Malthusian Dynamism and the Rise of Europe: Make War, not Love

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Malthusian conditions are a byword for stagnation. We argue that this view is wrong. Europe's relative riches in 1700 are best understood as the result of Malthusian forces favoring high per capita output. Favorable shifts in mortality and fertility schedules were responsible. Incomes between 1300 and 1800 rose because of two related but distinct European ”inventions” - a peculiar marriage pattern and a specific mortality regime. These interacted with the political, social and economic environment in such a way as to make higher equilibrium incomes sustainable.

Even in a Malthusian world, incomes can change, but only in the short-run. They did so markedly after the Black Death. As land-labor ratios rose in an economy subject to strong declining marginal returns, workers became more productive. Income after 1350 rose - perhaps by as much as a factor of three (Phelps-Brown and Hopkins, 1981; Clark, 2005). In a Malthusian world where land-labor ratios are a prime determinant of income levels, such riches should not last. Birth rates increase; death rates fall. Population rises in response to the windfall. Eventually, the economy returns to the previous equilibrium, with identical wages and population size.

The logic of the Malthusian world leads Clark (2007) to conclude that Englishmen in 1800 were as poor as their ancestors on the African savannah. Yet, Europe in the early modern period was unusually rich, despite abundant evidence that hard times could drive up death rates (Malthus' ”positive check”) and that they reduced birth rates.[1] Western Europe in 1700 already was at least twice as urbanized as any other part of the globe. Incomes probably towered over those in other areas, recent arguments by the 'California School' that emphasizes the productivity of the Yangtze area not withstanding.[2] The emergence of such differences in income should be puzzling in a world where Malthusian forces are strong, and technological progress as well as institutional improvements were slow.

This paper argues that Malthusian regimes are capable of sustained changes in per capita incomes. Shifting mortality and fertility schedules can lead to different steady-state income levels, with long periods of growth during the transition.[3] Europe checked the downward pressure on wages through late marriage, which reduced fertility; and a

[1]This may also have facilitated the transition to self-sustaining growth after 1800, as we argue in Voigtländer and Voth (2006).

[2]Pomeranz (2000); Goldstone (2003). Recent work by Broadberry and Gupta (2005) suggests that income differences remained substantial.

[3]This argument is also explored in Mokyr and Voth (2009).

mortality regime that combined high death rates with high incomes. We argue that both emerged as a result of the Black Death.

I. Malthusian Basics

The economy produces a homogenous good – food – using a Cobb-Douglas technology with labor (L) and land (T) as inputs. Per-capita income is given by

$$y = A\left(\frac{T}{L}\right)^{\alpha} , \tag{1}$$

where α is the land share of income. Land is in fixed supply. In the short-run, p.c. income grows in TFP (A) and decreases in population. Population growth γ_L, in turn, responds to nutrition, and is given by the difference between birth rates (b) and death rates (d). This relationship is captured by

$$\gamma_L = b - d \; = \; b_0 \left(y/\underline{y}\right)^{\varphi_b} - d_0 \left(y/\underline{y}\right)^{\varphi_d} \; , \tag{2}$$

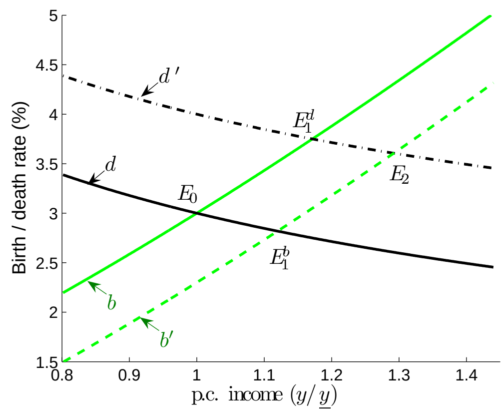
where $\underline{y}$ denotes "subsistence" income,[4] and b_0 (d_0) is the birth (death) rate at $\underline{y}$. We choose $b_0 = d_0 = 3\%$. This corresponds to a life expectancy of 33 years. Next, we use $\varphi_b \simeq 1.4$ and $\varphi_d \simeq -0.5$ as the elasticities of birth and death rates with respect to income, respectively.[5] Therefore, higher income translates into more births and lower mortality. This relationship is shown by the solid curves in figure 1.

In the short run, population L is given, and (1) determines p.c. income. In the long-run, however, the population dynamics given in (2) pin down the land-labor ratio, which in turn affects y. In the absence of technological progress, death rates equal birth rates, and L is constant. The same holds for per capita income. The level at which y stagnates depends on the location of the fertility and mortality schedules, as represented by point E_0 in figure 1. A one-time increase in TFP temporarily relieves Malthusian constraints; population can grow. Eventually, the falling land-labor ratio drives wages back to their original level. Per-capita income is thus self-equilibrating.

[4] Initially, incomes stagnate at this level. Note, however, that complete starvation need not follow if incomes fall below $\underline{y}$. Rather, death rates exceed birth rates, and population slowly falls.

[5] Values for φ_b and φ_d are from Kelly (2005). We discuss the choice of parameters in Voigtländer and Voth (2008b).

Figure 1: Long-run equilibria



Despite the power of self-equilibrating forces, stagnation at subsistence is not inevitable. In the following, we analyze three mechanisms that can change the long-run income level.

II. A European Mortality Pattern

War was the favorite game of princes. It was practiced avidly in early modern Europe. As Tilly (1992) shows, European powers were at war for an average 90 out of every 100 years between 1500 and 1800. How could European powers come to fight each other so frequently? In Voigtländer and Voth (2008b), we argue that the great plague of the 14th century is indirectly responsible.

As incomes increased beyond subsistence levels, Europeans everywhere began to buy more than just food. Many highly income-elastic goods were produced in towns, such as cloth and tableware, cutlery and shoes. Market transactions were necessary to obtain the cash for these purchases – monetization increased. Importantly, towns offered access to the liquid wealth that princes needed to fund their wars. Cities were also more easily taxed than peasants in the countryside, whose contributions were principally in kind. War, therefore, was a superior good for rulers in early modern Europe, and one whose availability depended more on the per capita income of citizens than on absolute output. In a highly fragmented political environment, the surge in available funds produced a rapid and sustained rise in the frequency and intensity of warfare.

Military technology in early modern Europe was too primitive to wreak much havoc directly, the horrors of the Thirty Years War not withstanding (Landers, 2003). Armed conflict was deadly not because of battlefield deaths or direct civilian casualties, but because of diseases spread by troops. The plague itself was brought to Europe as a result of the siege of Kaffa in the Crimea, after the besieging Tartars used catapults to throw the corpses of deceased soldiers over the city walls. Until the 19th century, diseases spread in the wake of marching armies were more deadly than the fighting itself. Geographical heterogeneity and the relative isolation of many population ensured that even mild diseases such as influenza could turn into a major cause of death.

Passing armies would often requisition seed and livestock, causing peasants to starve. While the destruction that followed was negative for output in the short run, frequent and early deaths were beneficial for the survivors' incomes. Higher post-plague incomes yielded a greater extractable surplus. This was partly used by European kings to fight each other. The upward shift in death rates was reinforced by two auxiliary factors - diseases spread via trade routes, and the unhygienic conditions in early modern European cities.

After 1348/49, the plague broke out again and again in Europe, before vanishing in the 18th century. Epidemics of other diseases, such as typhus and smallpox, were also common. Where they were not spread by troops on the march, they often arrived in the bottoms of merchant ships or on the waggons of traders. The last plague outbreak in Western Europe, in Marseille in 1720, was due to a merchant vessel bringing silk and other goods from the Levant. Trade increased as a result of the higher incomes after the Black Death. These higher incomes went hand-in-hand with higher death rates, thus producing a self-reinforcing effect in a Malthusian setting.

European cities were famously unhealthy. Before 1850, most of them would have disappeared had it not been for continuous in-migration. Life expectancy in London, 1580-1799, was approximately 27 years, compared to 35-38 in Britain as a whole.[6] In part, specific cultural practices were to blame. While Europeans dumped their chamberpots out of the window, Chinese cities ferried human excrement to the countryside, where it was used as fertilizer. Higher incomes meant that more meat was consumed in Europe. The proximity of animals such as chickens and pigs spread disease (Diamond, 1997).

[6] Landers (1993); Wrigley, Davies, Oeppen and Schofield (1997).

Finally, due to frequent warfare, many European cities were surrounded by massive fortifications. As population size increased, densities had to rise - expansion outside the city walls was dangerous, and moving Italian-style fortifications much too costly. High densities, polluted water sources, and unhygienic cultural practices conspired to raise death rates in Europe. As per capita incomes and agricultural productivity increased after 1349, urbanization rates went up. This itself raised death rates in the aggregate.

In combination, war, city mortality, and trade raised European mortality substantially. In Voigtländer and Voth (2008b), we show that these three factors raise country-wide death rates by more than 1% (in addition to the 3% background mortality). All of them were direct or indirectly related to rising incomes – as a source of financing for war, or as a cause for demand for trade and urban products. In turn, they facilitated the perpetuation of higher incomes, by relieving downward pressure on the land-labor ratio. Because the death schedule in early modern Europe shifted outwards, incomes could be permanently higher than they had been before the Black Death. This is shown as an upward shift of the death schedule in figure 1 from d to d'. The corresponding equilibrium is E_1^d, which combines higher p.c. income levels with lower population. Under plausible assumptions, this effect alone raises per-capita income by up to 20%, thus contributing importantly to the precocious rise in European per capita output.

III. The European Marriage Pattern

Fertility restriction was not uncommon in pre-modern societies. Chinese families used infanticide, and had low rates of marital fertility. However, West of a line from St Petersburgh to Triest, Europeans practiced a unique and peculiar form of fertility limitation (Hajnal, 1965, 1982). Women did not marry when they became fertile, but markedly later – age at first marriage could be as late as 25 or 28. Also, a high percentage (up to 15%) never married. Once married, however, there was no fertility limitation. Overall, European marriage pattern (EMP) prevented between a quarter and half of all possible births (Clark, 2007). Population pressure was thus reduced. This helped to maintain incomes (Wrigley, 1988).

What caused Europeans to adopt this particular marriage pattern is still unclear. Some theories emphasize inheritance rules, and the North-South divide in fertility within Europe. Others underline the role of labor markets and urbanization in giving women greater bargaining power (DeMoor and van Zanden, 2005). The system's origins are hard to pin down in time. Roman Europe had early and near-universal marriages for women. While there is evidence of some women remaining unmarried before 1000, EMP only found its full expression after 1400 (Hajnal, 1965, 1982). Religion cannot be the explanation – Europe was Christian long before it became a low-fertility area.

Our explanation for EMP adoption focuses on what many young women did before getting married. The vast majority - especially on the lower rungs of society - worked as servants, either in domestic service or in agriculture. Food and lodging were provided free of charge, in exchange for labor services. In addition, servants received a wage in cash. This was mostly saved in the hope of finding a better match in the marriage market. According to estimates by Kussmaul (1981), more than half of all English women and men aged 15-24 worked as servants during the early modern period – the vast majority of them in agriculture. In particular, women worked as servants in husbandry, milking cows and tending flocks.

The positive shock to incomes after the Black Death increased demand for the products of pastoral agriculture. While the extent of the rise in meat consumption after 1349 is disputed, the general switch in agricultural production from "corn to horn" (Campbell, 2000) is not. In addition to the higher demands for meat, production of wool surged – a classic 'superior good' of the period. By 1516, when Thomas More wrote of "man-eating sheep" in his *Utopia*, vast swathes of English land had been converted from arable to pastoral farming.

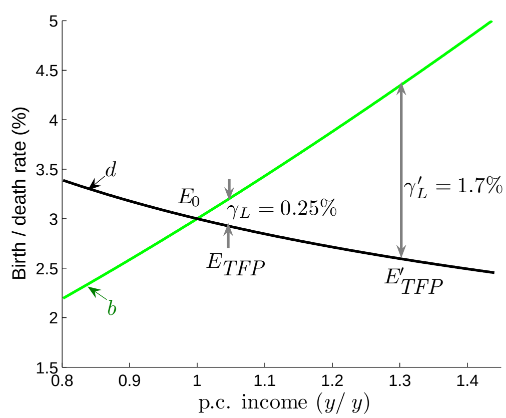
The rise in livestock production was land-using and labor-saving. In particular, it economized on the factor of production that had become particularly expensive after 1349 – male labor. Women could perform many of the tasks in animal husbandry. Because of the year-round labor requirements in pastoral farming, employing servants on year-long or multi-year contracts was convenient. These overwhelmingly lived in the household of the large landowners, and were obliged to remain unmarried. Thus, the positive demand shock for pastoral products after the Black Death laid the foundations for the emergence of EMP (Voigtländer and Voth, 2008a). For many women, spending an extended period before marriage as servants became a way of life.

Importantly, the institution also worked as a 'shock absorber' - in bad times, when wages were low, accumulating savings took longer. Marriages were delayed, and population pressure was reduced. Thus, EMP simultaneously reduced fertility rates overall, and facilitated adjustment to adverse shocks. This is shown by a downward shift of the birth schedule from b to b' in figure 1, leading to the new long-run equilibrium E_1^b.[7] The lower bound estimate – a difference of 25% between b and b' – implies a substantial rise in p.c. income, exceeding 10%.

IV. Technological Progress

We now turn to an alternative explanation – technological progress – and show why its effect on the rise of Europe was probably limited. Suppose that TFP grows at the rate γ_A. Following (1), this implies $\gamma_y = \gamma_A - \alpha\gamma_L$, where population growth γ_L is given by (2). Higher steady-state p.c. income goes hand-in-hand with faster population growth. In figure 2, p.c. income will grow until $\gamma_A = \alpha(b - d)$. At this point, TFP increases are offset by the growing population, and p.c. income stagnates in the new equilibrium E_{TFP}.

Figure 2: Ongoing technological change



We use the same parameter values as before to determine the magnitude of effects. During the early modern period, TFP grew at rates between 0.05 and 0.15% per year (Galor, 2005).[8] We assume that technological progress suddenly accelerates such that

[7] Strictly speaking, the EMP involves rotating the birth schedule, as well as a downward shift. Voigtländer and Voth (2008a) show that both effects emerge endogenously in response to product and labor market conditions after the Black Death.

[8] Low TFP growth apparently existed side-by-side with numerous important inventions (Mokyr, 1990).

γ_A increases from zero in E_L to 0.1%. In this case, the new long-run equilibrium E_{TFP} involves population growth $\gamma_{L,TFP} = b - d = \gamma_A/\alpha = 0.25\%$.[9] The corresponding increase in long-run p.c. income is less than 5%.[10]

How fast would technology have to grow to explain rising incomes in early modern Europe? Based on Maddison's (2001) figures we derive a lower bound of per capita output increases, focusing only on the period 1500-1700. Over these two centuries, European p.c. income increased by 30%. If this effect were driven solely by technological improvements, the rate of population growth in 1700 would have to be at least 1.7% (corresponding to equilibrium E'_{TFP} in figure 2).[11] To sustain per capita incomes at 30% above E_L, TFP would have to grow at $\gamma'_A = \alpha\gamma'_{L,TFP} \simeq 0.7\%$. Technological progress of this magnitude was not observed before the second half of the 19th century (Crafts and Harley, 1992; Antràs and Voth, 2003). If we assessed the strength of Malthusian responses accurately, improvements in the stock of useful knowledge and of organizational capacity were not fast enough to contribute to rising incomes significantly.

V. Conclusion

Europe's early modern riches were largely a gift of the dead, and of the unborn.[12] Europeans died early and married little, and late, given how high incomes were relative to the rest of the world. We argue that these peculiar features evolved in response to a massive, negative shock to population – the great plague of the 14th century. Because between a third and half of Europeans died, land-labor ratios increased. Higher production per head created fresh demand for the 'luxury products' of the day – mutton and beef, woolen cloth and city goods. As incomes surged, agriculture switched its focus from 'corn to horn', and cities swelled in size. The rise of pastoral production helped the emergence of the European marriage pattern. Women came to delay marriage long after first menarche because demand for their labor was now strong. This kept population pressure in check.

[9] This assumes a labor share in agricultural income $(1-\alpha)$ of 0.6.

[10] To derive this number, we use a linear approximation of (2) around the equilibrium without technological change ($y_0 = \underline{y}$ and $\gamma_{L,0} = 0$). This yields $\gamma_{L,TFP} = (\varphi_b - \varphi_d)b_0(y_{TFP} - y_0)/\underline{y} = (1.4+0.5)\cdot 3\% \cdot (y_{TFP}/\underline{y} - 1) = 0.25\%$. Rearranging, we obtain $y_{TFP}/\underline{y} = 1.044$.

[11] This follows from the same argument as above, which implies $\gamma'_{L,TFP} = (1.4+0.5)\cdot 3\% \cdot 0.3 = 1.7\%$. This number is ten times larger than the actual increase in European population between 1500 and 1700 (Maddison, 2001).

[12] With apologies to Alwyn Young (2005).

Rapid gains in urbanization also increased death rates, since European cities were unusually unhealthy. With city growth, trade increased, spreading disease. The same was true of wars, which Europeans fought with singularly high frequency after 1400. Greater expropriable surpluses and growing city wealth paid for the upsurge in fighting. In combination, urbanization, trade, and war produced an upward shift of the death schedule. This also reduced downward pressure on the land-labor ratio. A combination of both fertility and mortality changes in the aftermath of the Black Death leads to equilibrium E_2 in figure 1. It shows how lower fertility and higher mortality ensured that European wage rates did not return to their low, pre-Plague level. For plausible parameter values, our approach can explain a rise of per capital income of 30% – almost exactly the rise observed in Europe, 1500-1700, overall.

Even in a Malthusian world, Ricardo's 'Iron Law of Wages' need not hold. While equilibrating Malthusian forces may be strong, ensuring that a steady state is reached quickly, a wide range of equilibrium wage rates can be maintained indefinitely if birth and death rates themselves shift. We have argued that major shocks, such as the Black Death, produced such shifts. In our view, they were instrumental in the rise of European incomes far above subsistence during the early modern period – long before technological change became rapid.

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