The role of public intellectuals in shaping economic development policy debates

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ABSTRACT

Friedrich A. Hayek and R. Buckminster Fuller were major public intellectuals concerned with the public policy debates about economic development, centralized planning and political freedom. From very different perspectives, they enlarged the mid-20th century public debate about the role of government planning in creating economic prosperity. Neither man pursued his agenda solely within the realms of academic conferences and scholarly journals. Each mounted the public stage, attracted publicity and sought influence with business leaders, politicians and government officials.

Hayek championed markets when many academic intellectuals favored planned economies. He saw classical liberalism as the basis of both prosperity and political liberty. Hayek thought that large-scale planning almost always led to results opposite of the announced goals of such planning.

Fuller was an engineer, architect and social visionary. He championed large-scale planning and development by both governments and private enterprises. Unimpressed by both capitalism and socialism, Fuller argued that science, technology and industrialization were the drivers of economic prosperity, regardless of the political system of a country. He originated the concept of Spaceship Earth and argued for solving economic problems by addressing them at the global level.

The public debates about markets, regulation, planning and sustainable economies continue. The voices of both Hayek and Fuller continue to echo wherever those debates are held.

Keywords: economic development, R. Buckminster Fuller, Friedrich A. Hayek, public intellectuals, large-scale planning, spaceship earth

INTRODUCTION

This paper explores the intellectual contributions of Friedrich A. Hayek and R. Buckminster Fuller to public policy debates about economic development, centralized planning and political freedom. In different ways and from different perspectives, they enlarged the mid-20th century public debates about economic trends and the role of planning in creating economic prosperity.

Most intellectuals conduct research, publish scholarship and teach students. While academic intellectuals eagerly share their findings within their professional communities, they and their work seldom attract public attention. Employing esoteric research methods and using arcane terminology in their writings, academic intellectuals seldom develop a following among members of the public.

Academic intellectuals establish and maintained their professional reputations among the small circle of specialists within their own academic fields. Most world-class intellectuals, even Nobel Laureates such as Hayek, seldom have to worry about ducking paparazzi. Such intellectuals seldom interact directly with the public in any professional way. The results of their research and scholarship come to the public's attention, if at all, through the efforts of businesses, hospitals, schools, legislatures and public agencies.

Another type of intellectual – the public intellectual – seeks a different role and another audience. Not content solely with traditional academic achievements, public intellectuals step into the spotlight reserved for life's center stage. They write books for the general reader, appear on television programs, produce newspaper columns, testify before Congressional committees and participate in public policy debates.

CAREERS AS PUBLIC INTELLECTUALS

F. A. Hayek

Friedrich A. Hayek burst onto the public stage in 1944 with the publication of ***The Road to Serfdom.*** For most of the first half of the 20th century, the discipline of economics moved progressively and dramatically away from the classical conceptions of liberalism and a confidence in the efficacy of free markets to produce both prosperity and social justice. In the face of this trend toward socialism and the planned economy, Hayek mounted an attack on the increasing involvement of governments in economic affairs and the displacement of markets.

Born in Vienna, Austria, in 1899, Hayek was 45-years-old when he published his most famous work, The Road to Serfdom. With the publication of this book, Hayek became an intellectual celebrity, well known by the public as well as his academic colleagues. The following year, he solidified his academic reputation by publishing "The uses of knowledge in society" in the *American Economic Review* (1945). Based on his professional prominence and the fame from his book, Hayek launched a successful career as a public intellectual. He lectured widely across the United States and gained significant influence with academics, business leaders and policy makers.

Hayek's most potent argument was that government planning and intervention in economic affairs produced the exact opposite of its stated goals. To back up this assertion, Hayek meticulously showed that greater governmental involvement in economic activities resulted in reduced political liberty and economic freedom. In addition, large-scale planning

undertaken by the government produced a lower per capita income and a smaller capital stock. Hayek successfully attacked socialism on the ground of economic efficacy as well as the damage it did to political liberty. His attacks on the new conventional wisdom of economics stimulated a public re-assessment of the socialist economic policies that had gained ascendency, particularly in Europe, after World War I. After receiving the Nobel Prize for Economics in 1974, he continued to work actively in the public arena until his death at age 92.

R. Buckminster Fuller

Born in Milton, Massachusetts, in 1895, R. Buckminster Fuller was known most prominently as an architect, inventor and engineer. Fuller reached the peak of his fame as the designer of the 200-meter geodesic dome that housed the U.S. pavilion at the 1967 World's Fair in Montreal, Canada. The most famous image of Buckminster Fuller was on the cover of *Time Magazine.* For the cover, *Time* superimposed a headshot of Fuller over his Expo '67 dome. To complete the image, *Time's* graphic artist altered Fuller's cranium to resemble a geodesic dome.

Fuller wrote more than 20 books, held 27 patents and received 47 honorary doctorate degrees. He was a Fellow of the American Association for the Advancement of Science as well as the 1968 Gold Medal Award recipient from the National Institute of Arts and Letters. In 1983, he received the Presidential Medal of Freedom.

Fuller's geodesic dome embodied and demonstrated his economic insights as well as his engineering principles. Using industrial production and assembly procedures, commercial geodesic domes were manufactured quickly and inexpensively. Since the domes were structurally self-supporting, the interior space was uninterrupted by supporting columns. This allowed complete flexibility in the use of interior spaces. One of the more spectacularly launched geodesic domes was the auditorium for the Henry Kaiser's Hawaiian Village in Honolulu. Kaiser Aluminum manufactured the components for the aluminum-skinned dome at its Oakland, California, plant and shipped the components to Hawaii, where workers assembled the 145-foot geodesic dome in 22 hours. The Hawaiian Symphony Orchestra performed a concert in the completed dome 23 hours after the arrival of component parts on the site (Hatch, 1974).

In addition to his technical achievements, Fuller was an insightful critic of contemporary social and economic arrangements. He thought that both the Left and Right had missed the point concerning economic development. For Fuller, industrialization was the engine that drove economic progress. He believed that socialism and capitalism both failed to understand the power of science and technology to generate both prosperity and freedom. In the 1960s and 1970s, he lectured ceaselessly at universities throughout the world. His lectures were marathon affairs often lasting more than four hours. Fuller, too, lived a long life, remaining active in the public arena until his death at age 87 in 1983.

F. A. Hayek and R. Buckminster Fuller had much in common. Both were born just before the turn of the 20th century, gained prominence in late middle age and had their greatest influence late in life. Both were long-lived and continued their professional work throughout their lives. Both shared a passion for engaging important public issues and shaping the debates surrounding those issues. In addition, both wanted societies that created more economic prosperity and more democracy. Neither thought that economic systems that tried to reform human nature had a chance of success.

CONTRASTING VIEWS ON GROWTH AND ECONOMIC DEVELOPMENT

Hayek championed market capitalism and sought to beat back the growing 20th century trends toward both socialism and totalitarianism. Hayek argued that there was an inseparable link between political liberty and economic liberty. He maintained attempts to increase economic well-being through government-initiated planning were doomed to failure, decreasing both prosperity and political liberty.

The primary economic problem, according to Hayek, was maximizing economic efficiency in the face of scarcity. From his point of view, economic efficiency resulted from the personal, self-interested decisions of individuals participating in markets. Large-scale planning failed because centralized decision makers are unable to handle the volume of data or the unanticipated interactions of variables within complex systems. In short, centralized decision-makers could not achieve the stated goals of large-scale planning.

For Hayek, de-centralized decision-making was the more efficient approach to managing the complex interactions inherent in large economies. Within an industry, the decisions made within a specific firm were more likely to be efficient than those made by a planning board at the industry level. Similarly, the decisions made by individual attempting to maximize his or her own self-interest were more likely to be efficient than those made by an outside agency. Allowing firms and individuals to benefit or suffer based on the effectiveness of their decisions created a self-correcting system that improved over time.

The great question addressed by Hayek was how does a country's intellectual community turn its back on the ideas of classical liberalism in favor of the ideas of socialism? His answer was that the slow but substantial economic growth created by economic liberty came to be expected. However, those intellectuals not well versed in economics failed to see that classical liberalism was the foundation that made growth in living standards possible. As the country's intellectuals ignored the principles of classical liberalism, they searched for new ways to address the problem of scarcity. During the first half of the 20th-century, claimed Hayek, that search led the intellectual community to increasingly embrace socialism and planning as a substitute for liberalism.

Hayek (1944) claims that the champions of socialism captured even the language of liberty. In his words:

> To the great apostles of political freedom the word (freedom) had meant freedom from coercion, freedom from the arbitrary power of other men, release from the ties which left the individual no choice but obedience to the orders of a superior to whom he was attached. The new freedom promised, however, was to be freedom from necessity, release from the compulsion of the circumstances which inevitably limit the range of choice of all of us, although for some very much more than others. Before man could be truly free, the "despotism of physical want" had to be broken, the "restraints of the economic system" relaxed (p. 31).

Those intellectuals arguing for socialism and central planning suggested that the increasing complexity of the economy created the necessity for coordination by some sort of central agency. Hayek argues that the more complex the system, the less it is possible to be managed by some agency and the more it is necessary to rely on the decentralized planning that can only be accomplished by a well-working market system. His emphasis on decentralized

decision-making foreshadows contemporary management trends toward participative management and empowerment.

Best known as an architect and engineer, R. Buckminster Fuller, nonetheless, peppered his books and speeches unconventional economic insights. While Fuller was not a systematic, academic economist, his ideas challenged the conventional wisdom of economists on both the Left and the Right. He argued that the economic prosperity of a society depended on its degree of industrialized, regardless of the political system under which the economy functioned. Science and technology, expressed through large, industrial organizations, produced economic well-being and progress.

A supporter of government-sponsored, large-scale technological development, Fuller wanted to replace narrow political views of the economy with a global, sustainable economy aboard Spaceship Earth. The task of the economy, from Fuller's perspective, was to create highly productive systems that would overcome entropy.

ECONOMIC ABUNDANCE AND FREEDOM

Both Fuller and Hayek sought a society that produced abundance and distributed the benefits of that plenty widely throughout the society. However, their views on how to create such a society were at odds. Hayek believed that a limited government, the market system, individual decision making and political liberty were the surest ingredients for widespread prosperity. In Hayek's view, governmental planning to stimulate economic development and reduce poverty usually produced the opposite of its intended results. Instead of a small group of planners personally making decisions about the economy, Hayek preferred the impersonal workings of the market system.

Hayek seemed to accept that the economic growth delivered by the enterprise system would be at best slow and steady. The intellectuals Hayek feared were those who had not come to understand that the growth provided by the accumulation of capital and that the direction of this capital was efficiently accomplished only by profit-seeking entrepreneurs. Hayek saw the efforts of planners as the antithesis of entrepreneurialism.

Fuller, on the other hand, believed that accelerated technological innovation, global industrialization, large-scale planning and governmental initiatives were the keys to universal prosperity. For Fuller, the successful effort of the United States to send astronauts to the moon and back was the prototype project that pointed the way to greater economic development.

It troubled Fuller the find the work of Charles Darwin and Thomas Malthus used as inappropriate justifications for the poor performance of the economy throughout the history of civilization. When the Darwinian idea of survival of the fittest was combined with the Malthusian assumption that population growth would always outstrip the ability of the economy to supply resources to support the population, even compassionate, well-meaning individuals assumed as "a scientific fact that not only was there not enough to go around but apparently not enough for even 1 percent of humanity to live at a satisfactorily-sustaining standard of living. And because of entropy the inadequacy would always increase" (Fuller, 1968, pp. 37 - 38).

To Fuller, Social Darwinism was not science but a perversion of science used as a political excuse for tolerating permanent, grinding poverty. He also rejected the Malthusian equations used to bolster Social Darwinism. Fuller maintained that science, technology and, above all, industrialization would change the Malthusian equations. By increasing knowledge and deploying that knowledge as industrialization, humanity could hold entropy – that great

enemy of increasing order and complexity--at bay. Consequently, productivity could improve by orders of magnitude, not by single digit percentages. Fuller's logical conclusion was that a properly organized – i.e., planned – global, industrial economy could eliminate poverty.

THE IMPACT OF LARGE-SCALE PLANNING ON ECONOMIC PERFORMANCE

The question of centralized planning divided Hayek and Fuller more than any other issue. Their thinking about planning started from different perspectives and ended with different conclusions.

Hayek was impressed with the power of individual decision making, particularly when the decisions involved self-interest. Hayek saw that the quality of a decision depended on access to the relevant information and the likely impact of that decision on the personal well-being of the decision maker. Individuals engaged in market transactions based on personal self-interest tend to make efficient decisions in the face of scarcity. Consequently, Hayek opposed both large-scale planning and centralized decision-making.

For Hayek, centralized planning was inherently ineffective since it was cognitively impossible for one person or even a small group of people to process the amount information necessary to make appropriate decisions. The only solution, from Hayek viewpoint, was decentralized decision making, allowing many more individuals to make smaller, more personally relevant decisions. In *The Road to Serfdom*, Hayek (1944) lays out the following thesis:

> "There would be no difficulty about efficient control or planning were conditions so simple that a single person or planning board could effectively survey all the relevant facts**.** It is only as the factors which have to be taken into account become so numerous that it is impossible to gain synoptic views of them that decentralization becomes imperative. But, once decentralization is necessary, the problem of co-ordination arises—a coordination which leaves the separate agencies free to adjust their activities to the facts which only they can know and yet brings about a mutual adjustment of their respective plans" (p. 55).

Where Hayek saw the virtues of individual decision-making, Fuller argued that individual decisions often ignored important information that did not serve the immediate self-interest of the decision maker. Individual engaged in market transactions based on personal self-interest often make decisions that may have far-reaching, negative consequences for others not directly involved in the transaction. In contrast, Fuller championed the benefits of comprehensive thinking, large-scale planning and centralized decision-making.

In the last paragraph of *Operating Manual for Spaceship Earth*, Fuller issued a call for action: "So, planners, architects, and engineers take the initiative. Go to work, and above all co-operate" (1968, p. 133). Earlier in the same text, Fuller said the following about planning:

> "I think it's appropriate that we assume the role of planners and begin to do the largest scale comprehensive thinking of which we are capable. . . . Becoming deliberately expansive instead of contractive, we ask, 'How do we think in terms of wholes?' If it is true that the bigger the thinking becomes the more lastingly effective it is, we must ask, 'How big can we think?' " (1968, p. 59).

For Fuller, large-scale planning and decision-making were crucial to creating the magnitude of change he envisioned. The decisions of individuals were usually constrained by narrow, personal concerns that missed the possibilities of comprehensive change at the systems level. Fuller foresaw the possibility of increasing economic output by orders of magnitude by addressing economic problems on a global scale. Fuller was not interested in slowly increasing the productivity and efficiency of current economic systems, whether they are capitalistic or socialistic systems. He was interested in promoting global industrialization, which would drastically raise the standard of living worldwide.

DIFFERENT LEVELS OF ANALYSIS

In working out his economic theories, F. A. Hayek's unit of analysis was the largest geographical area with a common set of laws governing an economy. As shorthand, we could say that Hayek regarded the nation-state and its economy as the most relevant unit of analysis. Since he was most concerned about limiting coercive power, Hayek focused on individual freedom and the functioning of the economy within the context of the state.

Hayek did not embrace the status quo nor did he promote a "dogmatic laissez faire" economic system. From Hayek's (1994) perspective, competition required "adequate organization of certain institutions like money, markets and channels of information—some of which can never be provided by private enterprise" (p. 41). Rather, Hayek's system of individual liberty requires a carefully thought out legal framework that may be different from anything existing at the time of his writing. He relied on competition because that was the only coordinating system not based on the use of coercive or arbitrary authority.

In developing his economic insights, R. Buckminster Fuller's primary unit of analysis was the planet Earth. At his most expansive, his unit of analysis was the universe itself. Fuller developed the metaphor of "Spaceship Earth" to call attention to the need to analyze issues at the global level. According to Fuller (1968), the systems of the Spaceship Earth were well enough designed "to be able to keep life regenerating on board despite the phenomenon, entropy, by which all local physical systems lose energy" (p. 50).

Human beings have become increasingly successful at understanding and using planetary resources. When society better understands the operation of Spaceship Earth, the economic system can move from exploiting limited resources to aligning economic activities with self-sustaining, renewing systems. His nomenclature for the beneficial interaction of subsystems and behavior of whole systems was "synergy". Fuller (1968) asserted that synergy was "the only word in our language that means behavior of whole systems unpredicted by the separately observed behaviors of any of the system's separate parts or any subassembly of the system's parts. There is nothing in the chemistry of a toenail that predicts the existence of a human being" (1968, p. 71).

Before we had the terminology, Fuller was promoting the idea of a sustainable economy. Regarding the use of fossil fuels as short sighted, he urged that development of energy systems based on solar radiation, winds, and tides. To do otherwise, Fuller (1968) regarded as "lethally ignorant and utterly irresponsible to our coming generations" (p. 87).

The early evidence of the economic transformation made possible by science, large-scale thinking, clear-eyed planning and well-deployed technology prompted Fuller (1968) to assert that

> **"**we have gone from less than 1 percent of humanity being able to survive in any important kind of health and comfort to 44 percent of humanity surviving at a standard of living . . . undreamed of before. This utterly unpredicted synergistic success occurred within only two-thirds of a century despite continually decreasing metallic resources per each world person. It happened without being consciously and specifically attempted by any government or business. It also happened only as a consequence of man's inadvertently becoming equipped synergistically to do progressively more with less" (pp. 95 – 96).

SCIENCE AND TECHNOLOGY IN THE EVOLUTION OF THE ECONOMY

Hayek argued that the greatest drivers of economic efficiency were individual initiative and decision-making operating at the lowest levels of responsibility. Hayek's faith in Adam Smith's "invisible hand" led him to believe that larger-order economic systems spontaneously optimize themselves when individuals pursued their own self-interests. While he saw science and technology as inputs into the economic system that improved the ratio of outputs to inputs over time, he credited them with making incremental, marginal improvements to the economy.

Fuller, on the other hand, thought that science and technology as expressed through large-scale industrialization were the key drivers of economic productivity. As scientific understanding grew, technology became more effective, industrial machinery grew more sophisticated and economic productivity increased apace. During a few generations, the economy was able to increase its ability to provide abundance to an ever-larger percentage of a rapidly growing world population.

Fuller chronicled the evolution of technology over the last several centuries. Before the Industrial Revolution, productivity depended on hand tools and the skills of the artisan. The industrial revolution substituted machines powered by water or steam. Industrial tools required more than one person to manufacture and operate. Later, electricity and internal combustions engines supplanted water and steam. At the same time, industrial machinery became larger, more complex, more precise and faster. This is a much-chronicled and well-understood story.

Less well understood is the next stage of technological evolution. Fuller observed that during the third quarter of the 20th century technology became more "ephemeral," relying on chemical reactions, electronic circuitry and scientific principles. According to Fuller (1968), technology "was going from wire to wireless, from track to trackless, from pipe to pipeless, and from visible, structural muscle to the invisible chemical element strength of metallic alloy and electro-magnetics" (p. 34).

From Fuller's perspective, most of the world's economic problems stemmed from a failure to industrialize on a global scale. He was unimpressed with the idea that a country's economic success required a particular type of political system. Fuller (1969) argued that the success of an economy depended more on the citizen's "industrial machinery and their energy distribution networks" than on their political systems (p. 181). He considered the shift to global industrialization as an evolutionary step as significant as the earlier shift from hunting and gathering to agriculture.

In the decades since his death, the telecommunications, computer and electronics industries have demonstrated the validity of his insights regarding the economic transformative effects of technology. In a seminal article, Gordon E. Moore (1965), one of the founders of

Fairchild Semiconductors and, later, Intel, formulated the concepts that later became known as Moore's Law, which postulates that the number of transistors that can be placed on an integrated circuit has doubled approximately every two years. This exponential technological improvement is responsible for increasing power of computers at the same time that their prices are decreasing. Although Fuller may not have been aware of Moore's Law, he certainly recognized similar processes at work in other areas of technology.

Fuller regarded the planet as a whole (Spaceship Earth) as the appropriate level of analysis for determining the efficacy and efficiency of the economy. From this perspective, he found both socialism and capitalism wanting. Relying on the metaphor of Spaceship Earth, Fuller (1968) noted that "[d]ifferent parts of the crew speak different languages and are frequently at war with each other. Actions are uncoordinated, unplanned and made without consideration for the good of the whole" (p. 59). To solve these problems, Fuller urged large-scale planning based on the most comprehensive thinking possible.

WEIGHING THE EVIDENCE

At this point, we are tempted to ask, "Which of these public intellectuals had the greater insight?" They were working from the middle of last century, and we have the advantage of hindsight to make our evaluation. The Hayek hypothesis was that economic growth was sufficiently slow and steady that policy makers would come to take economic growth as a given. As politicians moved away from the study of the economic principles responsible for this growth, they failed to emphasize the roles of strong property rights, efficient financial institutions, competitive markets, freedom to trade and a limited government, they become willing to experiment with a different set of institutions to reduce economic want. Hayek claims these experiments away from individual incentives inevitably led to socialism, with freedom trampled by government planners.

Anecdotal evidence is easy to marshal in making Hayek's case. Strong empirical evidence is more difficult to come by. However, the Heritage Foundation, along with the *Wall Street Journal*, calculates the Index of Economic Freedom using standardized measures of business freedom, trade freedom, fiscal freedom, government spending, monetary freedom, investment freedom, financial freedom, property rights, freedom from corruption and labor freedom. The indexes allows a systematic ranking of economic freedom for 170 countries, with countries classified as free, mostly free, moderately free, mostly unfree, repressed or not ranked.

In 2010, The United States fell from the free classification to the mostly free classification. Economic Freedom declined in Business Freedom because of the uncertainty toward the regulatory environment and the negative effect of this uncertainty on entrepreneurship and job creation; a decrease in Trade Freedom through non-tariff trade barriers, the Buy American components of the stimulus bill and abandonment of various free trade agreements; and Federal government spending created record deficits. Monetary Freedom decreased because of the increased price distortion from government policy toward housing, healthcare, automotive and financial markets (Miller and Holmes, 2011). This is rather dramatic empirical evidence of the strength of Hayek's insight.

The Buckminster Fuller approach to economic growth was markedly different from that slow and steady growth described by Hayek. Fuller (1968) introduced the concept of "synergetics" to explain that wealth has two components: physical energy and metaphysical know how (p. 80). Fuller further explained that traditional economists have vastly

underestimated our wealth by recognizing only the usual labor and capital components of it while failing to assign a proper value to our knowhow. This explosion of "knowhow" has overcome the dreaded Malthusian calculus, allowing the percentage of the planet's affluent population to increase from 1 percent to more than 40 percent in less than a century. Equally remarkable was the fact that the planet's population also increased rapidly during that same period.

Fuller argued that Malthus was defeated because we have replaced the visible with the invisible, transitioning from a productive process relying upon people working with mechanical machines and tools to one based invisible electrical and magnetic energy along with chemical interactions. Production has become increasingly efficient as we rely increasingly on the invisible. That is, wealth increases as our "knowhow" increases. On the final page of the *Operating Manual for Spaceship Earth*, Fuller alludes to the increasing reliance upon that object that now stores much of our knowhow, the computer. Fuller was clearly at the cutting edge of thinking on this technological revolution. Moore's Law (that the number of transistors per chip would double every 1.5 to 2 years) was posited only in 1965. With the publication of the "Operating Manual" in 1968, Fuller's thinking was clearly on the cutting edge of this technological revolution, citing example after examples of technological developments that paralleled the insights later known as Moore's Law.

Information Technology (IT) along with developments in communications technology led to dramatic decreases in semiconductor prices, which stimulated investment in IT assets. The use of IT capital assets (computers, software and communications equipment) grew at almost 20 percent per year from 1995 to 1999, almost doubling the rate of the previous 5 years. Non-IT capital services grew at 3 percent a year and labor services grew at about 2 percent. Labor productivity has grown faster in the 1990's because of the contribution of technical progress (Moomaw, Olson, Applegate and McLean, p. 18). This technical progress seems to match well with Fuller's idea of the invisible "knowhow" parts of our wealth leading to a very visible contribution to our economic development. Our recent experience of technological productivity growing at geometric rates tips the evidence toward Fuller over Hayek in terms of insight about the fundamental drivers of economic development.

CONCLUSIONS

Hayek and Fuller served important roles as public intellectuals shaping the discussion of economic policy in the second half of the 20th century. Hayek was instrumental in questioning the drift towards a planned economy with an ever-larger role for the government. His ideas had more influence on public policy in the United States than they did in Europe. After the publication of *The Road to Serfdom*, free market ideas once again gained ascendency in the United States and saw their political fruition in the Reagan Revolution with its stress on smaller government, de-regulation, lower taxes and market solutions to social problems. Our analysis suggests that Hayek more completely understood the relationship between economic freedom and political liberty than Fuller did. We can credit Hayek with re-establishing the intellectual underpinning for policies favoring market solutions over governmental solutions to economic problems.

Fuller's contributions to the public policy debate were less direct but nonetheless important. Fuller was a technological optimist who saw science, technology and, above all, industrialization as the major forces generating economic progress. When most economists saw

technology as providing small, incremental improvements to economic well being, Fuller foresaw that technology could improve economic well-being by orders of magnitude. His speeches and books overflow with specific examples of new technology doing vastly more with vastly fewer resources. In this regard, Fuller provided a far more insightful analysis of the long-range impact of science, technology and industrialization on the economic well-being of society, regardless of that society's political system. In addition, his metaphor of "Spaceship Earth" sowed the intellectual seeds that produced the contemporary passion for creating sustainable, "green," economic systems.

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