Property Rights and The First Great Divergence:
Europe 1500-1800*

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Abstract

The paper provides an alternative explanation for the divergent paths followed by various European regions in the period leading up to the classical Industrial Revolution. The thesis advanced here is that what lies at the root of the First Great Divergence is the type of property rights inherited. As populations everywhere in Europe recovered slowly from the catastrophes of the late medieval period, what mattered for the direction taken was the size of the landlord class and their landholdings. In western Europe, where peasant proprietors tilled small plots, increases in population levels and advances in agricultural productivity led to lower real wages. Given the low incomes of landlords and peasants, demand for manufactured goods remained low and increasing returns to scale technologies did not have much room to expand. At the other extreme, in eastern Europe, second serfdom kept wages low, and rents high. But given the small size of the land-owning class, these rents could not generate enough demand for high-end manufacturing processes either. Northwestern Europe, being situated in the middle in terms both of the size of the landholding classes and their plots, prospered as wages failed to decline even when population levels rapidly rose. Combined demand from landlords and workers kindled an expansion of the manufacturing sectors using increasing returns technologies.

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1 Introduction

Sixteenth century England was a marginal agrarian economy with an urbanization level below that of Balkans. The urban manufacturing core of Europe was located (with the exception of the precocious Low Countries) along the shores of the Mediterranean. By 1850 a “reversal of fortune” had given England the lead with an income per capita that far exceeded that of the previous leader Italy.

The traditional answer to the question of how this reversal took place focused on the industrial revolution as the event that radically broke with the past of humanity, ushering in a new phase where, for the first time ever, “production started to grow much more rapidly than population.” A burgeoning analytical literature dates the break to around 1800, prior to which it is supposed that a Malthusian mechanism operated to pull incomes down to some stable, constant level whenever they happened to exceed it.

It is, therefore, paradoxical that in the last few years accumulated evidence has led a growing number of economic historians to question some of the basic tenets of the received wisdom concerning the timing, prehistory, and effects of the industrial revolution and the Malthusian transition. First, the currently accepted view is that the industrial revolution was much less of an abrupt transition, with earlier growth estimates of the British economy in the classic industrial revolution era, 1760-1830, being reduced by more than half. Given that in the mid-nineteenth century England had the highest income in the world, the lower growth estimates immediately raise the question: “If the industrial revolution was not substantial enough to explain England’s lead in 1850, where did it come from?”

Second, an implication of lower growth rates is that the contrast with the earlier periods in terms of incomes is now revealed to be not as sharp as once thought, making pre-industrial Britain as well as a number of neighboring countries more prosperous. Evidence from a variety of sources, including probate and pauper inventories, point to a “consumer revolution” in Britain and the Netherlands, with significant

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1 Bairoch, 1989, p. 179 puts the level of urbanization in Balkans and England in 1500 at 7-12% and 7-9% respectively.
2 The relevant figures for GDP per capita in Maddison 2001 are as follows. In 1500 Italy led the world with $1100 (in 1990 international $), while Belgium, the Netherlands and England had GDPs per capita of $875, $754, and $714. By 1870 England had moved forward with $3191, as opposed to $2753, $2697, and $1499 of the Netherlands, Belgium, and Italy.
4 For the modest growth in per capita income and real wages in Britain between 1770 and 1850, see Crafts and Harley (1992), Crafts (1985), Feinstein (1998), Mokyr (2004), and Williamson (1984).
5 This is the question posed by Allen (2001).
increases in the quantity, variety, and quality of consumer goods being registered well before the industrial revolution.\footnote{See de Vries (1994) and de Vries (2008).} Third, research on the history of English real wages indicates that they did not display a trend from 1500 to 1850, despite a sevenfold rise in population.\footnote{See Feinstein (1998) and Clark (2005) for English wages and Allen (2001) for the history of prices and wages in a number of European cities. Brown and Hopkins (1956) find the same pattern in their study of provincial wages.} These findings indicate that the economic expansions experienced by the English and Dutch economies in the crucial three-hundred-year period prior to the industrial revolution were very important achievements, constituting a marked departure from the Malthusian past. For the first time in western history, these economies kept pace with the population for a remarkably extended period of time.

While these considerations do not diminish the importance of the classical industrial revolution as a watershed event, they call for a more nuanced approach to the economic and social transformations that took place in the period leading to it. That this period should be subject to closer scrutiny follows from the revised assessments of historians of economic growth who argue that the industrial revolution can no longer be regarded “as the beginnings of growth altogether but as the time at which technology assumed an ever-increasing weight in the generation of growth” (Mokyr (2005)) and that the “accumulated evidence for an earlier increase in per capita income in northwestern Europe paired with a major refinement of material life casts serious doubt on the orthodoxy that the industrial revolution was the actual starting point for long-term economic growth” (de Vries, 2008, p.6).\footnote{See also Clark (2005) who writes “[t]hus the industrial revolution is not clearly an abrupt break around 1800 from a stagnant economy. It may just be the acceleration of a process of modern growth that began about 150 years earlier.”}

Once the roots of long-term growth are seen to be planted in an era earlier than has traditionally been accepted, the question that immediately arises is the one concerning the nature of this period and the determinants of the extensive growth registered.\footnote{It is “extensive” growth as per-capita incomes increased very moderately, if at all. “Intensive” i.e. long-run per-capita income growth is observed only after the industrial revolution proper.} To start with, note that even such extensive growth is restricted to a few regions in northwestern Europe: England and the Low Countries. The rest of both western and eastern Europe lagged behind. This is reflected most importantly in the wage and price series collected by Allen (2001) which shows that, while England and the Low Countries enjoyed a slight lead in terms of real wages relative to the rest of Europe in the fifteenth century, incomes significantly diverged in the next three centuries. The divergence is
mostly explained by the fall in continental real wages by half, while real wages remained roughly constant in northwestern Europe.\footnote{Everywhere real wages were subject to fluctuations, Thus, in the Low Countries, real wages declined slowly, but much more so than their counterparts on the continent. Real wages declined in England in the sixteenth century and then reversed course, rising slowly later on up to their previous levels.} Thus, while England and the Netherlands escaped the infamous “seventeenth century crisis,” the rest of the continent mostly succumbed to it.\footnote{Additional evidence of divergence is obtained from international comparisons of body size and height. For the late eighteenth century, the evidence summarized by Floud (1992) indicates that the British and the Dutch were the tallest people in Europe, while the French, Italians, and Spanish were shorter. Austrians and Hungarians were also of smaller stature (Komlos (1989)).}

This escape from the crisis was accompanied by a “consumer revolution” that found its expression in “a steady rise, generation by generation, of the number, range, and quality of material possessions” (de Vries, 2008, p. 124). Detailed regional studies covering areas as diverse as the Dutch countryside (Kamermans (1999) cited in de Vries, 2008), the English county of Kent (Overton et al. (2004)), London (Earle (1989)), Edinburgh and Glasgow (Nenadic (1994)), and income groups ranging from the rich to middling groups to paupers (McCants (2008), Styles (1994)).

The increased demand was met by substantial increases in manufacturing output. In England per capita cloth output more than doubled between the later fifteenth century and the 1640s. Import substituting English glassworks drove continental window panes out by the 1590s, bottles by the 1620s and drinking glasses and mirrors in the next decade. Around 1650 forty water-powered paper mills were in operation barely five decades after the opening of the first viable one. Iron output quintupled between 1550s and 1650s. Similar changes were observed for coal. In the Netherlands even more dramatic increases were registered in a wide variety of industries. Leiden’s cloth output rose from 26,600 in 1584 to 144,700 in 1664. Haarlem’s bleaching industry processed about 100,000 pieces in 1628 while it had only processed 20,000 in 1586. Amsterdam developed a rich portfolio of manufactures such as silk weaving and dyeing, leather working, diamond cutting, glass blowing and food processing: it had sixty sugar refineries in 1661 up from three in 1605.\footnote{See DuPlessis (1997) and the extensive literature cited therein.}

The period also witnessed technological advances, some of which were “almost as dramatic as those in textiles in the industrial revolution”.\footnote{This is how Clark 2003 describes the productivity gains in printing.} Examples are legion. For instance, glassworks, gunpowder nails, spectacles, and printing all saw substantial productivity gains. The “Dutch” loom was invented in 1604 and was in use in Leiden in...
1610. New techniques used in producing kersey represented a productivity gain of 40-60 percent over Yorkshire broadcloth. High fixed costs associated with wind-powered fulling mills did not prevent them from being adopted. These lowered the labor requirements dramatically and led to the near-collapse of the powerful Dutch fulling guild. New technologies employed by shipping yards enjoying economies of scale reduced the cost of Dutch ships 40 percent below that of the English ones in 1669.

What then accounts for this early period of economic expansion that constitutes the starting point for modern growth? One prominent answer, that of North, dates the English break with the past to the Glorious Revolution of 1688. The establishment of a constitutional monarchy and the security of property rights that followed is then argued to have promoted economic growth through a number of channels, all of which have been recently convincingly contested. Thus, for instance, studies of interest rates have been unable to find any growth promoting consequences of the Glorious Revolution (Clark 1996, Epstein (2000), Quinn (2002)). Others have shown that parliamentary rule in England led to taxes that exceeded those of absolutist France (Hoffinan and Norberg (1994), Bonney (1999)). Finally, and most importantly for my purposes here, it is now clear that England's economic expansion had begun long before the Glorious Revolution (Allen (2001), Clark (2003), de Vries (2008)). Acemoglu et al. (2005), on the other hand, emphasize the role of Atlantic trade in the rise of northwestern Europe. They argue that the American and Asian trades gave rise to a politically influential merchant class that demanded and obtained protection of property rights, which, in turn, paved the way for economic growth. Though this mechanism undoubtedly played a role later on, as Allen (2003), building on the work of Davis (1973) and Rapp (1975), points out the rise of northwestern Europe and the decline of Italy predates the rise of Atlantic trade by a century. A third answer, proffered by De Vries, emphasizes an "industrious revolution" taking place in northwestern Europe during the "long eighteenth century." This revolution is said to have involved an increase in market-oriented labor by households who

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14Duplessis (1997).

15Despite these changes, we do not, however, observe any significant TFP growth in this period. But this is also true not only for the classical industrial revolution era (1760-1830) but also the four decades that follow it. Clark argues that in this period “[m]ost of the economy saw no TFP growth, and the national TFP gains mostly came from one industry, textiles. Textiles contributed a large amount of national TFP growth because it met all three conditions above: it began as a substantial industry, its share of consumption did not decline with price declines, and there grew up a huge external market which eventually absorbed more than half of output. Absent textiles there would have been no change in the trend in TFP growth all the way from 1600-1869.” (Clark 2003, p. 46)

16See North and Thomas (1973) and North and Weingast (1989).
were eager to satisfy their new consumption goals. Thus, there was a simultaneous rise in both specialized production by households and their purchase of consumption goods with, however, a “consumer revolution” leading the way and providing the impetus to the increased production of consumer goods (de Vries (2008)). While this approach accounts for the observed increases in labor supply to markets, the rise of market production, and the consumer revolution, it is not of much help in answering as to why there was a reversal of fortune, i.e., why it fell to northwestern Europe to take the lead in these developments. Allen, whose work has focused squarely on this reversal of fortune, credits the success of this region to its productive agriculture, which, he in turn attributes to its vigorous urban economy (Allen (1998), Allen (2000), Allen (2003)). However, as Allen himself recognizes, the expansion of the latter is itself endogenously determined, while the initial level of urbanization, which can be taken as an exogenous variable, will not work for England because urbanization levels were substantially lower in England than either in Italy or Spain.\footnote{This last point is also made by Allen when he compares England and Netherlands to France and Germany on the one hand and Italy and Spain on the other (Allen (2008)). The other key feature Allen cites for success, participation in the intra-European trade (which preceded the rise of the Atlantic trade emphasized by Acemoglu et al. (2005) by a century and is more in line with the dating of the rise of northwestern Europe) would not do either as many eastern European countries participated heavily in this trade but remained economic failures.} If these attempts at explaining the success of Northwestern Europe do not succeed, what then might work?

The answer as to the cause of the European “great divergence” that I offer in this paper relies on the differences in the property rights in land that different European regions inherited from their medieval past. For the purposes of the argument, it helps to think of Europe at the beginning of the sixteenth century as being composed of three regions: the northwest (England and the Low Countries), the east (Europe east of Elbe), and the rest of western Europe. For various historical reasons, each region was characterized by a different set of distribution of rights to land. Thus, at one extreme were countries like France and western Germany, where at the end of the medieval era, in alliance with monarchs and princes, peasants were successful in ending serfdom with full legal recognition of their property rights to plots of land. Though these plots were initially relatively large, towards the end of the sixteenth century rising population and the subdivision of land left this region with a large class of peasant proprietors working on small plots of land. At the other extreme, east of Elbe, lords were able to reintroduce the “second serfdom” and redefine peasants as unfree and tied to the expanded estates of their lords. Here a small group of lords ended up with substantial holdings of
land upon which peasants, who were legally unable to move elsewhere, were forced to work. The northwestern European landholding pattern remained in between these two extremes. Thus, by the end of the sixteenth century, the land holdings of English farmers averaged around 60 acres, substantially larger than the plots of, say, French farmers or their medieval counterparts (Allen (1992)). In the Low Countries, farms entered the sixteenth century with sizes considerably larger than those in neighboring countries like France or western Germany, but somewhat smaller than the ones in England. I argue below that an important mechanism that helps explain the great divergence of early modern European economies and the start of modern growth is this difference in the distribution of landed wealth. The reasoning behind the mechanism is similar to the one described by Kevin M. Murphy (1989) where industrialization of certain sectors requires large enough domestic markets. Increasing returns technologies need to secure enough demand to cover fixed costs and break even. For this to happen over a wide range of sectors a broad spectrum of the population needs to have enough income to demand manufactured goods. In eastern Europe with its second serfdom and a small group of feudal lords siphoning off the income generated in agriculture, these conditions were hard to meet. In western Europe where the population mostly consisted of peasant farmers with small plots, individual landowners did not earn enough to generate enough demand for and, thus, to support a wide range of industries. It was only in northwestern Europe where landholdings were neither too small nor too large that a reasonably large number of households earned enough income to demand a broader spectrum of goods. However, even in England and the Low Countries demand by landed classes would not have been sufficient had this region not experienced an agricultural revolution that kept the real wages of its workers higher than their counterparts elsewhere and above the subsistence level.

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18 O'Brien (1996) argues that 1066 is not an inappropriate date to take as the start of divergence of property rights regimes in England and France. This is because the consolidation of Norman rule that followed led to major changes in the distribution of landownership and the status of indigenous populations in England. By the twelfth century the latter were largely enserfed, while in France serfdom had waned over large areas of Europe.

19 Brenner (1982) also focuses on property rights to explain the European divergence in this period. He argues that differences in such rights led to relatively larger farms in England and the Low Countries, giving them an organizational and productivity advantage and paving the way for the divergent paths. This last point has not found empirical support.

20 Obviously, for the argument to work exports must be either completely choked off or insignificant. In the period in question exports of manufactured goods were at best a negligible proportion of output.

21 Even in 1688, slightly above 20% of the English population were either “landed classes” or farmers
Parts of the argument adopted in the paper have their precedents in the analytical literature. Galor et al. (2009) build a model where inequality in landownership prevents the adoption of institutions promoting human capital formation. This is a setup where powerful landlords delay the implementation of education reforms, slowing the process of industrialization and the transition to modern growth. The model is thus complementary to the present one as it explicitly focuses on a later period (from 1820 on) when human capital formation became important. Bilancini and D’Alessandro (2008) provide an extension of the Kevin M. Murphy (1989) model to the case where only a fraction of the population owns land and discuss the various scenarios that give rise to different levels of industrialization. They do not link these to the regions and period in question here. Further their model, unlike the one below is static and confined to the case where workers only earn subsistence wages. Their setup, however, like the one here, emphasizes the role played by demand in determining the extent of industrialization.

Recently, Foellmi and Zweimüller (2006) have explored the role of income inequality in a model with demand-induced innovations. They show that changes in the distribution of income affect demand for goods and the incentive to innovate and, thus, long-run growth. Further, like Kevin M. Murphy (1989), Bilancini and D’Alessandro (2008), and this paper, they also adopt hierarchical preferences.

The rest of the paper is organized as follows. Section 2 sets up the model and derives the basic results concerning the divergent paths taken by different European regions before the classical industrial revolution. It shows that under certain historically-justified restrictions on the parameters of the model, one can derive different wage, land rent, labor supply, and “industrialization” levels for the three regions in which our interest lies. Section 3 concludes the paper.

(see Lindert and Williamson (1982) and Allen (2008)).

22 Earlier Mokyr (1977) had rejected a role for demand for the classical industrial revolution. The counter arguments of Ben-Shachar (1984) are valid below as population growth and the associated rise in agricultural productivity provide exogenous factors that affect demand. Bairoch (1997) argues that increases in demand played an important role in the classical industrial revolution.

23 Similarly, Jones (2008) argues that “efflorescences” prior to the English one failed to lead to industrialization because “distributions of wealth and power...biased investment and innovation towards luxuries...and sent inadequate signals to potential suppliers of the mass market.”

24 Matsuyama (2002) uses hierarchical preferences of the type below to explain the rise of “mass consumption societies.”

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2 The Model

2.1 Saving, Consumption, and Labor Supply Decisions of Agents

A given economy is populated by a mass of $N$ agents, of which there are three types: workers, landlords, and (potentially) entrepreneurs. In addition to possible wage income, landlords earn rents, $r$, on the land they own, while entrepreneurs earn profits $\pi$. Each agent lives for one period and decides (1) how much to spend on consumption, (2) how much labor to supply, (3) whether to leave bequests to offspring or not, and (4) how to allocate his consumption across goods. The decision concerning the allocation of consumption across goods is made in the second stage of a two-stage process, the first stage of which involves decisions (1), (2), and (3).

2.1.1 Point-in-time Consumption, Saving, and Labor Supply

At the first stage the agent maximizes

$$U = \eta_c \ln C + \eta_b \ln(\Upsilon + b') + \eta_l \ln(1 - l)$$

where $\eta_j$, $(j = c, b, l)$ and $\Upsilon$ are non-negative constants, and $l$, $C$, and $b'$, denote labor supply of a wage earner, a consumption aggregator, and bequests to offspring. The budget constraint of the agent is given by

$$C + b' \leq I$$

with $I = wl + y^i + b$ $(i = L, R, E)$ and $b$, and $y^i$ denoting bequests received from parents and non-labor income. Bequests to offspring $b'$ are constrained to be non-negative. It is straightforward to solve for $c$ and $b'$ as ($\Upsilon \equiv \frac{\eta_c}{\eta_b} \Upsilon$),

$$b' = \begin{cases} \frac{\eta_b}{\eta_b + \eta_c} (I - \Upsilon) & \text{if } I > \Upsilon \\ 0 & \text{if } I \leq \Upsilon \end{cases}$$

$$C = \left( \frac{1}{\eta_b + \eta_c} \right) \left( \eta_c I + \eta_b \Upsilon \right).$$

Thus, agents leave bequests to their offspring only if their incomes exceed a threshold level.

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$^{25}$See Galor and Moav (2004) for the use and implications of a similar log-linear utility function that yields savings as an increasing function of wealth.
Having decided how much of his income will be used for consumption, in the second stage the agent decides how much to buy of each available good. These are of two types: a homogeneous agricultural good ("food" for short henceforth), the price of which is taken to be the numerarire, and a continuum \([0, \infty)\) of manufactured goods. Each good indexed by its distance \(q\) from the origin. All agents have identical but hierarchical preferences over goods, with the consumption aggregator \(C\) given by:

\[
C = \begin{cases} 
  c & \text{for } c \leq \varpi \\
  \varpi + q \int_0^q \min \{1, x(q)\} dq & \text{for } c > \varpi
\end{cases}
\]

where \(\varpi\) is such that for \(q \in [0, \varpi)\) commodity \(q\) is consumed, \(c\) denotes food consumption, \(\varpi\) is the minimum amount of food that needs to be consumed before agents start buying manufactures, \(x(q) = 1\) if good \(q\) is consumed, zero otherwise. In this formulation agents first buy food and then (provided their income is high enough to purchase \(\varpi\) units of food) buy one unit of each manufactured good following the order in the interval. In what follows, I will assume that \(\varpi = \Upsilon\), i.e., agents will start leaving bequests only after they meet their food requirements.\(^{27}\) Agents with higher incomes buy the same goods as their poor counterparts plus more manufactures. As incomes rise what used to be luxuries eventually turn into necessities.

Labor supply is given by

\[
l = \begin{cases} 
  \left(\left[\eta_c + \eta_b + \eta_l\right]^{-1} \left[\left(\eta_c + \eta_b\right) \eta_c w - \eta_l \Lambda\right]\right)^{-1} & \text{if } (\eta_c + \eta_b) \eta_c w > \eta_l \Lambda \\
  0 & \text{if } (\eta_c + \eta_b) \eta_c w < \eta_l \Lambda
\end{cases}
\]

where \(\Lambda \equiv (\eta_c b + \eta_b \theta + \eta_c y^i)\) (for \(i = L, R, E\)).\(^{28}\)

It is useful to make the following historically realistic assumption\(^{29}\)

**Assumption 1.** \(y^i (i = R, E)\) is above a critical level such that \((\eta_c + \eta_b) \eta_c w < \eta_l (\eta_c b + \eta_b \varpi + \eta_c y^i)\), while \(y^L = 0\) and \((\eta_c + \eta_b) \eta_c w > \eta_l (\eta_c b + \eta_b \varpi)\).

Given equation (3), Assumption 1 implies that landlords and entrepreneurs do not supply labor, while workers receive only wage income.

Now, for future purposes, consider a worker who does not receive a bequest, \(b\), from parents (\(b = 0\)). Then there is a wage level, \(\tilde{w}\) at which the agent chooses not to leave a

\(^{26}\)Here I follow the formulation of Bilancini and D’Alessandro (2008).

\(^{27}\)Relaxing this assumption does not change the basic insights gained from the paper but unnecessarily complicates the algebra.

\(^{28}\)Note that \(l = 1\) if \(\eta_l = 0\). It is also straightforward to show that labor supply, \(l\), is an increasing function of the wage.

\(^{29}\)See below for the implications of relaxing this assumption.
bequest, i.e. $b' = 0$, or equivalently, from 1, $I = Y = \tilde{w}l(\tilde{w})$ (which implicitly defines $\tilde{l}$). Note that then all income is consumed: $C = \tilde{C} \equiv I = \omega$. First-order conditions yield $\eta c = \eta \theta = \eta c \tilde{w}(1 - \tilde{l}) = \eta c \tilde{w}(1 - \theta / \tilde{w})$. Solving this we get the critical wage level below which the worker does not leave bequests

$$\tilde{w} = \frac{(\eta c + \eta l)}{\eta c} \omega.$$  

### 2.1.2 Steady-State Consumption, Saving, and Labor Supply

At a steady state we have $b' = b = \bar{b}$. Thus, the budget constraint $C^i = T^i - b^i = wl^i + y^i + b - b' = \tilde{w}l^i + \bar{y}^i$ (with $\tilde{l}^i = 0$ ($i = R, E$), $\bar{y}^L = 0$ $\bar{y}^R = r$, $\bar{y}^E = \pi$ where $r$ denotes rent on land and $\pi$ is the profits earned by an entrepreneur) at a steady state. Now the first-order conditions of the worker’s problem imply

$$\bar{l} = \frac{\eta c}{\eta c + \eta l}$$  

(4)

and equation (1) yields

$$\bar{b} = \frac{\eta b}{\eta c} \left( \frac{\eta c}{\eta c + \eta l} w - \omega \right).$$  

(5)

Similarly, for landlords and entrepreneurs we obtain

$$\bar{b} = \frac{\eta b}{\eta c} \left( \bar{y}^i - \omega \right), \ i = R, E.$$  

(6)

### 2.1.3 Stability

Given $b^i_{t+1} = \nu(wl^i + y^i + b_t - \theta)$ ($\nu = \eta b / (\eta b + \eta c) < 1$) for the bequest levels to converge a sufficient condition is that

$$\left| \frac{\partial b^i_{t+1}}{\partial b_t} \right| = \nu \left[ \frac{\partial y^i_t}{\partial b_t} + 1 \right] < 1.$$  

For a given wage rate, for the workers, we have $\partial b^W_t / \partial b^W_t = \eta b / (\eta c + \eta b + \eta l) < 1$ $\forall b^W_t$ As $\nu < 1$ and with $y^R_t = R/M$ we have $\partial y^R_t / \partial b_t = 0$; thus, the stability condition also holds for the landlords.

### 2.2 Production and Incomes

#### 2.2.1 Agriculture

In the “agricultural sector” food is produced using land, $T$, and labor, $L_f$, under constant returns to scale. The agricultural production function is given by

$$Q_A = AF(T, L_f)$$  

(7)
where $A$ is a productivity parameter and $F(.,.)$ is a constant returns to scale production function.

Assuming that all agents are able to afford to buy the minimum amount of food, $\varpi$, goods market equilibrium in agriculture can be used to determine agricultural employment

$$\varpi N = AF(T, L_f)$$

where $\varpi N$ denotes demand for food.

Agricultural wages are a function of agricultural employment with $w^A = w(L_f)$, $w'(L_f) < 0$ following from the level of agricultural employment determined by equation (8). Note that this formulation is more general than but is consistent with workers being paid the marginal product of their labor services.

Landlords with mass $M$ own all the land. The distribution of land across landlords, though typically non-uniform historically, is taken to be uniform here. This would be a justified simplification to the extent that the focus is on the interaction between landlords on one hand and landless workers and other agents on the other, as is the case here. Total rents earned by landlords, $R$, follows from equation (8) and the wage equation as $R = AF(T, L_f) - wL_f$. Each landlord, then earns rents $r = R/M$. This implies that the higher is the number of landlords, ceteris paribus, the lower will be the rents earned by a landlord.

### 2.2.2 Manufactures

Each manufactured good is produced in a separate sector that is small relative to the rest of the economy. There are two technologies available for the production of any good $q$: (1) a traditional constant-returns-to-scale (CRS) one which requires the use of $\alpha$ units of labor to produce one unit of a manufactured good, and (2) an increasing-returns-to-scale (IRS) technology that requires a fixed investment of $k$ units of labor and $\beta$ units of labor per unit of output with $0 < \beta < \alpha$. Following Kevin M. Murphy (1989), I will take the substitution of IRS technologies for CRS ones to mean industrialization.

*Market Structure and Prices:* Markets where goods sold are produced using the traditional CRS technology are perfectly competitive. Thus, given the wage rate, $w^M$, in manufactures a good $q$ produced by a traditional technology fetches a price of $\alpha w^M$. Monopolistic firms using the IRS technology decide whether to enter a market and what price to charge. Observe that the maximum price that can be charged by a monopolist is $\alpha w^M$; anything above would lead to the loss of the market to its CRS competitors. To see that $\alpha w^M$ is also the lowest price a monopolist would charge note the following. Lowering
the price below $\alpha w^M$ would only be beneficial for a monopolist if the decline in price is compensated by an increase in sales. However, given the preferences adopted here, demand for commodity $q$ is independent of the price of this commodity. This is because consumers here demand one unit of each commodity type following the order $[0, \infty)$ until they use up the portion of their income devoted to the purchase of manufactures. As a result, the demand for a given type $q$ commodity depends only on the prices charged in markets $[0, q)$ and, thus, whether they have exhausted the amount set aside for the purchase of manufactures. It is therefore independent of the prices of commodities of type $\tilde{q} \geq q$.

Entrepreneurs (those who start IRS industries) make profits, $\pi$ of

$$\pi = (p_Q - \beta w^M)D_Q - kw^M = (\alpha - \beta)(D_Q - \rho)w^M + w^M$$

where $p_Q = \alpha w^M$ and $\rho \equiv (k + 1)/(\alpha - \beta)$. Note that for an IRS-firm to be started the potential entrepreneur should expect to earn an income that is at least as great as her reservation income, i.e., $\pi \geq w^M$. Further, if $\rho < 1$ it is straightforward to see that even with demand, $D_Q$, as low as one unit, it is the case that $\pi > w^M$ so that the IRS technology is always preferred to the CRS technology. To avoid this historically counter-factual result, I will assume that $\rho > 1$.

### 2.2.3 The Labor Market and Agents

At this point in the discussion it is useful to consider the allocation of labor across different sectors. First, note that free mobility of labor across agriculture and manufactures ensures that $w^A = w^M = w$. Second, given the mass, $N$, of the population and that of landlords, $M$, we have the rest, $L$, of the population either supplying labor ($L_f$ in the agricultural sector and $L_m$ in manufactures) or becoming entrepreneurs, $E$, and starting IRS firms. A mass $L_{CR}$ of the manufacturing workers are employed in the CRS sector, while a mass, $L_{IR}$ are in the IRS sectors. To sum up, we have

$$N = M + L, \quad L = L_f + L_m + E, \quad L_m = L_{CR} + L_{IR}.$$ 

Though so far we have determined the the number of workers in agriculture, the number employed in the CRS and IRS sectors in manufactures and the number of entrepreneurs remain to be calculated. Further, the determination of the allocation of agents across sectors is tied closely to the question of the relative sizes of these sectors and, therefore, the level of industrialization.
2.3 Industrialization Before the Industrial Revolution

Since the main purpose of this paper is to explore the consequences of property rights in land on the extent of “industrialization” during the period leading to the classical industrial revolution in England, it is useful to adopt the following strategy. First, recall the division of pre-industrial revolution Europe into three regions which differ with respect to the distribution of rights to land. One way of measuring such differences in the context of the present model is to suppose that the two extremes of highly concentrated land ownership in eastern Europe (with its “second serfdom”) and widely-diffused property rights in western Europe are represented by a small number of landlords in the former and a relatively large number in the latter. Northwestern Europe (England and the Low Countries) would then have a landlord class the size of which is somewhere in between these two extremes. Formally, I assume that

**Assumption 2.** \( M^{POL} < M^{EN} < M^{FR} \)

where for mnemonic purposes only I used superscripts \( POL, EN, \) and \( FR \) to denote eastern, northwestern, and western Europe (Poland, England, and France as representatives of their regions). For any given amount of land, this formulation yields relatively large and small landholdings respectively in eastern and western Europe, while the average land held by northwestern European landlords lies somewhere in between. The reverse ranking holds, \( \textit{ipso facto} \), for average land rents \( r = R/M \).

Second, I am interested in how such property rights in land interact with (i) the recovery of the population everywhere in Europe starting at the beginning of the three centuries in question, (ii) the productivity improvements in agriculture observed simultaneously, and (iii) with the differential response of wages to these developments. Recall that in this period continental real wages fell, while real wages in northwestern Europe remained trendless. Here the task is to replicate this result most importantly for western and northwestern Europe as wages in eastern Europe, where serfdom reigned, should be thought as politically determined given the ability of landlords there to impose and maintain strict restrictions on labor.\(^{30}\) To be able to explain the difference between western and northwestern wage patterns it is useful to start with the observation that the recovery of population levels everywhere were associated with productivity improve-
Here I will follow a recent line of thought suggests that the former induced the latter.\footnote{The thesis put forward by Brenner (1982) that it was the larger size of the farms in England that made them more productive than their smaller counterparts in France is highly controversial (see, for instance, Keyder and O’Brien (1978) and O’Brien (1996)) and runs counter to the findings of contemporary empirical studies (see Vollrath (2007) for a recent one).}

Formally, I start by supposing that workers get paid their marginal products in agriculture in western and northwestern Europe. Given goods market equilibrium in agriculture (equation (8)) we obtain

\[
\frac{dw}{dN} = w \left( 1 - \frac{\nu L}{\eta L} \right) (\varepsilon_{A,N} - \xi) \tag{9}
\]

where \( \xi \equiv -\frac{\nu A \eta L - \nu L \eta A}{\nu A \eta L - \nu L \eta A} > 0 \), and \( \eta L \equiv (\partial F(\ast)/\partial L_f)(L_f/F(\ast)), \eta_A \equiv (\partial F(\ast)/\partial A)(A/F(\ast)), \varepsilon_{A,N} \equiv (\partial A/\partial N)/N/A, \nu_L \equiv (\partial F_L(\ast)/\partial L_f)(L_f/F_L(\ast)) < 0, \eta_A \equiv (\partial F_L(\ast)/\partial A)(A/F_L(\ast)) \).

Thus, whether wages rise or not in response to an increase in the level of population depends on whether \( \varepsilon_{A,N} - \xi \) is positive or not. Note that though the elasticity of productivity with respect to population, \( \varepsilon_{A,N} \equiv (dA/dN)(N/A) \), is a purely technical “blackbox” parameter, one would not expect it to exceed one. So, the answer to our question lies in the value of \( \xi \). To see what is involved, specialize the production function to the CES form:

\[
F(T, L_f, A) = A \left[ aT^{-\varsigma} + (1 - a)L_f^{-\varsigma} \right]^{-1/\varsigma} \tag{10}
\]

where \( a \) is a distribution parameter and \( \varsigma \) denotes the usual substitution parameter. It then follows that

\[
\xi = \frac{1}{1 + \frac{1-a}{a} \sigma \tau^\varsigma} < 1 \tag{11}
\]

where \( \tau \equiv T/L_f \) is the land-labor ratio in agriculture. Now, most empirical studies find the elasticity of substitution \( \sigma = 1/(1 + \varsigma) \) to be in the 0.4 to 0.6 range. This implies that \( \varsigma > 0 \) (and taking \( \sigma = 0.4 \) yields \( \varsigma = 1.5 \)). As long as \( \varsigma > 0 \), it is clear from above that \( \xi \) is decreasing in \( \tau \), i.e., countries with higher land-labor ratios in agriculture would have lower values of \( \xi \) and, therefore, are more likely to have their wages rise in response to an increase in population. Allen (1998) and O’Brien (1996) point out that England

\footnote{Boserup (1981) argues that an increase in population forces farmers to open up more land in order to keep output from falling. Once all available land is used, they switch to a new set of farming techniques. de Vries (2008) adopts this line but emphasizes market incentives in explaining the induced a rise in productivity. Kremer (1993) finds that in the very long run higher population induces technological change. Galor and Weil (2000) assume that an increase in population leads to higher productivity growth.}
was a country with a land-labor ratio in agriculture that is higher than France. Thus, we have reason to defend the view that England was more likely to have wages remain high in response to the recovery of its population.

Note also how the share of labor in agriculture responds to an increase in population:

\[
\frac{dL_f}{dN} = \frac{L_f}{N}(1 - \varepsilon_{A,N}) \left[1 + \frac{a}{(1-a)\tau}\right].
\]  

(12)

Again, as long as \( \varsigma > 0 \), it is clear from above that countries with higher land-labor ratios in agriculture, \( \tau \), would have proportionately smaller increases in the share of labor in agriculture. Note also that a higher \( \tau \) makes the elasticity, \((dL_f/dN)(N/L_f)\), more likely to be less than one so that a one percent increase in population would lead to a less than a one percent rise in the agricultural labor force, reducing the latter’s share in total population. This also agrees with the historical accounts that show that a smaller percentage of the population in England than in France was engaged in agriculture in the period in question (see O’Brien (1996) among others).

Finally, to see how rents respond to an increase in population note that \( R = Q - wL_f \). Differentiation now yields

\[
\frac{dR}{dN} = \frac{R}{N^\rho} \left(\frac{1}{1 - \sigma} - \varepsilon_{A,N}\right).
\]  

(13)

Given that \( \sigma < 1 \), this implies that rents rise with an increase in population.

To sum up, so far I have argued that the recovery of European populations at the beginning of our period was associated with an increase in agricultural productivity. This had different effects on real wages and the allocation of labor across sectors depending on the inherited regime of property rights in land in different regions of Europe. Thus, given the relatively large landholdings, real wages in northwestern Europe remained roughly the same, whereas population increases combined with smaller plots of land in western Europe and serfdom in eastern Europe had the effect of reducing real wages. Rents on land rose everywhere (in proportion to initial rents per capita; see equation (13)).

I now turn to the consequences of these changes in real wages and rents on the structure of the manufacturing sector.

2.3.1 Manufactures

The Structure of Demand for Manufactures: Agents’ demands for manufactured goods are given by \( Q_i = (C^i - \bar{C})/\alpha w = (1 - \nu)(P^i - \bar{C})/(\alpha w) \). Thus,

\[
Q_L = (1-\nu) \frac{w^L + b^W - \bar{C}}{\alpha w}, \quad Q_R = (1-\nu) \frac{R/M + b^R - \bar{C}}{\alpha w}, \quad Q_E = (1-\nu) \frac{\pi + b^E - \bar{C}}{\alpha w},
\]
or, defining \( \delta \equiv \tilde{C}/w \equiv \tilde{w}/w \) (ratio of subsistence income to wages) and \( \gamma \equiv r/w \equiv R/Mw \) (ratio of per-landlord rents to wages), \( \theta \equiv (\alpha - \beta)/\alpha \) (the rate of profit) and recalling that \( \bar{C} = w\bar{l} + \bar{y} \), at a steady state

\[
\begin{align*}
\bar{Q}_L &= \frac{\bar{l} - \delta}{\alpha}, \\
\bar{Q}_R &= \frac{\gamma - 1}{\alpha} + \frac{\gamma - \delta}{\alpha}, \\
\bar{Q}_E &= \theta(\bar{D}_Q - \rho) + \bar{Q}_L. 
\end{align*}
\] (14)

Note that if workers earn just enough to cover subsistence expenditure on food (i.e. \( \delta = \tilde{l} \)) as when \( w = \tilde{w} \), \( Q_L = 0 \).

The following results prove useful in what follows.

**Proposition 1.** \( \bar{Q}_L < \rho \)

**Proof.** Noting that \( \bar{l} < 1 \), we have \( \bar{Q}_L < Q_L^* \equiv (1 - \delta)/\alpha \). If we can show that \( Q_L^* < \rho \) we are done. Suppose that on the contrary \( Q_L^* > \rho \). Given the definitions we then have \( (1 - \delta) > \alpha(k + 1)/(\alpha - \beta) \). This implies \( 1 - \alpha(k + 1)/(\alpha - \beta) > \delta \). Or, \( 0 > -(\alpha k + \beta)/(\alpha - \beta) > \delta \geq 0 \), a contradiction. \( \Box \)

**Assumption 3.** \( r \geq 2w \). That is landlords earn at least twice as much as workers.

**Proposition 2.** Maintain Assumption 3. \( \hat{Q} \equiv \theta(\bar{Q}_L + M - \rho) + \bar{Q}_L < Q_R \) with \( M < \rho \).

**Proof.** With \( M < \rho \), \( \hat{Q} < Q \equiv (1 + \theta)\bar{Q}_L = (2 - \bar{v})\bar{Q}_L \) (where \( \bar{v} \equiv \beta/\alpha = 1 - \theta \)). If we can show that \( \hat{Q} < Q_R \) we are done. Now, suppose \( \hat{Q} > Q_R \). Using (14), this implies \( 1 > (1 - \bar{v})(1 - \delta) > (\gamma - 1) \). But \( 1 > \gamma - 1 \Rightarrow 2 > \gamma = r/w \Rightarrow 2w > r \). A contradiction. \( \Box \)

I now turn to the discussion of how the various European regions fared in terms of developing their manufacturing sectors given the regime of property rights they inherited. Recall that this regime determined how they responded to the recovery of population levels in the period in question. Most importantly, we are interested in the real wages of workers and rents on land as these determined the demand for manufactured goods. The latter, was affected, ceteris paribus, by the number of landlords in each economy. Thus, of particularly interest here is that subspace of the parameter space \( \mathcal{M} \) to which each \( M^i \) \( (i = EN, FR, POL) \) belongs. The modeling strategy that I follow below is to parse this space so that each European region falls into a subspace which yields a historically roughly accurate characterization of the region’s economy for the period in question.

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2.3.2 Northwestern Europe

Here we need to determine the “extent of industrialization” and the “extent of the manufacturing sector” in northwestern Europe. Recall that in this case real wages remained roughly constant when population levels rose. In line with comparative historical evidence, I will make the following two assumptions for northwestern Europe.

**Assumption 4.** $w > \bar{w}$.

Thus, workers demand manufactures.

**Assumption 5.** $M < \rho < M + Q_L$.

That is, while the numbers of landlords is not high enough to generate demand for manufactures sufficient to cover fixed costs in IRS sectors, those sectors that receive demand $M + Q_L$ can cover fixed costs and switch to the IRS technologies.

**Assumption 6.** $\underline{M} < M < M^{EN}$

Assumption 6 has two parts. $\underline{M} < M$ (where $\underline{M} \equiv R/\pi$ with $D_Q = N$) implies that the number of landlords is so high that the richest entrepreneur receives income $\pi$ higher than the income $R/M$ of a landlord.\(^{33}\) $M < M^{EN}$ (where $M^{EN}$ is defined by $R/(w\underline{M}^{EN}) - \delta = \theta(M^{EN} - \rho) + (1 + \theta)Q_L/(1 - \theta)$ and obtained from $Q_2 = Q_R$) places an upper bound on the number of landlords so that their incomes exceed the wages of workers by an amount given by the productivity differential between the CRS and IRS sectors.\(^{34}\)

Now, given $w > \bar{w}$, everyone, $N$, demands manufactures. Since their number, $N$, exceeds that required to cover fixed costs, those sectors with mass $Q_L$ that receive everyone’s demand initially industrialize. The $Q_L$ entrepreneurs who receive $D_Q = N$ demand $\bar{Q} = \theta(N - \rho) + Q_L$ ($\bar{Q} > Q_R$ because the richest entrepreneur is richer than a landlord). Those $Q_R$ entrepreneurs\(^{35}\) receive $D_Q = M + Q_L$ and demand $Q_1 =$

\(^{33}\)The richest entrepreneur is the one whose good is bought by the most. With all agents buying some IRS manufactures, there are some goods that all agents buy.

\(^{34}\)The required ratio is historically justified. To have a sense of what is required, note that the condition $M < M^{EN}$ is equivalent to the condition $\frac{\beta}{\alpha} > \frac{\alpha - \beta}{2} \text{ or } \frac{Q_R}{Q_L} > 2\frac{\alpha}{\beta} - 1$. Thus, even when the IRS sector is twice as productive as the CRS sector, we require that landlords be able to purchase only 3 times more than wage-earners. Historically, this number is much higher. Note that Assumption (6), which is sufficient but not necessary, is needed below to have $Q_2 < Q_R$.

\(^{35}\)This is because $Q_L < \rho$ entrepreneurs cannot by themselves generate enough demand for IRS sectors. Only those sectors that receive the combined demand of $Q_L$ entrepreneurs and $M$ landlords can industrialize. These sectors have mass $Q_R$, the range which both the landlords and richest entrepreneurs can afford.
\[ \theta(M + Q_L - \rho) + Q_L < Q_R \] (inequality follows from Proposition (2)). Similarly, the \( Q_1 \) entrepreneurs who receive \( D_Q = M + Q_L + Q_R \) demand \( Q_2 = \theta(M + Q_L + Q_R - \rho) + Q_L < Q_R \) (by Assumption (6)) and the \( Q_2 \) entrepreneurs who receive \( D_Q = M + Q_L + Q_1 \) demand \( Q_3 = \theta(M + Q_L + Q_1 - \rho) + Q_L \). This describes a sequence the elements of which are \( Q_{i+2} = \theta(M + Q_L + Q_i - \rho) + Q_L \) for \( i \geq -1 \) (with \( Q_{-1} = 0 \) and \( Q_0 = Q_R \)). The Appendix describes the solution to this recursive equation and some useful properties of the sequence. It also shows that \( Q_i < Q_R \) \( (i \geq 1) \). This is used to establish the following result.

**Proposition 3.** The extent of industrialization in northwestern Europe is given by \( \tilde{Q}_{EN}^R = Q_{EN}^R \).

**Proof.** \( Q_R \) entrepreneurs receive \( D_Q = M + Q_L > \rho \) so they industrialize. Given \( Q_i < Q_R \) \( (i \geq 1) \) the mass of sectors using the IRS technology is bounded from above by \( Q_R \). \( \square \)

Aggregate demand that generates profits of the industrialized sector is calculated in Appendix 1 as:

\[
[N - (\Omega + Q_R)] Q_L + \frac{\Omega - \rho}{1 - \theta} (Q_R - Q_L) + \frac{\Omega + Q_R - \rho}{1 - \theta} Q_L \tag{15}
\]

Note that the quantities \( (\Omega + Q_R - \rho)Q_L \) and \( (\Omega - \rho)(Q_R - Q_L) \) have multiplier effects (with \( 1/(1 - \theta) \) as the multiplier, where \( \theta \) is the rate of profit), while \( [N - (\Omega + Q_R)] Q_L \) does not generate further profits through the multiplier.

### 2.3.3 Western Europe

We start by making a crucial assumption that restricts us to a subspace of the parameter space.

**Assumption 7.** \( M > \eta \). Thus \( Q_R < \rho \).

Assumption 7 (where \( \eta \) is defined as that \( M \) for which \( Q_R = (R/M - \overline{w})/aw = \rho \) holds) formalizes the idea that in this case property rights in land are so diffuse that landlord income, and, thus, expenditures on manufactures are low. It is then natural to make a second assumption here.

**Assumption 8.** \( M < M^{FR} \).
where I define $\bar{M}^{FR}$ by $\theta(\bar{M}^{FR} + Q_L + Q_R(\bar{M}^{FR}) - \rho) + Q_L = Q_R(\bar{M}^{FR})$. The implication of Assumption 8 is that each landlord is poorer than the richest entrepreneur but there is an upper limit on the income of the second-tier entrepreneurs such that their demand $\theta(M + Q_L + Q_R - \rho) + Q_L$ falls short of $Q_R$.

Here again given $w > \tilde{w}$, initially everyone, $N$, demands manufactures. Since their number, $N$, exceeds that required to cover fixed costs, those sectors with mass $Q_L$ that receive everyone’s demand initially industrialize. Reasoning similar to the northwestern European case above yields $Q_{i+2} = \theta(M + Q_L + Q_i - \rho) + Q_L$ for $i \geq 1$ as the recursive equation that governs the sequence of demands. Reasoning identical to the one discussed in the Appendix shows that here we also have $Q_i < Q_R$ ($i \geq 1$), which can then be used to establish the following result.

**Proposition 4.** The extent of industrialization in western Europe is described by $\tilde{Q}^{FR} = Q_R^{FR}$.

*Proof.* $Q_R$ entrepreneurs receive $D_Q = M + Q_L > \rho$ so they industrialize. Given $Q_i < Q_R$ ($i \geq 1$) the mass of sectors using the IRS technology is bounded from above by $Q_R$. □

### 2.3.4 Eastern Europe

The eastern European case is straightforward and characterized by the following two assumptions.

**Assumption 9.** $M^{POL} < \rho$.

**Assumption 10.** $w^{POL} < \tilde{w}$.

That is, in eastern Europe the land distribution is very concentrated ($M < \rho$), and, thus, the landlords have very high levels of income, $R/M$. Further, wages are kept low by political means (say at $w = \tilde{w}$). These immediately yield the following result.

**Proposition 5.** There exists no IRS sectors in eastern Europe: $\tilde{Q}^{POL} = 0$.

*Proof.* Given $M^{POL} < \rho$ landlords cannot generate enough demand by themselves to cover fixed costs in any IRS sector. Given $w = \tilde{w}$, workers do not buy any manufactures. Thus, there is not enough demand for an IRS sector to break even. □
2.3.5 First Great Divergence

We can now bring together the results for the three different regions. Given assumption 2 it is natural to have $r^{FR} < r^{EN} < r^{POL}$. Given Assumptions 6, 7, we also have $Q^{FR}_R < Q^{EN}_R$. We can now rank the “industrialized”, i.e. IRS manufacturing, sectors of the three regions.

**Proposition 6.** $\tilde{Q}^{EN} > \tilde{Q}^{FR} > \tilde{Q}^{POL} = 0$.

*Proof.* This follows directly from Propositions 3, 4, 5, and $Q^{FR}_R < Q^{EN}_R$.

Thus, northwestern Europe ranks as the most advanced economy, followed by western and eastern Europe. This last region is characterized by the absence of any manufacturing sectors using IRS technologies. The manufactures produced using CRS technologies there are only bought by landlords who are not numerous enough to support industrialization.

2.3.6 Dynamics

To see how these three regions move from one steady state to another in response to the increase in population levels and the associated improvements in agricultural technology, recall that rents on land increased everywhere, while wages fell in western and eastern Europe, remaining roughly constant in northwestern Europe.

Consider first the effects of a decrease in wages, $w$. Across steady states, this has no effect on labor supply (see equation (4)), reduces bequests (equations (5) and (6)), and $\overline{Q}_L$ and raises $\overline{Q}_R$ (as it raises $\gamma - \delta = (r - \bar{c})/w$) (equation (14)). On impact as wages fall, so does labor supply. Along the transient path, as bequests decline adjusting to their new lower steady-state level, labor supply recovers, but remains lower than its previous long-run level until it reaches the new steady state. As wages remain roughly constant and higher than elsewhere in northwestern Europe, labor supply there remains higher than the other regions throughout.

To see how $Q_L$ changes on impact note that though lower wages reduce the incomes of workers they also lower the relative price of manufactures. Formally, we have

$$\frac{dQ_L}{dw} = \frac{1}{[(\eta_c + \eta_b + \eta_l)\eta_c w^2 \alpha]} \{ \theta \left[ \eta_l \eta_b + (\eta_c + \eta_b + \eta_l) \eta_c \right] + b \eta_c [1 - (\eta_c + \eta_b + \eta_l)] \}$$

It is interesting to note that peasants in many regions in France practised “human hibernation.” With no work to perform they would entomb themselves in their homes for months at a time, spending their days in bed, sleeping most of the time to lower their metabolic rates and prevent hunger. See Robb (2007).
which, making the reasonable assumption that $1 \geq (\eta_c + \eta_b + \eta_l)$, implies that $dQ_L/dw > 0$ so that $Q_L$ falls on impact. Along the adjustment path as bequests fall, labor supply rises creating an ambiguity. But, taking both of these effects into account we find that

$$dQ_L/db = \frac{1}{\alpha w} \left[ 1 - \frac{\eta_l}{\eta_c + \eta_b + \eta_l} \right] > 0$$

so that $Q_L$ falls along the adjustment path as well. Thus $Q_L$ falls on impact, along the adjustment path, and across steady states.

With wages falling and $R$ rising, it is straightforward to show that $Q_R$ rises all along.

Though wages remain unchanged in GB, rents rise so does $Q^{GB}_R$. The bequests of landlords also rise along the adjustment path and across steady states everywhere. With $Q_R$ determining the extent of industrialization, Proposition (6) holds.

3 Conclusion

Above I built a model that may shed some light on the different and divergent paths followed by various European regions in the period leading up to the classical industrial revolution. The point of this exercise was to point out formally that though industrial revolution was a break with the past, it was not as radical a break as once thought and had a gestation period that went beyond a few decades and generations. This long period witnessed a divergence across regions and reversals of fortune. The thesis advanced here is that what lies at the root of divergent paths followed is the variety of property rights inherited. Thus, when populations everywhere in Europe recovered slowly from the shock they received, it was the size of the landlord class and their landholdings that mattered. In western Europe where peasant proprietors tilled small plots, increases in population levels and advances in agricultural productivity led to lower real wages. Given the low incomes of landlords and peasants demand for manufactured goods remained low and increasing returns to scale technologies did not have much room to expand. At the other extreme, in eastern Europe, second serfdom kept wages low, and rents high. But given the small size of the land-owning class, these rents could not generate enough demand for high-end manufacturing processes either. Northwestern Europe, being located somewhere in between these two extremes, in terms of the size of both the landholding classes and their plots, prospered as wages failed to decline even when population levels rapidly rose. Combined demand from landlords and workers kindled an expansion of the manufacturing sectors using increasing returns technologies.
Ultimately then the moral of the story formalized here is that property rights mattered in determining the divergent paths taken by the three regions.

**Appendix**

A. Consider the recursive equation $Q_{i+2} = \theta(M + Q_L + Q_i - \rho) + Q_L$ for $i \geq -1$ (with $Q_{-1} = 0$ and $Q_0 = Q_R$). It is straightforward to establish the following:

1. $Q_1 < Q_2 < Q_R$. The first inequality follows from $Q_2 - Q_1 = \theta Q_R > 0$. The second inequality follows Assumption (6). One can also show that $Q_i < Q_R \ (i \geq 1)$. This last point follows from
   
   (a) $Q_2 < Q_R$
   
   (b) $(Q_{2i+2} - Q_2 < 0, \ (i \geq 1))$. That is all even $Q_i$ are less than $Q_2$.

   (c) $(Q_{2i+2} - Q_{2i+1} = \theta^{i+1}Q_R) > 0, \ (i \geq 0))$. That is all odd $Q_i$ are less than their even counterparts.

   (d) $Q_{2i} \ (i \geq 1)$ fall at a decreasing rate $(Q_{2i+2} - Q_{2i} = \theta^i(Q_2 - Q_R) < 0, \ (i \geq 1))$.

   $Q_{2i+1} \ (i \geq 0)$ rise at a decreasing rate $(Q_{2i+3} - Q_{2i+1} = \theta^{i+1}Q_1 > 0, \ (i \geq 0))$.

   Both sequences converge to $Q = (1 - \theta)^{-1}[\theta(M + Q_L - \rho) + Q_L]$

2. The solution to the recursive equation is (with $Q_i \ (i = 1, 2)$ given)

   $$Q_i = \frac{Q_R(1 - \theta) \left( (\sqrt{\theta})^i + (-\sqrt{\theta})^i \right) + Q_1 \left( 2 - (\sqrt{\theta} + 1) (\sqrt{\theta})^i + (\sqrt{\theta} - 1) (-\sqrt{\theta})^i \right)}{2(1 - \theta)}$$

B. To calculate the total demand (above $\rho$) for the IT sector, we find the area of rectangles (see Figure) above $\rho$. Define $\Omega \equiv M + Q_L$. We then have (see Figure) as the total area above $\rho$: $\sigma^o = [(N - \Omega)Q_L + Q_R(\Omega - \rho)] + \sigma^o + \sigma^e$.

For the odd-numbered ones ($\sigma^o$), we have (with $Q_{-1} = Q_L, \ Q_0 = Q_R$)

$$\sigma^0 = (Q_1 - Q_{-1})Q_0 + (Q_3 - Q_1)Q_2 + (Q_5 - Q_3)Q_4 + ...$$

$$\sigma^0 = \sum_{i=0}^{\infty} (Q_{2i+1} - Q_{2i-1})Q_{2i}$$

For the even-numbered ones we have

$$\sigma^e = (Q_2 - Q_4)Q_1 + (Q_4 - Q_2)Q_3 + ...$$

$$= \sum_{i=1}^{\infty} (Q_{2i} - Q_{2i+2})Q_{2i-1}$$

When added these yield (after some manipulation) equation (15).
References


