6. INSTITUTIONS AND TECHNOLOGICAL ADVANCE

“The United States inherited a set of institutions – among them common law and property rights – from Great Britain. These institutions made Britain the world’s leading nation by the end of the eighteenth century….The result has been two and a half centuries of economic growth.”

Douglass North, Nobel Prize Winner, Economics, 1993

Introduction

Our examination of the sources of growth in the modern world establishes seemingly one simple point. There was no growth of real incomes in the long run from at least 10,000 BC to 1800 AD because of the failure of technology to improve at a sufficient pace to break the grip of the Malthusian Economy.

This was not because there was no technological advance in the world before 1800. Indeed it is important to emphasize that these early economies are not static. People even perceived that progress was occurring, as witnessed by the following quote.

"There be daily many things found out and daily more may be which our fore fathers never knew to be possible." Sir Robert Filmer (1653).

In the period before 1800 in Europe, for example, there were significant improvements in production technologies (though some of these same innovations were made earlier and independently in China). Thus the list of basic technologies which were unknown or unused in the ancient world is a surprisingly long one. These include, for example, the nailed horseshoe, which protected hooves from soil moisture which wore hooves out quickly and caused them to splinter. The Greeks and Romans also did not use stirrups which allowed cavalry with lances to be used as shock troops in warfare. In antiquity war was mainly conducted on foot, or horses pulled chariots. The Greeks and Romans also used horse harnesses which wound around the belly and neck of the horse. Experiments earlier this century by a retired French cavalry officer suggest that
harnessed in this way horses lose up to 80% of their traction power, since the neck strap presses on the windpipe and the jugular. In the medieval period horse collars which sat on the horses shoulders were introduced.

Medieval Western Europe, for all its lack of high culture, made more notable advances in basic production technologies than did the Classical period. The period called the Dark Ages (AD 500 - AD 1150) saw the introduction of horse shoes, stirrups, and horse collars. A notable innovation of the High Middle Ages (AD 1150 - AD 1500) was the windmill. The first of these documented with certainty were in Yorkshire, England, in 1185. Wind mills are more sophisticated machines than water mills since they have to be turned to face the wind. They were also able to develop more power than water mills. The largest windmills could deliver 20-30 horse-power, compared to less than 10 horse-power for water mills.¹

The medieval world also made major advances in shipping and navigation. Ships in the classical world mainly used a single square mainsail, and were steered by oars. This made them hard to maneuver, and it meant they could sail into the wind at only a slight angle. Ships basically had to sail with the wind, with all the limitations this implied. The late middle ages saw substantial improvements in ship design. New rigging with three masts that carried both square and lateen sails were adopted which considerably improved maneuverability. A sternpost rudder was added which reduced the effort in steering. Ship construction also improved. By 1300 the "carvel" construction technique diffused widely. In earlier methods the planking of the hull provided the structural strength of the ship which limited the size of ships. In carvel construction beams within the hull provide the structural strength, and the planking merely keeps the ship watertight. This allowed larger and lighter ships, which reduced transportation costs and increased seaworthiness. The Portuguese caravel was used by Da Gama, Columbus, and Magellan in their voyages of discovery. Reflecting improvements in construction and rigging the tons carried per sailor rose from 5-6 in 1400 to 7-8 in 1550, and continued to rise thereafter.²

¹Cipolla, pp. 172-4.

²Cipolla, p. 130.
Navigation also improved greatly. Greek and Roman ships seem to have not had any navigational aids, other than watching the stars and following the coastline. This limited the sailing season in the Mediterranean to the summer. The magnetic compass was introduced in the late middle ages, though it was not till after 1400 that it was used to steer ships. The ancients knew how to measure latitude by measuring the altitude of the polar star. But this was not used for navigation at sea till the late middle ages.\(^3\) All these developments in ship construction and navigation were the prerequisites of Columbus's voyages across the ocean in 1492, and Magellan's circumnavigation of the world in 1521.

Other devices often though of as timeless were medieval innovations. One was a button in clothing that was other than just decorative. This first appeared in Central Germany in the 1230s. Despite the great technical sophistication of oriental culture it never developed the button. The Japanese were introduced to them by Portuguese traders, and consequently still use the Portuguese word for them. Another medieval innovation was the spinning wheel. The earlier method of spinning, used in ancient Egypt 7,000 years ago, was the hand held distaff and spindle. This method was so slow that for very fine yarns it is estimated it would take perhaps 700 hours to spin 1 oz. Thus spinning was a major activity in these societies. The spinning wheel, introduced in the 12th century, allowed the spindle to turn 2-3 times faster, increasing output per worker by equivalent amounts. The basic spinning wheel was improved enough in the 16th century to further double the productivity of spinners.\(^4\) Weaving was also improved by the introduction of horizontal looms, where a foot operated treadle raised and lowered the warp threads to allow insertion of the weft. In 1589 the English clergyman William Lee devised a mechanical knitting machine which was extremely complex, but which spread quickly though Europe.

Spectacles were invented around 1285 in Italy. The fourteenth century saw the introduction of mechanical clocks and firearms. Gutenberg introduced movable type for printing in 1453. This innovation reduced the cost of producing books dramatically. The printing press spread rapidly across Europe. By 1480 there were

\(^3\)Measuring longitude was problem that was not solved till the eighteenth century. See below.

over 380 working presses in Europe. The first printers produced 300 pages a day. There were steady increases in productivity thereafter. By 1500 printers produced 400 pages per day, and by 1700 2000 pages a day.\

There were also great developments in the 17th century in science. Galileo (1564-1642) discovered the laws of motion of falling bodies and pendulums circa 1609, and Kepler (1571-1630) discovered the laws of Planetary Motion in the years 1609 to 1619. Finally Newton (1642-1727) enunciated the laws of gravitation in 1666. In mathematics analytic geometry was developed in 1637 by Descartes (1596-1650), while Newton developed Calculus in 1665.\

However, while technological progress was occurring there was a huge increase in the rate of technological advance around 1800. We can measure roughly the efficiency of earlier economies using both the insights of the Malthusian model, and the growth accounting developed in the last chapter.\

Thus we know from chapter 5 that assuming that the stock of physical capital adjusts so that it is proportionate to income, then

\[
G_{Q/L} = -[\gamma(1-\alpha)]g_L + g_A/(1-\alpha)
\]

If we assume that from when people first evolved up until 1800 the amount of output per capita was roughly constant, that means that

\[
G_{Q/L} = 0
\]

\[\Rightarrow g_A = \gamma g_L = \gamma g_N\]

assuming the expansion of the labor supply, L, is just proportional to the expansion of population, N. We know that typically in pre-industrial societies the share of land in national income is 0.33. Thus we can calculate long run technological advance at a world scale before 1800 just by looking at long run population growth.

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5Cipolla, p. 130.

6The 200 years before 1700 also saw tremendous progress in painting and literature. In Italy Leonardo da Vinci and Michelangelo lived from 1452 to 1519 and 1475 to 1564 respectively. Shakespeare (1564-1616) wrote most of his plays in the last decade of the 16th century.
Table 1 shows this calculation. As can be seen, for the world as a whole there is no period before 1700 when the calculated rate of technological advance even exceeds 0.1% per year. At a rate of technological advance of 0.1% per year output per unit of input increases by only about 10% per 100 years.

Table 2 shows population figures for China, Europe, and India from 200 BC onwards. Before 1700 there is only one period in one area where the calculated productivity rate would exceed .10% per year. That is in China from 1000 to 1100, where the implied growth rate of productivity equals 0.15%.

Figure 1 shows, for example, real wages of building workers versus population for England, the country which eventually experienced the Industrial Revolution, for the years 1250-1880. All the way from 1250-9 to 1640-9, a period of 400 years, the economy seems caught in absolute stasis, with the level of real wages dependent solely on population.

**Figure 1: Real Wages Versus Population, England, 1250-1869**

Notes: The line summarizing the tradeoff between population and real wages for the pre-industrial era is fitted using the data from 1260-9 to 1590-9.
Table 1: Growth Rate of World Population

<table>
<thead>
<tr>
<th>Year</th>
<th>Population (m.)</th>
<th>Growth Rate of Population (%/year)</th>
<th>Implied Rate of Technological Progress (%/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10,000</td>
<td>4</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>-500</td>
<td>100</td>
<td>0.03</td>
<td>0.01</td>
</tr>
<tr>
<td>1</td>
<td>170</td>
<td>0.11</td>
<td>0.04</td>
</tr>
<tr>
<td>1000</td>
<td>265</td>
<td>0.04</td>
<td>0.01</td>
</tr>
<tr>
<td>1300</td>
<td>360</td>
<td>0.10</td>
<td>0.03</td>
</tr>
<tr>
<td>1400</td>
<td>350</td>
<td>-0.03</td>
<td>-0.01</td>
</tr>
<tr>
<td>1500</td>
<td>425</td>
<td>0.19</td>
<td>0.06</td>
</tr>
<tr>
<td>1600</td>
<td>545</td>
<td>0.25</td>
<td>0.08</td>
</tr>
<tr>
<td>1700</td>
<td>610</td>
<td>0.11</td>
<td>0.04</td>
</tr>
<tr>
<td>1800</td>
<td>900</td>
<td>0.39</td>
<td>0.13</td>
</tr>
<tr>
<td>1,900</td>
<td>1,625</td>
<td>0.59</td>
<td>*0.77</td>
</tr>
<tr>
<td>2,000</td>
<td>5,500</td>
<td>1.22</td>
<td>**1.14</td>
</tr>
</tbody>
</table>

Note: *England, **United Kingdom. It is assumed throughout that output per person remained constant, and the share of land in income was one third. After 1800 the share of land fell and output per person rose, so that productivity growth cannot be calculated in this way. It is calculated from growth accounting formula applied to England or the UK.

Table 2: Growth Rate of Population, China, Europe and India

<table>
<thead>
<tr>
<th>Year</th>
<th>China $N$ (m.)</th>
<th>$g_L$ (%)</th>
<th>Europe $N$ (m.)</th>
<th>$g_L$ (%)</th>
<th>India $N$ (m.)</th>
<th>$g_L$ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-200</td>
<td>42</td>
<td>-</td>
<td>26</td>
<td>-</td>
<td>31</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>53</td>
<td>0.12</td>
<td>31</td>
<td>0.09</td>
<td>35</td>
<td>0.06</td>
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<tr>
<td>1000</td>
<td>66</td>
<td>0.02</td>
<td>36</td>
<td>0.01</td>
<td>79</td>
<td>0.08</td>
</tr>
<tr>
<td>1100</td>
<td>105</td>
<td>0.46</td>
<td>44</td>
<td>0.20</td>
<td>83</td>
<td>0.05</td>
</tr>
<tr>
<td>1200</td>
<td>115</td>
<td>0.09</td>
<td>58</td>
<td>0.28</td>
<td>86</td>
<td>0.04</td>
</tr>
<tr>
<td>1300</td>
<td>86</td>
<td>-0.29</td>
<td>79</td>
<td>0.31</td>
<td>91</td>
<td>0.06</td>
</tr>
<tr>
<td>1600</td>
<td>160</td>
<td>0.21</td>
<td>100</td>
<td>0.08</td>
<td>135</td>
<td>0.13</td>
</tr>
<tr>
<td>1700</td>
<td>160</td>
<td>0.00</td>
<td>120</td>
<td>0.17</td>
<td>165</td>
<td>0.20</td>
</tr>
<tr>
<td>1800</td>
<td>330</td>
<td>0.72</td>
<td>180</td>
<td>0.41</td>
<td>190</td>
<td>0.14</td>
</tr>
<tr>
<td>1900</td>
<td>475</td>
<td>0.36</td>
<td>390</td>
<td>0.77</td>
<td>290</td>
<td>0.42</td>
</tr>
</tbody>
</table>

Note: *It is assumed throughout that output per person remained constant, and the share of land in income was one third. After 1800 the share of land fell and output per person rose, so that productivity growth cannot be calculated in this way.

Why was the early economy in the grip of such stasis?

To illustrate the magnitude of this puzzle note that when European’s stumbled upon the peoples of the America’s, of Australia and of the Pacific who had been isolated from the Eurasian land mass for thousands of years, they encountered societies that had seemingly had little technological advance over thousands of years. It was the technological gap between the old and the new worlds that allowed the Europeans to so quickly establish supremacy in the new lands. Why did technology advance more quickly in Asia and Europe than in the rest of the world?

The aboriginals, for example, are believed to have arrived in Australia between 40,000 and 60,000 years ago – long before people first arrived in the Americas. But there is little evidence of any technological advance on the Australian continent in all that period up to the arrival of British colonizers in 1788, at least judging by the technological sophistication of the aboriginal society at first contact. Could aboriginal society in Australia have stayed with the same technological abilities forever had the rest of the world not made contact?

Further in some of these isolated societies they encountered seeming technological regression. The statues of Easter Island were mute testimony to a technological and organizational ability that the inhabitants had once had but no longer possessed. The inhabitants of Hawaii had arrived there by sea voyages they were no longer capable of undertaking. The Australian aboriginals again had seemingly reached Australia by sea, but no longer had any sea-worthy craft in most of Australia by 1788.

It is even claimed that China, the leading area of the world in technological sophistication as late as 1400, also went into a technological decline. When Marco Polo visited China in the 1290s he found they were far ahead of the Europeans in technical prowess. Their ocean-going junks, for example, were larger and stronger than European ships. In them the Chinese sailed as far as Africa. Yet within 200 years the Chinese lost the ability to build large ocean going ships. Similarly Marco Polo had been impressed and surprised by the deep coalmines of China. Yet by the nineteenth century Chinese coalmines were primitive shallow affairs which relied completely on manual power. By 11th century AD the Chinese measured time accurately using water clocks, yet
when the Jesuits arrived in China in the 1580s they found only the most primitive methods of time measurement used, and amazed the Chinese by showing them mechanical clocks. The decline in technological abilities in China was not caused by any catastrophic social turmoil. Indeed in the period after 1400 China continued to expand by colonizing in the south, the population grew, and there was increased commercialization.\footnote{As noted above there is now debate, however, on whether the Chinese had really fallen behind Europe technologically by 1800.}

These questions have been the subject of endless debate by historians, and there are a multitude of theories, most of which can be easily shown to be untenable. Some historians have argued, for example, that Greece and Rome made few advances in production technology because they were slave societies where much of the basic production work was done by slaves so there was no “need” to advance the production technology. Since labor was “free” to slave owners they had no interest in new technologies that saved labor and gave higher output per worker. This ignores the fact that whether you are using slave or free labor has no effect on the financial incentives to innovate in production technologies. To see the fallacy here note that in most slave societies it was possible for owners to rent out slaves.\footnote{In ancient Greek cities, for example, there were many slaves who were skilled craft workers and who lived on their own practicing their craft in return for sending to their owners an annual fee.} Thus an owner who used a less labor intensive method could generate extra income from any labor that was saved, just as the employer using free labor saves through the cost of less labor hired.
Theories of the Stasis of the Pre-Industrial World

Theories of the stasis of the pre-industrial world can be divided into some basic types. These are:

1. **Incentive Theories.** These assume that in their motivations and basic rationality people in all societies are the same. If the outcomes differ it must be because of the incentives individuals faced. In particular if technology advanced slowly through most of human history it must be because the economic incentives in societies before the Industrial Revolution were not sufficient to have people invest in technology. The problem then is to explain why societies did not develop incentives promoting technological advance earlier. Such an account is the most popular one among modern economists.

2. **Scale Theories.** We saw above just how small the population of the world was in most of the pre-industrial era. Another set of theories focuses on the effects of greater population size on technological progress.

3. **Accident Theories.** These stress that the path to modern technology lay not in people’s actions alone, but had irreducibly random and accidental elements. The Industrial Revolution might have happened in ancient Greece, it might have happened in China in 1400, or it might never have happened.

4. **Theories about the Transformation of People.** These stress instead that the path to modernity lay first through changing people’s desires and aspirations. People had to learn to want material goods in the way we do, or to care less about their present consumption and more about future consumption. People had to learn also to pursue goals in a systematic and rational manner.

In this chapter I am going to consider theories of the first type, those based on incentives.
Incentive Theories

The common core of all incentive theories is the idea that most societies before 1800 had material conditions and institutions that discouraged individuals from investing time and resources in the expansion of the productive capacity of the society. There was little incentive to expand the knowledge base of these economies.

As Charles Jones states:

Consider how the model economy would behave in the absence of property rights. In this case, innovators would be unable to earn the profits that encourage them to undertake research in the first place, so that no research would take place. With no research, no new ideas would be created, technology would be constant, and there would be no per capita growth in the economy. Broadly speaking, just such a situation prevailed in the world prior to the Industrial Revolution (Jones 2002, p. 121).

Over the vast course of history, the process of economic growth was sporadic and inconsistent. Because institutions such as property rights were not sufficiently developed, discoveries and inventions were infrequent. The investments in capital and skills needed to generate and apply these inventions were absent. Similar problems impoverish many nations throughout the world today (Jones, 2002, p. 196)

The picture many modern economists thus have of the world before the Industrial Revolution is thus composed of a mixture of all the bad movies ever made about early societies: Vikings pour out of longships and loot and pillage defenseless peasants and burn the libraries of monasteries, Mongol hordes flow out of the steppe on horseback to sack Chinese cities, clerical fanatics burn at the stake those who dare to question arcane religious doctrines, peasants groan under the heel of rapacious lords whose only activity is feasting and fighting, Aztec priest cut out the hearts with obsidian knives from screaming victims. In this world who has the time, the energy, or the incentive to develop new technology?
It is true that war and disorder was much more common in the pre-industrial period than in modern societies. War, for example, was the normal state of affairs within pre-industrial Europe rather than the exception. The states of pre-industrial Europe engaged in frequent low level hostilities against each other. Thus Scotland engaged in a struggle to stay free of English domination that lasted for over 300 years from 1296 to 1603, a struggle that was only ended by the Scottish king also becoming the English king. As a result of frequent Scottish raids in these years the area of England within 50 miles of the Scottish border remained very lightly populated in these years because of the frequent destruction of property. Similarly the English kings engaged in a two hundred year struggle to assert their claims to the throne of France and hold on to their French lands that lasted from 1346 until the reign of Henry VIII in the sixteenth century. The table below shows the percentage of years in which there was warfare somewhere in Europe at various times:

<table>
<thead>
<tr>
<th>Period</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>700-1000</td>
<td>83%</td>
</tr>
<tr>
<td>1501-1600</td>
<td>90%</td>
</tr>
<tr>
<td>1601-1700</td>
<td>96%</td>
</tr>
<tr>
<td>1701-1800</td>
<td>84%</td>
</tr>
</tbody>
</table>

In the sixteenth century France and Spain were at war almost continually. In the seventeenth century Russia and Poland were at war for 4 out of 5 years, Spain for 3 out of 4 years, and Austria and Sweden for 2 out of 3 years.

But while war was common, its impact was also much less than the total war of modern times. States in these early years were able to raise very modest amounts of money by taxation, and consequently they could support only very small armies. In the campaigns of Edward III against the French in the Hundred Years War from 1345 to 1360 the English typically fielded armies of less than 6,000 men, and their largest forces were only about 10,000. The French fielded larger armies of about 20,000. In Spain Isabella and Ferdinand conquered Granada in 1492 with about 20,000 men.

Indeed the years 1300 to 1800 in Europe saw a constant upward movement in the amounts states were spending on warfare, and in the consequent sizes of armies. The grandson of Isabella and Ferdinand, Charles V, deployed as many as 100,000 soldiers against the Turks in Hungary in 1532, and almost 150,000 at Metz in 1552. Charles VIII of France invaded Italy in 1494 with only
18,000 men, but Francis I attacked again in 1525 with 32,000, and Henry II deployed 40,000 at Metz in 1552.

By the mid-sixteenth century both France and Spain seem to have been able to support armies of about 150,000. Only in the 1670s as the French army got bigger did any army exceed this size. By 1691 Louis XIV's army was at 273,000, and by 1696 it had reached 395,000. There was another big increase in the size of armies after the French Revolution of 1789. On the eve of the French Revolution in 1788-9 the royal army had about 150,000 men. By 1794 France had about 730,000 men under arms. Napoleon invaded Russia in 1812 with his Grande Armee of 600,000 men over a front 125 miles wide.

This meant that in at least some pre-industrial societies while there were periodic disasters from conflict with other countries, and from internal struggles, the average experience of individuals was of substantial stability. In England, for example, we can find many villages and towns which in the entire history of the country from 1200 to the present never witnessed any event of any interest. Generation after generation of villagers grew up, farmed the land, had children, and died in dull predictability, disturbed in this entire period only by the periodic visitations of the plague, and by a few spectacular harvest failures. England is probably unusual in its extreme stability over long periods of time, but similar epochs could be found in Chinese, Japanese, and Indian history.

These were also societies where markets were often well developed and seemed to have functioned very well. We can illustrate this with data from the grain market in medieval England. Medieval England had relatively high transport costs, and information traveled very slowly within the economy. We might think that in this case markets would function rather badly. It turns out that for medieval England we have data on both the level of prices for wheat, and the yield of wheat for over 100 manors (medieval estates) for several hundred years.

This data when first analyzed seemed to suggest that the market did not work very well, since there are persistent average differences in price levels across manors. Figure 2 shows the average price for 107 manors whose locations are known in % above or below the national average for the years 1208-1453.
FIGURE 2: DEVIATIONS OF PRICES FROM NATIONAL AVERAGE (%)

Notes: To show all the observations some of the manors are displaced slightly in the figure. The Rivers Thames, Lea, and Wey are also shown, though they are not believed to have been navigable over the whole length portrayed in this figure in the medieval period.
But persistent price differentials are quite consistent with the existence of an integrated and efficient national grain market, and uniform prices are consistent with no national market. If there are grain producing and grain importing areas, and there are transport costs then grain prices will be higher in the importing areas by the amount of the transport costs. Also the absence of price differentials need not indicate that there is an integrated and efficient market: each local market could be an island quite separate from any other, but each could have on average the same kind of production conditions for grain, producing markets that on average have the same prices. Further there is great uncertainty in the medieval period about the size of local bushel measures used to measure grain, and grain quality may vary by location.

In many ways a better test of the spatial efficiency of markets is to look at what determined local prices. If markets functioned perfectly, and transport costs were low, the grain yield in a village should have had little effect on the price level. If yields were low there, but higher elsewhere, grain would flow in and keep prices low. If yields were high, but low elsewhere, then grain would flow out driving up prices here also. If, however, each village was isolated from the market then the only determinant of local prices would be local yields. What happens elsewhere in the economy would have no impact locally.

For 65 of the 107 manors whose average prices are summarized in figure 6 above we have sufficient data on both wheat yields and prices to carry out the test suggested above. If markets were highly localized, prices at each location should consequently be predictable in part at least from local yields. Thus to test the prevalence of markets formally I estimate the values of the coefficients a, b, and c that best describe the relationship between local prices, local yields and national prices

$$P_{jt} = a + bY_{jt} + cP^*_t + e_{jt}$$

where $P_{jt}$ is the average price in a given manor $j$ in the year beginning in September 29 of year $t$, and $Y_{jt}$ is the local yield in the harvest of the autumn of that year. $e_{jt}$ is a random element which enters because of errors in the measurement of prices, and the fact that prices vary over the course of the year, and $P^*$ is the general price level in the economy. The predictions we would get for the best fit for the coefficients above would be:
With no market operating outside prices will have no effect on local yields once we control for these, and prices will drop when yields are high (so that $b$ will be negative). With a complete market operating local yields will have no effect on prices so that $b$ will be 0, and local prices will move in line with outside prices so that $c$ will be 1. In the intermediate case where transport and transaction costs are high enough to blunt the influence of national market conditions on local conditions both $b$ and $c$ will be significantly different from 0.

Table 3 shows the estimated values of $b$ and $c$ using data for 54 Winchester manors and 9 Westminster manors from 1211 to 1452. In only 4 of the 39 manors shown is there any evidence of a significant negative connection between local yields and prices (shown by a * or ** depending on how strong the relationship is). Our best estimate is thus that the pure effect of local yields on local wheat prices is that if yields double, prices would decrease by about 2.7%. Also shown with a * or ** are the cases where the link between national prices and local prices, $c$, is less than 1. In general a doubling of the general price level is associated with a 99% rise in local prices. This test suggests that the market was working very well spatially, and that all the 65 manors observed were trading wheat in what was effectively a national grain market.

<table>
<thead>
<tr>
<th></th>
<th>$b$</th>
<th>$c$</th>
</tr>
</thead>
<tbody>
<tr>
<td>local markets</td>
<td>$&lt;$0</td>
<td>0</td>
</tr>
<tr>
<td>complete national market</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Manor</td>
<td>N</td>
<td>local yield</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----</td>
<td>-------------</td>
</tr>
<tr>
<td>Winchester (54)</td>
<td>4,699</td>
<td>-0.027**</td>
</tr>
<tr>
<td>Adderbury</td>
<td>101</td>
<td>-0.072</td>
</tr>
<tr>
<td>Aylesford</td>
<td>120</td>
<td>0.011</td>
</tr>
<tr>
<td>Beauworth</td>
<td>109</td>
<td>-0.011</td>
</tr>
<tr>
<td>Bentley</td>
<td>112</td>
<td>-0.010</td>
</tr>
<tr>
<td>Bishops Waltham</td>
<td>125</td>
<td>-0.021</td>
</tr>
<tr>
<td>Brightwell</td>
<td>122</td>
<td>-0.067</td>
</tr>
<tr>
<td>Burghclere</td>
<td>117</td>
<td>-0.022</td>
</tr>
<tr>
<td>Cheriton</td>
<td>113</td>
<td>0.021</td>
</tr>
<tr>
<td>Crawley</td>
<td>120</td>
<td>0.011</td>
</tr>
<tr>
<td>Downton</td>
<td>119</td>
<td>0.006</td>
</tr>
<tr>
<td>E. Meon</td>
<td>125</td>
<td>-0.010</td>
</tr>
<tr>
<td>E. Meon Church</td>
<td>102</td>
<td>-0.060</td>
</tr>
<tr>
<td>Ecchinswell</td>
<td>116</td>
<td>-0.031</td>
</tr>
<tr>
<td>Fareham</td>
<td>121</td>
<td>0.034</td>
</tr>
<tr>
<td>Farnham</td>
<td>107</td>
<td>-0.039</td>
</tr>
<tr>
<td>Fonthill</td>
<td>106</td>
<td>-0.041</td>
</tr>
<tr>
<td>Hambleton</td>
<td>118</td>
<td>0.009</td>
</tr>
<tr>
<td>Harwell</td>
<td>115</td>
<td>-0.094**</td>
</tr>
<tr>
<td>High Clere</td>
<td>101</td>
<td>-0.015</td>
</tr>
<tr>
<td>Ivinghoe</td>
<td>110</td>
<td>-0.057</td>
</tr>
<tr>
<td>Knoyle</td>
<td>104</td>
<td>-0.033</td>
</tr>
<tr>
<td>Mardon</td>
<td>116</td>
<td>-0.026</td>
</tr>
<tr>
<td>North Waltham</td>
<td>121</td>
<td>0.138**</td>
</tr>
<tr>
<td>Overton</td>
<td>128</td>
<td>0.012</td>
</tr>
<tr>
<td>Rimpton</td>
<td>106</td>
<td>-0.103**</td>
</tr>
<tr>
<td>Sutton</td>
<td>115</td>
<td>0.011</td>
</tr>
<tr>
<td>West Wycombe</td>
<td>108</td>
<td>-0.021</td>
</tr>
<tr>
<td>Witney</td>
<td>102</td>
<td>-0.126*</td>
</tr>
<tr>
<td>Woodhay</td>
<td>101</td>
<td>-0.016</td>
</tr>
<tr>
<td>Westminster (9)</td>
<td>245</td>
<td>0.003</td>
</tr>
<tr>
<td>Ashford</td>
<td>18</td>
<td>0.199</td>
</tr>
<tr>
<td>Birdbrook</td>
<td>47</td>
<td>-0.033</td>
</tr>
<tr>
<td>Bourton</td>
<td>47</td>
<td>0.111</td>
</tr>
<tr>
<td>Eyebury</td>
<td>29</td>
<td>0.081</td>
</tr>
<tr>
<td>Feering</td>
<td>45</td>
<td>-0.110</td>
</tr>
<tr>
<td>Icknham</td>
<td>10</td>
<td>0.544</td>
</tr>
<tr>
<td>Stevenage</td>
<td>11</td>
<td>-0.216</td>
</tr>
<tr>
<td>Todenham</td>
<td>35</td>
<td>-0.079</td>
</tr>
<tr>
<td>Cuxham (Merton)</td>
<td>38</td>
<td>0.002</td>
</tr>
<tr>
<td>Downham (Ely)</td>
<td>9</td>
<td>0.423</td>
</tr>
<tr>
<td>All (65 manors)</td>
<td>4,991</td>
<td>-0.025**</td>
</tr>
</tbody>
</table>
Thus the consistently low pace of technological advance before 1800, if it is to be explained by incentives, must be explained in terms of the social institutions of these societies. Most important there are the rules of property in a society and of the transmission of property. These define what can be owned, and how ownership is transferred from one party to another. These rules can be quite complex. Thus we think of modern America as a society of private property rights. But many property rights are limited in many ways by public authorities. I may own my house, but the city government can take some of its rental value each year in property taxes, and the city can limit the use I make of my property. In modern America people can own words, ideas, music, their likenesses and the names of things. People cannot, however, own other people. When there are disputes about who owns what there are recognized legal mechanisms to resolve these disputes (mechanisms that are in the USA notoriously cumbersome and expensive). But all of this is the result of the legal framework that has been established over time.

Douglass North and his followers have argued that these institutional rules defining property rights always discouraged the development of new technologies in the years before the Industrial Revolution. For this to be a convincing explanation of slow economic growth before 1800 economists need to show three things:

1. That innovative activity was typically motivated by material incentives.
2. That appropriate material incentives only developed around 1800.
3. That there were reasons why all societies before 1800 never developed the right institutions for economic growth.

The Motivation for Innovation

Douglass North and Robert Thomas give as an illustration of this argument that innovation is driven by the comparison of expected gains and expected losses the case of the determination of longitude at sea. To determine position at sea you need to measure both longitude and latitude. The problem of determining latitude was solved early, but the problem of measuring longitude was not
solved until well into the eighteenth century. Until then in voyages across the oceans longitude could only be estimated by trying to keep track of how far the ship had progressed each day. Mathematicians convened by Henry the Navigator of Portugal had determined around 1500 that position could be determined if there was an accurate enough measure of time. This clearly defined the technical problem. Thereafter prizes for the invention of a sufficiently accurate clock were in turn offered by Spain, the Netherlands, and then Britain (in 1714), as each became a major sea power.

The offer of the prize in Britain stimulated a search by clockmakers for a clock mechanism that would be sufficiently accurate. There was a clear gain to whoever produced the device – the British government was offering £20,000, which was about 500 times the annual wage of a carpenter. One watchmaker, John Harrison, spent most of his life in pursuit of this reward, producing on the third attempt a winning entry, but only after nearly 40 years of effort.9 Here is a case where the existence of the reward clearly drove the search for the innovation. Had the reward been only £20 then Harrison would not have devoted any effort to the quest. Had it been £20,000,000 then many other watchmakers would have been interested in the search.

North and Thomas, along with most economists, argue that the dominant motive behind innovation is just such a search for material gains.

The Incentives for Innovation in Early Societies

In general the private rewards from technical progress are heavily dependent on social institutions. For the product of invention, knowledge, is a good that cannot generally be kept to the discoverer if it is employed on a large scale in production. Horseshoes, stirrups, buttons, spinning wheels, reading glasses, and printing presses were all introduced in Europe between the end of the Roman Empire in the West and 1500. But all these innovations arrived in economies where there was no effective mechanism to protect property in knowledge. Thus unless a

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9Even though he succeeded in meeting the standards set by the British Parliament the inventor still had to press his case for nearly a decade before he got his money.
discovered worked an innovation on their own in secrecy, there was no way to make much money from innovations even if they sharply reduced the costs of products. The innovator could have worked the machine themselves, and profited by being able to produce at much lower costs than competitors. In that case the return from innovation would be very modest, and there would be little incentive for anyone to innovate.

But suppose innovators tried to increase their rewards by selling the device to others, or hiring others to work the machine. Most of the innovations introduced in pre-industrial societies were relatively simple to produce. Thus if they were sold, or others were hired to work them, they could be easily copied by other craftsmen. Once that happens the machine will spread to all competitors and the extra profits of the innovator will be exhausted. As Richard Roberts, the inventor of the power loom in the Industrial Revolution period noted, “no trade can be kept secret long; a quart of ale will do wonders in that way.” Similarly Arkwright the inventor of the first water-powered spinning wheel noted “We may swear [the hands] as we pleased, but if any body would give them a penny more, they would divulge it.” Thus there will be little financial inducement for people to pursue easily copied innovations if there is no effective system to protect property rights in knowledge in place in a society.

Similarly the crucial element in increasing grain yields in agriculture seemed to be simply introducing nitrogen fixing crops into the rotation. But once the discoverer of this told anyone else how could they profit from the knowledge? They would have nothing to sell to farmers using the new technique. Thus for the discoverers of early technologies to make profits there had to be some institution which rewarded innovators. This could be a monopoly right to produce a new product, or to produce the product in a new way, a right to collect royalties from the users of a new product or device, or a lump sum reward from the government to innovators.

Only if society has some such mechanism to give property rights in knowledge to the discoverer will there be much private

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10 Houghton, p. 111.
11 In the case of our more sophisticated technologies the discoverer of a new technique may be the only person with the required technological competence to produce the device. In this case they can profit even without any property rights in knowledge.
reward.

Thus in the case of the marine chronometer, the prize of £20,000 offered by the British government was very small in relation to the social benefit of the innovation. The future social gains from better navigation far exceeded the £20,000 prize. Even one ship saved by the device would have paid the prize cost. Had the government offered more money, or had the money been offered before 1714, then more people would have pursued the device earlier and hence with high probability the breakthrough would have been made earlier.

But early societies seem to have lacked even the legal notion that you could own property in ideas or innovations. Thus in both the Roman and Greek worlds when an author published a book there was no legal or practical way to stop the pirating of the text. Copies could be freely made by anyone who acquired a version of the manuscript (on papyrus rolls), and the copier could amend and alter the text at will. It was not uncommon for a text to be reissued under the name of a new “author.” It was common to condemn such pirating of works or ideas as immoral. Thus Pliny the Elder in his work *Naturalis Historia* laments “I have found the most professedly reliable and modern writers have copied the old authors word for word, without acknowledgement.” But writings and inventions were just not viewed as *commodities* with a market value, as we now view all such works.

The earliest foundations of a modern patent system, where an innovator is granted exclusive use of an idea for a period of time in return for disclosing the idea to the community, were found only in the thirteenth century in Venice. By then documents survive that indicate the Venetian state was probably giving inventors exclusive rights to exploit innovations. By the 15th century in Venice true patents in the modern sense were regularly being

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12 The monarchies of pre-industrial Europe were typically strapped for cash. And it was likely that the details of any innovation would have leaked out to competing naval powers that would have acquired the benefits at little cost.

13 This problem continued into at least the seventeenth century in England, where publishers quite freely pirated the works of authors.

14 See Pamela Long, “Invention, Authorship and Intellectual Property…”, pp. 853-7. The struggle over what you can have a property right in continues in modern society. Now the question is whether people have property rights over their genetic code, over information about their consumption patterns, over the use of pictures of them taken in public places and so on.
awarded. Thus in 1416 the Council of Venice gave a 50 year patent to Franciscus Petri from Rhodes, who was thus a foreigner, for a new type of fulling mill. By 1474 the Venetian patent law had been codified. There is evidence for Florence also in the fifteenth century of the awarding of patents. The Venetian innovation granting property rights in knowledge, which was very important to the famous Venetian glass industry, spread to Belgium, the Netherlands, England, Germany, France and Austria in the sixteenth century as a consequence of the movement of Italian glass workers to these other countries. Thus by the sixteenth century all the major European countries, at least on an ad hoc basis, granted property rights in knowledge to innovators. They did this in order to attract skilled craftsmen with superior techniques to their lands.

Since the Industrial Revolution did not arrive till at least 200 years after the spread of these patent systems to many European countries, it would seem that they cannot be the center of the story. What North and others argue is that these early systems, though formally patent systems, were ineffective for various reasons. One was that they were typically administered by sovereigns who were hard up for cash, and who so the systems not mainly as a way to encourage innovation, but as a method of raising revenue.

In England, for example, the patent system was introduced in the reign of Elizabeth I (1568-1603). But a patent cost £100, which was a considerable sum for a small innovator in these years, for only a 14 year monopoly on the device. The revenue went to the crown. In the seventeenth century the Stuart Kings in England, always hard up for cash, used this royal supervision to grant spurious patents as a way of raising money. The person granted the patent could then exploit their monopoly for profit.

After the Glorious Revolution of 1688-9 in England, when the Stuart monarchs were replaced by a monarchy that was largely a figure head under the control of Parliament, the new regime sought to escape the taint of scandal associated with the system by devolving the supervision of patents to the courts. Generally the courts would allow any patent to be registered as long as no other party objected. After 1689 the patent system in England was no longer viewed by the government as a potential source of revenue. No other major European country, argues North, had a formal patent system immune from political control as in England before

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15 A carpenter in the 1580s, for example, would earn about £13 per year.
1791. That was why innovation took off in the eighteenth century only in England.

Figure 4 shows a seeming connection between the arrival of the modern patent system and the amount of innovative activity in English society. But it is not as clear as this picture would suggest that institutional innovation in England was the true spur of the Industrial Revolution.
Figure 4: Patents per Year, England, 1660-1851
Was the Industrial Revolution caused by better property rights in knowledge?

Despite the claims made for the importance of the development of the modern patent system, immune from political control, in spurring the Industrial Revolution, the evidence is that innovators received very poor economic rewards even in England after the Glorious Revolution of 1688-9. The record also suggests that the amount of reward people got from the patent system was still heavily dependent on their political connections.

One problem was that even where property rights in new knowledge existed, the ability to enforce these through courts was often severely limited by the nature of the new technologies being introduced. If an innovation requires a large production plant, such as an auto assembly line, then it is easy for an innovator to enforce his/her property rights. There will be a limited number of infringers to pursue, and the infringers will have large capital assets that can be seized to provide compensation for the infringement. Similarly if the product produced is distinct, as opposed to an old product produced in a new way, it again makes the detection of infringement easier. But if the innovation is a new production process that is used by many small producers, and requires little fixed capital in production then successfully detecting infringers is impossible. Consider, for example, illegal copying of computer software. Even though it is illegal, prosecution of individuals for this is almost unheard of. Detection is difficult, and the gain from prosecution minimal. Large corporations, however, do not engage in large scale illegal copying of software. Disgruntled employees are only too happy to report such violations to software producers, and substantial sums can be extracted in damages.

Even after the reforms of 1688-9 the system in Britain was cumbersome and difficult to use, and there is plenty of dispute about how much this system actually did to promote innovation in the Industrial Revolution. Most of the innovators in the early Industrial Revolution period either did not try to protect their innovations with patents, or were unsuccessful when they tried to do so.

The textile industry for example was in the vanguard of technological change in the Industrial Revolution period. Figure 5 shows measured efficiency in the production of cotton cloth, taking cotton as a basic input. From 1770-9 to 1860-9 productivity
Figure 5: Cotton Cloth Manufacture, Productivity, 1770-1869

Note: The squares show the decadal average productivities. The years 1862-5 were omitted because of the disruption of the cotton famine.
rose about 22 fold. Something like half the entire productivity growth experienced by the English economy from 1760-9 to 1860-9 can be attributed directly to the innovations in textiles.

Yet the gains of the textile innovators were modest in the extreme. The value of the cotton textile innovations alone by the 1860s, for example, was about £115 million in extra output per year. But a trivially small share of this value of extra output ever flowed to the innovators. Table 4, for example, shows the major innovators in cotton textiles and the gains accruing to the innovators through the patent system or other means. Patents mostly provided poor protection, the major gains to innovators coming through appeals post hoc to public beneficence through Parliament. Also the patent system shows none of the alleged separation from political interference. The reason for this is that Parliament could, on grounds of the public good, extend patents beyond the statutory 17 years to adequately reward those who made significant innovations. James Watt, the developer of the steam engine, was the beneficiary of such a grant. But such grants depended on social and political protection just as much as in the old days.

There is also good evidence that a most of the innovation in the textile industry was quickly leaking from the innovators to other producers with no rewards to the innovators. Knick Harley has reconstructed the profit rates being made by some of the more successful cotton spinning and weaving firms in the early Industrial Revolution period. The cotton spinners Samuel Greg and partners earned an average profit from 1796 to 1819 of 11.7% per year, where the safe return on capital would be 5%. This is just a very normal commercial return for a risky venture such as manufacturing. Given the rapid improvements in cotton spinning productivity going on in the industry in these years it suggests that whatever innovations were being introduced were spreading from one firm to another very quickly. Otherwise leading firms such as Samuel Greg would have made large profits compared to their competitors. Similarly the firm of William Grey and partners made less than 2% per year from 1801 to 1810, which is a negative economic profit rate. The innovations in the cotton spinning industry seem to have mainly caused prices to fall, leaving little excess profits for the firms that were innovating.
Table 4: The Rewards to Textile Innovators in the Industrial Revolution

<table>
<thead>
<tr>
<th>Innovator</th>
<th>Device</th>
<th>Year</th>
<th>Patent?</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>John Kay</td>
<td>Flying Shuttle</td>
<td>1733</td>
<td>Yes</td>
<td>Impoverished by litigation trying to enforce patent. House destroyed by machine breakers 1753. Died in poverty in France c. 1764</td>
</tr>
<tr>
<td>Richard Arkwright</td>
<td>Water Frame</td>
<td>1769</td>
<td>Yes</td>
<td>Patents invalidated by courts 1785. Most of £0.5 m. fortune at death in 1792 made post 1781 when patents in dispute.</td>
</tr>
<tr>
<td>Samuel Crompton</td>
<td>Mule</td>
<td>1779</td>
<td>No – gave device to Bolton industry for £70.</td>
<td>Given grants of £500 by manufacturers subscription in the 1790s, and in 1811 of £5,000 by Parliament. Died subsisting on an a Parliamentary annuity of £63 in 1827.</td>
</tr>
<tr>
<td>Eli Whitney (USA)</td>
<td>Cotton Gin</td>
<td>1793</td>
<td>Yes</td>
<td>Forced out of business by infringers by 1797. Congress refused to renew patent in 1807. Made a fortune in the subsidized mass production of muskets, but never again patented his innovations.</td>
</tr>
</tbody>
</table>
The firm of Richard Hornby and partners in the years 1777 to 1809 was in a sector of the industry, handloom weaving, which had not yet been transformed by any technological advance. Yet its average profit rate was 11.4%, as high as Samuel Greg in the innovating part of the industry. The conclusion is that the host of innovations in cotton textiles do not seem to have particularly rewarded the innovators. Only a few such as Arkwright and the Peels became noticeably wealthy. Table 5 shows that at the end of the Industrial Revolution the wealthy in England were still largely the old landed class, and traditional merchants and bankers.

The uncertainties of legal protection for patents even under the new system are illustrated in the case of John Heathcoat, who patented a lace making machine in 1808. In 1813 when he tried to prosecute an infringer of his patent, he had to abandon the case when it was discovered that a copyist had omitted a single line from the patent specification. In 1816 his patent was secured in a different court case. But at this point there were said to be 156 unlicensed makers and owners of his machines. After the successful legal case Heathcoat agreed to issue licenses for 700 outstanding machines, licenses which produced an income of £10,000 per year. But many unlicensed machines continued in operation, reducing the price of lace, and hence the profit derived from the patent.

Thus the record of the British patent system was a very mixed one. Some innovators were able to secure their rights, but equally some fared very poorly in the courts. From 1750 to 1799 of 18 patent infringement cases brought to court where the verdict is known, only 7 were concluded in favor of the patent owner.16 Only in the 1830s did the courts become much more favorable to the plaintiffs. And the risk and cost of litigation induced many innovators to compromise with infringers for modest sums, or to tolerate infringement of their patents.

16 Dutton, p. 78.
Table 5: The Occupations of those leaving at least £0.5 m. in Britain, 1860-79

<table>
<thead>
<tr>
<th>Sector</th>
<th>All</th>
<th>Share of Non-Landed (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New Economy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textiles</td>
<td>17</td>
<td>13.8</td>
</tr>
<tr>
<td>Iron and Steel</td>
<td>15</td>
<td>12.2</td>
</tr>
<tr>
<td>Coal Mining</td>
<td>2</td>
<td>1.6</td>
</tr>
<tr>
<td><strong>Old Economy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>13</td>
<td>10.5</td>
</tr>
<tr>
<td>Banking and Commerce</td>
<td>69</td>
<td>56.1</td>
</tr>
<tr>
<td>Law etc</td>
<td>7</td>
<td>5.7</td>
</tr>
<tr>
<td><strong>Non-Land</strong></td>
<td>123</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Land</strong></td>
<td>256</td>
<td>-</td>
</tr>
<tr>
<td><strong>All</strong></td>
<td>379</td>
<td>-</td>
</tr>
</tbody>
</table>

The deficiencies in the patent system led some innovators to prefer secrecy as a way of trying to earn profits from their innovations. A famous example of this is Henry Bessemer’s machine for producing gilt powder. Until 1843 gilt powder for decorating was made from little sheets of bronze which were hammered by hand between skins to form bronze leaf which was then pulverized. This hand industry was so time consuming that the resulting powder cost as much as gold. The world gilt industry was concentrated in Nuremberg in Germany.

When Bessemer discovered a set of simple machines which would make gilt powder at far lower cost he decided against patenting his discovery since a patent required describing the machine well enough so that someone else could copy it, and patents only protected the invention in England, not in other countries. To keep his discovery secret he had the machine parts made by different metal forming firms. He and his two brothers-in-law then assembled the parts in an inner room of a factory which had a double set of doors. The inner door was only opened once the outer door had been locked. The factory operated for many years without others discovering the secret producing gilt for about 5% of the cost in Germany and earning Bessemer huge profits. The German industry allegedly sent agents to England to try to bribe workmen to reveal the nature of the machinery, but without success.

**Earlier Systems for Rewarding Innovation**

The argument that before the introduction of patent systems there was no incentive to innovate is also suspect. While earlier societies did not have patent systems, they often did have other institutions that rewarded innovation. And these systems can be argued to have been better suited to early economic conditions.

A general consideration is that a patent system is in fact not the optimal way to encourage innovation. Under a patent system an innovator gets rewarded by charging people a premium to use an idea whose cost to society is now zero, at least for a limited period. Figure 6, for example, shows the demand curve for an innovation. Some people are willing to pay a lot to use the idea,
Figure 6: The Costs of the Patent System
others will be willing to pay very little. The person granted a patent will set a price for use of the innovation that maximizes the rectangle under the demand curve. But at this price there are people who would get benefits from the innovation that exceed the social costs of supplying it to them (which for knowledge is 0). The sum of that loss is represented by the area of the triangle under the demand curve. Efficient use of the innovation (which means maximizing the benefits derived from it, measured in money, to the innovator and the users of the idea) requires that at least some consumers get use of the innovation at zero cost.

An alternative to patent systems are systems that award prizes to innovations based on their economic value to society. By giving a lump sum prize to innovators society in principle can both get efficient use from the new knowledge and give appropriate incentives for its production. A prize system can also potentially give more reward for innovation. For the total value of the innovation to society is measured by the total area under the demand curve. With a patent system the innovator never gets the full value of their innovation (unless they could charge each user the value of the innovation to them). Thus innovation is not encouraged to the extent of its social benefits.

We saw the drawback in the pre-industrial period of a patent system was the difficulty of pursuing many small violators of a patent. For an innovation like the railway or the steam engine, where there is a large investment made, and the machine is very visible and easy to locate patent rights are more easily enforced. The patent violator can be located and forced to pay recompense. But for a device that is easily manufactured or copied, and which is used by many, many people, such as a spinning wheel, enforcing patent rights can be impossible. The costs of suing each violator in such a case could easily exceed the benefits, especially if the violators have no assets that can be seized. Another advantage of a prize system is that it does not have to worry about this type of enforceability.

17 The patent system for modern drugs often leads to very inefficient use of new drugs. Thus the drug companies charge thousands of dollars for a year’s supply of the antiviral drug cocktail used to fight AIDS. This means that in poorer countries most people with AIDS go untreated. But the cost of producing these drugs is only a small fraction of the price charged - most of the price is to cover sunk costs of the research and development of the drug regime. If the governments were simply to buy out from the manufacturers the 17 year patent term for a large lump sum many more people would be treated.
Such a system of state prizes for innovations operated alongside patents in many European countries. In France in the eighteenth century the King would sometimes reward worthy innovators through either lump sum grants or life pensions, ennoblement and hence exemption from taxes, or set them up in royal manufactories. Thus when John Kay failed to enforce his English patent for the flying shuttle in the courts in England he went to France in 1749 and received large cash grants for instructing weavers on how to use the flying shuttle. The Swiss inventor Aimé Argand took out a patent for a new type of oil lamp in England in 1784, licensing the production to Matthew Boulton, James Watt’s partner. The ease with which the lamp could be made encouraged a host of infringements, and legal action had to be taken against them. But the legal case failed in 1785, and the patent was declared invalid. In contrast to his miserable experiences with the English court system in France Argand was granted a royal subsidy of £1,000 to set up a factory to produce his lamps, and his business flourished until the Revolution.

North and other institutionalists argue that such prize systems did little to encourage innovation before 1800 because monarchs generally paid attention to their own interests and not to those of society as a whole. It is probably correct to assume that the elites who ruled most societies before 1800 were largely self serving and took actions only if they perceived a gain to their financial or dynastic ambitions. Kings would not just sponsor innovation because it increased the total output of society, they would sponsor it if they believed that it would increase their revenues. But often the taxing power of early monarchs was surprisingly limited. Consider, for example, the English crown before 1688. The king generally collected in taxes 1-2% of total income through such things as customs duties. In this case if an innovation is perceived to lead to an increase in income for the kingdom as a whole of $\Delta Y$ per year, then the king will get an extra revenue of only $\theta(\Delta Y)$ where $\theta = 0.01$ or $0.02$. So the amount the king on average would be willing to pay to encourage innovation would in general be only a small fraction of the value of innovations to society.

But monarchs were not the only ones who could offer such prizes. Another potential sponsor of innovation were the craft guilds which operated in cities all across Europe from medieval times until the eighteenth century. Typically workers in a given occupation, such as weavers, would form an association which limited entry to those who had completed an apprenticeship. Smith attacked these guilds in the *Wealth of Nations* as conspiring
to restrain trade. But while the guilds certainly did try to limit membership, and keep the prices of their output or services high, they also served as a way of encouraging innovation through offering prizes to their members for improvements in technique. Or members would compete just for the honor of being recognized as someone who had advanced the technique of the craft in that city. Since producers in the guild in one city were in competition with producers in other cities, they were generally interested in innovations that would lower costs. By having control over its members the guild can raise the money to reward innovators by taxing its members. In this case those getting taxed would get directly the benefits, so that they would be much more willing to pay than in the case of monarchs.

Thus it is not obvious that the material rewards for innovation really increased so dramatically in England in 1689. The situation is much more confused and uncertain.
Rent Seeking and Productivity Advance

The cost of any activity in economic terms is what the person could earn at their next best choice of activity (this is called the opportunity cost). Thus the cost of innovation in any society is going to depend partly on what other avenues are open to potential innovators, and what the prospects of gain in these activities were. One argument used to explain the lack of innovation in earlier societies is that for a person of ambition and ability it was always more profitable to engage in some form of what is called “rent seeking.”

Rent seeking is any activity in any society that seeks merely to transfer output from one person to another without creating any more output. Rent seeking includes warfare, theft, much legal activity, and also considerable political activity. Productive activity results in more output to be divided up between the members of society, but rent seeking activity just results in the same output being diverted from one person to another. Examples of rent seekers in modern America would include political lobbyists, trade unions, many attorneys, many people in the advertising industry, as well as many stock brokers and financial analysts.

The major causes of rent seeking activity in the pre-industrial world would be religious endowments, warfare, and state revenues.

Consider, for example, the medieval Catholic Church in Europe. Pre-industrial Europe was by all appearances an intensely religious society, where the church was in all periods at the center of peoples’ lives. But this piety meant that by 1100 the church had become enormously wealthy in most of northern Europe. For pious lords and ladies gave or bequeathed land and property to the church in the hope of redeeming their sins after death. Church possessions tended to grow since the abbots and bishops were forbidden to part with endowments, while private estates would be split by inheritance, or sold to pay debts. Indeed it is estimated in England that the church owned about one third of the land by the late middle ages. By 1279 the English king was so concerned about the ever growing wealth of the church that he passed a law requiring that any further donations to the church receive a royal license (the Statute of Mortmain). In addition the church was entitled for its support to one tenth of the gross output of society in the form of the tithe. That meant that with the combination of land rents and tithe the church received about 25% of all income. This
was much more than the king received. A similar situation obtained across much of Europe.

Of the huge income of the church, very little was spent as charity to the poor. Instead the income served mainly to maintain the clergy and the nuns in a relatively wealthy lifestyle. The major bishops of the church had incomes as great as those of the richest private nobles. Even the ordinary monks of well-endowed foundations such as Westminster Abbey also lived very well. This meant that youths with energy and ambition could look to the church as an attractive career opportunity.

Why would the church, however, lead to any more rent-seeking activity than private landlords? The answer would be that the rents going to families from private land ownership are passed on through the inheritance system in a way that prevents much rent seeking. But the church revenues are up for grabs to whomever can exert most influence within the church hierarchy.

Cardinal Richelieu (1585-1642), for example, who was the French king Louis XIII’s main advisor, initially trained for a military career. But his family had the right to nominate the bishop of Lucon, a relatively minor church position, but one whose revenues were important to the family. The family had planned to make his older brother Alphonse the bishop, but his brother Alphonse refused to be nominated. Richelieu’s career was suddenly diverted towards the church. He was nominated for the position in 1606 at age 21, five years younger than the minimum age under canon law. That difficulty was removed by obtaining a papal dispensation. His ambitions for a larger career than his little bishopric were furthered in 1614 when he was elected as a clerical representative to the French parliament, the States-General. He was noticed by the royal family and in 1616 became a secretary of state to the king. Through political intrigue and the support of the French crown he attained the exalted position of cardinal of the church in 1622. By 1631 he was also elevated to a dukedom. The financial rewards for his political activities were considerable: in 1617 his income as bishop was 25,000 livres per year, by the end of his life it was 3,000,000. To secure the position of himself and his master, Louis XIII, he suppressed the Huguenots (Protestant dissidents) at home in 1629, while allying himself with Protestant princes in Germany against the Catholic Habsburgs.

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18 Church rules, for example, called for at least one quarter of the tithe to be spent on the poor, but the share actually spent was much less than this.
The earlier English equivalent of Richelieu, Cardinal Wolsey (c. 1475-1530), who was a contender for the papacy in the 1520s, had even more modest beginnings. His father was solidly prosperous, but a butcher by trade, who shows up in the court records of Ipswich, Wolsey’s home town for various offenses such as letting his pigs stray in the street, selling bad meat, and not having the correct weights and measures. Through a series of patrons Wolsey moved up the church hierarchy. In 1498 he was a fellow (lecturer) at a college in Oxford. By 1500 he acquired a rectory, a church position with an attached income. He was employed in diplomatic world by Henry VII, and was rewarded by being appointed by the king as Dean of Lincoln Cathedral in 1509. By 1511 was chief advisor to the young Henry VIII, and the benefits of his successful advise in war and diplomacy soon followed. By 1515 he had acquired the positions of bishop of Lincoln, bishop of Tournai (in France), archbishop of York, and finally cardinal of the church.\(^{19}\) Till his fall from grace in 1530 he reigned supreme over both the English church and the English state. He acquired in addition to the two bishoprics and archbishopric listed above the rights to the revenue of the abbey of St Albans, and the bishoprics of Bath and Wells, Durham and Winchester. He also enjoyed the pleasures of the flesh and had a number of illegitimate children. He obtained for his illegitimate son by the time the boy was 18 a deaconry, four archdeaconries, five prebends and a chancellorship (all church positions with attached revenues).

\(^{19}\) In large parishes the tithe was a substantial source of income. Thus the person appointed priest in such a parish got a rich living. Those appointed to direct such parishes (the rectors) found that they could cheaply hire other priests to carry out the duties keeping most of the income for themselves (the term vicar comes from the Latin vicarius for a substitute, thus the modern term “vicarious”). Thus the income from many parishes began to flow to distant monasteries who owned the right to the position, or to politically influential laymen appointed to the position. Further in both England, France, and Italy some people, in a practice called pluralism, began to occupy many of these benefices at the same time, deriving large incomes. Though Pope Alexander III legislated against this practice in the Lateran Council of 1179, the practice continued to be widespread. In the late thirteenth century, for example, Bogo de Clare, a younger son of an Earl of Gloucester, held simultaneously 29 church positions in England: he was probably not even a priest (G. G. Coulton, Medieval Panorama: the English Scene from Conquest to Reformation, pp. 137-141, 154-157). Bogo could hold his many benefices because he had obtained, presumably by suitable payment, a dispensation from the Pope to hold pluralities.
Ambitious people would advance in the church through such paths as becoming experts in theology, in canon law, and in church administration. But within the church their energies would be spend not in creating any more output for society, but in ensuring that they would be the recipients of the benefits as opposed to other less worthy clerics. Thus the church diverted many of the talented people of the society into what were in terms of the economy unproductive activities.

Interestingly Henry VIII reduced the influence and the share of income derived by the church in England quite sharply in the English Reformation of the 1530s. Henry seized many of its properties and sold them to private individuals. This sharply reduced the income available to the established church.

In the Chinese empire the state was more powerful earlier on and was the recipient of a much greater share of income than in most European states. The state was administered by a specially trained class, the Mandarins, between the beginning of the T’ang dynasty (600 CE) and the end of the Ming (1644 CE). Entry to this class was by a competitive exam open in principle at least to all. Those who sought high position would thus compete to learn the arcane knowledge that ensured success on these exams. They would be rewarded by rich careers in the bureaucracy. But if the bureaucratic functions they performed did little to enhance the economy then again this system would just divert talent to unproductive activity.

Warfare was another drain on the talented in earlier societies. War in Europe from the twelfth century to the eighteenth was pretty much a business. The ordinary soldier expected to be paid well in wages, with the hope of further rewards through booty, plunder and ransom. Wages for soldiers rose in line with general wages in the economy. In the 1260s Welsh archers were being paid 3 d. per day, compared to a typical wage of 1.5 d. a day for farm workers. These wages, however, largely served to cover just the costs of campaigning. The real rewards came in the form of grants of land when an area was conquered, and from ransoms for captured opponents.

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20 The people concerned would probably not have analyzed their activities in this way, and would instead have said that the mission of a worthy bishop was to bring his flock closer to God through the smooth running of the structures of the church.

21 CE = Christian Era.
Important prisoners would be ransomed by their families for handsome amounts, so in wars between countries the aim after defeating an opponent was to capture as many as possible. King John of France was ransomed by the English for the staggering sum at the time of £500,000 (this was the equivalent of 1,250,000 acres worth of farmland). Richard the Lionheart, captured on the way back from a crusade, was ransomed for £100,000. The Scottish king fetched only £67,000 when captured by the English. The typical procedure would be that if a high ranked opponent was captured he would be sold first by his captor to his own the King, who would house the captive until arrangements were made to ransom him (for a mark-up) back to his family. Of course, while there was profit in ransoms if a prisoner was captured, there was loss if you yourself were taken prisoner. So while there are many tales of low ranked knights becoming rich as a result of the fortunes of war, there as many of already poor families further impoverished by ransom demands.

Sir John Hawkwood (d. 1394), who was a soldier of such renown in fourteenth century England that he is honored by a painting on the walls of the Duomo cathedral in Florence, was supposedly the son of a tanner in a country village in Essex, England. He started life as an apprentice in London, but learned his military skills in the wars of Edward III of England in France. When the temporary peace of 1360 brought the fighting there to a close he organized a mercenary company of English soldiers and moved southward to Italy in search of employment. The wars between the various Italian city states gave much scope for this kind of work. Over the next twelve years he fought for Monferrato, Pisa, and Milan, before entering a contract with the papacy, then fighting against Milan. In 1375 the Florentines agreed to pay him 130,000 florins on condition he would not take up employment against them. In 1377 he reconciled with Milan, taking up arms against the pope. But by 1378 he had quarreled with Bernabo Visconti, the Milanese leader, and joined Florence (for another 130,000 florins). He had great success as the Florentine commander, but still found time to fight for Padua and in Naples. On his death in 1394 the Florentines gave him a magnificent public funeral and decreed a monument to him should be executed.

Yet though warfare was endemic, the numbers of people directly engaging in warfare in most pre-industrial societies was very small, smaller even than those in the Church. War in the end probably did not divert too many people from other activities
because it was largely what is called a “zero sum game.” The gains of one side came from the losses of the other, so that the expected return was 0. Indeed knights at the time seem to have realized the costs of doing battle, and pitched battles were relatively rare. A soldier in the English or French armies in the Hundred Years war would be lucky to have engaged in even one major battle in the course of a military career. Thus Edward I of England, who reigned from 1272 to 1307, and took part in military campaigns in Wales, Scotland, Flanders and Palestine, participated in only one true battle, in 1298 at Falkirk against the Scots. Instead armies spent most of their time maneuvering, besieging castles and towns, and despoiling the countryside.

Yet though there were plenty of activities - church, state and warfare – that engaged the talent of energetic people in all pre-industrial societies, there is no sign that such non-productive activities were any more a distraction before 1800 than after. The rise in the ability of states to tax their citizens in the seventeenth and eighteenth centuries resulted mainly in a rise in military expenditures. Figure 7, for example, shows military expenditures as a share of GDP in Britain from the 1720s to the 1830s. As the Industrial Revolution was proceeding the share of income poured into non-productive military expenditures rose to more than 15% per year from 1795-1815. Thus the state in Britain just at the time of the Industrial Revolution was absorbing much more of the income of society than most pre-industrial societies. For comparison state revenues as a share of national income in China are estimated at

- Ming (c. 1550) 6-8%
- Qing (c. 1750) 4-8%
- Qing (c. 1880s) 7.5%
- Qing (c. 1908) 5-10%

While the Chinese state was large before 1750 relative to most European states, measured in how much of the output of the society it managed to command, it was small compared to the British state in the Napoleonic War years.
Figure 7: British Military Expenditure as a Percentage of GNP
The Evolution of Institutions

A problem with all these institutional theories of incentives for economic growth and technological advance is that it is not obvious that institutions can be the independent determining factor in the operation of societies. For there is another view of institutions affecting economic life which is that institutions passively adapt to the technology and relative prices of economies, and play a secondary role in economic history. (Interestingly enough this was the view of Douglass North in 1972 in *The Rise of the Western World*. This is the same Douglass North who later argued that institutions play the key role in explaining economic growth).

The argument for this view is as follows. Economic institutions, being just a set of rules about who owns what, and how ownership is determined, can be changed at relatively small costs. It does not cost any more to have efficient institutions as does to have inefficient institutions. If an institution is impeding the production of the maximum potential output from a society, there will be pressure to change it towards one that promotes greater efficiency. Some set of people would gain from the change, and their net gains will be bigger than the losses of the losers. People are not stupid and if an institution is causing a serious loss of possible output they will reform it. Thus when we see institutions vary across time and place it will generally be because differences in technology, relative prices, and people’s consumption desires make different social arrangements efficient.

This view, however, implies that institutions can play no role in explaining economic development. Their evolution may be interesting, but is driven by more fundamental forces within economies. The history of the institutions in any economy is also not particularly interesting since their origins will have little bearing on their current functioning.

On this view there may be periodic ideological pushes to adopt institutions that are inefficient as a result of periods of religious fervor or social turmoil. Examples of religious fervor would be the arrival of Christianity in Europe, of Islam in the Middle East. Incidents of social turmoil would include the French Revolution of 1789, the Russian Revolution of 1917, and the Communist takeover of China in 1949. But if these new institutions are economically inefficient they will quickly evolve towards those that are more economically efficient.
One example of this, for example, is the method of deciding legal cases by “wager of battle.” When the Normans conquered England in 1066 they imported to English Law the right of a defendant in legal cases, including civil cases such as property disputes, to prove their case by “wager of battle.” In this procedure the defendant would duel with the plaintiff in a ritualized combat that could be fought to the death of one of the parties. They did this because of the warrior origin of Norman society (they were descendants of Norse invaders of France), and because of the religious belief that God would intervene on the side which was in the right.

These are well defined means of settling property disputes, but it would be argued, not mechanisms that would ensure that land was used productively, or that people would be encouraged to invest in land. Strong people could seize that land and assets of the weak, and have little to fear in the courts of law. But there are signs that this Norman innovation was reasonably rapidly altered to eliminate some of its inefficiencies. This legal option survived for a long period, but there are clear signs that it relatively quickly began to evolve to a form that gave more protection to legitimate land holders. As early as 1179 a tenant whose possession of land was challenged could for a price apply to the royal courts for a “writ of peace” prohibiting battle and requiring the case be settled by a jury of twelve knights from the locality. But if a tenant either knew they had bad title to the land, or feared the views of their neighbors who would form the jury, they could still defend their title by judicial combat.

By the mid-thirteenth century (i.e. circa 1250) the parties were allowed to name champions to fight judicial duels for them. The great religious houses with much land, and hence many territorial disputes, even kept champions in permanent training. Thus in 1287 the Abbey of Bury St Edmunds fought a duel for possession of two manors. The Abbey Chronicle records that:

\[
\text{We at length declared we would defend our right by judicial combat... The abbot paid a certain champion called Roger Clerk, who came from the district of Lincoln, 20 marks in advance from his}\n\]

\[^{22}\text{It is not clear, however, whether armed combat in settlement of property rights is any worse a way of settling disputes than hiring high priced attorneys to explore the niceties of legal theory.}\]
own money. After the duel Roger was to receive 30 marks more from him. The champion during the whole time of waiting (for the appointed day of the duel) stayed with us, accompanied by his trainer.... On St Calixtus’s day our enemies were victorious and our champion slain in judicial combat in London. And so our manors of Semer and Groton were lost without hope of any recovery.23

Since the annual wages of a laborer at this time would be less than 3 marks, the champion who was to receive 50 marks if successful was a highly skilled worker. Unlike the example above, the men who fought for pay generally did not fight to the death, and typically one would surrender to the other before fatal injury. As late as 1375 the funeral brass of Wyville, Bishop of Salisbury, has on it the figure of the episcopal champion who successfully defended the bishop’s ownership of Sherborne Abbey. But the right to be tried by combat largely fell into disuse sometime in the 1300s, replaced completely by the jury as a method of trial. (The right to “wager by battle” was not repealed formally until 1819. This followed a case in 1817 of private prosecution for murder (Ashford v Thornton) where the defendant demanded the right to trial by combat (the plaintiff refused to fight so the defendant was set free)).24

The elimination of trial by combat in medieval England hurt those with a lot of muscle and a bad attitude and aided those who were weak and mild. But the argument here would be that since fighting to settle property disputes was economically wasteful, and reduced the value of property to everyone, the legal system evolved away from this institution to more efficient methods of dispute resolution.

The general evidence on whether institutions do evolve towards efficiency is mixed, but seems to indicate that institutions that promote large social inefficiencies tend not to survive. Indeed the forces of economic interest are so powerful that when ideology meets economic interest generally the solution has generally been

24 In 1817 the defendant, Abraham Thornton, a bricklayer, was accused of raping and murdering Mary Ashford. After he was acquitted by a jury her brother was granted permission to prosecute Thornton for murder. The defendant then demanded trial by “wager of battle.” (Complete Newgate Calendar, v. 5, pp. 167-171).
to adapt the ideology to resolve the conflict.

An example of this is the payment of interest on loans. In early Christianity and even now in some interpretations of Islam the taking of such interest was regarded as usury, an immoral activity. The idea lying behind this, at least in the case of Christianity, was that money by itself was sterile. If someone borrowed money, and repaid it after a year, why should they have to pay interest for the loan? The money itself was not capable of producing anything, so a bargain that required interest was unjust to the borrowing party.

But banning all lending at interest frustrates many possible mutually beneficial bargains in any economy. Thus in both Christianity and Islam the religious scholars sought ways of reconciling the pure principles of the faith with the profit opportunities of the market place.

Thus while the Catholic church formally adhered to the doctrine against usury throughout the middle ages, in practice theologians thought up ingenious reasons why most types of lending were actually permissible under the ban. Indeed since the church itself was a major lender there was considerable pressure to find just such a reconciliation. Pre-industrial Europe was by all appearances an intensely religious society, where the church was in all periods at the center of peoples’ lives. But this piety meant that by 1100 the church had become enormously wealthy in most of northern Europe. For pious lords and ladies gave or bequeathed land and property to the church in the hope of redeeming their sins after death. Church possessions tended to grow since the abbots and bishops were forbidden to part with endowments, while private estates would be split by inheritance, or sold to pay debts. Indeed it is estimated in England that the church owned about one third of the land by the late middle ages. By 1279 the English king was so concerned about the ever growing wealth of the church that he passed a law requiring that any further donations to the church receive a royal license (the Statute of Mortmain). In addition the church was entitled for its support to one tenth of the gross output of society in the form of the tithe. That meant that with the combination of land rents and tithe the church received about 25% of all income. This was much more than the king received. But it

25The Koran prohibits “usury.” Thus [2.275] “GOD permits commerce, and prohibits usury.” Thus many Muslim countries have laws against the taking of interest on loans. But Islamic scholars differ in their interpretation of whether usury is any taking of interest for loans, or just the taking of excessive interest.
meant that the church was a very substantial actor in capital markets, since it had huge amounts of money to lend.

Thus by 1300 the following exceptions to collecting interest on loans were all well accepted in Christian Europe.

1. **Profits of Partnership.** As long as each partner took the risks, returns were allowed on capital directly invested in an enterprise (i.e. equity finance was allowed).

2. **Rent Charges.** Anyone could sell a proportion of rent on land or house in return for a lump sum. Thus a perpetual loan secured by real estate was allowed. Indeed the Church itself bought many rent charges as an investment for its substantial endowment.

3. **Annuities.** An annuity is a fixed annual payment paid in return for a lump sum until the person named in the annuity dies. This was permissible since the amount of the payment was uncertain. The Prior of Winchester sold these, and they were popular in German cities.

4. **Foregone Profits.** A lender could collect compensation for profits foregone in making a loan.

5. **Exchange Risk Premium.** A lender could collect a premium on a loan if it was made in one currency and repaid in another, to cover the exchange rate risk. To exploit this loophole lenders would draw up contracts in which they lent across foreign currencies twice in one transaction, so eliminating all currency risk, but still collecting the premium.

Thus the prohibition on usury had very little cost to pre-industrial Christian society. Essentially it only outlawed certain types of bond finance. Since there was still a demand for such loans this was met in two ways. The first was by allowing Jews, as non-Christians, to engage in such lending. The second was by simply ignoring the church rules when it proved convenient. Large scale finance - lending to Princes and the Vatican - was largely untouched by such regulations. By the end of the thirteenth century Italy was the center of the European financial system. The largest Italian banks had branches in the north west of Europe (some had more than 10 branches in total). There was even an
international financial crisis in 1341 when Edward III of England defaulted on his debts, causing the bankruptcy of two of the three largest banks in Europe (the Peruzzi in 1343 and the Bardi in 1346).

Similarly even in Muslim states that ban interest on loans various banking arrangements have been set up that allow depositors to still collect a return on their money, though in the form of a “partnership” instead of explicitly as “interest.” Such banks operate in Egypt, Kuwait, the Emirates and Malaysia currently.

In England usury became legal after the Catholic Church was replaced by the Church of England (as a result of the marital problems of Henry VIII), but the state for over 300 years fixed a maximum interest rate, as a residuum of the medieval distaste for interest. A loan violating the usury restriction was not legally enforceable. If the interest rate restrictions under the usury laws had been set very low they would have seriously interfered with the operation of the economy. But in practice the usury laws would set the maximum interest rate in line with market rates, and would normally set that rate above the free market rate, so that the restrictions would actually apply to relatively few loans. What is more, loans to the Crown, a large but unreliable borrower who often had to pay rates above the market rate because of the risk attached were exempted from the usury restrictions. Figure 8 shows the rates paid on rent charges, a kind of loan that was exempt from the usury laws, which indicates the free market rate of interest for very secure loans, and the usury law rate limits in the same period between 1570 and 1840. As can be seen the usury limit was always above the market rate, so it would always have a limited effect on the credit market.

Further the specified interest rates in the usury laws were not that easy to enforce since the contracting parties could easily inflate the size of the amount stated to be loaned in the written contract in order to circumvent the usury restrictions. On this first view usury laws survived in England because they imposed very little restriction on the economy.
FIGURE 8: ENGLISH USURY LIMITS AND FREE MARKET INTEREST RATES
We can find even more startling examples of the power of economic interest to undermine ideology. In Western Samoa in the Pacific, for example, the traditional rule in choosing chiefs was that the person be a close relative of the previous chief. Interviewed by an anthropologist people claimed they observed these rules. To confirm the legitimacy of the chief elaborate lineages were kept by each clan. But members have an economic interest in choosing as chief a rich person, since one of the duties of the chief is to provide feasts for the clan. The solution that was frequently used was that the lineages were distorted to make whoever was chosen seem more closely related to the previous chief. The interviewer would find that between visits to a community the new chief would be described as more closely related to the previous chief than he was.26

**Persistent Bad Institutions**

Economists interested in institutions argue that societies get stuck with bad institutions because while “bad” institutions always cost output as a whole, they can and do benefit some individuals. If these individuals have the political or police power to preserve the institution, then they will seek to preserve it whatever the cost to society as a whole. Thus medieval guilds by keeping out new entrants to crafts may have hurt output in the economy as a whole, but they might have helped the members of the guilds themselves, who thus clung to the guild form. The guilds in London, for example, were politically powerful in England in the years before 1688 because they were able to raise money from their members to help the king at times of need. The consumers who might be hurt by guild regulations were less politically powerful because they were a more diffuse group with less ability to organize and seek the king’s favor.

Since institutions can be used to reward individuals they will arise in predictable ways as the result of lobbying by interest groups. We can thus have a theory of institutions, a “political economy” of institutions, which explains why institutions arise when they do, and disappear when they do. Thus workers might

26The British colonial administrators upset this compromise system by keeping bureaucratic records that established once and for all the actual familial relationship of individuals.
seek legislation limiting hours of work as a way of increasing their well being through hours being reduced but wages kept the same. Similarly minimum wage legislation can be desired by high wage areas as a way of excluding competition from low wage areas. The proponents of such a “political economy” of institutions would thus argue that they are explicable as the interplay between various groups with a differential ability to organize legislation in their favor.

The issue for the “Political Economy” of institutions as an explanation of slow growth before 1800 is to explain why systematically early societies had institutions that discouraged economic growth. For if institutions were just randomly chosen, or chosen as the result of the interplay of various interest groups, why would all societies in the thousands of years before 1800 end up with bad institutions? Wouldn’t there be at least some by chance that would evolve good institutions? There must be something systematic that keeps early societies from rewarding innovation.

The common feature that North and others point to in early societies is that political power was not achieved by popular elections. Indeed there is a close association between democracy and economic growth. By the time England achieved its Industrial Revolution it was a constitutional democracy where the king was merely a figurehead. The USA, the leading nation in the world in Economic terms since the 1870s, has always been a democracy also. In pre-industrial societies, as a generalization, the rulers ultimately rested their political position through the threat of violence.

For economic efficiency in any society property rules have to be chosen to create the maximum value of total economic output. In such a case a disjuncture can arise between the property rules in the society that will maximize the total value of output, and the property rules that will maximize the output going to the ruling elite. Indeed North et al. have to argue that such a disjuncture

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27 It has to be noted, however, that the franchise was very limited. Voters were restricted to male property owners. Also since the vote was by a public ballot vote buying was common. Finally the number of votes it took to elect a member of Parliament varied widely across England. Until the 1830s there were famous “rotten boroughs” that elected a member of Parliament even though they had almost no population. These seats could effectively be bought by buying the land in the area.

28 Though again a limited one for much of that time.
systematically arises before 1800.

Consider, for example, the example of a slave society such as existed in much of the US south until the 1860s, or in Haiti until the French Revolution, or Brazil until the 1880s, or in Russia again till the 1860s. It is frequently argued that slavery is a very inefficient way to organize production in a society. Since the owner can seize all the output it is hard to give slaves incentives to produce well. And the owner has to engage a lot of resources in monitoring the slave.

The statement that slavery is an inefficient institution is equivalent to the statement that

\[ \text{mp}_f > \text{mp}_s \]

where \( \text{mp}_f \) is the marginal product of freed slaves, and \( \text{mp}_s \) is the marginal product of slaves. In this case total output in the society is increased by freeing slaves. But also in this case the owners and the ex-slaves should be able to arrange a deal whereby both the slaves and the owners are better off. Suppose that the owners have to spend the equivalent of a wage of \( w_s \) to feed, clothe and house slaves. The annual profit from owing a slave is thus

\[ \pi_s = \text{mp}_s - w_s \]

That means that a freed slave could make an annual payment, \( \pi_f \), where

\[ \pi_s < \pi_f < (w_f - w_s) \]

that would make both the owner and the ex-slave better off. Thus if slavery really is a socially inefficient institution it should end spontaneously by market forces. There should be no need for abolition movements, wars and anti-slavery crusades. Indeed in ancient Athens it was common for skilled slaves to live on their own in the cities and just make an annual payment to their owners, who otherwise left them to their own devices.

But suppose that the freed slaves instead of using their freedom to happily make their annual payments \( \pi_f \) to their former masters, instead used their freedom to organize and overthrow the unjust social order that condemned them to support the former ruling class. Or they could even just use their freedom to migrate to some adjacent society where they did not have to pay the annual

53
exaction. Then even though emancipation increases the total amount of social product, it reduces the income to the ruling class. I portray the situation in figure 9. Suppose that a society with slavery produces a total surplus of 1 unit, which all goes to the ruling class. The existing set of payoffs are shown as the number pair (1,0) in the bottom part of the diagram, where the first number denotes the lords’ surplus, and the second number the slaves’ surplus. Suppose also that emancipation increases the total surplus to 3 units. Then the conditions for slaves buying themselves out of slavery seem to exist. In particular a deal where after emancipation the lords get 2 units of the new surplus, while the ex-slaves get one unit should be accepted by both parties. This outcome is shown as the path where the lords’ emancipate and the ex-slaves keep to the agreement. But once emancipation occurs, suppose that the ex-slaves get to control the distribution of income. Then they would want to take all the surplus themselves, leaving the lords’ worse off. In this situation there is no way the slaves can commit to uphold their end of the deal, and thus no incentive for the lords’ to enter into it. The problem is that there is no outside arbiter of
Figure 9: The Emancipation Decision

Note: In technical terms the decision tree above is called a “prisoners’ dilemma” game.
property rights and thus no way for the slaves to commit to honor
the agreement.

This example with slavery is just a specific example of what
“institutionalists” would argue is the general problem of pre-
industrial society: the struggle over the distribution of goods and
power limited the output of these societies.

There have indeed even in the modern world been some recent
examples of how the struggle over distribution of power and
resources can dramatically hobble societies. Somalia, for example,
is ethnically a relative homogenous society in north Africa. But
the traditional social structure emphasizes allegiance to clans –
there are estimated to be something like 500 clans and sub-clan
groupings. Members of clans support each other and expect
members of other clans to similarly support their own groups.
From 1969 to 1991 Muhammad Siyad Barre ruled Somalia
effectively as dictator. But there was widespread belief that Barre
promoted members of his own clan, the Marehan, to government
positions while excluding members of other clans. These excluded
clans united in a civil war, and eventually drove Barre from power.
But as soon as Barre was deposed a civil war broke out among the
victorious clans. The country became divided into armed fiefdoms
controlled by clans and clan alliances. During the 23 months
following Barre's overthrow about 50,000 people were killed in the
civil war (out of a population of about 9 million), and an estimated
300,000 died of starvation as the economy collapsed. The state of
anarchy, with armed coalitions having divided the country into
numerous warring territories has continued to the present. No
agreement to end the conflict has been possible, because some
clans are unwilling to surrender any power to a national
government that might come under the control of their rivals.29

So the general argument “institutionalists” would make is that
pre-industrial elites did not undertake policies to foster

29 The United Nations came into Somalia in 1992 with the hope of setting up a
national government under its supervision that would resolve the “prisoners'
dilemma” issues raised above. This resulted in a war between the leader of one
of the largest clans (the Habr Gidir), Mohamed Farrah Aidid, and the U.N. forces
led by the U.S.A. Interestingly Mark Bowden in a brief description of the
climatic battle of this war argues that the U.N. policy in Somalia failed precisely
because the premise that the chaos stemmed from mutual distrust was mistaken.
Bowden argued instead that the conflict was driven by mutual hatred between
clans that was so strong that people would rather endure misery than
compromise. See Mark Bowden, Black Hawk Down: A Story of Modern War.
technological advance because they did not perceive any benefit to themselves from economic growth. How did that work in practice?

**Conclusion: Institutions as the Obstacle to Technological Advance**

Can the slow growth of technology in the world before 1800 be traced to the institutions of these early societies. We see that technological advance should depend in large part on the institutions of societies. Do innovators get rewarded, and what are the institutions that encourage this? Does the society siphon off the talents and abilities of the ablest by creating other avenues to pursue wealth and status that merely involve taking output from one person and giving it to another? We see many failings of early economies in these respects. Property rights in knowledge were generally absent, and enforcement of these property rights was difficult even where they existed. Institutions such as the medieval Catholic church attracted many of the most talented people to activities that were not conducive to technological advance. But it is still hard to understand why no society before 1800 happened to hit upon the right set of institutions if the set of social rules was the only impediment preventing more rapid technological advance. Why was there a systematic tendency for pre-industrial societies to end up with institutions that did little to encourage technological advance? That is a question that no-one has answered.

**Bibliography**


