**The Elasticity of Science:** Working Paper (2018)

**The Question:** Many studies show that science funding affects the pace and quantity of research output, but it may also affect the direction of research. Academic scientists typically set their own research agendas, and are usually funded by "Open" grants that give them flexibility to choose their own projects. But government, non-profit, or private funding agencies sometimes use Requests For Applications (RFAs) to incentivize researchers to tackle specific research questions, thus influencing the direction of research. For example, the National Institutes of Health (NIH) may decide that more research is needed for a specific disease after an urgent health crisis. This paper uses RFAs from the NIH to estimate the "elasticity" of research direction. In other words, how much extra funding does the NIH have to offer scientists to induce them to change the direction of their research? Are RFAs an efficient way to steer research toward productive uses? Are the inducements to change research programs temporary or permanent for individual scientists?

**The Results:** This paper finds that scientists are fairly inelastic, meaning it takes a lot of grant funding to incentivize them to change the direction of their research even a little. An estimated elasticity of 0.1 means that a 10% increase in funding causes scientists to change the direction of their research by 1%, as measured by a project similarity score. Another way to think about this number is that the NIH has to offer an additional $3.7 million to convince a scientist to switch to a project that is one standard deviation less similar to their research program. Comparing scientists who scored just below the peer review threshold for funding with those above shows that both RFA and Open grants increase publications equally by 15%. RFA grants only temporarily change the direction of research. After grant award, there is a sudden shift toward the RFA topic in the first couple years for winners, but after 5 years, the winners and losers of the RFA are again doing work that is equally dissimilar to the RFA.

**The Lessons:** Evidence from the Request For Applications program in the NIH suggest that it is expensive to convince researchers to change the direction of their research. RFA grants are very productive relative to open grants, but the productivity gap is mostly driven by the composition of scientists that choose to pursue them. More productive researchers generally apply for RFA grants. The RFA grants would also be more cost-effective if they had more permanent effects on researcher agendas, but after the grant expires, most scientists return to their original research program.

**The Research Approach:** The NIH issues Requests For Applications (RFA) which offer funding for research projects about specific diseases, populations, and/or methodologies. This paper estimates a model of entry as a function of the dollars offered for the grant and the similarity of the author's pre-existing research. Scientific similarity is intended to capture ease of transition between projects, such as whether two experiments use the same equipment, inputs, and expertise. In practice, the author measures similarity between requests, proposals, and articles by quantifying the amount of overlap in keywords in the text of the documents. Finally, he uses the peer-review funding cut-offs and the proposal rankings to compare the winners and losers of grant competitions to estimate the productivity of each type of grant.