**Displacement or Augmentation?**

**The Effects of AI on Workforce Dynamics and Firm Value**

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**READING NOTES**

For the **Forth** **Reading Assignment**, I chose one of Ms. Wang’s papers[[1]](#footnote-1) about Artificial Intelligence (AI) that she mentioned in class. After completing the reading, I **summarize** this paper and record **reading notes** as required by the assignment.

***SUMMARY.***

**The main topic of this paper is studying the impacts of AI innovation on firm-level workforce dynamics and corporate valuation.** As we all know, AI has been developing rapidly during the past few years, and its tremendous impact on the labor market and company value has sparked extensive discussions among researchers. However, the lack of large-scale evidence on AI innovation and labor dynamics makes it difficult for previous studies to determine the augmen-ting or displacing effects of AI in the labor market, as well as to explore the impact on firm value

To explore the causality between AI innovation and labor-market and firm-value, the authors conduct comprehensive and detailed regressions using over three million patent filing texts from 2007-2023 and microdata on worker flows. At the data level, the authors first collect and process the full-text database of patent applications and grants as the data on firms’ AI innovations. They apply the RAG and other techniques to categorize AI innovations into five overlapping functional areas: perception, inference, prediction, creativity, and engagement for subsequent use. The dataset that details the employment of individual workers and their job transitions to, from, and within firms is also obtained. To address the endogeneity of AI innovation and firm-level linkages, the authors construct instrumental variables that can account for two or more different types of patenting by a firm in a given year and build up a two-stage regression framework.

Based on this identification framework, the authors draw the following conclusions in their empirical analysis of the impact of **AI innovation on the labor market**: (1) Perception-based and engagement-based innovations significantly increase innovating firms’ use of skilled labor, whereas inference-based innovations significantly decrease it; (2) Many AI innovations increase the demand for skilled labor by complementing workers in their pre-existing roles rather than helping workers to expand into entirely new roles; (3) AI innovation categories that augment skilled labor (i.e., perception and engagement) have either positive or insignificant effects on unskilled labor growth, while the AI category that displaces skilled labor (inference) also displaces unskilled labor. Based on the above analysis, they classify each patent as augmenting or displacing and use regression analysis to explore the effects of these types of AI innovation on firms’ Tobin’s Q. Their conclusion of the **firm-value effects of AI innovation** is that while augmenting AI innovations generally translate into higher firm valuations, their exact value impact depends heavily on the labor market circumstances surrounding the innovating firm, and the displacing patents have insignificant effects on Tobin’s Q.

Overall, this paper not only further digs into the impact of AI innovations on employment and firm value, adding to the relevant literature; more importantly, it offers a new methodological approach to the study of large-sample textual data that can potentially be applied to many other questions in finance and economics. (469 words)

I have drawn a framework figure for the article, as shown in **Figure 1**, to help readers understand the article summary more clearly.



**Figure 1.** The framework of this paper.

***NOTE.***

This recent two-week course focused on the underlying algorithms, practical applications, and specific impacts associated with AI. In the class, Mr. Wang cited this paper to briefly explain the impact of AI on the labor market, which aroused my great interest. Therefore, I chose this paper for this reading assignment.

Admittedly, the core of the article is the empirical analysis as well as the inference of causality, but limited by the lack of knowledge in this part of the article, I can only have a framework perception of the regression process in the article. However, the final conclusion of the analysis gives me a clear understanding of the impact of AI on both employment and company value.

What's more, the author of the article has vectorized the patent text using LLMs, which is a great inspiration for our second data analysis. My group will also move forward along this line to complete the structuring of the relevant text data.

**QUIZ QUESTIONS AND ANSWERS**

***Q1.*** *How do the authors identify and categorize AI patents with artificial intelligence methods?*

***Answer:***

The overall approach to identifying AI innovations from among the millions of U.S. patent applications filed during 2007-2023 consists of two main steps:

* First, build a custom RAG system and use it to construct a training sample of labeled patents for each of the five AI categories.
* Second, use the data thus labeled to train downstream machine-learning classifiers that can categorize all patent applications in the entire sample.

In addition, they check various responses given by the LLM to ensure that the RAG approach is able to distinguish different types of patents correctly and reliably. After that, they conclude that the LLM is capable of differentiating between fine shades of meaning in patent abstracts.

***Q2.*** *How do the authors address the endogeneity when studying the link between AI innovation and firm-level employment?*

***Answer:***

They follow the approach of prior work that uses the quasi-random assignment of patent applications to patent examiners within different U.S. Patent and Trademark Office art units. Specifically, they extend the approach of the previous study to construct instrumental variables that can account for two or more different types of patenting by a firm in a given year. They also build up the two-stage least-squares models to examine the true causal effects.

***Q3.*** What are the effects of AI on workforce dynamics?

***Answer:***

In the conclusion part of the article, the authors summarize the causal impact of each innovation type on worker flows. They can be divided into **three parts**:

* AI innovations related to perception or engagement significantly **increase** skilled labor growth, AI while innovations related to inference significantly **reduce** it.
* Skilled labor augmentation through AI innovation appears to mainly take the form of increased **external hiring rather than reduced job separations** or internal reskilling.
* Augmentation concentrates on existing “core” roles within the firm rather than in entirely new roles, and it **does not appear to represent skill-biased technological change**.

***Q4.*** *What are the effects of AI on firm value?*

***Answer:***

This paper shows evidence that augmenting AI patents generally has a positive effect on firm value as measured by Tobin’s Q while displacing patents (as well as patents that are neither augmenting nor displacing) have insignificant effects on Tobin’s Q. Moreover, the difference in the value effect between augmenting patents and displacing patents is statistically significant. Taken together, these findings suggest that firms can benefit most from AI innovations that augment skilled labor rather than displace it.

However, the value gains associated with augmenting AI patents materialize only when, from the standpoint of the innovating firm, there is good mobility and availability of skilled workers in the external labor market.

***Q5.*** *What are the core contributions of this article?*

***Answer:***

There are **four main contributions** of this article:

* Firstly, they add to a stream of papers that study the adoption of AI technology and its consequences for certain occupations
* Secondly, this work is also directly related to recent papers that explore the implications of AI technologies for firm growth and employment.
* Thirdly, the paper contributes to the literature that examines the broad economic implications of automation, skill-biased technological innovation, and creative destruction.
* Finally, this work offers a new methodological approach to the study of large-sample textual data that can potentially be applied to many other questions in finance and economics.

1. <https://ssrn.com/abstract=4787286> [↑](#footnote-ref-1)