Science and the Free Market: How Government Distorts Scientific Research through Public Funding.

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Introduction

Science[1] is understood by general society as an essential means of building prosperity. It is even deified by some people, who think that science is the cure for all ills – physical, mental, and governmental. But however one views science and its benefits, governments can be clearly seen to play a significant role in the production of scientific knowledge in the modern world. Most people take this institutional arrangement for granted, but rarely do people take a step back and ask whether or not science should be sponsored by the state in the first place. Is state-sponsored science the right way to conduct scientific research within society?

The main argument used in defense of publicly-funded, state-sponsored science is that insufficient incentives exist to encourage the right amount of scientific research, especially fundamental (or basic) research. This constitutes a "market failure" to provide for the "public good" of research, and the economy is not producing at a suboptimal level. Therefore, the government should intervene by funding worthy scientific endeavors through taxation of individuals and businesses.

This author contends that the nature of *state-sponsored* scientific research is problematic at best and outright deceptive at worst. First, public funding of science is by nature a socialistic production process, and all the problems inherent in socialism will affect the advancement of science. Second, other problems arise when science becomes entangled in the web of the state, such as government control of research, poorly conducted research via perverse incentives, property rights issues, moral hazards, and agenda-based research. Following these explanations, how science actually advances is then examined, and a free market model for science funding is proposed.

The Calculation Problem & the Knowledge Problem

[1] Reference to "science" in this paper generally indicates the physical sciences rather than social sciences.

Socialism is characterized by the factors of production being centrally planned. Ludwig von Mises said that "the aim of Socialism [is] to transfer the means of production from private ownership to the ownership of organized society, to the State" (Mises, 1951, p56). One can expect from socialistic endeavors that the government will attempt to reorganize already existing institutions so that it can control how they produce. Not only does socialism blatantly abuse individuals through appropriation of legitimately owned property, it's re-application of the means of production cannot be done so effectively.

The socialist system of production is inherently flawed, as there is no rational, valid means of economic calculation to allocate scarce resources in an efficient manner, explained in the devastating critique of socialism by Ludwig von Mises and others (Mises 1975; Hayek 1945). Knowledge cannot be concentrated into a single entity at the top, i.e. government, that can command and control what gets done in an economy. Rather, knowledge is distributed within society, and the only way this distributed knowledge can be used effectively is when market participants can freely make decisions on how to apply scarce resources. Government is irreparably deficient in making efficient decisions.

The production of scientific knowledge is based on the same principles of praxeology to which all other fields are subject. There is no exceptionality in science that makes it immune to the problems of socialism. Applying this critique of socialism to science, this means that the government has no rational means of figuring out what research *needs* to be done and what doesn't. Furthermore, they have no rational means to determine *how much* resources to commit to any research program. At best, the government can take signals from the free market that a research area is beneficial, at worst they are stabbing at the air. Under the free market, the price system signals market participants regarding how to invest resources efficiently and therefore would invest in research that adds value. This applies even to philanthropic efforts of wealthy donors to scientists – they are signaled through the price system what the research is worth *to them as donors*. A central-planning government cannot accomplish this.

Other Problems of Publicly-Funded Science

The fundamental problem of publicly-funded research is that the government is the effective controller of *what* is researched. At the university level, this is a subtle breaking of the concept of academic freedom, which is the belief that freedom of inquiry is essential to professors and students for expanding the corpus of human knowledge. The government technically does not *force* the choosing of research topics, but the influence that they wield through the power of the purse is tremendous. It is naïve to assume that government is a "neutral party" to scientific research. Funding of research by businesses admittedly is not devoid of influence, but in this case the free market is signaling what research is profitable by offering incentives to produce excellent research. Reisman (2006) argues that state-sponsored science reverses the roles of truth and money in research:

In a free market, it is the truth and importance of the science that drives the raising of money. Money is raised in order to facilitate the development and dissemination of the science. Money is the means; science is the end. With state-sponsored science, this relationship is largely reversed. The state, in effect, offers pots of money in the form of 'grants' for the study of matters selected by politicians and their appointees, and then scientists must choose areas of investigation that are most

likely to secure them some of that money… The meaning of this state of affairs is that the initiative for science passes from scientists to the state.

A further result of this institutional arrangement is poorly conducted research, which ultimately drives up the cost of the best research. The government claims that through its own funding of research that a more "optimal" amount of research is conducted, but how can anyone know what the "optimal" level of research is in an economy? Knowledge is distributed throughout an economy – not centralized in the government apparatus – and only on the free market can this knowledge of what needs to be researched be used effectively through the price system.

Thus, two observations can be immediately made about state-sponsored science. First, government funding will tend to take money away from the very people who *can* make the right decisions about where to commit money. That money could have otherwise been used to further *better* science or simply to push the economy forward through other investments. Second, funds earmarked by the government for research will have a much higher chance of being sent to projects that will not be conducted properly, because those distributing the funds are not in the position to know how to use those funds efficiently. An example of this is the National Aeronautics and Space Administration (NASA), which consumes an inordinate amount of money for research, much of which arguably has little to no net benefit. Indeed, how could those benefits even be calculated given that value is subjective and that there is no means of economic calculation to consider other alternative projects? What is more, government funding in this instance acts as an artificial increase in demand, and on net this will increase the cost of research across the board.

Practical property rights issues also abound in publicly-funded science. Since "the public" funds the research, exactly who should profit from the results? Stated another way, who owns the research? The public? The Federal Government? The researcher? The university? "Society?" Ambiguities such as this enter into all "public goods" problems and are not resolved easily. Moreover, in science the property rights issues are exacerbated by intellectual property laws, specifically patents. IP considerations often drive major research programs in universities for personal and institutional benefit. Using taxpayers' money to obtain patents you can enforce upon taxpayers is obviously a lucrative opportunity. Stephan Kinsella (2001) has noted that intellectual property is illegitimate in property rights theory. Thus, one could expect that the presence of intellectual property would distort the market toward research with high patentability options, but not necessarily high real applicability. Furthermore, securing patents becomes more important than doing more innovative work. Boldrin and Levine (2008) relate the history of the steam engine created by James Watt. Following receipt of his patent, Watt spent much more time litigating his intellectual property rights than improving the original design. Once the patent expired, however, the market exploded with innovation upon the steam engine all over Europe and the United States. Imagine how frequently unseen events of this kind must occur in the technologically advanced world of research today?

Publicly-funded science results in moral hazards. Scientists are for the most part insulated from the risk of failure in their own research. In fact, continued funding of projects is frequently dependent on what "future research" is left in a current project, and thus perverse incentives are introduced into the system that reward spendthrift behavior.

Instead of over-delivering results and conservatively using resources, prodigality is encouraged.

Other questions of morality inevitably arise as well. How can it ever be moral to use other people's money to support research with which they disagree? One might argue that only research known to be *generally acceptable* to the public should be done. However, this begs the question: how could anyone know what is acceptable without first knowing *everyone's* preferences? The notion that general acceptability can be found is an impossibility. Unlike society generally agreeing that "murder is wrong," there is no way to rationalize "let's build a Large Hadron Collider, it's what everybody wants." It is no surprise, then, that there is so much outcry against various research programs from interest groups. Examples include stem-cell research (opposed by many who are pro-life), evolutionary biology (opposed by some Christians), and weapons research (opposed by anti-war activists). However beneficial these topics might be, ends do not justify means. On the truly free market individuals decide how to spend their money on a voluntary basis alone, and would thus resolve many of the problems.

A final major concern of publicly funded science, related to moral hazard, is agenda-based research. As mentioned, the government is essentially the determiner of what science gets done. But from the public's perspective, science is understood as a means of making their lives better. The government is in the perfect position to take advantage of its subjects by using science as a basis for fear, and then for control. A perfect example of this phenomena is environmental science. At one time, the United States government – including poster-child NASA – was concerned about global cooling and tried to push its agenda against citizens. This, however, gave way to being concerned about global *warming*, and among the worst of the alarmists are those in high-up government offices. Under the guise of "science," the government has taken control of a great amount of the energy and transportation industry, and unfortunately recent trends seem to indicate that this appropriation of power over the marketplace will continue. This is even easier to accomplish when one's own assets are not at risk, and the expectation is that the taxpayer will continue to bear the costs of one's research.

The Advancement of Science

Historically, science has advanced when individuals have exercised their minds in freedom, whether in personal, university, or industrial labs. Copernicus and Galileo, for instance, were opposed by the government and the state church for advocating their scientific theories. They had to be supremely confident in the validity of their ideas to withstand such intellectual assault. Would they have been more or less likely to comply with the authorities if their livelihood depended upon the same authorities? Perhaps their integrity would have won out in the end (we cannot know for certain), but surely the decision would have been made more difficult if their funding was on the line.

The industrial revolution was easily one of the greatest periods of economic growth the world has ever known. The United States obviously benefitted greatly because of its relatively free market at the time. Yet, the United States government funded very little public science, and in fact numerous basic science and applied science innovations occurred devoid of state interference throughout the world. If the public-science advocate is correct, then how could the industrial revolution have taken place?

Another interesting counter-example to the necessity of government sponsored science is this author's personal research area – polymer science. In the early years of the field, it took some time for scientists to be convinced that "macro-molecules" could truly exist. The overwhelming majority of early research in polymer science was conducted by chemical companies such as Dow and DuPont. Without the tenacity of industry researchers such as Wallace Carothers and private university researchers like Hermann Mark, polymer science could not have moved forward. Even now, despite the large amounts of money dedicated by the government toward polymer research, the innovations arguably making the greatest difference to people today are coming from investments in the private sector.

Science guided by the state would likely miss such opportunities as described above. Instead, state science will tend toward affirming the status quo in order to keep their funding sources. Furthermore, the inclination of the state will be to fund those people who will, in turn, support the state back. Again, an example of such action is the global warming alarmists who advocate massive government intervention in the marketplace to "solve the problem."

If the public-science position is correct, then it is difficult to envision why any scientific research ever occurred before the government became involved. An even more difficult question for the public-science advocate is why private enterprise continues to fund research when public funding *is available*. Butos and McQuade note in their work that industry in recent years keeps investing in research at a growth rate that appears consistent with past data, while government funding of research has increased at disproportionate levels (See Figure 1).

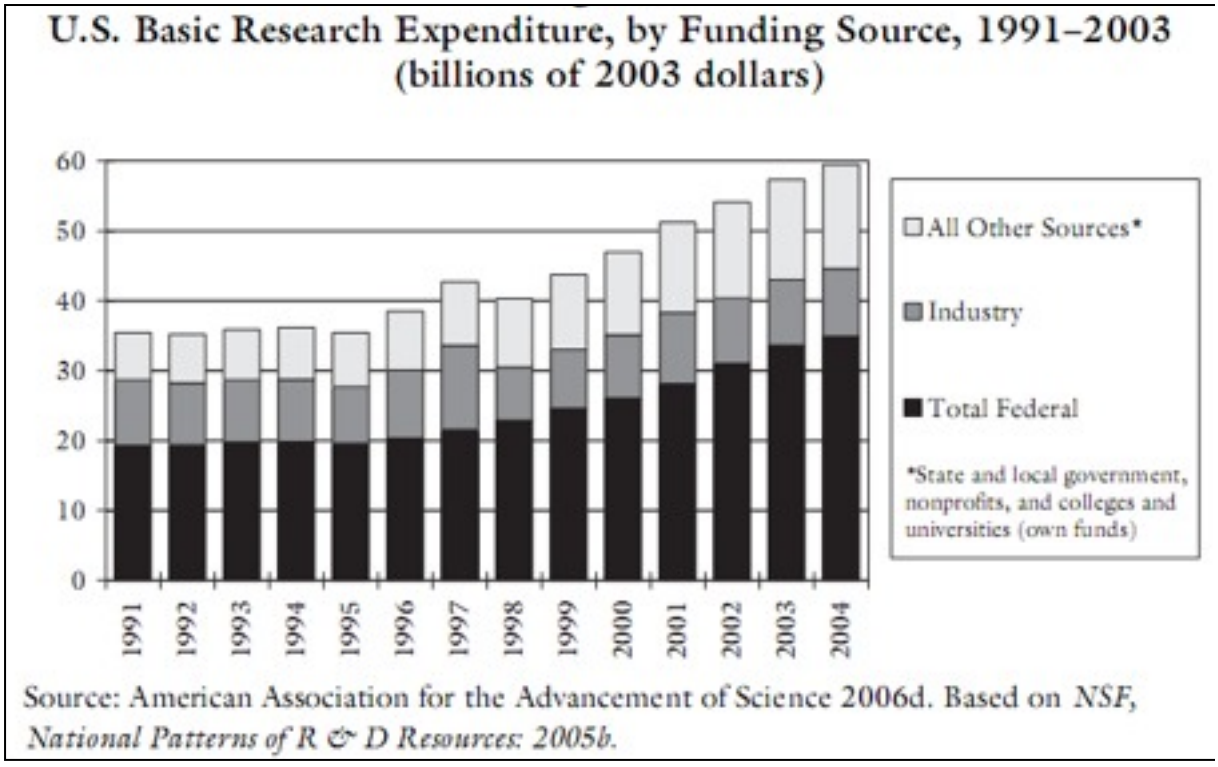

Figure 1: Basic Research Expenditures, from Butos & McQuade (2006)

If public science were a central key to prosperity in the way that the government argues, then one could expect a corresponding swell of wealth through these "public investments" in research. Yet, there appears to be no correlation whatsoever between funding for publicly funded-research and GDP, even on a delayed time-scale (where growth in GDP would be seen further in the future). This casts further doubt on the notion that the government is necessary to support the critical scientific research that *does* make the difference in the modern economy.

A Free Market Model for Science Funding

A sufficient model for how scientific research progresses in a completely free market economy must take into account both industrial research and academic research. Industry shall be considered first for two reasons: (1) it is a simpler system to understand, and (2) the expectation is that industry will be one of the primary funding options for academic research.

Scientific research in industry is conducted, first and foremost, with the goal of expanding or enhancing production in some way. Research is a means of creating more "roundabout" production methods, that is, increasing production by extending the production process. For example, catalyst research might be conducted by a chemical company so that a product might be produced more efficiently and thereby increasing their profits. Being the "first mover" in research also has the added benefit of netting the first re-investable profits into the firm. With ever more roundabout production being demanded over time, the inevitable outcome is that basic research *must* become a priority to any science-based company. All production that is science-based must come from sound theory, and thus one must expect that industry will invest in theoretical research at multiple points along the structure of production. Unquestionably, the free market *will* demand research, including basic research, over time.

Scientific knowledge gained through industrial research can be kept completely internal to a company as "trade secrets." Certainly this can work to their advantage in many instances. However, other incentives exist that would motivate companies to be more open in publishing new results. First, just as a company's public image is enhanced when a company makes a contribution to a charitable organization, so it will be when it makes a contribution to the scientific community. This attracts good will of consumers, but more importantly it attracts the good will of other scientists. If a firm is seen as being on the "cutting edge" of scientific research, then they will be more likely to attract the top talent that can further expand their business. Second, being open with good research does not, by definition, mean that a firm loses business opportunities that they would have had otherwise. Adequate proof that the research works can, in fact, open up new business opportunities. Expertise in *implementing* the research is an economic asset. No company can have a competitive advantage in all forms of implementation at one time. Consultancy happens quite frequently in the management sectors of firms, and a likely consequence of research openness would be consultancy in implementing science and engineering solutions. While reverse engineering is always a possibility for a competitor, marketing the research in a more open manner could even eliminate the perceived advantage of intellectual property itself. Openness does confer multiple economic benefits without losing the "first mover" incentive.

In recent years, the consortium model of different companies pooling resources for shared research has been making great strides. An interesting example of this progression is Sematech, which ironically is in the incredibly competitive industry of microelectronics. Sematech is a non-profit organization that conducts basic research in semiconductor technology. Consortia members include such companies as AMD, Freescale, IBM, Intel, NEC, Samsung, and Texas Instruments. Quoting Sematech's website:

Semiconductor and emerging technology research is both high cost and high risk. Our membership represents about half of the world's semiconductor production… Because we all face many of the same constraints and long-term concerns, we work together to leverage resources and keep the industry vital and growing ever stronger.

Granted, the Federal Government also funds the Sematech effort to a small extent, but the fact that this is being pursued by such large and competitive companies indicates that joint ventures in research are not only feasible, but also are already taking place.

Can scientific research in academia survive in a truly free market just as it appears now? No, but certainly there are many options for how academic research will proceed once the government is out of the picture. Funding in academia could be obtained from a number of different sources, including personal funding, wealthy individuals, university endowments, business donations, and contracted projects with profits retained by researchers. The first three list items are relatively simple to understand. Scientists can always use their own assets to further their research. Wealthy businessmen or heirs have historically been supporters of scientific research. Many continue to do so, and one would expect that these individuals left untaxed would support science even more. University endowments (and department endowments) clearly would be a significant funding source for research.

When considering businesses, though, the question arises – what exactly are the incentives for businesses to support research in academia? Have we not already admitted that there exist great incentives for industry to conduct their own research programs? But in the same way that joint ventures can confer economic advantages, so also can supporting academic research confer benefits in a variety of ways. Charitable donations to research institutions elicit a positive public image, and in some cases can be a substitute for direct advertising. Government could potentially act in a positive way by providing tax breaks for companies (and even individuals) supporting scientific research in educational institutions. The way the current regime works is that companies are taxed to provide inefficient funding for research they did not choose, but tax breaks would encourage a company to seek out useful research to support. Admittedly, zero-tax would be better on all levels, but in a taxed economy a tax break provides added incentive to contribute.

More important are the incentives of contracted research. Businesses could invest in projects of specific interest that they might not wish to do themselves. Perhaps a project requires experience, expertise, or labor that would cost them more to do themselves than they prefer. However, this research could potentially be of educational value for certain groups who are willing to do it at a reduced cost to gain experience. Enter the university research group. Professors often have scientific expertise unavailable to companies, and they employ graduate students who are eager to gain experience and earn a degree.

Businesses could contract with these professors, providing them with the funding to solve a particular problem. The professor, as a completely free agent in the market, can negotiate the terms of the contract regarding ownership of the results and commission upon completion of the research. Those who are most successful at accomplishing the research objectives specified in their contracts would be able to command the best premium for their services, thereby supporting their research of purely personal interest. Thus, the institutional arrangement of firms, educators, and students enhances the division of labor for the benefit of scientific knowledge, student education, and business production.

One might object to this analysis thus far: If industry becomes this heavily involved in academic research, will they not simply take control of all of it? Not in the least. All of these arrangements are voluntary in nature. Scientists are in control of what projects they accept and reject, and businesses are not forced to fund research blindly through taxation. Scientists must play by the rules as well; they do not have the *right* to free resources to do whatever they want. All mankind is limited by scarcity. The privilege of being funded to do what is personally interesting to them is earned by providing value to others in some way – whether that may be results from contracted research or the satisfaction of a donor. As mentioned previously, funding is not required to come from industry. If the government is taken out of the picture, there can be no crowding out of research funds from government confiscation of wealth, so wealthy individuals wanting to fund science can do so more effectively.

In summary, consider the following situation in absence of government intervention: Suppose I am an academic researcher in the sciences. I can teach to attract graduate students, who essentially act as "employees" in my research program. I want to continue in my work and to gain prestige in the scientific community; therefore I will act in ways that help these students produce the best research they can. I can take contracts from companies to do specific projects in my field of expertise, or even beyond. I can negotiate these contracts so that the students and myself are sufficiently rewarded for our efforts. Part of the contract could include additional payments – "profits" – that would go into our general research funds for personally motivated projects. Companies can also donate to my general research fund, motivated by four factors: enhancing their public image, obtaining tax breaks, progressing scientific knowledge that may benefit their business in the future, and educating students so they are adequately prepared for work in industry. Ultimately, *I control the research program, not the government*. All actions in this context are completely voluntary, and I am able to procure the funds that I desire to do personally motivated research by providing value to others in some way, whether through psychic benefit from acting charitably or through freely trading skills and expertise. Science is advanced, and no one is coerced in the process.

Conclusion

Publicly-funded scientific research is socialistic in nature and exhibits all the inherent problems that socialism entails as well as many more problems specific to scientific research. Therefore, government should cease intervening in scientific research with public funding. The free market is fully capable of supporting research in all parts of the structure of production, including research at the university. Finally, a model has been proposed for

how scientific research will potentially proceed in industry and in academia on the free market.

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