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William J. Baumol: The Free-Market Innovation Machine

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Introduction: On the Engine of Free-Market Growth

The Bourgeoisie [i.e., capitalism] cannot exist without constantly revolutionizing the instruments of production. . . . Conservation of the old modes of production in unaltered form was, on the contrary, the first condition of existence for all earlier industrial classes. . . . 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 and Friedrich Engels, 1847

As soon as quality competition and sales effort are admitted into the sacred precincts of theory, the price variable is ousted from its dominant position. . . . But in capitalist reality as distinguished from its textbook picture, it is not that kind of competition which counts but the competition from the new commodity, the new technology. . . . —competition which commands a decisive cost or quality advantage and which strikes not at the margins of the profits and the outputs of the existing firms but at their foundations and their very lives. This kind of competition is as much more effective than the other as a bombardment is in comparison with forcing a door.

—Joseph A. Schumpeter, 1947, p. 84

Under capitalism, innovative activity—which in other types of economy is fortuitous and optional—becomes mandatory, a life-and-death matter for the firm. And the spread of new technology, which in other economies has proceeded at a stately pace, often requiring decades or even centuries, under capitalism is speeded up remarkably because, quite simply, time is money. That, in short, is the tale told in this book—an explanation of the incredible growth of the free-market economies. The capitalist economy can usefully be viewed as a machine whose primary product is economic growth. Indeed, its effectiveness in this role is unparalleled. The primary purpose of this book is to

attempt an explanation of how this machine works. Note the underlying observation: that its extraordinary record of innovation and growth is hardly fortuitous. Nor is it the result of unrelated external developments analogous to the end of the “Little Ice Age” that occurred just after the inception of the Industrial Revolution and that probably contributed substantially to agricultural output. The point is that, once capitalism was in place and fully operational, a flow of innovation and the consequent rise in productivity and per capita gross domestic product were to be expected. Whatever the deficiencies of the free market, it is certainly very good at one thing: the manufacture of economic growth.

And, as is true of the other accomplishments of the market economy, none of this was the result of deliberate decisions or planning. The free market, once the institutional impediments to its development had been reduced sufficiently, just grew by itself and by itself became the machine that generates innovation and growth in dramatic profusion. For, as will be shown here, the market economy’s makeup is such as automatically to ensure that result. This suggests that the analysis provided in this book, if it proves valid, promises to be of substantial value in practice, particularly to those nations that have not yet shared in the growth benefits proffered by the market, and whose relative poverty seems actually to be increasing.

How large a share of the economy is constituted by the growth machine? If we focus on the machine’s central component alone—its research and development (R&D) activity—the numbers are not impressive. In 1998, total U.S. expenditure on R&D from all sources amounted to about \$227 billion, or some 2.6 percent of gross domestic product (GDP). This share of GDP was growing, but only slowly: an average of about 1.4 percent per year over the forty-five years, 1953–98.¹

This is, however, too narrow a view of the growth apparatus. The available estimates indicate that more than 60 percent of the labor force in the United States is engaged in activities in the “information sector” of the economy (though it is difficult to define and measure unambiguously)—far more than in manufacturing and agriculture, which, combined, constitute less than 20 percent of the total. This sector includes the processing, recording, analysis, and dissemination of information. It also encompasses the training of those who will carry out the nation’s R&D in the future. Of course, much of the activity of the information sector has little connection with growth, but it is implausible that its growth-supporting work constitutes a negligible

1. National Science Board (2000).

share of the total. The evident conclusion is that, whereas the core activity in the growth machine is hardly enormous in size, a very substantial part of the U.S. population that is economically active outside the household is at least peripherally engaged in running the machine.

CENTRAL TOPICS OF THE BOOK

It is the spectacular and historically unprecedented growth rates of the industrialized market economies—the growth rates of their productivity and their per capita incomes—that, above all, set them apart from all alternative economic systems. Average growth rates for about one and a half *millennia* before the Industrial Revolution are estimated to have been approximately *zero*, and, although there was undoubtedly some growth starting around the tenth century, it proceeded at a snail's pace by modern standards. Even the most well-off consumers in pre-Industrial Revolution society had virtually no goods at their disposal that had not been available in ancient Rome. In fact, many consumption choices available at least to more-affluent Roman citizens had long since disappeared by the time of the Industrial Revolution. In contrast, in the past 150 years, per capita incomes in a typical free-market economy have risen by amounts ranging from several hundred to several thousand percent!² So, when public indignation contributed to the collapse in the late 1980s and early 1990s of many of the world's communist regimes, and when even the masters of China turned toward capitalist enterprise, what they wanted, surely, was to participate in the growth miracle that Karl Marx and Friedrich Engels were able to discern so early in the experience of capitalism.

This book seeks to explain the unprecedented and unparalleled growth performance of the capitalist economies and provides a theory of the imperfect but, nevertheless, creditable efficiency of the capitalist growth process. The analysis attributes this performance primarily to competitive pressures, not present in other types of economy, that force firms in the relevant sectors of the economy to unrelenting investment in innovation and that, contrary to widespread belief, provide incentives for the rapid dissemination and exchange of improved technology throughout the economy. Finally, the book moves toward the integration of growth theory into the central body of mainstream economic analysis. It is clear that innovation plays a far larger role in

2. See Baumol, Blackman, and Wolff (1989). Nordhaus (1997) used the history of lighting to study long-term growth rates of real wages; he found that the quantity of illumination that could have been bought with just one hour of labor in 1992 would have required the wages of more than 1,800 hours in 1900.

the activities of many key firms and industries than the current theoretical literature takes into account. My goal here is to indicate ways in which the analysis of business decisions can be reoriented to eliminate this significant gap. Let me indicate what I hope to achieve here in each of these areas.

Explaining the Growth Miracle of Free Enterprise

The virtual absence of any explicit attempt to explain the fabulous growth record of the free-enterprise economies in general, with their transformation of living standards and creation of technological innovations undreamed of in any previous era, is perhaps the most glaring omission of recent economic growth theory, despite all of its substantial contributions. I have been unable to find any systematic theoretical work seeking to account for this incredible record, or any investigation of why this economic system is so different in its productivity accomplishments from all other economic systems that have ever been tried.³

I will concentrate on a number of explanatory influences, including some necessary preconditions for the existence of a workable free-market economy, some likely consequences of the existence of such an economy, and some items that are both. Among the most important of these conditions are:

- **Oligopolistic competition** among large, high-tech business firms, with *innovation as a prime competitive weapon*, ensuring continued innovative activities and, very plausibly, their growth. In this market form, in which a few giant firms dominate a particular market, *innovation has replaced price* as the name of the game in a number of important industries. The computer industry is only the most obvious example, whose new and improved models appear constantly, each manufacturer battling to stay ahead of its rivals.
- **Routinization** of these innovative activities, making them a regular and even ordinary component of the activities of the firm, and thereby minimizing the uncertainty of the process. It is estimated that some 70 per-

3. So far as I have been able to find, the issue is addressed directly only in some four pages of Marx and Engels' *Communist Manifesto* (1848) and in six pages of Schumpeter's *Capitalism, Socialism, and Democracy* (1947), examples of which appear in this chapter's opening quotations. These comments are meant to distinguish my subject matter from the mass of historical and theoretical work, much of it profound, dealing with such subjects as the special history of the advent of capitalism in Western Europe, the role of innovation in growth, etc. The contributions of David Landes, Nathan Rosenberg, Joel Mokyr, Richard Nelson, and F. M. Scherer come at once to mind, and there are many others. But my special focus here is on capitalism as an enormously powerful growth machine. My task is to investigate how the machine works and why it is so effective.

cent of U.S. research and development spending is now done by private industry, much of it incorporated into firms' day-to-day activities.

- **Productive entrepreneurship** encouraged by incentives for entrepreneurs to devote themselves to *productive* innovation rather than to innovative rent-seeking (the nonproductive pursuit of economic profit such as occurs in inter-business lawsuits), or even to destructive occupations, such as criminal activities
- **The rule of law**, including enforceability of contracts and immunity of property from arbitrary expropriation.
- **Technology selling and trading**, in other words, firms' voluntary pursuit of opportunities for profitable dissemination of innovations and rental of the right to use them, via licensing, even to direct competitors.

All of these are features of a capitalist, or free-market, economy; in other types of economy they are either absent or exist in far weaker form. I will argue that these features are crucial for the explanation of the extraordinary growth accomplishments of the free market. Moreover, neither their consequences nor their origins are mere accidents, but contain elements that economic analysis can help to explain.

Imperfect but Substantial Economic Efficiency and Growth under Capitalism

My second central topic is the rough economic efficiency of the growth process of the free-market economies. Textbook accounts suggest that free-enterprise economies are characterized by a tendency toward *static efficiency*. That is, firms are driven by market forces to use the most economical of the available methods of production and to supply the product mix best suited to consumer demands. But, according to these accounts, these economies are also distinguished by extreme violation of the requirements of efficiency *in the growth process*. Most notably, the very substantial *spillovers* that derive from innovation—the fact that a considerable proportion of the benefits of innovation is enjoyed by persons who have not contributed to the innovation—are said to lead to a magnitude of innovative activity far below the optimum level.⁴ If inventors could retain more of the gains for themselves, the argu-

4. A dramatic example is the transistor, invented at Bell Laboratories, then owned by AT&T. For a variety of reasons, AT&T, whether voluntarily or involuntarily, allowed others free use of this invention, which then became one of the key contributors to the information age. But surely no major invention has provided benefits only to its inventor. Indeed, it is the general public that has gained the most from inventions ranging from timekeepers to electricity to telephony.

ment goes, there would surely be more inventions, and current inventors would surely put more effort into the process. Yet this conclusion seems to fly in the face of the observation that the main achievement of the capitalist economy is in fact its spectacular and unrivaled growth performance, and not its rather questionable static efficiency.

One need not be an economic historian to conclude that disparities in *static* efficiency do not constitute the really dramatic difference between the capitalist economies and the economic systems that preceded it, as well as those that were until recently designed to displace it. Undoubtedly, the rules of static efficiency were violated in both medieval China and the defunct Soviet Union where, for example, input prices must frequently not have been those that induced the most efficient use of labor and raw materials. But such efficient pricing is probably also widely missing today in the United States, Japan, and Germany. And even if these three countries came closer to satisfying that criterion, one may well doubt that the resulting contribution to living standards would be profound.

These observations underlie one of the main heterodox conclusions of this book: although the capitalist *growth* process certainly does not quite meet the requirements of perfect economic efficiency, there is reason to believe that it comes far closer than standard economic theory might lead us to conclude. Spillovers do, indeed, tend to impede the introduction of innovations whose social benefits (unlike their private returns) exceed their costs. Yet I will argue that, once the beneficial *distributive* consequences of the spillovers of innovation are taken into account, the result is likely to approximate something like optimality, in a sense to be defined. Finally, the profitability of the rental of proprietary technology enhances the rapidity with which the economy moves toward the current technological frontier, that is, toward adoption by most or all producers of the latest and most appropriate technology and product specifications. These forces together lead to a degree of efficiency in growth that, though far from perfect, is nevertheless impressive.

Incorporating Growth Analysis into Mainstream Microeconomic Theory

Innovation and growth surely originate from the activities of individuals and business firms—the entities studied in microeconomic analysis. Growth therefore cannot be fully understood without incorporating it into microeconomic theory. Yet the *core* of that body of analysis contains little on the subject. It will be argued in this book and, I trust, demonstrated that innovation can fortunately be integrated into the standard structure of micro-

economic analysis more directly and more easily than might be expected. This is made possible by the competitive market pressures that force firms to integrate innovation into their *routine* decision processes and activities, thereby subjecting it to standardization and to the calculus of profit maximization. In addition, its place in the structure of microeconomic theory is facilitated by the recognition that, to a profit-seeking firm, investment in research and development is just another investment option, and that the products of this R&D are just intermediate inputs to the production of other outputs by the proprietor of the innovation and other business firms.

As a longtime practitioner of microeconomics, I certainly do not want to denigrate its very substantial accomplishments. On the contrary, this book is built with the very effective analytic tools that the microeconomic literature has provided. However, it is apparent that the standard microeconomic analysis, in giving secondary place to innovation and failing to treat it as a primary weapon of competition, has not gone far enough in a direction vital for comprehension of the accomplishments of the free-market economic system. Innovation has been relegated to a peripheral place in the microeconomic literature, outside the central structure of the analysis. There has been a profusion of very illuminating microeconomic writings on innovation, but these have generally dealt with relatively narrow (though important) issues, rather than addressing the place of this activity in the theoretical structure as a whole. This new literature continues to lie well outside the main structure of microeconomic analysis, the body of material that at least used to be called "value theory." Prices and directly related variables still are at the heart of microeconomics, while the theory of innovation remains in the outskirts. Certainly, perusal of any economics principles textbook for first-year students will show a substantial number of chapters devoted to the price mechanism, and sometimes, but not always, there will be a single chapter in which innovation has a central role. Thus, it is no exaggeration to say that in economic analysis innovation is only a sideshow and is certainly excluded from the central ring of the main performance.

In drawing attention to this omission, I am not repeating the banal observation that the "realism" of economic theory is far from perfect, a criticism that has been leveled repeatedly at the most creative writings of economics for well over a century. Rather, the argument of this book is in the opposite spirit. It suggests that, once outlays on innovative activity are recognized as just one of the investment options open to the firm, then the theory of capital and investment already provides the logic and the instruments with which one can quickly close much of the gap. Once this is done,

innovation can and should become a centerpiece of the microanalytic literature, as it is in the economy of reality. It will thereby contribute both to the understanding of the actual economy and to its utility in application.

An integrated theory of innovation that brings its position in microtheory closer to that of price should help us to deal with a number of issues. The analysis of innovation should provide an explanation of the amount spent on innovation, and should show how it fits in with the determination of the other variables of the pertinent market model. It should be capable of dealing with the role of innovation in the theory of resource allocation, income distribution, and welfare analysis, and in dynamic as well as static models. In each of these areas this book will seek to provide a beginning, though it will not pretend to explore its subject definitively. What I do hope to end up with is a preliminary mapping of the subject as a whole, showing that the way is now open for exploration and deeper analysis by others, some of whom may find it convenient to take off from the approaches that will be illustrated here.

One of the reasons innovation is absent from the core of microtheory is failure to take account of the routinization of much of inventive and innovative activity, a subject to which we will return. For this transformation of the process makes it far easier to incorporate rivalry in innovation into the core of the microeconomic theory of the firm. We can far more easily subject such a customary, regular, and predictable activity to systematic analysis than the erratic, unpredictable “Eureka! I have found it!” kind of discovery, to which romantic histories attribute the bulk of invention. Routine innovation changes all that, because the decision process and its competitive consequences become nearly indistinguishable from those characterizing any other form of investment. A firm’s management is faced with an ordinary budget-allocation decision in which investment outlays are apportioned among competing uses such as plant and equipment, advertising, and R&D. In a sense, all of these are abstracted into many anonymous money-earning opportunities for the firm. Their common feature is that they all entail outlays now whose (risky) payoffs can be expected only in the future. The decision on which new variant of some major type of equipment will be purchased by the firm is based per se not on considerations such as the ingenuity of its design or its economical use of fuel, but, ultimately, only on the payoff it promises. The same is true of the decision about whether additional investment funds should be devoted to marketing or to research.⁵ Thus, the range of applica-

5. Of course, the results of investment in R&D are less clearly foreseeable than those of investment in expanded plant, for example. But, for analysis of the two investment decisions, the difference is only a matter of risk, and a difference only in degree.

tion of the standard and well-developed theory of investment can at once be extended to include the routinized innovation process.

In short, the analysis of routine innovation can get substantially further and can yield more clear-cut microeconomic conclusions than can analysis of an innovation process that is largely fortuitous and unpredictable. Indeed, it can put us well on the road to “an integrated theory of innovation” that will promote our understanding of the workings of the economy and help us to extend the range of useful applications of the analysis.

THE GROWTH-PROMOTING
ATTRIBUTES OF CAPITALISM:
HAMLET’S REAPPEARANCE

It is tempting to argue that the avoidance by recent growth theory of any systematic study of the capitalist growth miracle is like a performance of Shakespeare’s *Hamlet* without its central character, the Prince of Denmark. Ophelia, Polonius, and Hamlet’s mother and uncle all play their roles, but Hamlet himself is missing from the stage.⁶ So, too, the growth literature is full of invaluable analyses. But much of it is unsuited to deal directly with the distinction between the growth accomplishments of capitalism and those of other economic systems, because these analyses are preponderantly ahistorical, and all explicit references to the special features of free-market economies have been expunged.⁷

This book attempts to break away from this orientation, taking at least a preliminary step toward the historical orientation of Marx and Schumpeter, by coming to grips with the uniqueness of capitalist growth. In brief, the following features of innovation in the free-market economies indicate more fully the logic of my analysis, which has already been suggested.

6. The phrase “a performance of Hamlet without the prince of Denmark” was widely used in Great Britain some decades ago, and was also employed by Joseph Schumpeter.

7. Clearly, Paul Romer (1990) and Robert Lucas (1988) and, soon after them, Gene Grossman and Elhanan Helpman (1991a and b), building upon Robert Solow’s fundamental work (1956), among others, have made a major breakthrough by inaugurating a formal theory of endogenous innovation. There is no conflict between anything that will be said here and what they have written. Indeed, I trust they will agree with me in regarding their research and mine as complementary, with the two together providing the basis for an analysis of innovation that is, as it should be, integrated into the central corpus of economics. However, their work is not designed to deal with the difference between the growth record of capitalism and that of other economic forms. Their analysis is ahistorical and macroeconomic and does not emphasize routine innovation as distinguished from endogenous innovation activity of just any variety. None of this can be considered a shortcoming of their models, given their very different purposes.

Capitalism Is Unique Not in Invention but in Innovation

Although a number of other economies have produced an astonishing profusion of inventions, virtually none of them possessed a mechanism that induced, let alone rendered mandatory, the cascade of innovation that has characterized free enterprise. Here I use the term “innovation,” distinguished from invention, in the Schumpeterian sense: as the recognition of opportunities for profitable change and the pursuit of those opportunities all the way through to their adoption in practice; in particular, as the activity of recognizing economically viable inventions and doing whatever is necessary to bring them to market or to ensure their effective end-use by some other means.⁸ Medieval China and ancient Rome had their spectacular profusion of inventions, but most of them proved to be dead-ends in the absence of a systematic innovation mechanism capable of ensuring that they would not languish.

Beyond Mere Incentive: Invention as a Life-and-Death Matter for Capitalist Firms in Sectors Ripe for Invention

The market mechanism achieves much of its efficiency and its adaptation to consumer desires through financial incentives, by providing higher payoffs to those firms that are more efficient and whose products are most closely adapted to the wishes of consumers. The same mechanism obviously drives innovation in an even more powerful way. For oligopoly firms in the high-tech sectors of the economy, it is in fact a matter of survival. The firm that lets its rivals outperform it substantially in innovative products and processes is faced with the prospect of imminent demise. The firm must innovate or die. To paraphrase Dr. Johnson, the prospect of hanging is a powerful stimulus to the imagination.

Irresistible Pressure for Routinized Corporate Innovation as a Supplement to Independent Innovative Activity

To protect themselves from the risks just described, business enterprises have incorporated innovative activity into their routine operations. Such innova-

8. Innovators, who prepare inventions for the needs of the market and promote their sales, are often not primarily inventors themselves. Thus, James Watt’s partner, Matthew Boulton, was clearly the market planner and salesman for the Boulton–Watt steam engines, and, arguably, Edison was more innovating entrepreneur than inventor. “Although popular American legend elevates Edison above his peers, he did not in fact make any quantum leaps in [electric] technology [when he discovered his carbon-filament lamp in 1882]. The first lighting by electricity took place with the electric-arc lamp as early as 1845 . . . Edison combined technical inspiration with commercial perspiration when he also generated electricity and distributed it from the Pearl Street substation in New York in 1882” (Nordhaus, 1997, p. 37).

tion activity is no longer a largely unpredictable process, in which changes in social psychology control the fortuitous appearance of individuals who possess the determination and inspiration needed for innovation. Particularly in the high-tech sectors of the economy, the pressures of the competitive market force firms to systematize the innovation process and to seek so far as possible (in the immortal words of the great comedian W. C. Fields) “to remove all elements of chance” from the undertaking.⁹

As Schumpeter and others have already noted, innovation is, as a result, increasingly becoming an accustomed and predictable procedure. Business firms systematically determine the amounts they will invest in the R&D process, systematically decide on the ways in which they will interact with their rivals in this area, and even systematically determine what it is that the company’s laboratories should invent.

In substantial portions of the oligopolistic sectors of the economy, where huge firms dominate markets, innovation has become the preferred competitive weapon. Indeed, the contest for better new products and processes becomes an arms race, with failure to keep up constituting a threat to the firm’s survival. This is a force that contributes substantially to capitalist growth.

Competition makes it too risky for firms to depend primarily for their new products and processes on the unpredictable efforts of independent inventors. Instead they have changed much of the economy’s R&D into an internal, bureaucratically controlled process, as, for example, in pharmaceuticals, computers, and even photography. They have *routinized* it.

FEEDBACK: INNOVATION STIMULATES FURTHER INNOVATION

Once innovation takes off, including in this not only the inventions themselves but also their successful marketing and profitable utilization, this facilitates and stimulates further innovative effort. The obvious connection is that the demonstrated profit opportunity is sure to attract other inventors, other investors, and other entrepreneurs whose task it is to ensure that invention is put to effective and remunerative use.

But successful innovation encourages more of this activity in other ways, as well as helping to ensure the success of this further effort. As is well recog-

9. This phrase is uttered when a novice (whom Fields is seeking to lure into a card game) questions the morality of “games of chance,” Fields hastens to reassure his victim: “Young man, when you play with me, all elements of chance have been removed!”

nized, new products have often given others the idea for related new products that either serve as superior substitutes (for example, the jet airplane as substitute for propeller planes) or serve as supplements to the preceding new products or service (for example, the electric refrigerator as something that followed the creation of the electricity network). The one invention may also indicate ways to make it easier and less costly to manufacture other new products. Finally, the innovation process itself leads to improvements in the way R&D is carried out, thereby providing another stimulus to further innovation. In sum, innovative activity can be considered a cumulative process, in which there is feedback from one innovation to the next; once the free market has launched its innovation machine, the inherent structure of the mechanism leads the machine to grow more powerful and productive with the passage of time.

MARKET INCENTIVES FOR RAPID DISSEMINATION

Depending on prices, it is often most profitable for the monopoly owner of an innovation to specialize in the business of renting the input to others rather than using it itself as an input to its own final product. Sometimes the highest profits are obtained by the owner of the rights to an invention if it simultaneously uses the invention as an input in its own production *and* rents its use to others. As a result, there is widespread technology trading and marketing of licenses for a firm's proprietary technology in the United States and, apparently, in other countries with technologically advanced economies. Many firms do not fight to keep the technology to themselves, and some actively promote it as a profitable business. Such dissemination of technology as a profit-seeking business practice helps to spread the use of the latest techniques and production of the latest goods and services. It speeds the elimination of obsolete economic activities, and the financial rewards of technology dissemination help to internalize the externalities of the innovation process.

DOES THIS EXAGGERATE THE ROLE OF INNOVATION?

Innovation is, of course, a primary source of the capitalist growth miracle, starting off with the "wave of gadgets"¹⁰—the surge of innovation that prob-

10. This, according to T. S. Ashton in his classic little book (1948) on the Industrial Revolution, is the way in which one schoolboy (quite appropriately) defined that revolution.

ably began to gather force as early as the fourteenth century and perhaps first reached a substantial pace early in the nineteenth century. It can be argued that virtually all of the economic growth that has occurred since the eighteenth century is ultimately attributable to innovation.

Yet, one may well maintain quite reasonably that this is an exaggeration. For example, as economic growth literature emphasizes, much has undoubtedly been contributed by investment in the capacities of the individual—in “human capital”—notably through expansion of education, through learning-by-doing, and through the spillovers from accumulated learning. Similarly, crucial contributions to growth have been made by enormous investments in plant and equipment. But with the very limited resources available to the extremely impoverished societies of earlier centuries, there was little possibility of diversion of any substantial quantity of resources to either of these types of investment.¹¹ For the bulk of the population of earlier periods of history, bare survival was the critical problem, and it left only minimal resources for investment in education and productive capacity. Only the productive surpluses that innovation began to make possible, first in agriculture and mining and then in manufacturing, made feasible the enormous increases in investment in inanimate and in human capital that are widely judged to have contributed greatly to economic growth. So it is reasonable to say not only that innovation has contributed to the growth process, both directly and at second remove, but that without it the process would have been reduced to insignificance.

REMARK ON THE ROLE OF GREED

I have often heard it said by intelligent observers (who were not economists) that the prosperity and growth achieved in the free-market economies are wonderful things, but that the process was seriously sullied by the exercise of greed that it stimulated. This is not a new issue; indeed, it is related to a Renaissance debate involving some of its leading thinkers, which they raised on religious grounds: How could a beneficent and all-powerful deity allow human conduct to be governed by such unsavory motivations? One of Adam Smith’s most brilliant contributions was a viable resolution of this dilemma that remains illuminating today.

11. It is also noteworthy that neither investment in human capital nor investment in physical capital is a distinguishing feature of free-market economies. Both were, for example, very substantial in the economy of the Soviet Union. Thus, emphasis of these two sources of growth contributes to the ahistorical character of many growth models.

In effect, Smith demonstrated that competition is capable of dealing with the problem and that it does deal with it effectively. That is what the famous (but much misunderstood) “invisible hand” passage in *The Wealth of Nations* is really about. This passage tells us that competition obviously provides the minimally acceptable solution, by preventing the greedy “merchants and manufacturers” from deriving any excessive profits from their ill-motivated activities. Thus, it denies them the fruit that their greed-driven efforts were designed to attain.

But that is only the beginning of the miracle of competition according to Smith. For, rather than only eliminating any excess reward to the exercise of greed, it turns the tables and harnesses that greed to serve the general welfare. Under competition, greedy producers must strive to provide a better product on better terms than their rivals are offering. They must find out what consumers want, and they must match their output to those wants. They must supply as much of their product as they can induce consumers to accept at the low prices enforced by the competitive market.

As Smith explains:

As every individual . . . endeavours as much as he can . . . so to direct [his] industry as its produce may be of the greatest value; every individual necessarily labours to render the annual revenue of the society [its GDP] as great as he can. He generally, indeed, neither intends to promote the public interest, nor knows how much he is promoting it. . . . [B]y directing [his] industry in such a manner as its produce may be of the greatest value, he intends only his own gain. . . . [H]e is in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention. . . . By pursuing his own interest he frequently promotes that of the society more effectually than when he intends to promote it. ([1776] 1904, p. 481)¹²

It is to be noted that the issue relevant for Smith and for the discussion of this book is not whether the motivation force in question is to be viewed approvingly as “responsible pursuit of the profit motive” or is more appropriately classed among the seven deadly sins. Rather, the analysis starts from the position that the profit motive is very much alive and very widely present. It exists and cannot be wished away. Then the pertinent question is not only whether there exist arrangements that can prevent its most objectionable consequences but whether, more than that, they can redirect the forces engendered by this motive so as to benefit society and not just fail to harm

12. It will be noted that the passage contains no explicit reference to competition, but its role is surely clear from the context.

it. Smith's answer is that there is such an institution—competition—though he warns us that it is an institution that needs to be defended from the predictable (and widely observable) attempts by those who are affected by its constraints to evade it or undermine it altogether.

This story is particularly applicable to free-market innovation and growth. Without the profit-driven competition of the innovating firms seeking to be the first to learn how to make the better mousetrap or the better computer, and to bring these products rapidly to market, more quickly and cheaply than their rivals, and without the opportunities for profitable dissemination that allows technical progress to pervade the economy rapidly, how much more modest would the growth record of the market economies have been? All this is patently driven by what some call the “profit motive” although others, less affectionately, just call it “greed.” But it is greed harnessed to work as efficiently and effectively as it can to serve the public interest in prosperity and growth.¹³

CONCLUSION: THE FREE-MARKET ECONOMY AS INNOVATION MACHINE

As already asserted, it seems clear that it is innovation, not price-setting, to which management gives priority in important sectors of the economy. It is persistently forced to do so by the market. But the central body of micro-economic analysis gives its attention primarily to price determination, and by doing so may, arguably, be omitting a critical feature of the competitive process in more recent periods. Further, the omission removes the bridge that can connect the static and the dynamic analysis.

Of course, price legitimately plays an important role in the central economic models: as a conduit of information to the market it is an indispensable variable of general equilibrium theory. However, I will argue that innovation plays a role of at least comparable importance for the theory of the firm and competition. And, although recent macromodels of growth have turned their attention to endogenous technical change,¹⁴ they have not sought to explore the heart of the free-market growth process, which is the competitive pressure that forces firms to create, seek out, and promote inno-

13. Of course, it arguably is not a very good promoter of other public interests in terms of objectives such as preservation of the environment, prevention of unemployment, and many others. I have no intention of minimizing the importance of these considerations, but merely want to point out that they are not the subject under discussion here.

14. See footnote 7 above.

vations. It is essential for a credible theory of endogenous technical change to treat explicitly the role of market forces as major determinants of innovative activity itself along with price and other pertinent variables.

Free-market economies *are* fundamentally different from all other economies that the world has known. The most spectacular and, arguably, the most important manifestation of that difference is the extraordinarily superior growth performance of free-market economies. This book explores the mechanism that accounts for that performance. Using a blend of theory, history, and bits of more recent data, I seek to provide an analytic approach that not only deals with capitalist growth *per se*, but also indicates how the analysis can be brought from the isolated suburbs of the theory of the firm and industry and moved into its center, where it surely belongs.