Declining SBIR/STTR Phase I awards at the 5 Major SBIR Agencies:

The Impact of Business Cycles, Budgets, and Agency Commercialization Strategies

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Declining SBIR/STTR awards

APPLICATION PATTERNS IN THE CONTEXT OF THE US ECONOMY

This paper assesses a number of hypotheses that could explain observed patterns in Phase I applications at the five major SBIR/STTR agencies. The basic patterns and problem are outlined in charts 1 and 2 below, which show patterns of Phase I applications and the distribution of the decline in Phase I applications across the five major agencies.
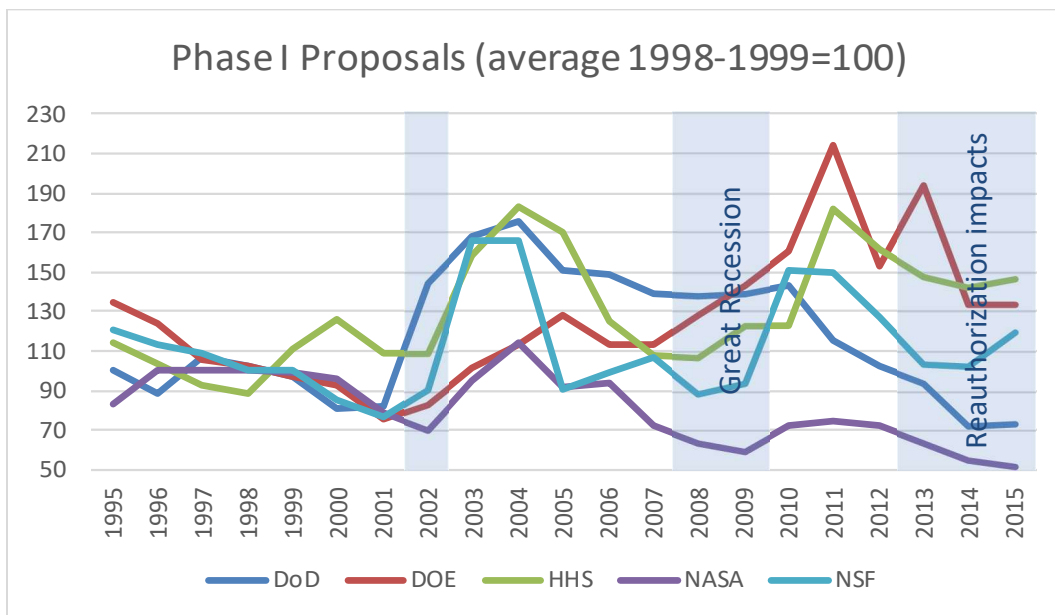
Source: SBA Annual Reports (all charts in this report are sourced from SBA annual reports data unless otherwise specified.

Note: DOE data 2011-2013 are biased upwards by the inclusion of ARRA funding in totals reported to SBA.

The period up to the end of the Great Recession shows proposal patterns at the 5 major SBIR agencies moving broadly in alignment.[1] Dates below do not always describe each agency: they identify broad patterns

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[1] This assessment focuses on the five agencies that provide more than 97% of program funding: DoD, HHS, DOE, NASA, NSF

- 1995-2001. Applications decline slowly as the economy improves after the dot-com bust in 2001.
- 2001-2005. Applications grow very sharply during and immediately after the 2001 recession. Application numbers for NASA and DOE grow more slowly than for the others
- 2004. Application numbers peak for DoD, HHS, and NSF
- 2005-2008. Once again applications decline as the economy improves. DoD decline is sharper and more prolonged.
- 2009-2011. Applications are up sharply as other sources of funding dry up during the Great Recession. Applications at DoD and NASA recover less than elsewhere.
- 2011-2014. Applications fall as the economy improves.
- 2014-2015. The decline in applications stops, and modest improvement begins except at NASA.

The linkage between the business cycle and total P1 applications is illustrated in chart 2. It shows that the relationship between overall P1 applications at the major agencies and the US growth rate is modestly positive. The Pearson correlation fits best when using a 2-year lag between growth rates and awards (i.e. award patterns follow growth with a 2-year lag, but the overall effect is a modest negative correlation at -0.47. Overall, awards tend to fall (after a lag) as economic growth increases.

Chart 2. Phase I applications (5 major agencies) and US growth rate, 1994-2015
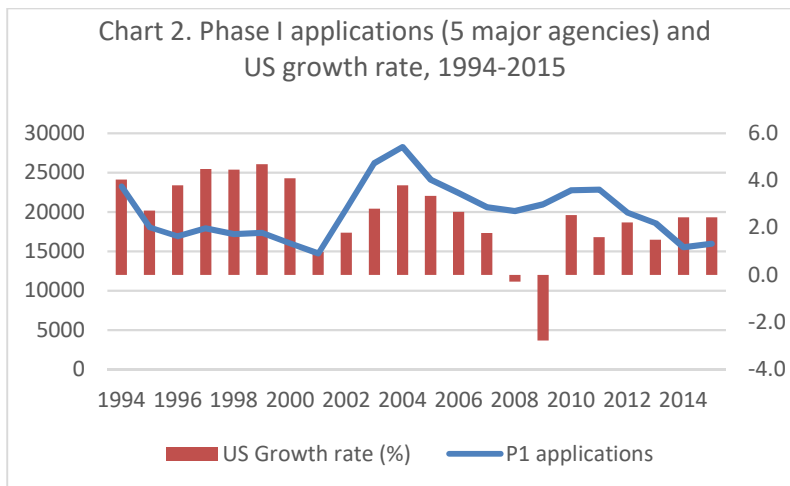
There are however important differences between the agencies. Table 1 below shows that the 2-year lag effect is strongly negative at HHS, DOE and NASA, but weakly negative at DoD and weakly positive at NASA. So if the business cycle largely explains shifts in application patterns at the three granting agencies, it does not provide a very good explanation for observed patterns at DoD and NASA. These differences are important.

Table 1. Pearson values for correlation between number of Phase I applications and US annual growth rate, 1994-2015, by major SBIR agency

	DoD	DOE	HHS	NASA	NSF	Big 5 agencies
0 lag	-0.13	-0.13	-0.07	0.72	0.23	-0.03
1 year lag	-0.34	-0.40	-0.13	0.53	-0.35	-0.32
2 year lag	-0.24	-0.80	-0.61	0.31	-0.70	-0.47
3 year lag	0.01	-0.66	-0.65	0.17	-0.45	-0.27

Source: SBA applications data; World Bank growth data

This analysis suggests that the decline in applications at DoD and NASA is the core of the problem – in fact, that it is the entirety of the problem. On average, firms submitted an average of just over 20,000 Phase I applications to the Big 5 agencies every year from 1991-2015. In 2014, there were 15,510 and in 2015 there were 15,983. So as of 2015, applications were running at about 4,000 or 20% below average, and 43% below peak (in 2004).

Chart 3 below shows that DoD and NASA account for more than 100% of the gap between the average number of applications 1994-2015 and the number received in 2015. Indeed, HHS, NSF, and DOE all show a modest increase in the number of Phase I applications above their historic average, most likely because the program in 2015 is larger than it was on average during the preceding period.

Chart 3. Number of applications at 5 major SBIR agencies: average for 1994-2015, and 2015
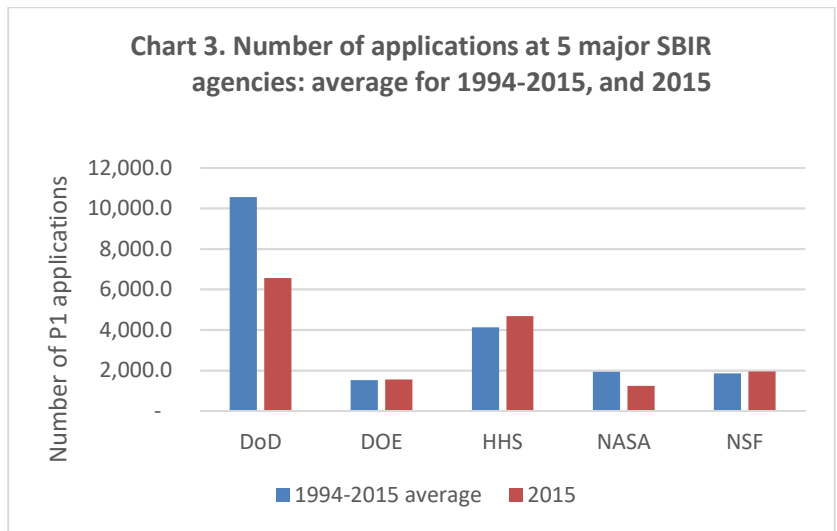
The observed decline in Phase I applications is therefore entirely explained by decline in applications at DoD and NASA. Patterns at the other three agencies – HHS, DOE, and NSF – are best explained by the lagged impact of the business cycle, which is strongly and negatively correlated with award patterns. As business conditions decline, alternative sources of funding for small businesses shrink, including investments and both research contracts (on which many small innovative businesses depend) and markets for their products. Conversely, as business conditions improve, the relative attractiveness of non-SBIR funding expands, and applications decline.

APPLICATIONS PATTERNS AT DOD AND NASA.

So why do applications at DoD and NASA not follow the lagged business cycle, and why have applications fallen so far and it seems permanently? Chart 4 shows that patterns at both DoD and NASA largely followed the US business cycle until the mid-2000's. There was a steady decline in applications after the 1991 recession, and then a sharp increase after the 2001 recession the decline at DoD and NASA. The increase at both agencies was higher than average and led to peak awards for both agencies around 2004.

DoD and NASA patterns continued to follow the business cycle until the Great Recession, with applications falling from their 2004 peak. But starting around 2007, the DoD/NASA pattern diverged sharply from HHS/DOE/NSF. While the latter continued to follow the business cycle and ticked up sharply during the Great Recession, DoD applications remained flat, while NASA's continued to fall until 2010.

From then on DoD and NASA applications fell sharply and consistently. There has been no recovery, and the trend is clearly downward. Overall, DoD Phase I SBIR applications are down 56% since their peak in 2004, and down 49% since 2010.

Chart 4
P1 applications at DoD and NASA 1994-2015
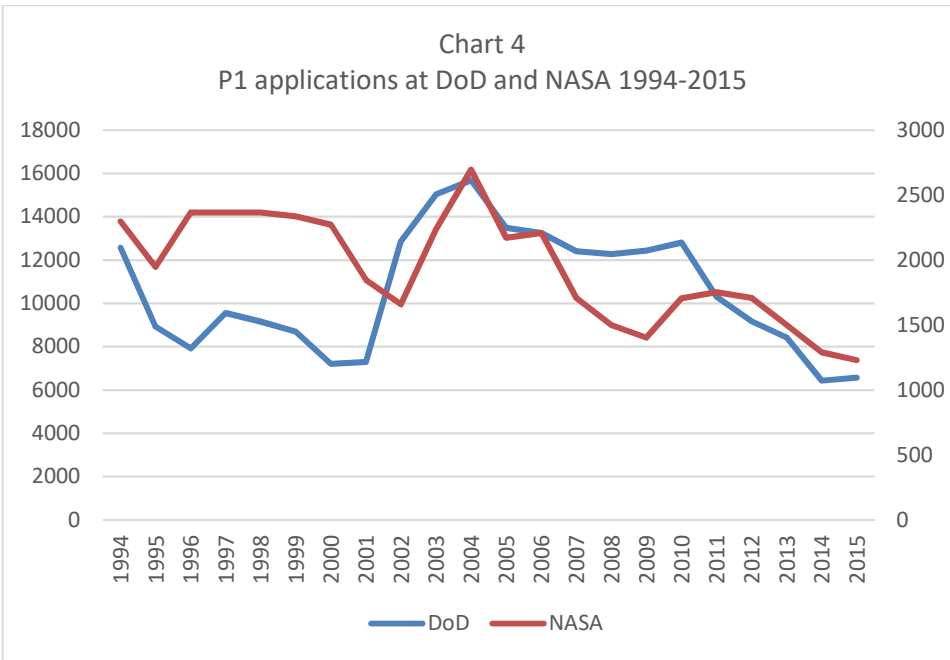
So what explains the change in DoD and NASA patterns starting with the Great Recession and intensifying after 2010? A number of hypotheses might be advanced:

- Declining funding for SBIR in general
- Relative decline in Phase I funding share (funding shift to P2 and P2.5)
- Declining number of topics
- Declining success rates, which makes the program unattractive
- Cancellation of major research-intensive programs
- Difficulties with auditors/DCMA. Making SBIR less attractive
- Possible impact of applying CCR scores to applications, screening out commercially unsuccessful companies
- Exclusion of previous major participant companies (over 500 employees, or acquired by larger company)
- Sector shifts in small company activity

DOD AND NASA: APPLICATIONS AND AWARDS

Using Occam's Razor, the simplest explanation for the decline in applications is that the number of topics and awards declined in tandem. And there is indeed a close correlation between the number of P1 awards made and the number of P1 applications: the number of applications per award doesn't vary all that much, although as we will see, that ratio declined somewhat after

2010. Chart 5 shows the relationship between applications and awards: the Pearson rho is 0.80, showing a high degree of correlation.

Chart 5. DOD P1 applications and awards 1994-2015
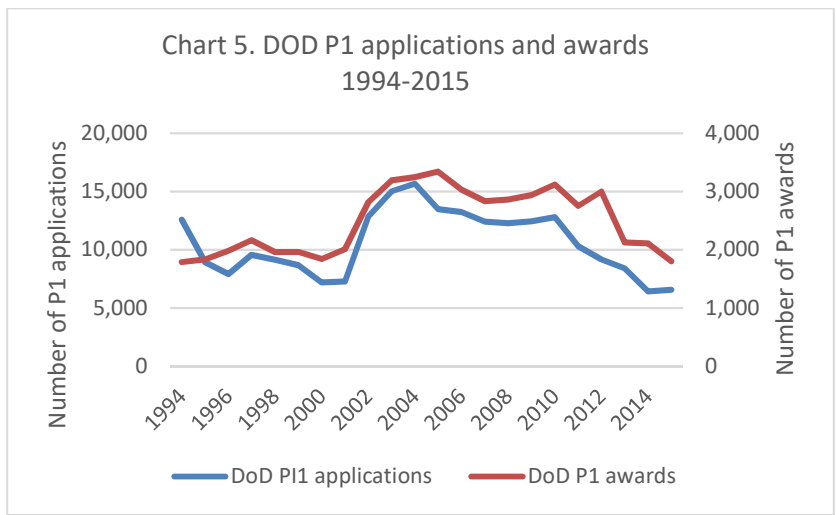
So the primary reason for the decline in DoD awards after 2010 is that there were fewer Phase I awards to compete for, as shown in chart 5.

FUNDING FOR PHASE I: EXPLAINING THE DECLINING NUMBER OF PHASE I AWARDS

The number of Phase I awards is a function of three components: the overall amount of funding provided to the SBIR program; the share of funding allocated to Phase I; and the size of Phase I awards.

SBIR PROGRAM FUNDING AT DOD AND NASA: DEMAND SIDE DRIVERS

Total funding at DoD for the SBIR program declined sharply after 2010, from $1.24 billion to $0.93 billion in 2015 (see chart 7).[2] This is a decline of 25% in available funding. Given the very close correlation between the number of awards made and the number of applications received, a decline in funding that reduced the number of awards will also have the effect of reducing the number of applications.

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[2] Funding and awards data is drawn from SBA annual reports and other data provided by SBA

Chart 7 SBIR total obligations ($000s) 1994-2015
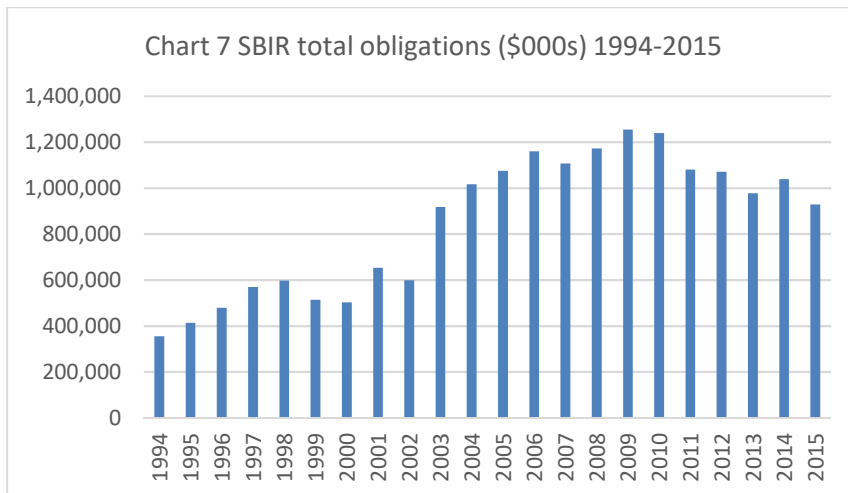
In fact, the data show that DoD has made an effort to protect Phase I funding from the decline in overall program resources. Chart 8 shows the percentage of program funding devoted to Phase I. It shows that in 2011-2015, the Phase I share of the program averages 17.4% - up from its 14.6% share in the preceding 5 years, although the decline since 2012 is also apparent.

**Chart 8 Phase 1 share of total SBIR obligations (%) 2006-2015**
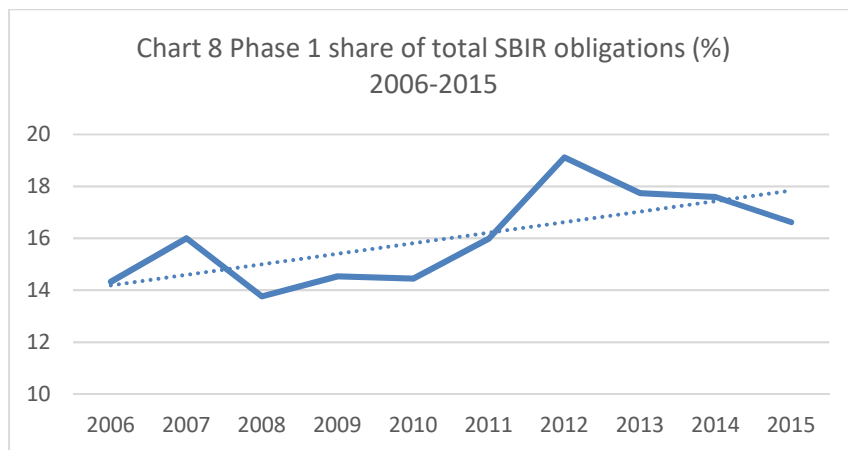
So despite the various initiatives focused on Phase II that aimed to improve commercialization (e.g. Phase 2.5), the data clearly show that Phase I funding has not been shortchanged. Total funding is down, but the share spent on Phase I is up since 2006.

The third variable driving award numbers is changes in the size of awards. Chart 9 illustrates the average size of Phase I awards, and demonstrates the impact of the increased award size that followed the 2011 reauthorization. While funding varies at different DoD components, the DOD-wide average is very consistent. Between 1987 and 2011, Phase I awards were consistently within a few thousand dollars of the average, $87,000. But that changed in 2012,

and from 2012-2015 the average award size jumped $20,000 to $118,000 (rounded) - an increase of 34%. So if funding had remained steady, this single change would all other things being equal have resulted in far fewer awards. Had DoD retained its previous award level of $87,000, it would have made 1,878 P1 awards annually on average during 2012-2015. With the higher award sizes, DoD actually made an average of 1,395 during that period – a drop of 26%. That is the direct impact of larger award sizes.

**Chart 9 DoD Phase I average size of award 1994-2015**
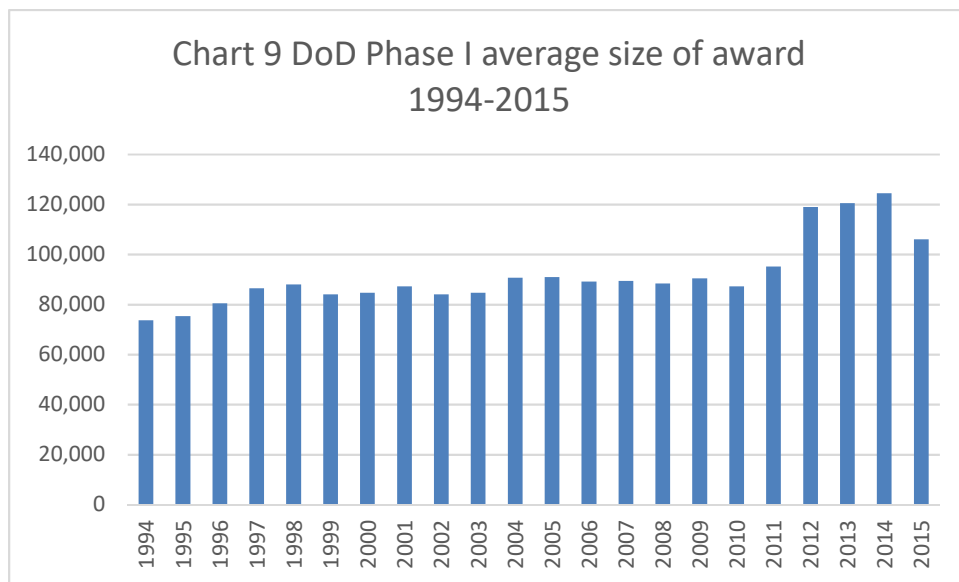
The overall DOD story with regard to proposals is therefore now fairly clear

- SBIR funding has fallen substantially at DoD: overall funding is down 25% from the 2010 peak. Without any other program changes, this would normally result in a decline in Phase I awards of about 25% also.
- DoD has to some extent tried to project Phase I, so its share of overall program funding is up slightly, which ahs the effect of increasing the number of awards.
- These protections were completely overwhelmed by the second major change in funding patterns: the increase in the average size of award driven by changes made in the 2011 reauthorization. This itself has resulted in a decline in the number awards of about 25%.

Changes in funding and award size are a very large part of the story. But they are not all of it.

CHANGES IN COMPANY INTEREST IN THE PROGRAM

One way to quantify company interest in the program is to look at the number of applications per award (we could also look at company applications per subtopic published in the solicitation, but this data is less readily available especially for periods before 2008). Application patterns did in fact shift somewhat: the number of Phase I applications per awards dropped after 2010, as Chart 10 shows.

Chart 10 Number of DOD applications per Phase I SBIR award, 1994-2015
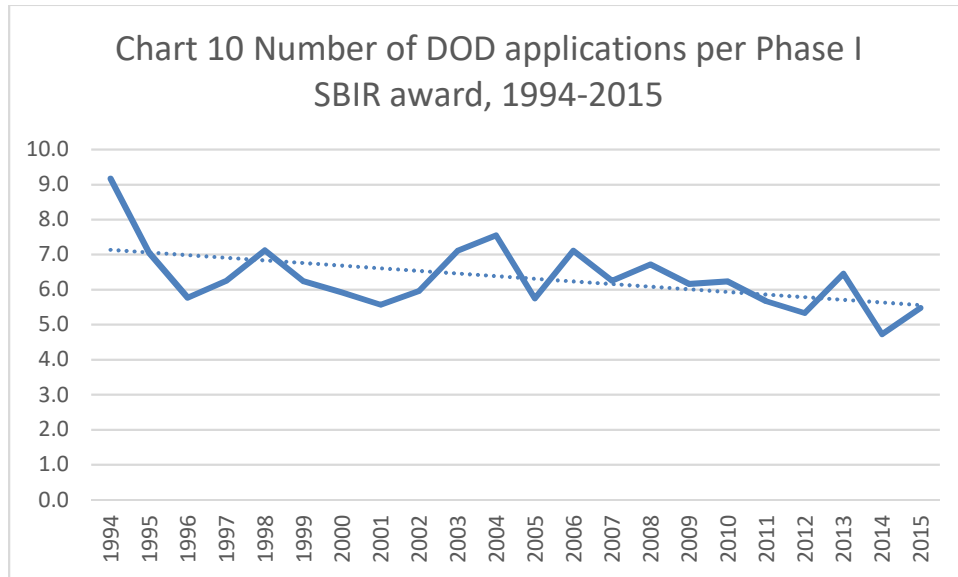
The average number of applications per Phase 1 award was 5.5 during 2011-2015, down from an average of 6.5 in the previous 11 years. 2014 marked the low water mark: 4.7 applications per award is the lowest figure by almost half an application. Based on these numbers, the decline in applications per award accounts for 15% of the overall decline in applications since 2010.

One possible explanation is that topics have become more specific (i.e. narrower) and hence are attracting fewer applications. This may be true but there is no systemic evidence for or against this argument.

Another possibility is that SBIR has become more bureaucratic and application has become both less attractive and more technically difficult to complete. David Green of PSI recently noted that applications now required far more work than they used to. And a number of SBIR participants told the National Academies that they were seeking to reduce or eliminate their participation in DoD SBIR because the auditing process was so onerous. However, changes in the application process to not in themselves seem to offer much explanatory power, as similar shifts have been observed in all the major SBIR agencies as they converted from paper-based to electronic submission. And applications have not overall declined (beyond business cycle

volatility) at the three granting agencies. So a more challenging application process offers little in the way of explaining application patterns.

Other possible explanations include:

- **Companies leaving the program**. Companies with a strong track record of applying for a winning SBIR awards may have left the program. for example, Foster-Miller was acquired and hence no applies for funding. Other companies have become so successful that they no longer fit under the 500-employee cap for SBIR companies. Given the large number of applications made by these bigger firms, their absence is likely to have reduced overall application numbers.
- **Fewer startups.** The number of US startups has been falling since 1978, and in 2015 Americans started fewer businesses than they did in 2013.[3] Estimates also suggest that the numbers of high tech startups, companies that might apply for SBIR funding, have also declined.[4] However, unless we can find evidence that there are especially fewer startups in defense and aerospace, the lack of decline at other agencies suggests that this is not a good explanation for declining application numbers.
- **Focus on non-SBIR technologies.** Companies may be increasingly focused on technologies that are not funded by SBIR, or have product cycles that are too short for SBIR funding (e.g. most digital technologies where product cycles are often measured in months). Detailed data are not available to test this argument, and again this seems unlikely to be DOD specific.
- **Successful emphasis on commercialization.** In discussions with prolific SBIR companies (notably Creare and Physical Sciences), companies have claimed that the are changing their internal review for SBIR applications, focusing only on those that are more likely to be commercially successful. This is a direct result of SBIR program efforts to enhance commercialization, but may have the side effect of reducing the number of applications from companies that were in the past prolific applicants. Creare averaged 19 P1 SBIR awards in 1997-2008; since then it has averaged 5.5 Assuming a success rate of 15%,

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[3] Hathaway, Ian, and Robert Litan. "The Other Aging of America: The Increasing Dominance of Older Firms." *Brookings Institution* (2014).

[4] Haltiwanger, John and Hathaway, Ian and Miranda, Javier, Declining Business Dynamism in the U.S. High-Technology Sector (February 2014). Available at SSRN: https://ssrn.com/abstract=2397310 or http://dx.doi.org/10.2139/ssrn.2397310

this suggests that Creare alone accounts for a decline of about 85 applications per year (across all agencies). But this is still a small part of the overall decline.

The fact is that DoD accounts for more than three quarters of the total decline, so needs to be a major focus. Its pattern is also unique – a steady downward trend across 2004-2014. Need to develop a careful timeline of potentially important activities at DoD e.g. funding shifts within the program, number of topics. Also need to break out DoD into major components: we don't know from the data so far whether there are significant differences between the components. Do we have component level data for applications?

    a. NSF

          i. Tight limits on number of applications per company and PI

NSF P1 applications took a sharp downward turn in 2011. Is that when limits on applications per PI and company were tightened?

    b. DOE

          i. Main issue is to explain why DOE applications have increased
         ii. Share of applications in renewable energy sector?
        iii. May have become more relevant/important as sector has become more important

The most important agency-specific issue related to the degree to which DOE limits applications in renewable energy. Need to review application patterns with a focus on these topics.

    c. NIH

          i. Concerns about selection process (especially problems with confidentiality and inclusion of potential competitors)

NIH matches the business cycle hypothesis better than any other agency. May be that biomedical firms are especially sensitive. Need to develop data on availability of alternative funding (e.g. from PWC venture database and CrunchBase).

    d. NASA

          i. Declining number of relevant companies

    ii. Growing attractiveness of working for the commercial space sector as an alternative

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About Incumetrics

Incumetrics is a small company focused on measuring, evaluating, and assessing innovation and developing policy for companies, nonprofits, regions, and national governments. It is led by Dr. Robin Gaster, who was the lead researcher on the National Academies series of reports on the SBIR program, and who is also publisher of the Great Disruption blog, focused on the impact of technology and globalization on the future of work.