AMERICANS for ENERGY LEADERSHIP

Grounding Our Innovation Policy Debate

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As Congress begins to debate whether the DOE deserves a funding increase to support innovation initiatives, a look at its record over the last two years will become a key point of contention. Organizations such as ARPA-E and the Energy Frontier Research Centers (EFRCs) will come under particular scrutiny with regard to their cost and effectiveness.

Programs of any nature, whether public or private, will always have a mixed record of successes and failures. It is equally inevitable that proponents and opponents of a given program will focus on certain elements of that program in order to make the strongest possible case for their position. This disagreement can be healthy when it helps policy makers to get a complete and revealing assessment of that program. Once each argument is made in full, a productive debate can begin and the most effective policy can be crafted. However, the increasing polarization between proponents and opponents of government financial support for innovation is, at times, preventing this healthy debate from occurring.

Take the recent debate hosted by Information Technology and Innovation Foundation (ITIF) and Breakthrough Institute (BTI), “To Cut or Invest”. Fred Block of BTI and Robert Atkinson of the ITIF, representing the innovation hawks, held a firm line that government intervention is necessary due to market failures. David Kreutzer of the Heritage Foundation and Jerry Taylor of the Cato Institute supported spending cuts for government investment programs, maintaining that government funded programs were inefficient, tolerant of bad ideas, and prone to bloated budgets and ‘pork’ projects. While Taylor didn’t mention this in the debate, his colleagues at Cato Institute maintain that government funding has a negligible or negative effect on innovation separate from the federal tax dollars wasted. This idea focuses on the adverse effects of driving out private investment and on forcing a non-ideal technology to dominate a market.

While both sides were in agreement that certain regulatory and tax reforms, such as an R&D tax credit, would encourage beneficial research in the private sector, they disagreed on almost every other point. This impasse has become commonplace in the larger debate, as innovation hawks call for massive direct government support for innovation while budget hawks refuse to acknowledge that government intervention has ever had a positive impact on the economy.

A significantly more nuanced debate than ‘cut or invest’ is necessary to arrive at the best policies for stimulating innovation. Certain government interventions have been more successful than others. Government determination and funding was essential in creating the Internet, and there are clear instances of government intervention overcoming market failures such as when AT&T refused to build the initial infrastructure to demonstrate the internet technology – the task was instead taken on by the state-run British Post Office.

On the other hand, the government’s attempt to push synfuels likely involved too much government direction and became an expensive project which

failed to address its intended goal of oil-independence. However, innovation hawks deem the synfuel project a moderate success while budget hawks consider the discovery of the internet to be a lucky accident or an example of private industry salvaging an otherwise useless government research initiative.

This total lack of agreement prevents an intelligent discussion on the merits of each program. There are some basic facts not subject to interpretation. At the end of the day, the Internet was developed and viable synfuels were not. It is time for a more nuanced discussion of what worked and what didn't in each of these programs so that we might learn from past experiences. As Congress debates funding for innovation projects, it should benefit from an historical narrative grounded in reality rather than interpreted to support a party line.

A full and balanced evaluation of the U.S. government's research efforts is a massive undertaking, and it may be impossible to determine with certainty the effects of each element that contributed to success or failure. It is this ambiguity which allows such disparate interpretations to coexist. But in order to develop intelligent policy for future research initiatives, it is imperative that we better understand what policy elements worked and in what specific situations.

Sematech: A Case Study

Consider the case of Sematech. Sematech was a government-industry partnership founded in the late 1980s to help the U.S. microchip industry regain its dominance in response to a massive threat from low-cost, efficient Japanese manufacturers. It is a particularly interesting case because both camps claim it as a clear example in favor of their position. It was largely successful, and it utilized a combination of the policy elements championed by innovation hawks and deficit hawks. Rather than debate which recommendations were more important to Sematech's success, this article will look at the situational factors that made these policies effective in this case.

First some of the facts. By the early 1980s, American companies held a dominant position in the microchip industry. During this decade, the Japanese and American industries pursued very different strategies for growth, and in 1985 the U.S. industry experienced a precipitous decline in market share as cheaper Japanese chips began to dominate the market. By 1987, Sandy Kane, an IBM executive, began preparing what he called an "obituary" [14] for the U.S. semiconductor industry, detailing how such a powerful industry was completely wiped out over the course of a decade.

The military feared that, as the microchips necessary to wage modern warfare started to come from overseas, America's national security would be at risk. Industry experts predicted that the microchip industry would only continue to grow, and furthermore that control of another industry, the computing industry, was dependent on domestic dominance in microchips.

However, despite this gloomy picture, by 1994 U.S. chip makers were once again ahead in global market share, with bright prospects for the future. Furthermore, Sematech, the organization tasked with creating this change, announced in 1994 that it no longer needed government investment, and would become fully supported by its private member companies.

This was an undeniably a success for the United States, but what caused it?

The first important issue is the loosening of regulatory restrictions that allowed U.S. firms to work together without violating anti-trust laws. The 1984 National Cooperative Research Act already allowed cooperation on matters of pure R&D, but did not allow for cooperation on improving manufacturing processes. Sematech allowed these restraints to be relaxed, so that private firms could more easily cooperate on so called 'pre-competitive' R&D for manufacturing processes.

While such restrictions were put in place to avoid anticompetitive practices by industrial cartels, such deregulation made sense in this case. Manufacturing increasingly small and complex microchips requires incredibly sophisticated materials and tools. The development costs for this equipment is prohibitively expensive for individual companies, particularly for the small firms that specialized in equipment manufacturing. Japan circumvented this problem by 'vertically integrating' equipment suppliers, chip manufacturers and the government in order to pool resources to conduct the necessary research. The result was a sophisticated manufacturing process in Japan that produced higher quality chips more cheaply than in America.

Until the regulations were loosened for the Sematech consortium, American companies were prohibited by law from engaging in the kind of coordination needed to develop these processes. It is important to note that this absolutely critical step in regaining American competitiveness did not in itself require funding from the U.S. government. This was a case of the government needing to get out of the way of industry and by deregulating the chip manufacturers the government was able to reap major economic gains at little cost.

Deregulation is not without risks, however, and the government took important steps to ensure that relaxing anti-trust rules didn't negatively impact competition. The government understood how important improved manufacturing processes were for American microchip firms. Therefore, they demanded that Sematech quickly make available their discoveries to smaller chip firms through licensing agreements. That way, the small, entrepreneurial firms that couldn't afford the annual dues of Sematech could continue to compete. This kind of selective deregulation was a deft policy move that ensured maximum economic benefit while protecting competitiveness within the industry.

The second major contribution of the Sematech initiative was the role of government in coordinating the member organizations and helping to direct the research. A conservative criticism of government involvement in private research is that the government doesn't know as well as private firms what research should be undertaken. By 'picking winners,' the government does not force technologies to prove themselves in the marketplace and might waste money on research initiatives that finally fail.

However, several aspects of the microchip industry made government involvement preferable. First, rather than picking a specific technological solution, the government merely outlined a broad objective – to improve American manufacturing processes. This macro level direction focused the research on issues that the government deemed critical while allowing the freedom for private industry to determine the best technological solutions. Furthermore, Japan was already benefitting from such a research initiative, so the government was assured it would be worthwhile and private industry had signaled their approval of the research objective by donating half of the $200 million in funding for the project.

Also, as previously stated, the unique technological challenge of improving manufacturing processes required encouraging cooperation not spurring competition. Coordinating both competing microchip manufacturers and their equipment suppliers was a vast and daunting task. Companies within the microchip industry had relied on maintaining a technological edge over one's competitors, and therefore each company was reluctant to risk revealing any of their proprietary information. The relationship between chip manufacturers and their suppliers was equally strained. In this hostile environment,

the government was able to play an important coordinating and policing role. It both demanded cooperation between these organizations and created financial incentives to do so. The government's role in creating the necessary trust between organizations cannot be overstated.

Finally, there is the issue of the Department of Defense's $100 million annual contribution to Sematech. Even if one were to accept that Sematech was beneficial to the U.S. chip industry, and that government involvement was necessary to making it succeed, many of its organizational achievements did not inherently demand a government investment to the tune of $100 million. If the R&D was so essential to the survival of the industry, why didn't the industry fund it itself?

The answer, innovation hawks would contend, is that many of the benefits of Sematech were externalities and would not be realized by the companies making the investment. First of all, the national security implications of relying on foreign microchips were not relevant to the chip companies, but were of major importance to the government and the American people. Secondly, the economic implications for support industries and the personal computing industry would not impact the bottom line of chip manufacturers (except for firms like IBM that also produced computers), but it would represent a major hit to the wider American economy.

Private firms were expected to contribute because they stood to gain from the innovation. But because the federal government had so much to gain as well, it makes sense that they also contribute.

On a practical note, the specific nature of this technological challenge favored the use of a direct cash investment rather than an R&D tax credit. First of all, a direct cash investment gives government more control over the research initiative. While this might not always be desirable, for reasons previously mentioned it made sense in this case. A cash investment allowed the government to direct research toward an established technological challenge (manufacturing processes). It also gave the government the ability to set ground rules for the consortium, which actually allowed them to be more fair than an R&D tax credit. Not only did this help companies to build trust in one another, but it allowed the government to protect small, entrepreneurial firms that didn't have the resources to participate in manufacturing research. A purely private consortium (benefitting from R&D tax credits) would have kept manufacturing advancements to themselves to maximize profits, which would have spelled the demise of small chip firms. But because it controlled a large part of the funding, the government was able to ensure that such firms could remain competitive.

Finally, the nature of this problem required a single, focused research effort rather than small, independent initiatives. By directly funding such an initiative, the federal government was able to focus industry efforts whereas an R&D credit could have been used by firms to work on small, independent projects that would not have solved this challenge.

Conclusion

It is important to note that the technological challenge facing the microchip industry in the late 1980s was unique from any research initiative undertaken before or since. I have attempted to outline some of the reasons why above. Therefore, the policy solution that launched Sematech might not be a good model for the renewable energy innovation challenges of today. However, by understanding why various parts of this policy initiative were successful, policy makers can have a basis for debating and designing future policy.

For instance, one might discover that solar photovoltaic companies are still in an early stage of scientific R&D, much like the microchip industry in the 1970s. If this is the case, ensuring that entrepreneurial companies are allowed to compete through R&D tax credits might be the best way to proceed. However, if various solar manufacturers all suffer from a lack of precompetitive technology, such as immature manufacturing processes or the high price of producing silicon wafers, then an investment that cheapens the inputs for all solar PV manufacturers might be desirable. Either way, until both historical and current technological challenges are broken down into their situational factors and policy components, any attempt to develop effective policy will be clumsy and uninformed.

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Tucker Willsie is a Contributor in AEL's New Energy Leaders Project and his work will be regularly featured on the website. The views expressed are those of the author and do not necessarily reflect the position of AEL.

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