

## **Dissertation Review – Hrendash: “Essays on Economics of Innovation” (CERGE-EI)**

In this 3-chapter thesis, the student studies various aspects of the economics of science and innovation. Each chapter focuses on a different question that is relevant to the current literature. The first chapter proposes a new method to identify clusters of innovative activity. To do this, they combine both geographic and social proximity of inventors using an algorithm that incorporates patent quality inside and outside of possible clusters. They also use a method of identifying the importance of the clusters for patent quality measures using a panel of inventors where they observe inventions by the same inventor within and outside of a cluster.

In the second chapter, which I believe is the strongest of the three chapters, the student estimates the impact of a USPTO program that expedites the patent examination process, the Track One Prioritized Examination. Using a differences-in-differences approach combined with a matching technique, the student finds that the program significantly increases commercial reassignment.

The last chapter examines the reasons for the well-documented ageing of the scientific workforce, focusing on the field of chemistry. They build a demographic model of the U.S. chemistry faculty and use it to estimate the importance of different channels to the aging of the faculty - changes in entry age, retirement, and new hires, finding the reduction in new hires is the driving force in aging.

I found the thesis to be very strong, with clear writing and careful data analysis. I have the following comments and questions (by chapter):

### **Chapter 1**

In this chapter, it would be good to see more discussion of the economic significance of the approach or at minimum a discussion of how the economics literature that studies spillovers could benefit from this approach. This could involve just more discussion in the literature review, or using the method to go back and reassess some published studies that identified clusters using a different method.

I like the approach of using a panel of inventors who move in and out of clusters to see how being in a cluster is associated with quality measures. This part of the analysis was not highlighted from the start and could be explained and emphasized more in the introduction.

The panel approach made me wonder how to think about timing here and whether the cluster is dynamic, since inventors are moving. If the clusters are changing over time as inventors move in and out, how does the student account for this in the analysis?

The approach to identify cluster uses measures of the “performance” of patents, to see if the performance in the cluster is significantly different from outside. The student refers to existing measures used in the literature, but I wondered if any other measures could also be relevant.

## **Chapter 2**

This is a very nice and carefully done chapter looking at the impact of a program to expedite the review process of patents at the USPTO. I think this current chapter is sufficient for a defense, but with some additional work, the paper has the potential to publish well.

One issue is the selection on observables in which inventors choose to participate in the program, which the student documents and discusses well. They use variant of a propensity matching on observables approach to address this potential source of bias. This seems like a reasonable approach, and it does not seem like the student can do more than this.

The chapter is quite polished through the main results in its current form. Future drafts could strengthen the last part of the paper, in particular to do more analysis of heterogeneity in the treatment effects. The student has access to a number of observables about the inventors and the patents, so seeing which inventors or patents benefit more from expedited review would be a useful addition.

For the policy implications and generalizability of the results, it would be helpful to perhaps compare pendency and policies for expedited review in other countries (beyond the discussion currently in the introduction) to help readers understand if the US is similar or different from other places.

It is surprising that the participation rates were so low (pg. 35-36), and this could be an area for future research to understand what the reasons for the low participation are and whether behavioral or financial interventions would increase participation.

## **Chapter 3**

This is a very interesting and timely analysis. I think broadening the analysis to another field could have high returns given the importance of the topic. Throughout the paper, the student refers to the model as the U.S. scientific workforce, but it is based on data of chemistry faculty, which is a very specific subset of the overall scientific workforce – the academic faculty in one field. This can be adjusted easily in the text, but will raise questions about the generalizability of the model and results. It might be that adding another field would raise interest in the paper, although it might not be possible to get comparable data to the ACS.

The student focuses on 3 main channels (changes in entry age, retirement, and new hires), but does not discuss too much the specific determinants of these channels apart from the background information, in particular the role of policies. In future work, it would be interesting to see how specific policies or economic events impacted these channels themselves, like changes in the incentives to retire, financial downturns, or specific NSF funding programs. Another question is how differences in the incentives to work in industry, which is a very common career path for chemistry PhDs, impact these channels.

The chapter is quite silent in the role of more women entering Chemistry in the 1970s and 1980s (although the title alludes to this as an “Old Man’s” game). Since gender is available in the ACS, it would be helpful to at least show the dynamics of the gender ratio and whether this interacts with any of the channels examined in the analysis.

**Overall, I found the thesis to be of high quality and I believe the thesis satisfies formal and content requirements for a PhD thesis in economics. My comments and suggestions above are ways to potentially improve the paper but are not critical to be addressed prior to a defense. Thus, I recommend the dissertation in its current form for a defense.**