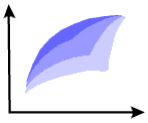
Efficient Frontier



An Online Journal of Practical Asset Allocation

Edited by William J. Bernstein
and Susan F. Sharin

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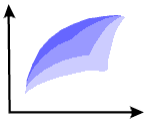


William J. Bernstein

Reflections on Money Management: Of Risk Premium Collection, Patience, and Spreading Your Bets

It is all too easy to confuse market efficiency and rationality. More than one skeptic has pointed out the inconsistency between occasionally "barking mad" markets (page *xi* of *The Four Pillars of Investing*) and the tenets of the efficient market hypothesis.

I indeed believe that markets are both highly efficient and, at times, highly irrational. The former refers to the extreme difficulty of selecting individual securities that will produce excess risk-adjusted returns, while the latter refers to the fact that risk premia occasionally get completely out of whack, as they did during the late nineties and the entire middle third of the twentieth century.

While I'm not going to reveal precisely how I've allocated assets in the past, it's in the ballpark of the DFA Model Strategies—heavily weighted towards small cap, value, and foreign equities, keeping the bond portion of the portfolio relatively short. And, of course, as passive as possible.

I can tell you two other things:

1. Over the past few decades, the DFA Model portfolios have blown the doors off a conventional market-weighted approach—so much so that during the twenty-year period ending September 2003, only a 58/42 stock/bond mix (using the Lehman Brothers 1-5 Year Aggregate) was needed to equal the 11.52% return of the Wilshire 5000 in that same time period.

2. Any manager using such an approach, let alone one more highly torqued, will not long survive in the world of pension or private wealth management; even the most efficient strategies will underperform the S&P 500 for prolonged periods of time, as occurred in the late 1990s. Very few managers can outlive three or more years of double-digit tracking errors.

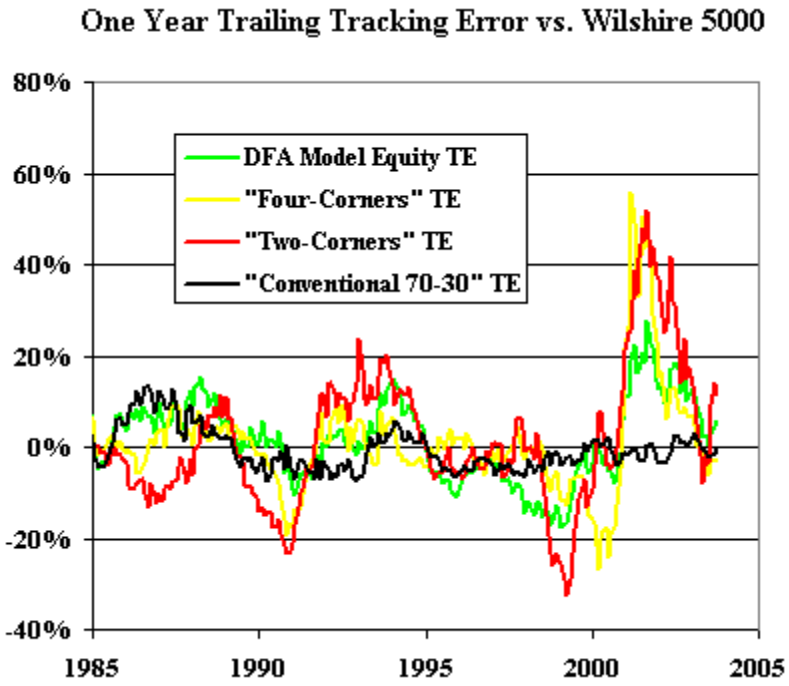
To demonstrate just how bad this tracking error can be, I've calculated below the returns of the following five all-equity portfolios over the past 20 years (ending September 2003, rebalanced every 12 months):

- Wilshire 5000
- Conventional: 70% Wilshire 5000, 30% EAFE
- DFA Model: Heavily weighted towards value and small
- More torqued: A "four-corners" approach of 25% each domestic and foreign large and small value
- Most heavily torqued of all: a portfolio consisting only of small value stocks—half foreign and half domestic

Their returns were 11.70%, 11.52%, 14.41%, 14.22%, and 14.05%, respectively. Clearly, exposure to the global value factor was of some benefit during the past 20 years, while exposure to the global small factor was not. (For the record, the 20-year Fama-French value factors were about 2% for domestic equity and 3% for international; both size factors were near zero, consistent with the larger magnitude and greater reliability of the value factor.)

While the more highly torqued series (the last two) did not outperform the more balanced DFA Model strategy, this is likely an artifact of the lack of an international small-value series before 1995. In any case, if one accepts the three-factor model, it is irrelevant; more highly torqued portfolios have higher *expected* returns, and their behavior can be used to demonstrate the unbearable pressure they bring to bear upon investors of all stripes.

Now for the "money shot." Below, I've plotted the one-year trailing tracking error, in increasing order of "torqued-ness" towards the value and small risk factors for the four all-equity portfolios (Conventional 70/30, DFA Model, Four Corners, and Two Corners) versus the pure Wilshire 5000.



What you're looking at is a plot of just how badly you're going to feel during periods when the S&P 500 is the toast of cocktail party conversation, as it was during the 1920s, early 1970s, and late 1990s.

If you're an institutional investor, the damage will be significantly worse. Dipping much below the –5% level for more than a year or two is usually fatal. While you might have skated through the 1990s with the Conventional 70/30 portfolio, the DFA Model strategy would have made you a deadster by 1998, and the Four- and Two-Corners approaches would have sent you packing on at least three occasions. For example, in 1997 the return of the Wilshire 5000 was 31.28% versus 25.89% for the Conventional, 13.32% for the DFA Model, 8.26% for the Four-Corners, and 4.02% for the Two-Corners portfolios.

Even Berkshire shareholders would have tossed Warren and Charlie out on their ears with the relative underperformance of the last three portfolios.

If you desire a fuller appreciation of the constraints that hobble institutional investors, I cannot recommend highly enough *Fortune and Folly: The Wealth and Power of Institutional Investing*, a dead-eye dissection of the pension fund industry by two anthropologists, William O'Barr and John Conley. In the late 1980s, they donned the requisite field garb from Brooks Brothers and went forth to find out what makes this exotic breed tick.

The professors discovered they were dealing with not one, but two separate tribal cultures:

- Corporate pension fund managers. This group was usually "recruited" from within their companies. The quotation marks signify that a transfer to the company's pension fund

division was, and still is, generally not viewed as a promotion. Nevertheless, these organization men and women viewed themselves as "can-do" types whose bias was towards active managers. Further, since they were funding a corporate obligation, their investment results eventually fell to the company's bottom line, as many owners of common stocks have found out to their recent chagrin. While losses consonant with those in the broad market are tolerable, underperforming the market was not.

- Public pension managers, that is, those managing the defined-benefit plans of public employees. These plans tended to be relatively small, understaffed operations, which is fortunate, since this mandated much more passive management than seen in private plans. The Prime Directive of the public plan manager was "Thou Shalt Not Get Thy Name in the Newspaper." This translated into not lagging the risk-adjusted broad market by too terribly much. Two to three percent behind? No problem. Five percent? Better tell your secretary to hold all calls from the *Daily News*. While the private fund manager may be rewarded for superior performance, no public manager in the history of the world has ever found herself celebrated on the 11 o'clock news for beating her benchmark.

What does this mean? While you won't find many pension managers who haven't heard of Fama and French, my passive-fund sources tell me that they nibble only ever-so-slightly at small stocks and do not tilt at all towards value. I'm not quite sure of the reason for this, but suspect it has to do with the small factor's positive correlation with the market, whereas the value factor has a negative correlation, making the former a somewhat safer bet than the latter. The Frank Russell Company, one of the nation's largest pension fund consultants, considers neither small nor value a risk factor, that is, neither deserving of a returns premium.

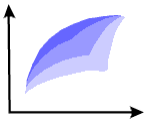
While the small investor who tilted towards value and small in the late 90s grew mightily discouraged, he or she could not be fired. In 2000, the worm turned with a vengeance—I suspect there will be a very high positive correlation between retirement age within the boomer cohort and portfolio-weighted price-to-book. This investor felt the sting of relative underperformance in the 1990s and considers the longer-term reward of staying his own personal course fair, but not overly generous, compensation for the pain of the Bubble Years.

Obviously, not everyone can, or even should, tilt. If you work for a value company or a small company, it's probably not a good idea. Even if you "qualify" by virtue of temperament and employment, these risk factors aren't a sure thing. That's why they are called "risk premia."

But as an investor, you must, by definition, bear some degree of uncertainty and lay your money down. To value-load or not? To small-load or not? You

must choose.

Efficient Frontier



William J. Bernstein

The One-Fund Holy Grail

Wouldn't if be ducky if the average small investor could get an inexpensive, efficient asset allocation from just one fund? While this might put me out of a job, it would be great news for the overwhelming mass of investors who view managing their retirement assets with the same enthusiasm as a trip to the colonoscopist.

Well, I'm not out of work yet, but I'm starting to sweat a bit. Within the past several months, both Vanguard and Dimensional Fund Advisors have made available several one-size-fits-all portfolios, and while not perfect, they're not bad—not bad at all.

Let's begin with Vanguard's Target Retirement funds, whose compositions are tabulated below:

Fund Target Date	Total Stock Market	European	Pacific	Bonds
2045	71.5%	12.7%	5.2%	10.6%
2035	63.6%	11.3%	4.7%	20.4%
2025	47.8%	8.5%	3.5%	40.2%
2015	39.7%	7.0%	2.9%	50.4%
2005	34.7%	0.0%	0.0%	65.3%

For the first four funds, the Bond portion is the Total Bond Portfolio, with a tad of cash; for some strange reason, the 2005 fund splits the bond portion between Total Bond and the TIPS fund.

The idea is, you buy the fund that corresponds to your retirement date and, as you and the fund managers grow older, the stock allocations gradually fall. (The stock-bond formula is interesting—Mr. Bogle makes a good case for the bond allocation equal to your age; the 2045 and 2035 funds use age minus fifteen, and the 2025 and 2015 funds use age minus five. Only the 2005 fund uses the Bogle recommendation.) The Target Retirement funds are completely indexed, and at a rock-bottom 21-23 basis-point expense ratio, it's hard not to like these funds. Theoretically, you can set up your account and not even have to adjust the allocations as you age.

There are several minor flaws in this strategy, though. The bond duration is just a tad longer than necessary—about four years. And why did they drop the foreign allocation from the 2005? If international diversification is a good idea

at high and medium stock exposures, it's just as good at a low one. But the overarching flaw, in my opinion, is the underweighting of REITs, small, and value stocks, particularly abroad.

If you believe that there is indeed a risk premium attached to small and value stocks and that REITs provide diversification benefit, then it's worth considering Dimensional's model equity allocation:

S&P 500	20.0%
U.S. Large Cap Value	20.0%
U.S Microcap	10.0%
U.S. Small Cap Value	10.0%
REIT	10.0%
International Large Cap Value	10.0%
International Small Cap	5.0%
International Small Cap Value	5.0%
Emerging Markets	3.0%
Emerging Markets Large Cap Value	3.0%
Emerging Markets Small Cap	4.0%

This model portfolio, which can be diluted with the desired amount of bonds, provides more than adequate exposure to the various factors and is used as a starting point by many advisors. The only problem, of course, is that you have to hire an advisor to use this type of strategy, which is not practical for the average small investor.

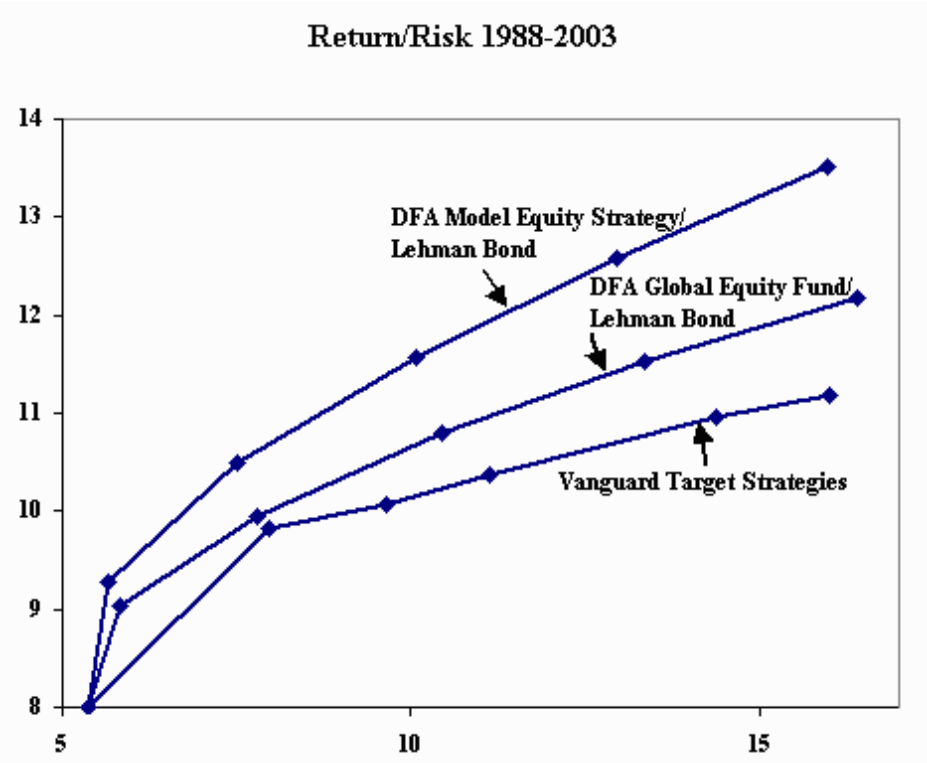
Many small investors do, however, have access to DFA through their 401(k) plans, and the good news for them is that they now have available a one-size-fits-all approach: DFA's new family of global funds. The global funds come in three flavors: 100% equity, 60/40 and, for some inexplicable reason, 25/75. Alas, the composition of the global equity component (and fund) is rather different from the above model allocation:

S&P 500	25.0%
U.S. Large Value	25.0%
U.S. Small Cap	18.0%
REIT	2.0%
International Large Cap	5.0%
International Value	10.0%
International Small Cap	10.0%
Emerging Markets	2.0%
Emerging Markets Value	2.0%
Emerging Markets Small	1.0%

Note how there is no direct small-cap value exposure either in the U.S. or abroad, the REIT and emerging-markets components are relatively small, and

the global-equity component uses small cap instead of microcap. DFA's reasons for these deviations from the model portfolio are, respectively, that it is cheaper to obtain exposure to the value factor with large caps than with small caps, that most investors already are exposed to real estate through home ownership, and that emerging markets and microcaps are both too expensive and too volatile for the average investor with minimal advisor exposure.

Again, not perfect, but very good. Below, I've plotted how these three approaches have done over the past 16 years. In order for the comparisons between the three strategies to be apples-to-apples, I've used the Lehman Brothers Aggregate Bond Index, the strategy employed in the Vanguard Target Retirement funds, as the diluting asset in all three cases. All three strategies assume annual rebalancing. The top curve is the return from the full-bore DFA model equity strategy, the middle curve is the new DFA global equity fund and the bottom curve, the Vanguard Target strategy:



A few words of warning. First, the value and small strategies have had salutary returns during this period. Although this is consistent with theory, there's no guarantee that it will be true going forward; that's why they're called "risk premia." Second, there's very little chance of equity returns being as high in the future as they have been in the past 16 years, and there's *no* chance that the Lehman Aggregate will return 8% going forward. *Caveat emptor*.

That said, my clear preference, obviously, is the DFA global family. If you have a 401(k) plan, do not have exposure to these vehicles, and plan to stay a while with your current employer, it's definitely worthwhile to pester your HR administrator to get them included. The 60/40 portfolio is a good one-step allocation, but with a 55 basis-point expense ratio, you're better off using the

100% equity fund in combination with one of the low-cost Vanguard short-term bond funds. (Make sure your company uses the DFA I-class funds; the R-class funds carry an extra 25 basis-point expense ratio for advisory/administrative expenses.)

If you don't have access to the DFA funds, then you can juice up the Vanguard Target strategies with a tad of their small value, large value, and REIT index funds. Obviously, there is a tradeoff between complexity and efficiency; this is true even with the DFA strategies, where lower cost can be obtained by using a cheaper separate bond fund instead of the stone-simple 60/40 fund. And, in the same vein, you can also juice up the DFA global-equity strategy to closely mimic the DFA "model portfolio" by adding their international and U.S. small-value funds, which some 401(k) plans also carry.

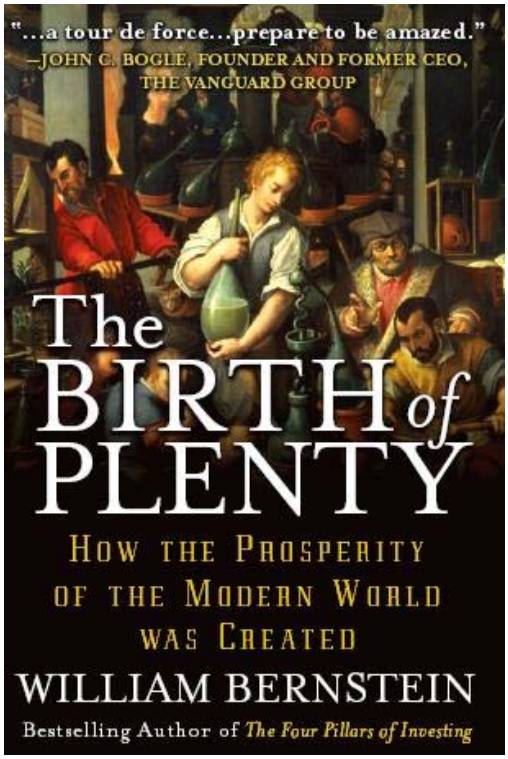
No doubt Vanguard and DFA will expand their retirement offerings, and other firms may choose to follow suit. But for now, both companies offer excellent low-cost fire-and-forget portfolio management for those adverse to pulling a bunch of asset-class strings in their retirement accounts

Efficient Frontier

William J. Bernstein

***The Birth of Plenty**, an inquiry into the origins of modern prosperity, now occupies shelf space in bookstores around the nation and with online booksellers throughout the world. The first printing is currently available at a reasonable discount from Amazon.com. Should you purchase the book and find an obvious typo or grammatical error, please don't hesitate to report it.*

With the kind permisison of McGraw-Hill, I've reproduced Chapter One below.---WB



CHAPTER ONE

A Hypothesis of Wealth

> *The bourgeoisie, during its rule of scarce one hundred years, has created more massive and more colossal productive forces than have all preceding generations together.*
>
> —Karl Marx, Manifesto of the Communist Party

It's all too tempting to lament the state of the world, particularly when you focus on the melodramas of mankind—violent conflicts, large-scale malfeasance and failure, and the latest installments in the age-old racial and religious hatreds that permeate the human story.

A paragon of such fashionable pessimism has been journalist Anthony Lewis, who, at the end of a long and distinguished career, was asked whether the world had gotten to be a better place since he had begun covering it a half century earlier:

> I have lost my faith in the ideal of progress. I mean that in the sense that it was used at the beginning of the twentieth century, that mankind is getting wiser and better and all—how, how can you think that after Rwanda and Bosnia and a dozen other places where these horrors have occurred?[1]

Mr. Lewis' problem is that his subjective criterion—that mankind has not achieved moral perfection as defined in Ivy League universities and the editorial suites of the *New York Times*—sets the bar too high. Mr. Lewis seems unaware that we *can* measure the welfare of mankind; in fact, we can do it superbly. Contrary to his gloomy impressions, the second half of the twentieth century was far less murderous than the first. Further, the proportion of the world's population subjected to totalitarianism, genocide, starvation, war, and pestilence has been steadily decreasing over the past two centuries, with most of the improvement coming in the half century that so depressed Mr. Lewis.

Consider that from 1950 to 1999, average life expectancy in the developed world increased from 66 years to 78 years; in the developing world, it increased from 44 years to 64 years. The nearly universal Western outcome of living to old age, rather than resulting from the rare stroke of luck, may be the greatest accomplishment of the past fifty years. Or consider that over the same period, the world's real per capita gross domestic product (GDP)—the amount of goods and services produced by the average person, adjusted for inflation—nearly tripled. Or that by the year 2000, real per capita GDP in Mexico was significantly greater than that of the world leader in 1900, Great Britain. And if you're not impressed with mankind's material progress in the last fifty years, as measured in dollars and cents, you should at least note that almost any measure

of social progress you wish to examine—infant mortality, literacy and mortality rates, or educational levels—has dramatically improved in all but a few still-benighted corners of the planet.[2]

Escaping the Trap

The modern world seems to stagger under the load of ever-increasing population, with each year adding scores of millions of new mouths to feed. At the birth of Christ, Earth supported slightly more than 250 million people, by 1600, about a half billion. Sometime around 1800, the one billion mark was reached, the second billion was added by 1920, and the third attained in 1960. Presently, there are in excess of six billion souls on our planet.[3] The increasing congestion of urban life, particularly in the third world, gives the impression that the world's population is growing far faster than the 1.85% annual rate of the past half-century.

Overcrowding on our planet is a recent phenomenon, an artifact of the world's newfound prosperity. Before the modern era, famine, disease, and war more often than not overwhelmed the human inclination to procreate. Over the first two million years of human history, population growth did not greatly exceed 0.001% per year. After the advent of agriculture 10,000 years ago, the rate of population growth increased to approximately 0.036% per year, and in the first century A.D., to 0.056% per year. After 1750 the growth rate climbed to 0.5% per year, passing 1% only in the early twentieth century.[4]

In modern times, the dismal economics of increasing population is virtually synonymous with Thomas Malthus. Born of local gentry in 1766, he graduated from Cambridge with honors in 1788. Like many bright young university men of the time in England and Scotland, he fell under the sway of Adam Smith's new science of "political economy" and devoted his life to the quantitative study of humankind.

The England of the aspiring economist's formative years seemed as Hobbesian as Smithian—a time of worsening food shortages and not a little famine, particularly in neighboring Ireland. In 1795–96 and 1799–1801, war and poor harvests combined to cause food riots in England.5 The root cause of the shortage was obvious to Malthus: "The power of population is infinitely greater than the power of the earth to produce subsistence for men." Humans can reproduce rapidly, whereas agriculture is subject to the law of diminishing returns. The natural tendency, then, is for humanity to outrun its food supply. (The common conception of Malthus's thesis—that population increases geometrically, while the food supply increases arithmetically—is nowhere to be found in his writings.)

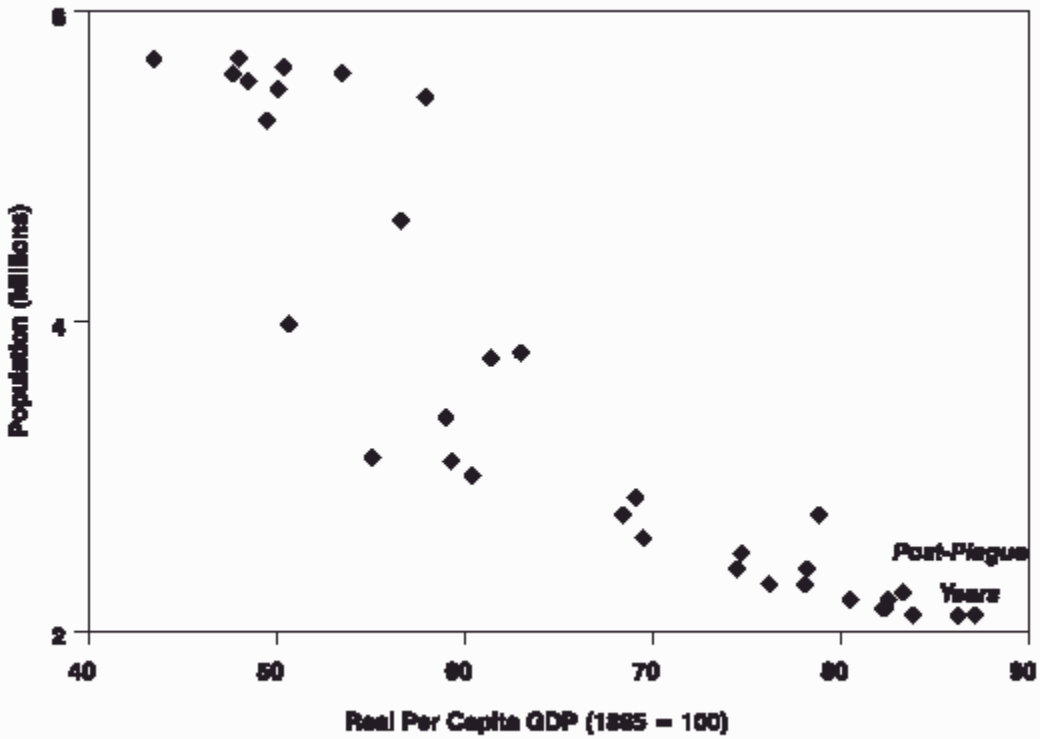
Malthus's infamous "positive checks" were not limited to the classic fama, pestis, et bellum (famine, plague, and war), but also included a host of lesser evils: unhealthy working conditions, backbreaking labor, overcrowded and unsanitary housing, and poor child rearing. If, for a brief moment, food became plentiful, population would rise rapidly. Soon enough, though, the increased supply of workers would drive down wages. This would make food less

affordable and, discouraging marriage, would slow population growth. Low wages would then induce farmers to hire more workers, which would, in turn, bring more land into production, starting the whole process again at a slightly higher level of population and food production—the notorious "Malthusian Cycle."

In Malthus's harsh world, a nation's food supply—and its population—grew slowly, if at all, so the standard of living was inversely proportional to the number of mouths to feed. Were population to increase, there would not be food enough to go around. Prices would rise, while wages, and the standard of living in general, would fall. If, on the other hand, the population were suddenly to plunge, as happened during the Black Death of the mid-fourteenth century, the survivors' food supply, wages, and standard of living would rise dramatically.

Malthus had observed firsthand the late-eighteenth century famines, which burned this sequence of events into his consciousness. Figure 1–1 plots the per capita GDP of England from 1265 to 1595 versus population size.

FIGURE 1–1 THE MALTHUSIAN TRAP IN ENGLAND, 1265–1595



Source: Population data from *British Population History from the Black Death to the Present Day,* Michael Anderson, ed. (Cambridge: Cambridge University Press, 1996), 77; per capita GDP from Gregory Clark, "The Secret History of the Industrial Revolution," Working Paper, 2001.

The thin, crescent-shaped distribution of the data points depicts the "Malthusian Trap." Historian Phyllis Deane neatly summarizes the concept:

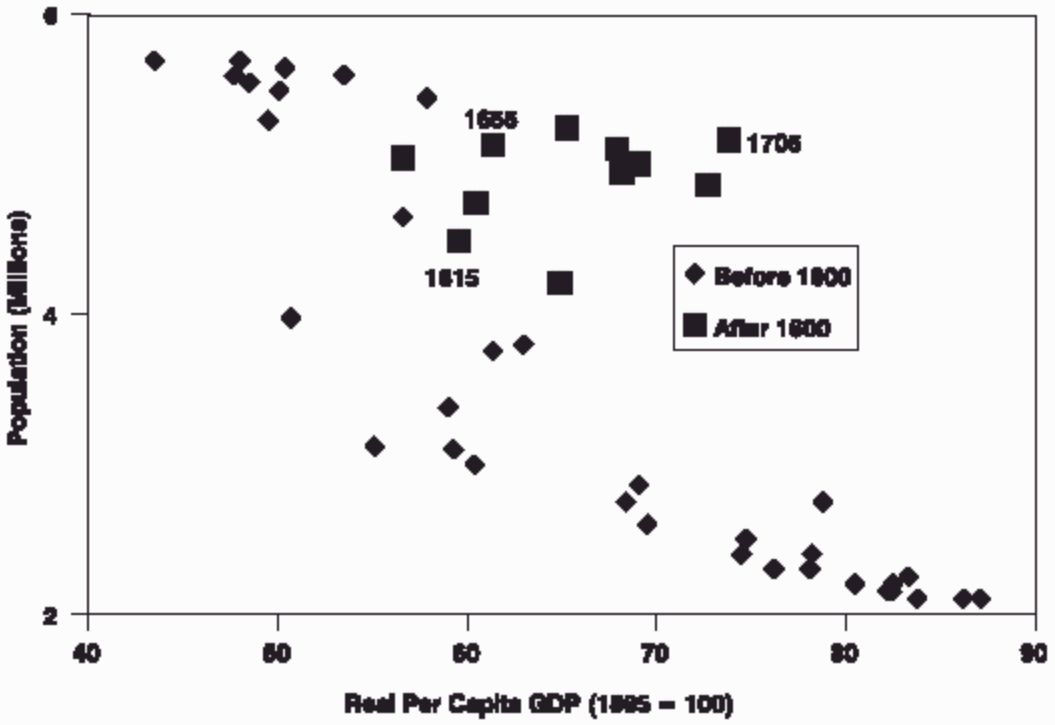
> When population rose in pre-industrial England, product per head fell: and, if for some reason (a new technique of production or the discovery

of a new resource, for example, or the opening up of a new market), output rose, population was not slow in following and eventually leveling out the original gain in incomes per head.[6]

In this eternal cycle, agricultural production might rise, but population followed in lockstep, dooming mankind to a near-subsistence-level existence.

Paradoxically, soon after Malthus immortalized this grim state of affairs in 1798 with his *Essay on the Principle of Population*, it abruptly came to an end in Western Europe. Figure 1–2 shows that a bulge developed in the crescent sometime around 1600, and as Figure 1–3 illustrates, population cleanly broke out of the crescent after 1800, never again to return to starvation's edge.

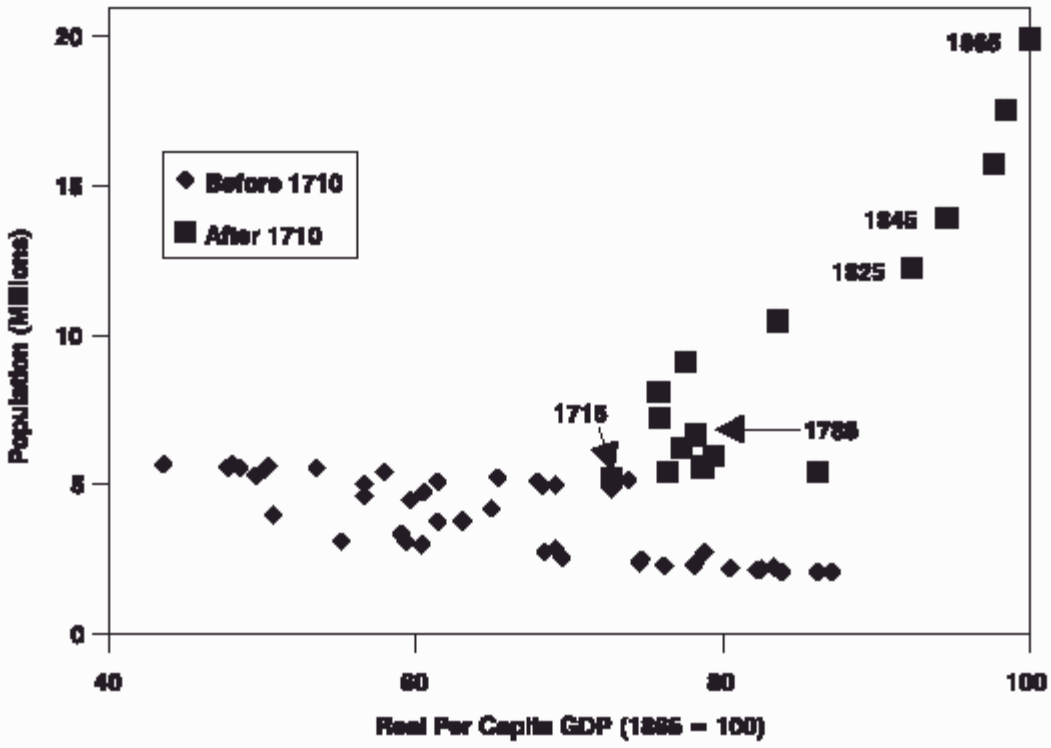
FIGURE 1–2 THE TRAP BREAKS DOWN AFTER 1600



Source: Population data from *British Population History from the Black Death to the Present Day,* Michael Anderson, ed., 77; per capita GDP from Clark, "The Secret History of the Industrial Revolution."

The vertical population scale in Figure 1–3 has been broadened so that the original crescent appears as a flattened pancake at the bottom of the graph. The escape from the trap was made possible not by an increased birth rate but by a 40% decline in the death rate, the result of rapidly improving living standards that were, in turn, born of skyrocketing economic growth.[7]

FIGURE 1–3 BREAKING OUT OF THE TRAP AFTER 1800



Source: Population data from *British Population History from the Black Death to the Present Day,* Michael Anderson, ed., 77; per capita GDP from Clark, "The Secret History of the Industrial Revolution."

The nature of that growth changed dramatically in the centuries following 1600. Initially, the growth was "extensive," consisting of a significant expansion of the national economy caused purely by population increase, unaccompanied by real improvement in the wealth or material comfort of the average citizen. For the first time, the British economy mustered enough growth to keep pace with population numbers. By the nineteenth century, however, growth had become "intensive," outpacing even the human urge to reproduce, with advances in per capita income and an increase in material well-being at the individual level.[8]

How Nations Become Wealthy

Beginning around 1820, the pace of economic advance picked up noticeably, making the world a better place to live in. What happened? An explosion in technological innovation the likes of which had never before been seen. An apocryphal schoolboy, asked to define the Industrial Revolution, is supposed to have replied, "In 1760 a wave of gadgets swept over England."[9] That anonymous boy was on to something. New technology is the powerhouse of per capita economic growth; without it, increases in productivity and consumption do not occur. From first principles, then, the question can be asked, "What is needed to develop gadgets?" Four things:

- Property rights. Innovators and tradesmen must rest secure that the fruits of their labors will not be arbitrarily confiscated, by the state, by criminals, or by monopolists. The assurance that a person can keep *most* of his just reward is the right that guarantees all other rights. Note the emphasis on the word *most.* The right to property is never absolute. Even the most economically libertarian governments, such as Singapore and Hong Kong, levy some taxes, enforce some form of eminent domain, and maintain some restrictions on commercial freedom of action. Similarly, confiscation can be more subtle than that which occurs in feudal or socialist states. A government that fails to control inflation or maintain proper banking controls, such as Brazil's in the 1980s or present-day Zimbabwe's, steals from its citizens as surely as Edward III and Stalin did. In premodern Europe, government-granted monopolies, while highly profitable to those who exercised them, sapped the incentive of the rest of the nation.

- Scientific rationalism. Economic progress depends on the development and commercialization of *ideas*. The inventive process requires a supportive intellectual framework—an infrastructure of rational thought, if you will, with a reliance on empirical observation and on the mathematical tools that support technologic advance. The scientific method that we take for granted in the modern West is a relatively new phenomenon. Only in the last four hundred years have Western peoples freed themselves from the dead hand of the totalitarian, Aristotelian mind-set. Even today, particularly in parts of Africa, Asia, and the Middle East, honest intellectual inquiry places life and property at grave risk from the forces of state and religious tyranny.

- Capital markets. The large-scale production of new goods and services requires vast amounts of money from others—"capital." Even if property and the ability to innovate are secure, capital is still required to develop schemes and ideas. Since almost no entrepreneur has enough money to mass-produce his inventions, economic growth is impossible without substantial capital from outside sources. Before the nineteenth century, society's best, brightest, and most ambitious individuals had scant access to the massive amounts of money necessary to transform their dreams into reality.

- Fast and efficient communications and transportation. The final step in the creation of gadgets is their advertisement and distribution to buyers hundreds or thousands of miles away. Even if entrepreneurs possess secure property rights, the proper intellectual tools, and adequate capital, their innovations will languish unless they can quickly and cheaply put their products into the hands of consumers. Sea transport did not become safe, efficient, and cheap until two centuries ago with the development of steam power, and land transport did not follow suit until about fifty years later.

Not until all four of these factors—property rights, scientific rationalism, effective capital markets, and efficient transport and communication—are in

place can a nation prosper. *These four factors first coalesced, briefly, in sixteenth century Holland but were not securely in place in the English-speaking world until about 1820.* Not until much later did the four factors begin to spread over the rest of the globe.

The absence of even one of these factors endangers economic progress and human welfare; kicking out just one of these four legs will topple the platform upon which the wealth of a nation rests. This occurred in eighteenth-century Holland with the British naval blockade, in the world's Communist states with the loss of property rights, and in much of the Middle East with the absence of capital markets and Western rationalism. Most tragic of all, in much of Africa, all four factors are still essentially absent.

Economic History by the Numbers

The heroes of this quantitative story are the economic historians who have spent their lives uncovering the outlines and contours of human well-being over the centuries. Chief among them is an obscure Scottish economist named Angus Maddison. Born in Depression-era Newcastle, his upbringing hints at the source of his fascination with economic development:

> My father had a steady job as a railway fitter but I had two unemployed uncles, and there were many unemployed neighbors. The unemployed were not only poor but depressed. Many loitered aimlessly at street corners, looked haggard, wore mufflers and cloth caps and smoked fag ends. Their children were often sickly and tubercular.[10]

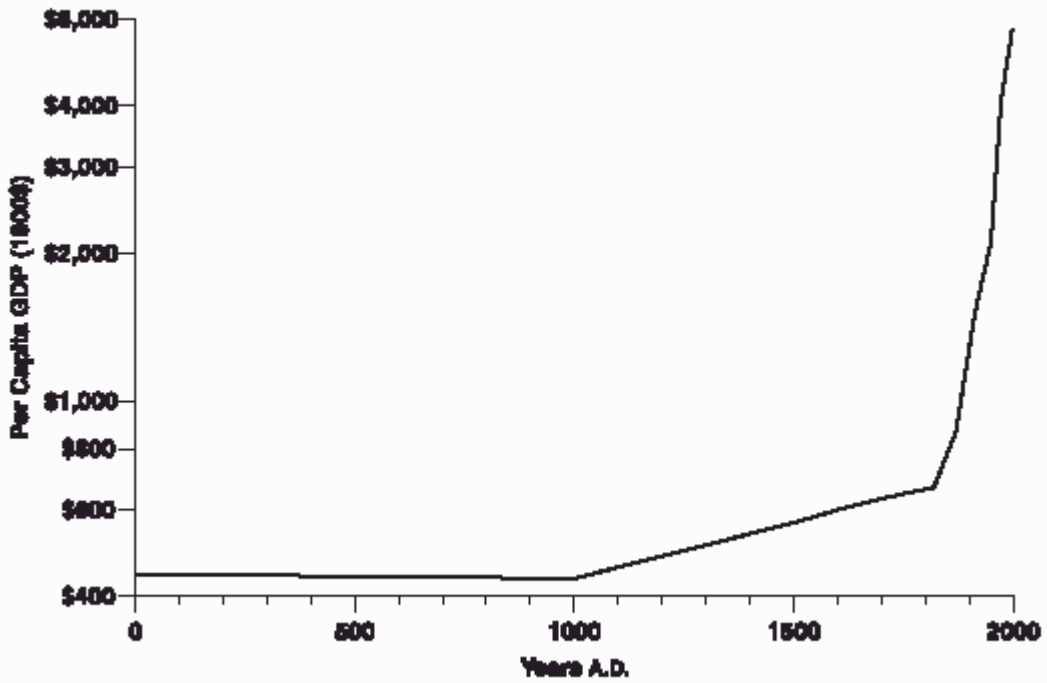
Maddison excelled in school and spent his formative years in the rich intellectual stew that was wartime Cambridge.[11] He fondly quotes one of his instructors, Dharma Kumar: "Time is a device to prevent everything happening at once; space is a device to prevent it all happening in Cambridge." The development of each of the above four critical factors connects strongly to this fabled university. If England was the birthplace of modern prosperity, then Cambridge was its maternity ward, producing many of its principal midwives: Francis Bacon, Isaac Newton, and jurist Edward Coke, as well as dozens of others central to the story of this book.

For a quarter-century after his graduation in 1948, Maddison worked for the Organization for European Economic Cooperation (OEEC), which was established to direct Marshall Plan funds after World War II, and its successor, the Organization for Economic Cooperation and Development (OECD).12 He spent much of his time shuttling to and from third-world nations, particularly Brazil, Guinea, Mongolia, Pakistan, and Ghana. Time and again, he was struck by the enormous differences in wealth and well-being among nations he found on his journeys. In 1978, he accepted a professorship at the University of Groningen in the Netherlands and began to work out a coherent vision of world economic development.

The portrait that Maddison and others painted was as stunning as it was unexpected. The lot of the average individual, measured as real per capita GDP,

did not change at all during the first millennium after the birth of Christ. Over the next 500 years, between A.D. 1000 and 1500, things did not get much better. Figure 1–4, which plots Maddison's estimates of world per capita GDP since the year A.D. 1, brings the welfare of the average person into sharp focus. Before 1820, there had been only minuscule material progress from decade to decade and century to century. After 1820, the world steadily became a more prosperous place.

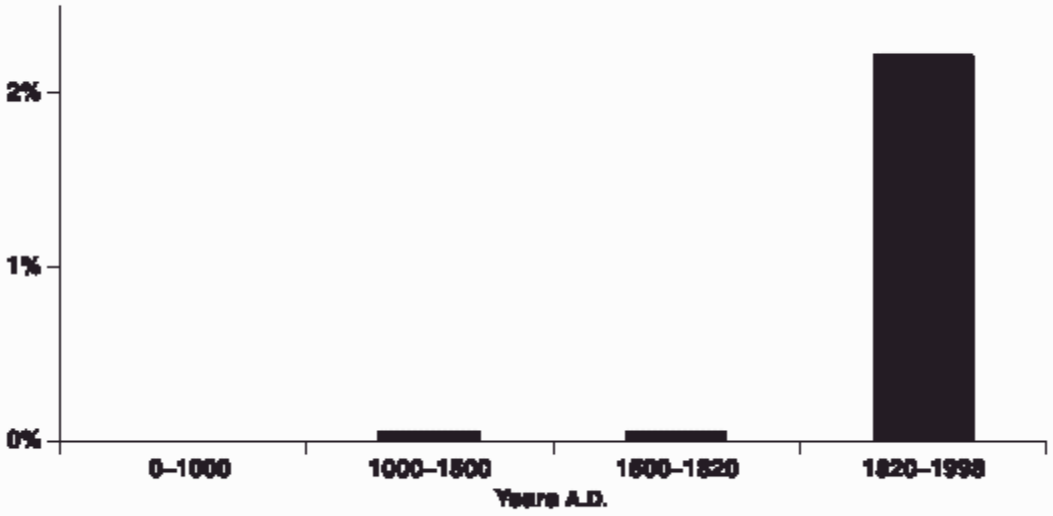
FIGURE 1–4 WORLD PER CAPITA GDP (INFLATION-ADJUSTED)



Source: Maddison, *The World Economy: A Millennial Perspective*, 264.

The data are "noisy" enough that identifying 1820 as the annus mirabilis of world economic growth is more than a little arbitrary. The British data, as we shall see, put the ignition of growth a bit later; the American data, a bit earlier. Whatever date is chosen, however, it is clear that sometime in the first half of the nineteenth century, growth of the global economy took off, bringing prosperity despite the repeated devastation of war, civil strife, and revolution.

FIGURE 1–5 ANNUALIZED PER CAPITA WORLD GDP GROWTH (INFLATION ADJUSTED)



Source: Maddison, *The World Economy: A Millennial Perspective*, 264.

Figure 1–5, which summarizes the average annual growth in worldwide real per capita GDP, displays the breakout that occurred about 1820 from a different viewpoint. Once again, prior to 1820, there was little improvement in the material welfare of the average person. This picture is contrary to that commonly taught in the nation's humanities departments. From the perspective of the Romance language expert or the art historian, the Renaissance appears to be the pivotal point of the second millennium. The great writers and artists of that period, however, did little to improve nutrition, to augment transport, or to prevent plague. In an age when the average person never ventured more than a few miles from the place of his birth, the Sistine Chapel frescoes could do little to uplift the collective human spirit.

Economists have found it easy to criticize Maddison's estimates of income and production in centuries long past. After all, how can he be certain that the annual per capita GDP of Japan at the birth of Christ was $400 in current dollars, rather than $200 or $800? Maddison himself concedes the point: "To go back earlier involves use of weaker evidence, greater reliance on clues and conjecture."13

The modern era presents a more basic problem. Even the most accurate economic data cannot measure the real value of new inventions. How much would J. P. Morgan have paid for even a cheap seat on a jumbo jet from Kennedy Airport to Heathrow? What value would Shakespeare have placed on the ability to churn out five thousand words a day on a Macintosh and then e-mail them to a few dozen friends? Even the poorest citizens in the developed West have access to goods and services, such as reliable automobiles, television, and the Internet, that were unavailable at any price a century ago. While many modern goods and services are of dubious value, others are not. As late as 1940, pneumonia and meningitis, which today can be prevented with a

few dollars' worth of antibiotics, struck down those at the pinnacle of wealth and power almost as frequently as they felled the poor. In a different vein, try to imagine what the great engineers and physicists of the early twentieth century could have managed with a personal computer.

How do economic historians measure the GDP of ancient Rome or of the Carolingian Empire? After all, millennia ago there was no Commerce Department and no Bureau of Economic Analysis. Not until the seventeenth century did early demographers like John Graunt and Caspar Naumann begin tabulating actuarial data, and not until two centuries later did economists begin to collect the first accurate aggregate financial data for individual countries.

If you want to measure economic progress over the centuries, you first must ask, How much money is necessary to sustain a subsistence level of existence? Maddison estimated that in an underdeveloped nation in 1990, about $400 per year was required. Next, economic historians use whatever data they can find to determine what percentage of a population existed at this level. A society in which nearly 100% of the population is engaged in farming and that does not export any substantial amount of its agricultural products lives, by definition, very close to the $400 per year subsistence level. It is highly arbitrary to assign the same $400 per capita GDP, as Maddison did, to Europe at the beginning of the first century A.D., to China in 1950, or to modern-day Burkina Faso, but doing so at least provides economic historians with a benchmark against which to measure economic growth.

Another way of viewing this is to look at the "urbanization ratio"— the proportion of the population living in cities larger than, say, 10,000, and, by inference, a measure of the proportion engaged in farming. At the height of the Greek and Roman periods, only a tiny percentage of the populace lived in cities of more than 10,000. By 1500, the largest city in Europe was Naples, with 150,000 inhabitants. Only 865,000 Europeans, or about 1% of the continent's population, lived in cities of more than 50,000. Another 6% lived in towns of more than 10,000. More than 90% of Europeans, then, were engaged in agriculture in the medieval period. In the great civilizations of Asia, which during the medieval era were far more advanced than those in Europe, the percentage of the population engaged in agriculture was even closer to 100%; the vast riches of the tiny ruling elites did little to raise the overall level of prosperity in these domains. So it seems likely that before 1500, the world's overall per capita GDP was close to the $400 subsistence level defined by Maddison.

In the U.S., fully 70% of the working population was employed on the farm as late as 1820. (Since the U.S. exported a large part of its agricultural output, living standards were much higher than suggested by the low urbanization ratio.) By 1998, that figure had fallen to 2%. Those who romanticize farm life should bear in mind that in the modern world, the percentage of population engaged in agriculture is a powerful marker of poverty. (At the dawn of civilization, the situation was reversed; humankind was just making the transition from the even less productive life of the nomadic hunter-gatherer to the relatively more prosperous sedentary existence of the farmer. Perhaps the hunter-gatherers of the period bemoaned the soft, new, soulless ways of the

farmer—among many Native American tribes, farming was disdained as women's work.)

In recent years, economic historians have identified periods of sustained economic growth before 1500 in various nations. Economist E. L. Jones points out that vigorous growth took place in Sung China (960–1279) and in Tokugawa Japan (1603–1867).14 Iron production in the late Sung period reached a level that was not achieved in Europe until the mid-1700s. Jack Goldstone of the University of California at Davis calls such periods "efflorescences," spans of time in which technology and the standard of living, at least among the ruling class, rapidly advanced.15 Even Jones and Goldstone admit that growth in the premodern world was fragile and ultimately ephemeral. Following the Mongol invasion, the Chinese economy fell into a centuries-long coma from which it is just now emerging.

Europe did produce some economic growth after the fall of Rome. The early medieval period saw the switch from a two-crop to a three-crop rotational system, the invention of the horseshoe and horse collar, the water mill, the windmill, and the replacement of the two-wheeled cart with the four-wheeled variety.16 Economic historians disagree about just when these changes began to result in growth, with estimates ranging from the eighth century to the fifteenth century.

Although they produced extensive growth, these advances merely resulted in increases in population, leaving the well-being of the average citizen unchanged. The wide range of opinion on dating the renaissance of growth in the post-Roman world is proof enough that per capita growth (the best measure of the improvement in well-being of the individual) could not have been substantial or sustained.

The beauty of examining very long historical sweeps is that this "washes out" even large uncertainties about growth. If, over a period of a thousand years, for example, we overestimated the beginning or ending per capita GDP by a factor of two, this would entail an error of just 0.07% per year in the annual growth rate. Put another way, world per capita GDP growth since the birth of Christ could not possibly have been as high as, say, 0.5%; if it were, per capita GDP would have grown from $400 in current dollars to over $8.6 million by the year 2000! We can be certain, then, that, for most of this period, growth was indeed very close to zero.

Putting it yet a third way, even the most wildly optimistic estimates suggest no more than a doubling or tripling in global per capita GDP between the year A.D. 1 and A.D. 1000, versus the eightfold increase in the 172 years following 1820. During this same 172-year period, per capita GDP in the U.K. grew tenfold; in the U.S., twentyfold.

The Two Percent Productivity Cruise Control

The vigor of modern economic growth is astonishing. Throughout the 1800s, real per capita GDP growth in what is now called the developed world

gradually accelerated to about 2% per year, then maintained that pace throughout the entire turbulent twentieth century. Table 1–1 lists the growth of real per capita GDP in sixteen nations during the twentieth century, dividing them into countries that were physically ravaged by world war or civil war and those that were not.

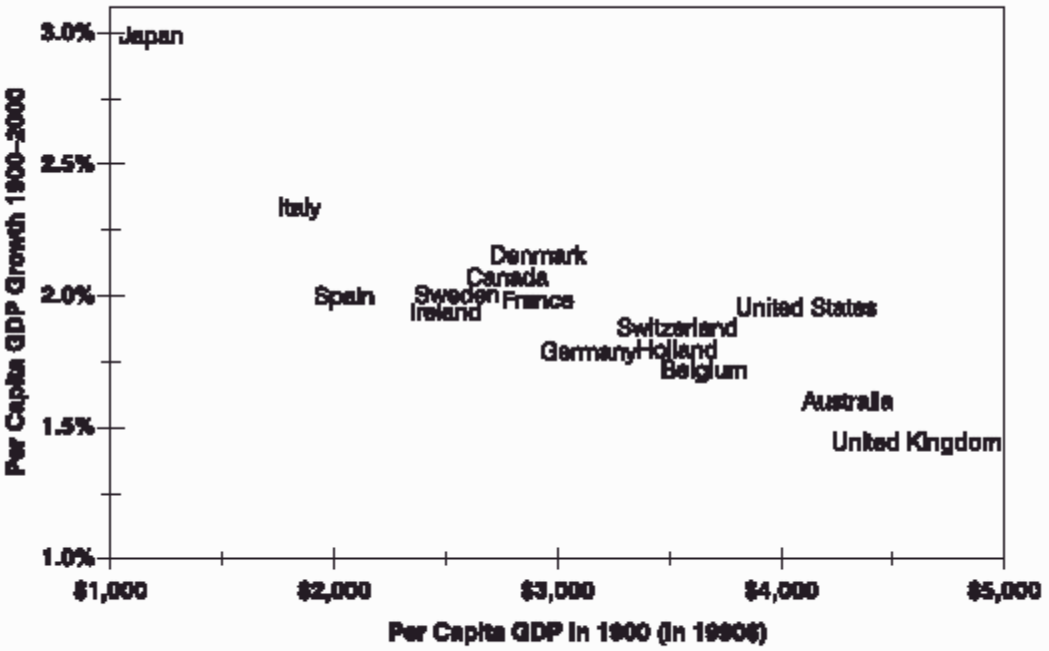
TABLE 1–1 ANNUALIZED PER CAPITA GDP GROWTH, 1900–2000

War Damaged	Per Capita GDP Growth
Belgium	1.75%
Denmark	1.98%
France	1.84%
Germany	1.61%
Italy	2.18%
Japan	3.13%
Netherlands	1.69%
Spain	1.91%
Average for war-damaged countries	**2.01%**
Not War Damaged	**Per Capita GDP Growth**
Australia	1.59%
Canada	2.17%
Ireland	2.08%
Sweden	1.96%
Switzerland	1.72%
United Kingdom	1.41%
United States	2.00%
Average for countries not damaged by war	**1.85%**

Source: Data from Maddison, *The World Economy: A Millennial Perspective*, 276–79; Maddison, *Monitoring the World Economy 1820–1992*, 194–97; and Organization for Economic Cooperation and Development.

Notice how tightly around 2% the growth rates cluster—thirteen of the fifteen nations increased their per capita GDP between 1.6% and 2.4% per year. It is as if an irresistible force—a sort of economic cruise control—propelled their productivity upwards at almost exactly 2% per year—not faster, and not slower. Notice also the absence of difference between the average growth rates of the war-torn and non-war-torn nations. The devastation of war, apparently, does no long-term damage to the economies of developed nations.

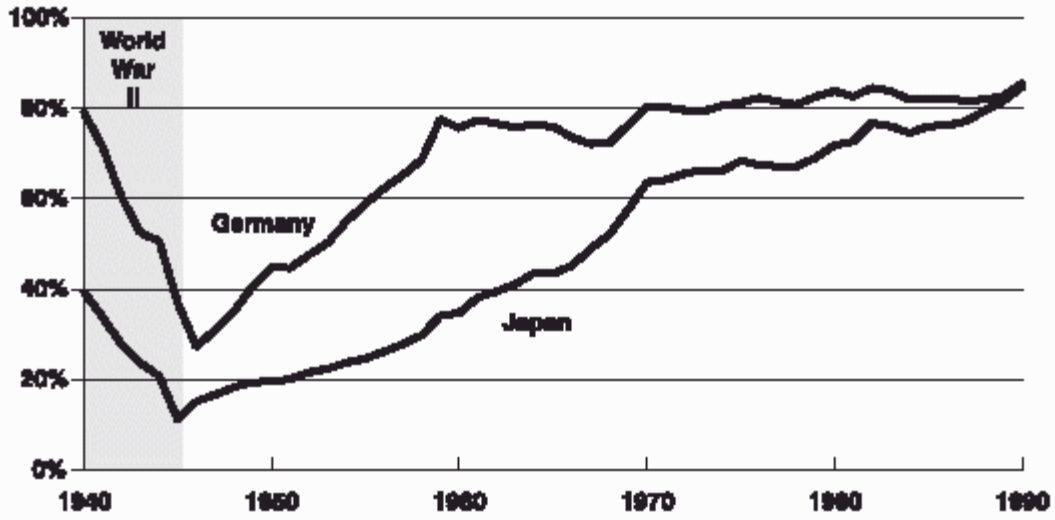
FIGURE 1–6 GROWTH VERSUS BEGINNING WEALTH



Source: Maddison, *The World Economy: A Millennial Perspective*, 276–79, and *Monitoring the World Economy, 1820–1992*, 194–97; and Organization for Economic Cooperation and Development.

Table 1–1 and Figure 1–6 display another fascinating characteristic of Western economies—those that were the wealthiest in 1900 tended to grow the slowest over the course of the twentieth century, while those that were the least wealthy tended to grow the fastest over the same period. In other words, the per capita wealth of the most advanced nations tends to converge. Japan, which started out the twentieth century as the poorest of the nations listed, saw its productivity grow at 3.0% per year, while the leader in 1900, Great Britain, grew at only 1.4% per year.

FIGURE 1–7 PER CAPITA GDP VERSUS U.S. (U.S. = 100%)



Source: Maddison, *Monitoring the World Economy, 1820–1992*, 194–97.

The most spectacular example of the resiliency of the Western economies—the tendency to "catch up"—is shown in the recovery of per capita GDP in postwar Germany and Japan. The devastation visited upon the Axis powers' economic machinery during the war years is clearly visible at the left edge of Figure 1–7. Japan began World War II with a per capita GDP that was 40% of the U.S. value; by war's end that figure had fallen to just 15%. Germany's per capita GDP fell from 80% of U.S. per capita GDP during the same period to 40%. By the 1960s both nations had regained their prewar per capita GDP value relative to the U.S.

In premodern times, such a comeback from disaster would have been impossible: Per capita GDP in China, after flowering under the Sung Dynasty, remained flat for seven centuries after the Mongol invasion. The Western growth machine, in contrast, reduces the catastrophe of conquest to mere historical hiccup. By 1990, Japan's relative per capita GDP had grown to the point where it approached that of the U.S. While the enlightened policy of the Second World War's victors was an important factor in Japan and Germany's rapid recovery, such beneficence does not account for Germany's performance after its defeat in the First World War, when, despite the punishment exacted at Versailles, she took just two decades to recover enough to conquer most of Europe.

The beginning of the nineteenth century did not herald the transformation of every corner of the world. At first, only Europe and its New World offshoots prospered. Nonetheless, over the ensuing 200 years, the Western variety of growth spread over the rest of the globe.

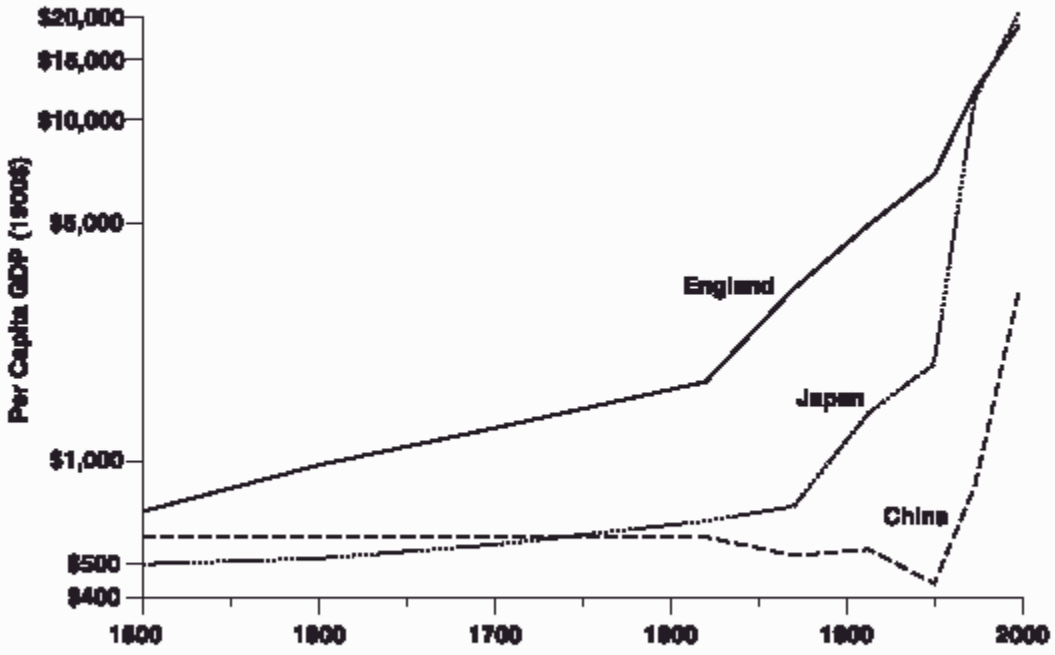
Before 1820, there were hints of the coming prosperity. Maddison estimates that in A.D. 1500, European per capita GDP averaged $774, with Renaissance Italy reaching $1,100.17 But Italy's relative prosperity would not last long.

After 1500, it would stagnate, while Holland began to experience persistent, if sluggish, economic growth. About the same time, Britain's growth rate began to increase as well, although more slowly than Holland's.

The Glorious Revolution of 1688 brought a stable constitutional monarchy to England and the importation of a Dutch king, and the cream of Holland's financial institutions and Dutch advances in the capital markets soon followed across the North Sea. Still, it took more than a century for English growth to accelerate rapidly. Not until the middle of the nineteenth century did the average Englishman live better than the average Dutchman—and that came about only because the British enforced a decades-long naval blockade of Holland, which was followed by Napoleon's dismantling and exploitation of the Dutch Republic.

The British seeded its overseas colonies not only with its people but, even more critically, with its legal, intellectual, and financial institutions as well. The great economic transformation did not begin to spread to the rest of Europe and Asia until much later. There, its effects were highly uneven, as shown in Figure 1–8, with the "takeoff" of England, Japan, and China occurring in 1820, 1870, and 1950, respectively.

FIGURE 1–8 PER CAPITA GDP (INFLATION-ADJUSTED)



Source: Maddison, *The World Economy: A Millennial Perspective*, 264, 276–79.

Why investigate this backwater of early modern history? Because sometime around 1820, the world seemed to turn over on its axis. Because the course of human economic progress before then can best be likened to the stunted growth of underbrush; afterwards it resembled the vigorous and steady growth of an

oak. Because the story of how property rights, scientific rationalism, capital markets, and modern transportation and communication finally came decisively together in the nineteenth century, producing the modern wealth machine, is crucially relevant to modern life.

To start out, we'll examine the state of everyday life in Western Europe before 1600, keeping in mind the four preconditions for economic progress. The medieval period can be summed up with some simple vignettes, loosely organized under the four essential growth factors.

The Premodern Absence of Property Rights

Short of outright slavery, no system denied property rights and individual liberty as medieval feudalism did. Today, the very word itself—"feudalism"—retains only a shadow of its former impact. Imagine, for a moment, that you are a typical eleventh-century peasant. You kneel before your master, who clasps your hands in his. You then vow to give him your exclusive, unceasing service. Your pledge is not financial or commercial; rather, you are pledging your life and honor. You live without money, exchanging your labor, and not infrequently, your life, for his protection against the outside world.

The essence of the feudal relationship was that it was *nonfinancial*. The manor yielded little excess produce for sale, and almost all exchange was done by barter. Feudal lords rarely thought of their patrimony in monetary terms, and serfs had scant use for coin. Adam Smith noted with wonder that as late as 1745, a Scottish laird could outfit 800 men for battle with a manorial income of less than £500 per year.18 Vestiges of feudal rights still existed in several neighborhoods of Paris until they were finally abolished in the early stages of the French Revolution.19

The lords were almost as enslaved as their serfs. As Marx observed, it was closer to the truth that the land, the preeminent asset of the premodern world, inherited the lord, rather than the other way around. As we'll see, land is highly flawed as a society's major storehouse of wealth, being not easily divided, traded, or improved.

Further, in the moneyless society of the feudal state, goods that could not be stored had to be consumed before they spoiled. Where modern society displays wealth through material possessions, feudal society displayed wealth through feasts of consumption.

The very concept of property rights in such a moneyless society was unthinkable; a peasant's hut and tools were but mere extensions of his self, a concept that survives to this day in the European tendency to provide dwellings with personal names. The hut, after all, belonged to the master, and the tools could not be sold at any price, because there were no buyers, public markets, or money itself. Consider Adam Smith's description of the peasant's lot:

> The occupiers of the land were generally bondmen [serfs], whose persons and effects were equally his [the lord's] property. Those who were not

> bondmen were tenants at will, and though the rent which they paid was often nominally little more than a quit-rent, it really amounted to the whole produce of the land. Their lord could at all times command their labor in peace, and their service in war. Though they lived at a distance from his house, they were equally dependent upon him as his retainers who lived in it. But the whole produce of the land undoubtedly belongs to him, who can dispose of the labor and service of all those whom it maintains.

Thus, the medieval serf had little incentive to produce a crop in excess of his manorial obligations or to increase the productivity of the land he worked. If the lord owned him and the whole of his output, why should he labor mightily, let alone innovate? Even more critically, the feudal structure left little room for nationhood. Politics were indeed strictly local. "Not citizen to state but vassal to lord was the bond that underlay political structure. The state was still struggling to be born," writes Barbara Tuchman.[20]

The feudal system not only failed to protect ownership and recognize equality under the law; it also throttled basic consumer activity. Sumptuary laws, which specified just what could be worn, according to rank and income, suffocated an economy whose primary manufactured product was textiles. In Florence, ermine was allowed only to nobles, physicians, and magistrates, while in France, a lord or lady could purchase only four costumes per year, one of which had to be for summer wear, but only if annual income was more than six thousand livres. English law also dictated strict income levels for the wearing of particular garments. Nobility seemed to count double; an English aristocrat might wear a certain costume if his annual income was £500 per year, whereas a merchant needed £1,000 of income for the same privilege.[21]

Early in the second millennium, the spread of the money economy eroded and eventually destroyed feudalism. The moment that a peasant could sell his labor to the highest bidder, the ties that bound servant and master dissolved. Only then could vital *national* legal and capital institutions develop. Not only were individuals able to buy their freedom with coin of the realm; at times, entire villages did so, as when the northern French city of Coucy-le-Château bought its charter of liberties from the penniless widow of the lord for 140 livres in 1197.[22]

The Importance of Taxing in Earnest

All countries require revenue; how governments tax is the stuff of the life and death of nations. In the premodern world, states typically burdened their poorest and most powerless members with taxes. All inevitably failed. Just as successful nations guarantee property rights by demanding impartiality in deciding ownership, so, too, must they demonstrate the same fairness in deciding how they tax wealth and income. Such was decidedly not the case in the medieval world, where the nobles, in exchange for physically "protecting" their serfs, were exempted from land taxes. The priesthood got into the game as well. Since it spiritually "protected" the serfs, the feudal tax structure also spared the clergy, to whom great wealth was often no stranger.

Mean Streets

Effective property rights require protection from crime. Medieval towns were unimaginably dangerous places, with a general level of violence so great that homicides were twice as common as accidental deaths. Deadly brawls constituted a routine part of everyday life, and tournaments, which provided surrogate martial activity to knights made redundant by the longbow and siege catapult, were often marred by wholesale slaughter. Only 1% of murderers were brought to justice. Kidnapping was a popular source of livelihood, particularly among unemployed knights.[23]

It could not be any other way. In 1500, the very concept of law enforcement as a governmental charge seemed unimaginable. The London bobby got his name from future prime minister Robert Peel, who gave the world its first metropolitan police force, *in 1829*.[24] Before then, the prudent gentleman did not venture onto London streets without his hangar (sword), dagger, and pistol.

Beyond the city walls, lawlessness reigned absolute. Highwaymen plied their trade, sometimes in roving gangs and sometimes alone, with near impunity. Soldiers, when not engaged in Crusades, dynastic feuds, or papal ambitions, periodically swelled the ranks of highwaymen. Only walls provided a town with effective protection against its lawless environs. Since walls were expensive, town life crammed itself into as little space as possible. The streets, nothing more than narrow, open sewers, teemed with townspeople and disease; the first demographers documented death rates from infectious diseases that were twice as high inside the walls as they were outside.

Most people lived in tiny villages and worked small adjacent fields. Not until 1500 did farmers clear the wolf-infested forests. Everyone, from toddlers to the aged, performed backbreaking field work, usually unaided by the plow. Until A.D. 900, it was the rare peasant who could afford to harness horses and oxen with collars for fieldwork.

The squalor of medieval dwellings was unimaginable. According to the greatest of all Renaissance humanists, Erasmus of Rotterdam,

> Almost all the floors are of clay and rushes from the marshes, so carelessly renewed that the foundation sometimes remains for twenty years, harboring, there below, spittle and vomit and wine of dogs and men, beer . . . remnants of fishes, and other filth unnameable. Hence, with the change of weather, a vapor exhales which in my judgement is far from wholesome.[25]

Families slept together on one foul bed, and chimneys were almost unknown. Soot covered the walls of all but the newest huts. Lack of proper exhaust resulted in house fires that brought roaring death to large numbers of villagers, particularly women, who, clad in highly flammable dresses, tended wood-fired pits and stoves.

The past few paragraphs describe the circumstances of peasants who were

relatively well-off. The less fortunate had little or no shelter at all. In the subsistence-level premodern society, famine and pestilence knocked constantly at the door. During times of extreme famine, cannibalism was not unknown; travelers were occasionally killed for their flesh, and there were even reports of gallows being attacked for sustenance.[26]

Pestilence regularly engulfed the Continent. The most famous episode occurred in 1347, when a Genoese merchant fleet docked at Messina, at the tip of the Italian boot. Most of the fleet's sailors were dead or dying from a strange new illness, later recognized as bubonic plague. Within a few decades, it had killed nearly one in three Europeans.

The Premodern Absence of Scientific Rationalism

Today, "separation of church and state" seems a quaint phrase from the era of the Founding Fathers, whose modern relevance is confined to the judicial treatment of fringe issues such as school prayer and public Christmastime displays. In premodern Europe, the Church was a smothering ubiquity, "the matrix and law of medieval life, omnipresent, indeed compulsory. Its insistent principle that the life of the spirit and of the afterworld was superior to the here and now is one that the modern world does not share, no matter how devout some present-day Christians may be."[27]

Jefferson and Madison's obsession with the church/state nexus was grounded in the pervasiveness of organized religion in the premodern world. Paradoxically, the separation of church and state is a notion implicit in Christianity from its earliest days: "Render therefore unto Caesar the things which are Caesar's; and unto God the things that are God's," says Jesus to the Pharisees.[28] Making that separation a reality, however, would take time; from the conversion of Constantine onward, the state showered God's temporal representatives with land and riches. The wealthier the Church grew, the more corrupt and detached it became.

Today, the words heresy, blasphemy, and *auto-da-fé* are most commonly used in a satirical context; in the five hundred years before 1600, they struck terror into every European soul. Hobbes's characterization of life in a state of nature as "solitary, poor, nasty, brutish, and short" aptly described the medieval earthly existence; man's ultimate reward came only in the afterlife. Although incurring the displeasure of the religious authorities could lead to a person's being tied to a furiously burning pile of timber, that punishment paled in comparison to the grisly deaths choreographed by the various Inquisitions. The most infamous instrument of torture was the "old iron maid," a frame contraption that slowly squeezed hundreds of pikes into the victim's body, leaving the person a gory, barely living mass that was then cast into a pit of revolving knives.[29] Yet even the most painful exit from life was preferable to the fear of consignment to the eternal fires of hell.

What sorts of offenses could trigger such awful fates? Almost anything that displeased or challenged the power of the Church, including, but not limited to, questioning its authority, its beliefs, and most important, its wealth. The

infractions could be remarkably oblique. For example, early in the sixteenth century the Polish astronomer Mikolaj Kopernik, now better known by his Latinized name, Copernicus, deduced that the earth was, in fact, not the center of the universe, but rather itself revolved around the sun. Heretical views were more or less tolerated as long as they were published in the then-universal language of scholars—Latin. Since this ancient language was understood by almost no one outside the ruling ecclesiastical, royal, and merchant elite, such controversies did not reach the peasantry. Copernicus himself wisely did not cross the Latin/vernacular line, and was thus tolerated by the Vatican. Even the most enlightened scholars of the age, including Erasmus and Thomas More, criticized his new cosmology. Interestingly, he was less well received north of the Alps, with many Reformation leaders, including Martin Luther, calling for his head.

When Italian philosopher Giordano Bruno foolishly circulated pamphlets espousing many heterodox views, including support for the Copernican system that was written in the vernacular, a Vatican Inquisition saw him burned at the stake. In the ensuing decades the Church fought a futile rearguard action against heliocentrism, finally bringing its most authoritative supporter, Galileo, before the Inquisition. Shown the instruments of torture, he recanted.

By the late medieval period, the Church held the kind of absolute ideological power that might have been envied by Stalin, Hitler, or Pol Pot. As the saying goes, all power corrupts, and absolute power corrupts absolutely; by 1500, the weakness at the core of the Church was obvious to even the most devout. Bribery, simony (the sale of offices), and extortion became the watchwords of ecclesiastical life. The decay peaked during the Avignon papacy, where "everything the Church had or was, from the cardinal's hat to the pilgrim's relic, was for sale."30 Bishops and cardinals amassed fabulous fortunes from the sale of tithes and indulgences (forgiveness for sins purchased from the Church). John XXII, who wore the papal tiara from 1316 to 1334, exhibited a legendary appetite for gold cloth and fur. Noble families purchased appointments to the priesthood for small children, and twenty-year-old archbishops were not unknown.[31] Of 624 papal dispensations of legitimacy granted in 1342–43, 484 went to the offspring of clergy. In parts of sixteenth-century England, the clergy were indicted for almost a quarter of all sex crimes, more than ten times their proportion of the population.

Opposition to Church corruption, while relatively quiet and scattered, slowly grew, particularly in the postapocalyptic atmosphere that followed the fourteenth-century plague outbreak. The Beghards, a popular countercultural movement, professed a clergy-free path to salvation, the right to noble and church property, and free love. Neither the Church nor the ruling class looked kindly on its members, and many were burned at the stake. The most popular poem from the period, *Piers the Plowman,* provides a catalogue of medieval human failing, with pride of place awarded to the clergy.

A more solid foundation of dissent was laid down by the brilliant fourteenth-century Oxford don John Wyclif, whose opposition to Church dominance found shelter in England's long-running feud with Rome. As Martin Luther's

direct intellectual ancestor, he "metaphorically nailed his own thesis to the wall," in the words of Barbara Tuchman, with his De Civili Domino (On Civil Government). This tract proposed the confiscation of Church property and the exclusion of priests from government. Eventually, Wyclif, like the Beghards, denied the doctrine of transubstantiation and the very necessity of the priesthood itself. This did not ingratiate him with either the English or the Roman clergy, who attacked his many heresies.

Wyclif also translated the Scriptures into the vernacular. Fortunately, he lived in the pre-Gutenberg era, so his crime went unamplified by the printing press. In 1381, Balliol College, where he had been master, banished him—a relatively mild sanction. In doing so, Oxford harmed itself more than it did Wyclif. The university went into two centuries of decline, while Wyclif, a highly effective preacher, remained influential until he died of natural causes three years later.[32] After his banishment, his followers, the so-called Lollards, went underground. Thus began the long English Puritan/Dissenter tradition.

The Tyndale Affair provided the post-Gutenberg bookend to Wyclif's English Bible. The 1457 invention of the printing press by Johannes Gutenberg of Mainz, Germany greatly amplified the heretic's voice. William Tyndale, a classics scholar at Cambridge and Oxford, had initially delighted Henry VIII with his opinions on the preeminence of royal power over that of the Church. In 1525, Tyndale, like Wyclif (and numerous naughty monks before them), translated the New Testament into English. In the century and a half between the Wyclif and Tyndale episodes, the printing press had changed everything, magnifying Tyndale's heresy a thousand-fold. The very thought that uneducated peasants might now be able to read and discuss Scripture was repellent to the clergy; all that was expected from 90% of the population was illiteracy and blind obedience.

Publishers in Tyndale's native England would not touch the manuscript. He fled to Germany, where his Bible almost made its way into print in Cologne before being discovered by local clerics. Finally successful in the Protestant stronghold of Worms, Tyndale sent six thousand copies of his translation back to Britain, where they were hungrily devoured. At the insistence of then-devout Henry VIII, the Continental clergy imprisoned Tyndale for sixteen months, tried him for heresy, then had him publicly strangled. For publishing the Bible. In English. (This was before Henry VIII broke with the Church over the annulment of his marriage to Catherine of Aragon.)

One hundred and seventy-five Wyclif Bibles survive today, so at least several hundred must have been produced. Possession of one was enough to convict the reader of heresy. Transcribing several condemned the perpetrator to be burned, but since these had to be hand copied, the risk of auto-da-fé was relatively small. Tyndale's use of the printing press upped the ante on both sides; heretics who employed the printing press were playing with fire, both figuratively and literally.[33]

When Martin Luther finally used the Gutenberg press as a battering ram to topple Church authority, he replaced it with an equally odious, if less corrupt,

tyranny. Typical of this new Protestant zeal was John Calvin's role in Geneva. An itinerant missionary, Guillaume Farel, invited the refugee pastor to the newly Protestant city by the lake. Calvin was not the city's "dictator," as is often represented by modern historians. Instead, he merely served as head of the Consistory, a group made up mostly of ordinary lay people that was charged with guarding the morals of the Republic. (In fact, Geneva did not even grant Calvin citizenship until five years before he died.) Over the sixteen years of Calvin's guidance, the Consistory condemned eighty-nine people to death, mostly for witchcraft. By the standards of the time, this was unexceptional. Neighboring Catholic states executed far larger numbers of heretics, usually after hideously cruel tortures, which the authorities in Geneva generally avoided. Perhaps the most famous judicial episode of the era was Geneva's 1553 trial and execution of the heretic Michael Servetus for denying the Trinity and infant birth. When questioned whether he wished to be tried in Geneva or France, he fell on his knees and begged for Genevan justice.

What Calvin and his Consistory did create was a premodern version of the nanny state. No matter was too small for this merry group, to whom the term "micromanagers" is easily applied. In 1562, they compelled François de Bonivard, an elderly, recently widowed Genevan, to remarry a much younger woman. When the new wife inevitably sought the affections of a younger man, the city beheaded her lover and drowned her. On another occasion, the Consistory discovered five elderly men who could not render an adequate account of the Protestant faith. The Consistory ordered them to hire a tutor and demonstrate the catechism before the next public communion.[34]

Even before the partition of government power among king, parliament, and judiciary guaranteed individual liberties, the rule of law, and property rights, God and Caesar would have to be rent asunder. Fired by ideological fervor, religious wars—Catholic versus Protestant, and Protestant versus Protestant—burned through Europe for almost two hundred years. The conflicts exhausted and weakened the participants. This, in turn, paved the way for both independent secular governments and the more tolerant message of the Enlightenment.

The Premodern Absence of Effective Capital Markets

The modern businessperson takes for granted the easy availability of money from others—capital. Today, the most reputable large corporations can obtain long-term loans for improvement and expansion at just over 5% per year from the bond markets, with well-secured small entrepreneurs paying only a few percent more.

Even before money first appeared five thousand years ago, humans lent and borrowed. For thousands of years, loans of grain and cattle were made at interest; a bushel or calf lent in winter would be repaid twice over at harvest time. Such practices are still widespread in undeveloped societies.

The history of ancient credit markets runs broad and deep. Much of the earliest historical record from the Fertile Crescent—Sumer, Babylon, and Assyria—

concerns the lending of money. Hammurabi's famous Babylonian Code—the first known comprehensive set of laws—dealt with commercial transactions. A few small ancient examples will suffice. In Sumer from 3000 B.C. to 1900 B.C., the usual interest rate for a loan of barley was 33%, whereas the rate for a loan of silver was 20%. The difference between the two rates reflected the fact that barley loans were riskier than silver loans, since the latter could not be consumed or spoil; nor could a "silver crop" fail.35

Such high interest rates are prohibitive for long-term projects; at 20% per annum, the amount owed doubles in less than four years. With such a crushing future burden, no rational businessman or corporation borrows to fund a project that will not become profitable for five or ten years, as is the case with most large commercial undertakings.

Interest rates, according to economic historian Richard Sylla, accurately reflect a society's health. In effect, a plot of interest rates over time is a nation's "fever curve." In uncertain times rates rise because there is less sense of public security and trust. Over the broad sweep of history, all of the major ancient civilizations demonstrated a "U-shaped" pattern of interest rates. There were high rates early in their history, followed by slowly falling rates as the civilizations matured and stabilized. This led to low rates at the height of their development, and, finally, as the civilizations decayed, there was a return of rising rates. For example, the apex of the Roman Empire in the first and second centuries A.D. saw interest rates as low as 4%. The above sequence holds only on the average and over the long term, with plenty of shorter-term fluctuations. Even during the height of the Pax Romana in the first and second centuries, rates briefly spiked as high as 12% during times of crisis.

After the Fall of Rome (traditionally dated A.D. 476), rates in the Empire skyrocketed. Little more than two centuries later, Western commerce received yet another staggering blow—Mohammed's Hejira and the rise of the Arab empire, which overran most of the Iberian Peninsula. By acquiring control of the Gibraltar Straits, the Arabs effectively cut off Mediterranean trade.

The historical trace of interest rates simply disappears during the late Roman period and does not reappear until almost a millennium later, in England. There, rates well in excess of 40% were recorded in the twelfth century, and in Italy, rates averaged about 20% later in the same century. The first glimmer of a more reasonable future appears in Holland, where rates fell to as low as 8% as early as 1200.

Such high interest rates suggest a virtual absence of capital markets and constituted a commercial and economic straitjacket from which there would be no escape for centuries. As religious doctrine strangled intellectual progress, so, too, was everyday commerce hamstrung by the absence of capital markets. The Christian prohibitions against moneylending did not help. The ban's origins were scriptural, starting with Exodus 22:25: "If thou lend money to any of my people that is poor by thee, thou shalt not be to him as a usurer." Saint Augustine held that "business is itself an evil," while Saint Jerome opined that "a man who is a merchant can seldom if ever please God."[36]

In A.D. 325 the Council of Nicaea, the first organized Church conclave, forbade lending by clerics, and by 850 the Church began to excommunicate lay moneylenders, not that much demand existed for capital in Europe's stunted commercial markets to begin with.

The strictures against moneylending slowly gained in strength. By 1139, the Second Lateran Council declared even mortgages usurious. The height of ecclesiastical anticapitalist fervor, not to be matched until the era of Lenin and Marx, occurred in the mid-thirteenth century, when Saint Thomas Aquinas revived the Aristotelian notion that all large-scale commercial activity was inherently sinful.

Moneylending is as much a part of the human repertoire, and just as difficult to legislate away, as the consumption of drugs and alcohol. Even at the height of antiusury fervor, pawnshops lined medieval streets; Holland actually licensed moneylenders, who regularly supplied capital to the ruling princes. Jews, who could not be excommunicated, lent freely. Not until after 1571, when the Fifth Lateran Council lifted the prohibition against usury, could investors underwrite vigorous commercial activity.[37]

The Premodern Absence of Effective Transport and Communications

For a thousand years after the fall of the Empire, the decaying Roman roads were still the best highways in Europe. According to historian Laurence Packard:

> People "stayed put" in the Middle Ages; until the time of the crusades there was very little journeying about. The profound ignorance of geography, of places beyond one's immediate locality, helped to create a fear of strange regions and strangers, which amounted to superstition. Real dangers, such as robber barons, pirates, bad roads—or no roads at all—broken bridges—or no bridges at all—provided very effective obstacles to trade. Each feudal lord, moreover, collected tolls on traffic, and these tolls so increased the cost of goods [that] grain could not be transported from the land of plenty to the land of dearth because costs would eat up the profit, or raise the price so high that the starving people could not pay for it.[38]

As noted by Packard, the mechanical lack of transport was only part of the problem. In the words of economic historian Eli Heckscher, "In the Middle Ages the greatest obstacles to trade were the tolls." In the modern era, the word "toll" conjures up the fee for using an improved road or a border tariff. Before 1800, however, tolls were the unabashedly arbitrary and major source of revenue for many local rulers, who set up toll stations at critical choke points, such as navigable rivers and passes, so that traders could not avoid them.[39]

The absence of roads in northern Europe was a two-edged sword. On the one hand, it protected Scandinavia and most of Germany from permanent Roman conquest. On the other hand, this poor state of transport throttled all commerce

north of the Alps, especially in Scandinavia. For a millennium after the Fall of Rome, news and goods traveled only as fast as the cumbersome sailing vessels of the day: five weeks from Venice to Constantinople. To inland destinations, transport was even slower and less efficient—it took four weeks to travel the overland route from Venice to London. Most peasants never left the town of their birth. Only the sturdiest and luckiest could survive long sea voyages, and only the wealthiest could afford the supply of horses necessary for long overland journeys. As late as the turn of the twentieth century, which brought the Ford Model T, the overwhelming majority of Americans lived and died within twenty miles of their birthplace.

Before 1800, lack of adequate transport did not merely threaten commerce; it was deadly in its own right. In the modern world, where food can easily be shipped from areas of surplus to areas of shortage, crop failures rarely cause mass starvation. In the Middle Ages, by contrast, one town could experience catastrophe, while its neighbor in the next valley prospered; this was particularly true of areas not favored with river or sea transport. (In the twentieth century, Communist nations, by interfering with normal market and transport mechanisms, became history's most successful purveyors of mass starvation.)

The cost, danger, discomfort, and above all, the agonizingly slow pace of travel before the advent of steam power stagger modern sensibilities. As late as the mid-nineteenth century, bulk transport on the Continent was lucky to make twenty miles per day. Typically, it took almost six weeks for goods to travel the 290 miles from Paris to Lyon—less than ten miles per day. Coach passengers were fortunate to cover territory at twice that rate.

Traveling expenses were fearsome. In 1820, coach fare from New York to western Ohio—the frontier of civilization at the time—ran $80, or two month's wages. In England, a journey of sixty miles cost a pound sterling, or about a week's wages. (The traveler could save almost half the fare if he were willing to hang off the side of the coach.) Only the wealthiest could afford a coach-and-four.

The main expense of travel involved the repeated change of horses that was necessary over long distances. Finally, the high density of horses, oxen, and mules in the crowded cities created problems of aesthetics and hygiene mercifully long forgotten.

Travel safety in the premodern era proved an even larger consideration. The highwayman did not disappear from England's roads until the mid-eighteenth century, but coach robberies occurred on the Continent with alarming frequency well into the nineteenth. English travelers in Italy reported that as late as 1817, coach passengers were frequently killed, stripped, and then burned in their vehicles. The threat of petty thievery loomed as a constant concern, and coach accidents were remarkably common. In 1829, one coach traveler between New York City and Cincinnati recorded no less than nine overturns on rough corduroy (log-surfaced) roads. Fatalities were an everyday occurrence.

The discomfort of long coach and sailing ship journeys taxed even the hardiest

of travelers. The English painter J. M. W. Turner wrote of an Italian journey made in 1829:

> The snow began to fall at Foligno. The coach from its weight slid about in all directions. I soon got wet through and through til at Sarre-Valli the [coach] slid into a ditch and required six oxen, sent three miles back for, to drag it out; this cost four hours, so we were 10 hours beyond our time at Macerta, consequently half-starved and frozen, we at last got to Bologna. But there our troubles began instead of diminishing. We crossed Mont Cenis in a sledge—bivouacked in the snow with fires lighted for three hours on Mont Tarrat while the [coach] was righted and dug out. The same night we were again turned out to walk up to our knees in a new-fallen drift.[40]

From the beginning of recorded history, people, goods, and information moved no faster than the speed of the horse or the sail and continued to do until the dawn of the modern era. The harnessing of the steam engine for use in the ship and the railroad locomotive in the mid-1800s and the elimination of the toll stations by powerful national governments would supply the last of the four factors necessary for economic growth. The development of the railroad, the steamship, and the telegraph ignited prosperity beyond the fevered imaginings of the most optimistic premodern dreamer.

Land, Labor, and Capital

Before 1500, the well-being of the average human being was stagnant. The roots of that stagnation should by now be obvious. First and foremost, there was no incentive to create wealth, since it was not safe from the depredations of the feudal aristocracy, the state, the Church, or common criminals. Second, no European dared to think creatively or scientifically, since original thoughts often condemned their creator to oblivion both in this world and the next. Third, even had wealth-creating inventions and services been conceived, the capital necessary for their development was unavailable. Finally, even had such inventions been produced in large number, their inventors could not have advertised and inexpensively transported their wares to consumers in distant cities.

Traditionally, economists break down the production of wealth into three "inputs": land, labor, and capital. Economists believe that understanding how these classical inputs behave and interact reveals the historical roots of global prosperity. In order to build a farm, a factory, or a satellite network, all three are needed; how productive each factor is separates the rich man from the bankrupt.

If you are an entrepreneur, what matters is not how productive the average tract of land, employee, or loan is, but how productive the *marginal* piece of land, employee, or loan is. The term "marginal" refers to that land, labor, or capital *available to you at the moment*. It does little good to plan to farm in an agricultural district if all of the good land is taken and the only tracts available to you are of poor quality. Or to build a textile factory in an area with a skilled

labor pool, but where all of the best workers are already happily employed. Or to plan a tract of apartments in a place where existing mortgages carry low interest rates, but the rates on new loans have risen.

Of the three classical inputs, marginal land—that available to you at the moment—is the least productive. Since at any given time, the most productive land is already under cultivation, only lower-quality land will be easily available for purchase and development. New farms are almost never as productive as existing ones. Therefore, increasing investment in an agricultural economy is a losing game. The law of diminishing returns applies with a vengeance to farming.

Marginal labor, on the other hand, tends to retain its productivity better than land. As long as a trainable workforce exists, subsequent investment in more factories should be just as productive as the original investment. The hiring of increasing amounts of labor benefits from economies of scale; it is cheaper, on a per-worker basis, to train a hundred than to train ten. Further, marginal labor is blessed with the "learning curve." As creative workers and their supervisors devise ever-better training and work procedures, they become more efficient. Thus, marginal labor often becomes more productive with each subsequent hire. In modern terminology, industrial economies, which are labor-intensive, are said to be "scalable" (meaning that their size and output can be rapidly increased), while agricultural economies are not. Industrial economies grow easily; agricultural economies, only with great difficulty, if at all.

Finally, capital, along with the communications technology that underlies it, becomes increasingly productive with increasing investment. A point comes when capital markets achieve "critical mass," with dramatic improvements in efficiency.41 Such was the case with the telephone, the credit card, the Internet, and, most notoriously, the Windows computer operating system—each becoming widespread enough that they became necessities of life.

The capital markets themselves behave in the same way. A nation’s savings does little good if it is squirreled away in mattresses or under floorboards or on deposit in an inefficient banking system, as occurred in early industrial France, where distrust of the banking system denied the accumulation of great wealth to worthwhile enterprises. Markets work best when all of the buyers and sellers of a particular item are confined to the same place at the same time. In such a situation, the pricing of that item becomes very "efficient," that is to say, everyone buys and sells at nearly the same price. The most easily understandable example of this is ticket scalping. When the state strictly enforces antiscalping laws, scalpers and their customers will transact surreptitiously and in many places. As a result, ticket prices will vary widely. Further, since the scalpers almost always have better information than the buyers do, prices tend to be high. Such a market is said to be "inefficient." Enlightened communities have discovered that when scalping is allowed at a given place and time, generally just outside the main gate shortly before the event, prices are low and uniform. The reason for this is obvious: Confining the ticket sales to a brief period and small area maximizes the flow of information to both buyers and sellers and thereby eliminates the natural advantage of the scalpers. The Holy Grail of market efficiency is to place all of the world’s

buyers and sellers of a given item in exactly the same place at exactly the same time—in other words, eBay.

Financial markets work in identical fashion. When large numbers of buyers and sellers of capital can be brought together in one place, such as on the floor of the New York Stock Exchange, capital becomes cheaper and more reliable; the productivity of capital increases. In other words, as financial activity increases, interest rates fall and stabilize. Government also plays a central role in the investment process by eliminating uncertainty in the cost and supply of capital. Or, as President Clinton asked of Alan Greenspan in 1993, "You mean to tell me that the success of the program and my reelection hinges on the Federal Reserve and a bunch of fucking bond traders?"42 Yes, Mr. President, it did. William Clinton's overwhelming 1996 reelection victory owed itself in no small part to the success of Greenspan's monetary maneuvering.

The same situation holds with transport: It is more efficient to ship large quantities of goods in large vessels than to ship small quantities in small vessels. Likewise with communication—a messenger or telegraph service that transmits large amounts of traffic will offer its services more cheaply than a less busy one; such businesses are highly scalable. The ultimate high-productivity scalable industry is software. Once you have borne the expense of its development, distribution and sale are practically free, particularly if you are distributing it electronically. The productivity of marginal capital, bolstered by modern telecommunications and benefiting from an increasing number of participants, is thus the highest of the three traditional factors. Marginal labor is less productive; marginal land, least of all.

Knowledge: The Fourth Input

Several decades ago, as the rapid, sustained increase in Western wealth and productivity became more and more apparent, economists realized that the classic three-input model, which attempted to explain economic output on the basis of land, labor, and capital productivity, did not adequately explain this happy state of affairs. Economist Paul Romer suggested that at some point, scientific and technological knowledge itself becomes an important factor in growth. He pointed out that society benefited from technology's "externalities"—the rapid adoption by all manufacturers of the best practices of the industry leader—and that the marginal productivity of knowledge grows as more of it is accumulated, similar to the increasing marginal productivity of the capital markets.[43] In Romer's world, economic growth is limited only by the human imagination, and there exists no reason why its rate should be limited to the historical 2% real rate of productivity in the world's industrialized nations.

Stage One: Hunter-Gatherer

Let's consider how these four inputs (land, labor, capital, and knowledge) have played out in human history. In very broad terms, economic historians separate the human saga into four stages: hunter-gatherer, agricultural, industrial, and postindustrial. This four-stage paradigm is, of course, a gross oversimplification. In present-day Brazil, for example, significant numbers

engage in each of the four categories. Even in the world's most advanced nations, the last three stages are all still vitally important.

For more than 99% of our time on earth, however, humans existed exclusively as hunter-gatherers. This extraordinarily land-intense activity supports only about one inhabitant per square mile. Further, nomadic hunter-gatherers quickly exhaust edible fauna and flora in a given locale and are constantly on the move. Hunter-gatherers retain only minimal physical possessions and forgo fixed housing.44

In terms of the four economic inputs, hunter-gatherers are most dependent on land and labor, and the productivity of both remains constant. It is impossible for the tribe to increase the number of animals or berries over the thousands of square miles of its range. Labor is similarly limited, with improvements in hunting-gathering productivity few and far between. While increasing the amount of labor (the number of hunters and gatherers) on a given piece of land may temporarily increase the production of the land (measured in berries and buffalo), output will quickly fall as they pick the territory clean.

Hunter-gatherer societies do not need capital. In economic terms, then, such societies are economically crippled, since they depend on the least productive of the four inputs—land—and the productivity of their labor forces improves slowly, if at all. Finally, the stock of knowledge in a hunter-gatherer society also improves only glacially. Since advances in "hunter-gatherer technology" were made over such long time frames, measuring in the thousands of years, the calculation of growth rates becomes meaningless.

Stage Two: Farming

About 12,000 years ago, humans first began to settle the Fertile Crescent and farm. Agriculture is vastly more productive than hunting and gathering, allowing for population densities of up to a few hundred inhabitants per square mile. When farming communities came into contact with hunter-gatherers, the latter had small chance of survival, for four reasons. Foremost was simple population density—hunter-gatherer societies with one person per square mile could not compete militarily with farming societies having scores, and in exceptional cases such as the islands of Java and Honshu, hundreds, per square mile. Second, farming societies evolved a relatively small elite of soldiers who specialized in the annihilation of their nomadic neighbors. An even smaller elite of rulers planned and directed these efforts. (The specialization in societal roles made possible by farming, when well-enough developed, became known as "civilization.") Third, the close proximity of humans and domesticated animals in agricultural communities gave rise to pathogenic microorganisms such as smallpox and measles. While the agriculturists developed immunity to these microbes, the microorganisms proved lethal to their hunter-gatherer neighbors. Smallpox killed far more Aztecs than the arms of Cortez, and in the seventeenth century, this pathogen may have killed as many as twenty million Native Americans in North America before substantive contact with the white man even occurred.[45]

Last, and most important, many farming communities embraced the institution of individual property rights. It is nigh on impossible for hunter-gatherers to establish discrete ownership of vast tracts of wild habitat. While many, if not most, early farming ventures were communal, we shall find that soon after the dawn of recorded history, farmers began to individually own and run their plots. Such farms became far more efficient than their communal competitors, and societies that favored property rights quickly found themselves at an enormous advantage not only over their hunter-gatherer neighbors but also over communal farming societies as well.

Nobel Prize-winning economist Douglass North, who has called the agricultural transition "the first economic revolution" (the second being the Industrial Revolution), says that

> The first economic revolution was not a revolution because it shifted man's major activity from hunting and gathering to settled agriculture. It was a revolution because the transition created an incentive change for mankind of fundamental proportions. The incentive change stems from the different property rights of the two systems. *When common property rights over resources exist, there is little incentive for the acquisition of superior technology and learning*."[46] (Italics added)

Farming's main economic handicap lies in the fact that, as in hunting and gathering, land is the most critical input. If the population grows, for example, by 10%, then farmers must bring more land into cultivation in order to maintain the same per-person food consumption. This marginal farmland will not be of the same quality as existing farmland and will consequently be less productive. Farmers will thus have to cultivate *more than* 10% additional land in order to feed the increased population. This does not mean that progress in agricultural productivity is impossible—advanced irrigation and fertilization techniques, crop rotation, and the tandem-hitched plow dramatically increased per-acre yields. But many centuries separated these advances. If, as historians have suggested, crop yields quadrupled in the years between A.D. 1000 and 1500, that represented a growth rate of just 0.28% per year over the period. Between these two dates, population increases forced poor-quality marginal land into cultivation, canceling out most, if not all, of the increase in agricultural productivity that occurred in that half-millennium. Thus, the standard of living of purely agricultural societies remained relatively static.

Yes, the shift to an agricultural economy around 12,000 years ago produced a vast increase in world population. And, yes, modest subsequent improvements in agricultural technology resulted in further population increase. However, these advances did not produce a sustained improvement in living standards. As recently as the mid-eighteenth century, famine was a regular occurrence in Europe; in the nineteenth century, the Great Hunger killed over a million Irish citizens.

Some "knowledge gains" were made in the medieval era, but these were sporadic. Eighteenth-century England's "improving farmer," who constantly sought to apply the latest agricultural methods, was still a long way away.

Such was the sad state of affairs so compellingly described by Malthus: a world where population growth overwhelms the glacial improvement in agricultural output.47 The classic Malthusian "positive checks"—*fama, pestis, et bellum*—supplied the inevitable solution to the imbalance between need and nourishment.

Stage Three: Industrialization

By about 1500 the modest improvements in agricultural techniques, coupled with the first stirrings of property rights, capital markets, and transportation technology, allowed substantial numbers of workers to leave the farm and engage in manufacturing. In both northern and southern Europe, manufacturing meant one thing: textiles. In Italy, skilled weavers processed silk and other exotic fabrics into luxury items. The English shipped raw wool to Burgundy (roughly, modern Holland, Belgium, and northern France), where highly skilled artisans spun and wove it into fine cloth. Shipbuilding and machinery gradually developed as well. Although the Chinese had long exported textiles and porcelain, these industries were not proportionately large enough to allow a significant percentage of the Chinese population to escape agriculture, as occurred in Europe.

Manufacturing requires little land; its limiting factors are labor and capital. Although the law of diminishing returns occasionally governs labor, labor is not as sensitive to increasing scale as land is: The productivity of workers generally does not suffer greatly as more are hired. In the modern era, labor productivity may actually increase with growth, since the increasing density of workers and work places facilitates communication among producers—witness Detroit's automobile assembly lines and Silicon Valley's chip factories.

Better yet, manufacturing is capital-intensive. As old plants become obsolete, new ones must be built at great expense. Increasing population density begets more efficient capital markets; with growth, the financing of manufacturing capacity becomes progressively easier. Last, in an industrial society, knowledge becomes increasingly recognized as the road to wealth, with "best practices" quickly evolving and spreading, raising the output of all.

At some point in the nineteenth century in Europe and in the U.S., a "virtuous circle" came into being: Advances in technology begat improvements in productivity, which, in turn, begat increasing wealth, which then begat yet more capital to fuel still more technological progress. As the industrial economies increasingly employed highly productive capital and knowledge inputs, growth became self-sustaining and unstoppable.

"Build it and They Will Come"

The rapid economic growth of industrial societies bewitched entire generations of economists. Surely, they argued, the key to economic development was industrialization itself. The mere construction of factories and modern infrastructure and the training of workers should automatically result in the vaunted "economic takeoff."[48] Alas, as the sorry modern history of Soviet

industrialization and gargantuan third-world infrastructure projects built with foreign aid have demonstrated, there is more to prosperity than factories, dams, and railroads. (*Plus ça change*: In Chapter 9 we'll explore the failure of industrialization-from-above in the eighteenth-century Ottoman Empire.)

A nation reaches the industrial stage of development not merely as the result of industrialization per se but because of the existence of the vital underlying institutions of property rights, scientific inquiry, and capital markets. Once a nation has reached that stage, it has broken the chains of poverty. Economic growth, if you will, becomes encoded into its very culture. Even when such nations suffer massive destruction of the outward physical manifestations of their economies, as occurred to the Axis Powers during World War II, they rapidly regain and surpass their former prosperity.

Far worse than war is the corrosion of property rights. Twice in the twentieth century, eastern Germany recovered within a few decades from the physical effects of devastating world war. It will take her generations to recover from communism.

Stage Four: Postindustrial Society

The outline of yet another stage in human economic development—so-called postindustrial society—slowly emerged in the last part of the twentieth century. In a postindustrial society, manufacturing gives way to the provision of services. The postindustrial economy requires even less labor and land than its industrial predecessor. While this new regime requires at least as much capital as the old industrial system, its appetite for the knowledge input, mainly in the form of technological innovation, is ravenous. Where a telephone company might have hired armies of operators forty years ago, it now makes do with far fewer technicians, servicing the public with massively expensive satellite, cellular, and fiber-optic networks. Since the capital markets and knowledge base are the most "scalable" of the four input factors, capital- and knowledge-intensive postindustrial societies should sustain the highest growth.

The Western world did not arrive at such an agreeable state overnight. It took most of the second millennium to correct feudalism's suppression of property rights, throw off the intellectual stranglehold of the Church, overcome the lack of capital markets, and rectify the absence of effective transport and communication. Only with the completion of these four tasks could citizens of the new industrial and postindustrial societies enjoy the fruits of their labors.

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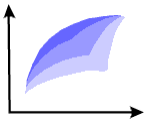
Efficient Frontier



William J. Bernstein

Links of the Month

A Fama-French Trilogy of Working Papers

Few processes are as critical to free market capitalism as the provision of capital to new enterprises; the nature, returns, and risks of these enterprises lie at the core of our economic system. A recent trio of papers from Fama and French speak to these issues:

- Who issues new equity? Almost everybody. In a very recent working paper, Fama and French note that new-share issuance, particularly by established firms, is endemic. (This article, incidentally, compliments a study done by Rob Arnott and myself demonstrating a fairly steady overall 2% annual dilution of existing common-stock shares, a working version of which was published here a few years back.)

- In a paper recently accepted in the *Journal of Financial Economics*, the authors uncover a startling discontinuity in the performance of initial public offerings (IPOs) over the past few decades: they are becoming more like lottery tickets and less like ongoing operations. Between 1973 and 1990, the ten-year death rate for new issues rose from one in six to almost half. At the same time, the dispersion of future profitability of these issues increased dramatically. In other words, while you're much more likely to buy a deadster, a few of these issues will do very well indeed.

- Finally, in another recent working paper, Fama and French wonder if, perish the thought, people actually buy stocks for other than financially rational reasons. This is not exactly a revolutionary concept; what is new and interesting is that the authors formalize the hypothesis and set it up for future testing. The relevance of this hypothesis to the IPO process is obvious.

A New Book by Kotlikoff and Burns

I normally don't go in for doom and gloom, but *The Coming Generational Storm* by economist Larry Kotlikoff and finance writer Scott Burns should be on every citizen's bookshelf. The health and income needs of the baby boomer

generation—the "pig in the python"—are going to soon tear through our society's social fabric like a razor through silk, and it's only a matter of time before the younger folks paying the bills throw up their hands and say "enough!"

Kotlikoff and Burns are equal-opportunity offenders, sparing neither Democrats, who never saw a social welfare scheme they didn't like, nor beast-starving Republicans. Both authors are genuinely funny men; there are points in the book where you won't know whether to laugh or cry. Buy it, read it, and enjoy it. You'll be informed and forearmed.