of surviving children recorded in male wills by location.

---

[1] De Vries, 2008, 1181.

[2] Communist Manifesto (alleged to be a mistranslation of the original German). Engels refers later to rural life in terms of "the isolation and stupor in which it has vegetated almost unchanged for thousands of years" (*Housing Question*, Pt. III, Chapter 3).

London testators had few surviving children. Even among a relatively prosperous group of men, those leaving wills, the London population without constant migration from the countryside would have declined by more than a quarter each generation.

Here I show that higher mortality in cities did little to alter the strong association of wealth and reproductive success in pre-industrial England, and by extension the rest of Europe that shared with England the European Marriage Pattern. This was for two reasons. First although fertility was lower in the cities, the rich had as strong a reproductive advantage in cities as in the countryside. Second while massive London had extremely low rates of net fertility, smaller English cities and towns differed little demographically from those with non-farm occupations in rural areas. The majority of the pre-industrial urban population was located in these smaller towns.

The low net fertility of men in London and other urban areas did have a significant effect however in restraining English population growth before 1800, and thus in maintaining incomes in the Malthusian regime well above what they would have been had there been no urban areas.[3] Mortality in the cities also created a demographic regime that was surprisingly modern in terms of completed family sizes.

Since people were exposed to very different health environments in large cities like London than in the countryside, we can however, use their demographic behavior in town and countryside to test whether the peculiar demography of pre-industrial Europe was just a behavioral response to high child mortality rates. Was net fertility high among the rich because high mortality implied that to ensure at least one or two surviving children, average family sizes had to be big? The answer from comparing the behavior

[3] This is an argument that stems back at least to Wrigley, 1967.

of families in town and country is that there is no sign that child mortality risks before 1800 had any influence on demographic behavior. Instead the rich chose to have more surviving children than the poor whatever the mortality regime. Thus the Industrial Revolution began in a demographic regime that was very different from that in the modern world. It was not the product of any greater investment by parents in their children through smaller family sizes. If there is a quality-quantity tradeoff in fertility it comes significantly after the onset of the Industrial Revolution in 1770.

Mortality in Pre-Industrial Cities

There were three reasons for poor reproductive success by men in London and in towns. First, as table 1 shows, London men had a lower marriage rate than in smaller towns and the countryside. Many more died without evidence in their wills that they had ever been married. Interestingly this was happening despite the fact that pre-industrial cities had a considerable surplus of women.[4] London women's fertility must consequently have been even lower than that of men.

But the net fertility of the married or widowed was still much higher in the countryside, as the last column of table 1 shows. One major contributor to this was the much lower survival rate of city children. I can calculate child mortality by matching a subset of testators to parish records of births and baptisms attributable to that testator. For each birth, the testator's will attests whether the child was alive at that date. From this I can calculate the fraction of children, by location and wealth class, surviving to a given age. As table 2 shows, the survival rate of children to reproductive ages was lower in towns. Only 44% of London children whose birth or baptism was

[4] See Finlay, 1981, 140-2.

recorded survived to age 25. At the other extreme the children of rural males engaged in farming had survival rates of 69%.

These differences in survival rates between urban and rural families explain much, but not all, of the differences in net fertility for married couples. As table 2 shows, the implied gross fertilities of the most rural families was still about 25% higher than that for London families. Thus on balance the low net fertility of London males was only partially explained by its very high child mortality rates. Had London child mortality rates been the same as the average of rural rates men's net fertility levels there would still have been only 80 percent of those in rural areas (actual rates were 51 percent of rural rates).

Table 3 shows that urban areas were particularly difficult for boys. In London only 42% of sons survived to age 25, in comparison to 47% of daughters. In contrast for the most rural of families, those in the countryside engaged in farming, 71% of sons survived to age 25 but only 67% of daughters. The excess of women in the cities thus partly stemmed from the much greater health dangers of the urban environment to males.[5]

Adult males also had lower life expectancies in urban areas than in rural. For a group of the will makers I can calculate their age at death by linking them to the date of their birth or baptism in the parish records, or to the date of their first marriage or first born child.[6] From this I can calculate their life expectancy at age 25, by looking at testators dying only aged 25 and above. Table 3 shows that males who survived to 25 had an average age of death of

---

[5] The excess of females in cities has been explained by differential female migration to cities because of the opportunities for women in domestic service. But for London deponents in ecclesiastical courts, 1675-1725, the proportion of women born outside London (69%) was less than the proportion of men (74%). Earle, 1994, 47.

[6] This assumes that they had the average age of marriage or birth of first child.

53.4, but for those engaged in farming in the countryside the average age of death was 59.7. This difference, while significant, is less dramatic than the differences in child mortality. Thus the young adults who migrated to cities like pre-industrial London did not place themselves at substantially higher mortality risk.

They did, however, expose their children to much greater mortality risks. Combining the information on adult mortality with the life tables of males born in each location up to age 25 gives life expectancy at birth. For men in London in 1500-1800 this was only 22.6 years, even though testators and their children formed the upper end of the income distribution. In contrast for men in farming in the countryside it was 42.8 years.

Net Fertility by Location and Assets

From 1500 to 1800, as table 4 shows, the rich produced many more surviving children than the poor. In the table testators are divided into rough quartiles based on the income they would get from their wealth at death. The annual earnings of a laborer in this period would be about £10 per year, and of a craftsman £15, so the richest group had earnings from their assets at least three times that of a laborer, and double that of a craftsman.

This strong association of fertility with assets at all locations means that the lower net fertility of cities could only create an overall negative association of net fertility with assets if there was an impossibly strong correlation of the rich with cities. If the rich and poor were equally distributed across all locations "survival of the richest" would be as strong with the presence of cities as without. If a concentration of the rich in the cities was to reverse this general pattern then what would be crucial would be

the fraction of the rich found in London, not in smaller cities which had net fertility rates little below those of the rural areas.

Table 5 shows the share of the population at various dates 1500-1800 estimated to fall into each category. To estimate the share of the rich living in each location I can use the ratio of testators with asset incomes of £31 or more, relative to those more representative of the average male, those with asset incomes less than £6. That ratio was 0.64 for farm testators, 0.68 for town testators, and only 0.28 for rural non-farm testators. For London I do not have a representative sample from which to estimate this ration. But even if we assume this ratio was much higher that of the farm population it still implies a very modest reweighting of the rich towards areas of lower fertility.

The last column of table 4 shows the implied net children per male of each asset class in the country as a whole if the rich were fully five times the share of males in London as in the countryside. In this case London, with on average 7% of English population in 1500-1800 would contain 31% of the richest men. Yet as the last column of table 4 shows this would still leave intact a very strong pattern of "survival of the richest"

Why 'survival of the richest'?

We can again use links of testators to the parish records of births, baptisms, and marriages to get some insight into the causes in all locations of higher net fertility by the rich. The first thing that emerges is that it is only very modestly explained by higher rates of child survival. Table 6 shows the survival rates of children to age 25 by wealth class. Because of small sample sizes the data is divided just into urban and rural populations. In both locations the rich had a very modest advantage in terms of child survival.

Also the survival advantage is exhausted once we get to quite modest wealth levels and there is no further gain thereafter. The reproductive success of the rich must thus mainly stem from their having higher rates of gross fertility than the poor in both town and country.

If we look at the determinants of gross fertility, we find that many factors combine to produce higher gross fertility rates for the rich. More rich testators were married than for poor, in both rural and urban areas (table 7). As table 7 also shows, the poorest men in urban and rural communities also tended to marry wives who were a little older at first marriage (though here the numbers of observations make any conclusion tentative).

But there were also differences in the number of children born within marriages. Table 8 shows the numbers of births observed for families with at least one observed birth for marriages before 1790 by wealth. There were 25% more observed births for the richest group. This higher gross fertility could be the result of closer spacing of births, or a longer span of childbearing. There was no difference in the spacing of births between rich and poor. Thus if we look at the gap between the first and second births controlling for location and time period there are no significant differences by wealth (births are more closely spaced in London, presumably as a result of the much higher mortality there).[7] And if we look at the average birth span within marriage it tends to be higher for the richer. Instead what created the difference was a longer span of childbearing in the marriages of the rich. The last observed birth for the richest group is nearly 3 years later measured from marriage than the last observed birth of the poorest group.

If we consider the ways in which fertility could be limited by men in pre-industrial Europe we see that these include avoidance of marriage, marrying

[7] The birth interval is lower for the richest group, but this difference is not statistically significant.

older women, increasing the gap between births by such methods as coitus interruptus, and earlier stopping of births by abstinence and other methods. Looking at the higher gross fertility of the rich in urban and in rural settings we see little sign of any of these steps towards control – rich men married more frequently, they married younger women, and the fertile span in marriages was significantly longer. The only sign of possible control was that the gap between births was significantly higher, controlling for location, time period, and total numbers. But that may be explained by the differences in child mortality between rich and poor: the gap between births was low for all men in high mortality London.

In particular richer men show no sign that they were responding through marital and other behaviors to the differential mortality regimes in rural and urban areas. *A Farewell to Alms* sought to explain the Demographic Transition of the late nineteenth century as a product of the Industrial Revolution of 1800 by suggesting that it was a response to lower mortality rates. Net fertility rates have in fact changed little between the Malthusian and the modern era, as figure 1 shows for England. The argument was that in the pre-industrial world in order to have reasonable chance for a surviving child families had to produce many more offspring than was ideally desired. The rich thus used their resources in the pre-industrial mortality regime to have larger numbers of births. But as the process of producing surviving children became more certain in the nineteenth century, they sharply reduced their gross fertilities, and did so before the poor who were slower to experience these mortality reductions.

But if this explanation is to be correct then richer men placed in the widely varying mortality regimes of pre-industrial England should have responded by varying their reproductive behavior also. In particular those in the relatively safe rural environments should have exhibited such behaviors

as marrying older women, and reducing gross fertility within marriage. Instead what we see in table 9 is that ever married rich men produced more births in the safer rural environment than they did in London. In a separate paper I and Neil Cummins also show that the rich in England change their fertility behavior within marriage quite quickly for marriages commenced in 1800 and later towards lower gross fertility rates within marriage. They do this in a period where, except for London, there is no observed improvement in their child survival rates. As a consequence of this change chances of a surviving child fell significantly for the rich after 1800.

The pre-industrial demographic regime thus shows a fundamental difference in terms of the response of fertility to income.

Urbanization and Aggregate Incomes

It is well known that England and the Netherlands were rich by the standards of the Malthusian era. These societies were richer in particular than India, China and Japan on the eve of the Industrial Revolution. To what extent did the very high mortality rates in large European cities like London and Amsterdam, as well as their lower levels of gross fertility, contribute to this unusual wealth? I calculated above like expectancy at birth for men in pre-industrial London. At 23.3 the life expectancy of males in London is extremely low even by the standards of the pre-industrial world. In 1801 London had a population of 959,000, one in 9 of the English. It was the second largest city in the world, after Beijing. Amsterdam, at 200,000, was considerably smaller, but still contained 1 in 13 of the Dutch. What would English population and income have been by 1800 in the absence of London and other urban areas?

Using the data in table 1 I calculate an alternative national population growth rate between 1500 and 1800 where the population of London and other urban areas was instead assumed to have the net fertility of the non-farming population in rural areas. Since most of the population would be those with asset income less than £6 per year, I use the fertility of this group as the reference level for this exercise. With just this adjustment, and assuming no feedback on fertility from potentially lower incomes as a result of larger population, I calculate the counterfactual population levels shown in figure 2. Population in 1801 is calculated to increase by 51 percent from its actual level.

The effect of this higher population on incomes can be calculated by assuming that production was roughly Cobb-Douglas, and that higher population levels would not have changed the rate of return on capital.[8] In that case if the population in 1800 changed from N to N* then the new wage w* relative to the old, w, assuming wages were the marginal product of labor would be,

$$\frac{w*}{w} = \left(\frac{N}{N*}\right)^{\frac{c}{(1-a)}}$$

where c is the share of income going to land and natural resources, and a the share going to capital. For England in 1800 c was in the range 0.20-0.25, and a in the range 0.25-0.30. Thus the decline in wages from an increase of population of 51% would be 11-13 percent. This is not a dramatic decline, and is less than what was observed empirically when population in England increased in the sixteenth century. Thus between 1500-9 and 1580-9 the growth of population of 52 percent was accompanied by a 28 percent decline in real wages. But in either case this simulation exercise confirms the

[8] This assumes that yields in agriculture could increase significantly to maintain a higher level of population.

important role that London and other urban places played in restraining population growth in such high income societies as pre-industrial England and the Netherlands.

Conclusion

Large urban areas in pre-industrial Europe, such as London, created a very different disease environment. However, they did not diminish the surprising and powerful fact of pre-industrial European demography – the overwhelming reproductive advantage of the rich. The relative importance of very large cities such as London and Amsterdam however, did raise incomes in countries like England or the Netherlands before 1800. Without London English real wages could have been 10-30% lower by 1800 on the eve of the Industrial Revolution. The reproductive behavior of both rich and poor in the very different mortality risk environments they were exposed to before 1800 does imply however that the reversal of the income-fertility relationship after the Industrial Revolution cannot be explained by declining mortality risks in the late nineteenth century.

Table 1: Male Testators 1500-1800, Literacy and Net Survivors by location

Group	Number	Literate (%)	Surviving Children (all)	Single (%)	Surviving Children (married)
London	556	76	1.47	19	1.76
Town	665	76	2.45	13	2.82
Rural – non farm	1,473	62	2.54	15	2.98
Rural – farm	1,971	51	3.16	10	3.50

Table 2: Mortality in Town and Country 1500-1800

Group	Births	Fraction alive at 25 (all)	Implied Gross Fertility (married)
London	445	0.44	3.99
Town	1,161	0.63	4.50
Rural	1,628	0.67	4.45
Rural - farm	2,123	0.69	5.06

Table 3: Male Life Expectancy in Town and Country 1500-1800

Group	Males alive at 25	Females alive at 25	Fraction Surviving Children Female	Average age at death	Implied Male e_0
London	0.42	0.47	0.54	53.4	22.6
Town	0.60	0.66	0.50	57.0	34.8
Rural	0.69	0.65	0.47	58.1	40.5
Rural– farm	0.71	0.67	0.48	59.7	42.8

Table 4: Net Children by location as a function of assets, 1500-1800

Asset income	London	Town	Rural	Farm	ALL[a]
£0-6	1.10	1.78	2.05	2.36	2.13
£6-13	1.49	2.37	2.65	3.03	2.60
£13-31	1.56	2.46	2.83	3.58	2.94
£31-	2.03	3.51	3.60	3.97	3.28
ALL	1.42	2.45	2.54	3.16	

Notes: [a]Assuming rich men are more times as frequent relative to the general population in London than in farm occupations.

Table 5: Urban and Rural Population Shares, 1500-1800

Period	London	Town	Rural	Farm
1500	0.02	0.07	0.31	0.60
1550	0.02	0.08	0.30	0.60
1600	0.05	0.09	0.26	0.60
1650	0.07	0.08	0.25	0.60
1700	0.11	0.11	0.18	0.60
1750	0.11	0.14	0.25	0.50
1800	0.11	0.14	0.40	0.35

Table 6: Survival Chances to age 25 by wealth class

Asset income	Fraction surviving to 25 (all)	Fraction surviving to 25 (rural)	Fraction surviving to 25 (urban)
£0-6	0.60	0.62	0.49
£6-13	0.68	0.71	0.55
£13-31	0.65	0.69	0.51
£31-	0.69	0.73	0.54

Table 7: Marriage Rates and Ages, Urban versus Rural

Group	Rural, Percent never married	Urban, percent never married	Rural, female age first marriage	Urban, Female Age First Marriage
£0-6	13.6	18.3	25.5	24.1
£6-13	12.9	15.5	23.5	22.8
£13-31	9.6	15.3	23.3	24.6
£31-	8.4	9.7	23.8	22.8

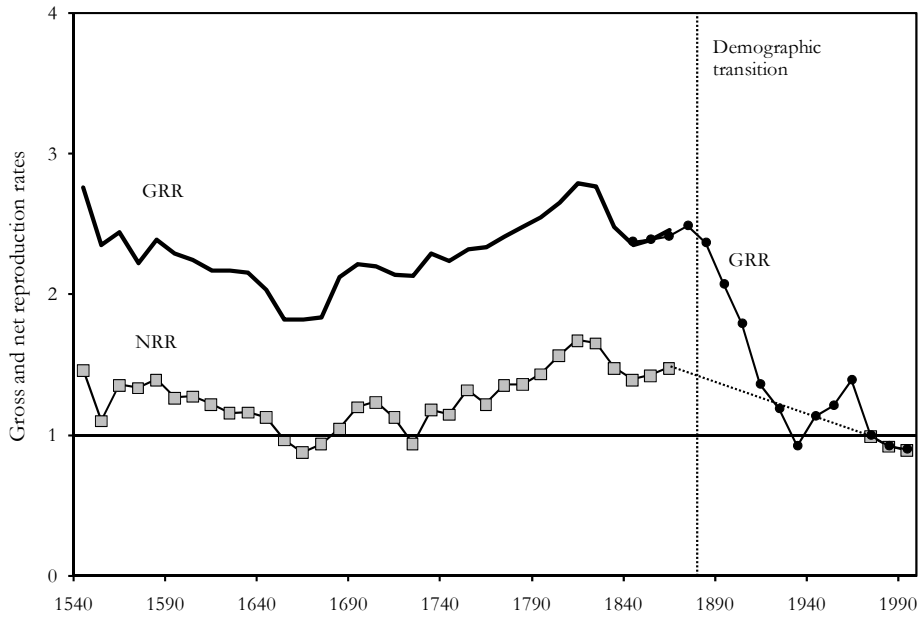
Table 8: Birth Intervals and Birth Span

Group	Number of Families	Observed births	Birth Interval (1-2)	Span – marriage to last birth	Average gap between births
£0-6	165	4.01	2.27	10.79	2.40
£6-13	151	4.38	2.29	12.93	3.02
£13-31	141	4.76	2.40	12.51	2.79
£31-	110	4.95	2.06	13.54	2.83

Table 9: Fertility of the rich married as a function of child mortality

Location	Net Fertility	Survival rate (25)	Gross Fertility
London	2.18	0.41	5.37
Town	4.00	0.65	6.12
Rural	4.05	0.71	5.67
Rural – farm	4.27	0.73	5.87

Figure 1: Net and Gross Fertility, England 1540-2000



Source: Clark, 2007, figure 14.6.

Figure 2: English Population without reduced fertility in urban areas

References:

Clark, Gregory. 2007. *A Farewell to Alms: A Brief Economic History of the World.* Princeton: Princeton University Press.

Clark, Gregory and Neil Cummins. 2008. "Malthus to Modernity: Income, Fertility and Economic Growth in England, 1500-1912."

de Vries, Jan. 2008. "Review of *A Farewell to Alms." Journal of Economic History*, 68(4): 1180-1.

Earle, Peter. 1989. *The Making of the English Middle Class: Business, Society and Family Life in London, 1660-1730.* Berkeley: University of California Press.

Earle, Peter. 1994. *A City Full of People: Men and Women of London, 1650-1750. London: Methuen.*

Finlay, Roger. 1981. *Population and Metropolis: The Demography of London, 1580-1650.* Cambridge: Cambridge University Press.

Harding, Victoria. 1990. "The population of London, 1550-1700: a review of the published evidence." *London Journal*, *15*.

Knauft, Bruce M. "Divergence between Cultural Success and Reproductive Fitness in Preindustrial Cities" *Cultural Anthropology*, *2*(1):

Landers, John. 1993. *Death and the Metropolis: Studies in the Demographic History of London, 1670-1830.* Cambridge: Cambridge University Press.

Sharpe, Pamela. 2000. "Population and Society 1700-1840." In Peter Clark (ed.), *The Cambridge Urban History of Britain, Volume II, 1540-1840*, 491-528. Cambridge: Cambridge University Press.

Woods, Robert. 2003. "Urban-Rural Mortality Differentials: An Unresolved Debate." *Population and Development Review*, 29(1): 29-46.

Wrigley, E. A. 1967. "A Simple Model of London's Importance in Changing English Society and Economy, 1650-1750." *Past and Present, 37*: 44-70.