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Assessing Early Labor Market Effects of Generative AI

EVIDENCE FROM POPULATION DATA

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Abstract

This study examines the short-term impact of generative artificial intelligence (GAI) on employment and wages using data covering all wage earners from Finland. Employing a synthetic difference-in-differences approach, we analyze how the launch of ChatGPT affected occupations with varying levels of exposure to GAI.

Our findings reveal that wages increased more in highly GAI-exposed occupations compared to less exposed ones following ChatGPT's introduction. However, we do not observe statistically significant changes in employment levels between more and less exposed occupations. Additional analyses comparing more- and less-exposed occupations within specific occupational groups yield qualitatively similar results. These findings contrast with some previous studies on online labor markets but align more closely with research using nationally representative data.

The positive wage effect observed in AI-exposed occupations could indicate that GAI is primarily enhancing rather than replacing human labor. The lack of significant employment effects might suggest that the impact of GAI on job creation or destruction may take longer to materialize or might be offset by other factors in the labor market.

Tiivistelmä

Generatiivisen tekoälyn lyhyen aikavälin työmarkkinavaikutusten arviointi tulorekisterin avulla

Tässä tutkimuksessa tarkastellaan generatiivisen tekoälyn lyhyen aikavälin vaikutuksia työllisyyteen ja palkkoihin käyttäen tulorekisteriä. Käytämme synteettistä erot-erotuksissa-menetelmää ja analysoimme, miten ChatGPT:n lanseeraus vaikutti ammatteihin, joissa altistuminen tekoälylle vaihteli.

Tuloksemme osoittavat, että palkat nousivat enemmän erittäin altistuneissa ammateissa verrattuna vähemmän altistuneisiin ammatteihin ChatGPT:n julkistamisen (marraskuussa 2022) ja sitä seuranneen generatiivisen tekoälyn laajemman käyttöönoton jälkeen. Emme kuitenkaan havaitse tilastollisesti merkitseviä muutoksia työllisyysasteessa enemmän ja vähemmän altistuneiden ammattien välillä. Lisäanalyysit, joissa vertaillaan enemmän ja vähemmän altistuvia ammatteja ammattiryhmien sisällä, tuottavat laadullisesti samankaltaisia tuloksia. Nämä havainnot ovat ristiriidassa aiempien alustataloustyömarkkinoita koskevien tutkimusten kanssa, mutta vastaavat paremmin tuloksia tutkimuksista, joissa käytetään kansallisesti edustavia tilastoja.

Tekoälylle alttiissa ammateissa havaittu positiivinen palkkavaikutus voi osoittaa, että generatiivinen tekoäly ensisijaisesti täydentää eikä korvaa ihmistyövoimaa. Merkittävien työllisyysvaikutusten puuttuminen saattaa kuitenkin viitata siihen, että tekoälyn vaikutus työpaikkojen luomiseen ja tuhoutumiseen voi näkyä tarkasteluikkunaa pidemmällä viiveellä tai että muut työn kysyntään vaikuttavat tekijät voivat kumota generatiivisen tekoälyn käyttöönottoon liittyvän vaikutuksen.

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Keywords: Generative artificial intelligence, Technological change, Employment, Wages, Occupations

Asiasanat: Generatiivinen tekoäly, Teknologinen muutos, Työllisyys, Palkat, Ammatit

JEL: E24, J21, O33

Introduction

Occupations are collections of tasks that can be carried out with different combinations of human labour and capital. Generative artificial intelligence (GAI) will affect the task composition carried out by humans because it may replace humans in some tasks and complement human labour in other tasks. Since the launch of ChatGPT in November 2022, there has been a lot of discussion on the labour market impacts of GAI.

The starting point for studies of the labour market impact of GAI is the creation of indices that measure how exposed occupations are to GAI (e.g. Felten et al. 2021, Eloundou et al. 2024). The precise definitions of exposure vary, but the indices measure the technical feasibility of performing tasks in an occupation with GAI. However, labour market impacts depend not only on exposure but also on many social, legal, and technological factors, and Pizzinelli et al. (2023) have recently incorporated such factors into exposure measures.

Key studies on the labour market impact of GAI focus on online labour markets. These studies utilise a difference-in-differences analysis (DID) comparing submarkets exposed to GAI to non-exposed submarkets before and after the launch of ChatGPT (and subsequently other major GAIs). Liu et al. (2023) find a decline in demand and supply for text- and programming-related tasks. Qiao et al. (2023) in turn find that in some markets labour demand and earnings fall (e.g., in translation) whereas in others labour demand and earnings increase (e.g., in web development). The results in Hui et al. (2024) show that freelancers in affected occupations face employment and earnings losses and that high-performing freelancers suffer the most. Demirci et al. (2024) find that the introduction of GAI reduces labour demand in the automation-prone jobs and that the remaining jobs become more complex.

The results obtained using nationally representative data are differ from those focusing on online labour markets. Albanesi et al. (2023) correlate changes in employment shares of occupations to measures of AI exposure using labour force survey data for 16 European countries in 2011-2019. Their results show that the employment share of occupations more exposed to AI has increased in almost all countries. They find no link

between wages and exposure to AI. Acemoglu et al. (2022) find that task composition changes in establishments and firms that are more exposed to AI, but there is no link between AI exposure and employment and wages at the occupational level. Their interpretation is that the effects of AI are too small to be detected at the occupational or industrial level.

Our approach is similar to studies using online labour market data, but we use monthly data that covers all wage earners in Finland to study how earnings and employment are affected by AI. We use the AI exposure measure developed by Pizzinelli et al. (2023) and conduct a synthetic difference-in-differences analysis at the occupational level. Prior studies using nationally representative datasets have used annual data and have not conducted DID analyses.

Data

The main dataset used in this study is the Incomes Register from Statistics Finland, a national database maintained by the Finnish Tax Authority. It contains information on wages, pensions, and benefits. Information on wages is available as of January 2019. Owing to their nature, these data are accurate and reliable. The data are released for research purposes at a monthly frequency.

The data contain occupation codes at the four-digit level. The occupational classification TK-10 is a national version of the ISCO classification. We match this data with the AI exposure measure of Pizzinelli et al. (2023). This measure builds on the AI exposure index developed by Felten et al. (2021), which measures the overlap of generative AI applications and task content of and occupation. To this measure, Pizzinelli et al. (2023) add a measure of complementarity, that is, the social, legal, and technical factors that affect how likely it is that AI will complement rather than substitute humans in an occupation. Occupations receiving a high score on the measure of Pizzinelli et al. (2023) are those with a substantial number of tasks that can be carried out with generative AI technologies and few social, legal, and technical factors that would create complementarities with human labor. The index scores

occupations relative to other occupations. Since GAI continues to evolve rapidly, the index is best seen as a short-run measure.

The key dependent variables in the regressions are employment and earnings. Employment is calculated as the number of employees working in an occupation each month, and the earnings concept is total earnings, which includes all taxable earnings from employment relationships.

Methods

To estimate the causal effect of the introduction of GAI, we use the synthetic difference-in-differences method (Arkhangelsky et al. 2021), which generalizes and unifies the difference-in-differences and synthetic control methods. Like the synthetic control method, it matches the pretreatment trends of the treatment and control units, and like the difference-in-differences method, it allows additive unit-level shifts.

In the main analysis, the treated occupations are those that are in the top 10% of occupations on the C-AIOE index of Pizzinelli et al. (2023) and the control occupations are those in the bottom 10% of occupations on this measure. The before-period is 1/2019 to 11/2022, and the after-period is 12/2022–8/2024. The standard errors are calculated using clustered bootstrap (1000 replications), and to estimate the model, we use the Stata command described by Clarke et al. (2023).

As a supplementary analysis, we compare more exposed occupations (the C-AIOE index above the median) to less exposed occupations (the C-AIOE index below the median) within a one-digit occupational class. This is motivated by the fact that in the main analysis, the treatment and control groups comprise quite different occupations, and although the method accounts for differences in the composition of the treatment and control groups, a more credible analysis compares more similar occupations. We use the median as a cut-off to have enough clusters for the analysis.

Results

Table 1 presents the results. The results for all occupations show an estimated treatment effect on wages of 78€, which is about 2% of the average wage. This means that the average wage in the most exposed occupations increased more than the average wage in the least exposed occupations following the launch of ChatGPT. The estimated employment effect is small and statistically insignificant.

The supplementary analyses focus on ISCO major groups 2 (Professionals) and 3 (Technicians and associate professionals), as these are the major groups that are most exposed to AI. The results show that for both groups, the estimated treatment effect on wages is about 30-40€, which is statistically significant at the 10% level for technicians and associate professionals. The estimated employment effects are not statistically significant; however, the point estimates are positive for professionals and negative for technicians and associate professionals.

Table 1 The impact of AI technologies on wages and employment at the level of occupations

	All occupations		Professionals (ISCO level 2)		Technicians and associate professionals (ISCO level 3)	
	Wage level	Employ-ment	Wage level	Employ-ment	Wage level	Employ-ment
Treatment effect	78.322***	11.647	31.601	29.041	37.659*	-50.210
	(24.896)	(51.661)	(19.36)	(35.537)	(22.073)	(35.558)
N	6256	6256	5916	5916	5508	5508
N clusters	92	92	87	87	81	81

Note. The table displays the treatment effects and clustered bootstrap standard errors estimated using the synthetic difference-in-differences method. * p < 0.1, ** p < 0.05, *** p < 0.01.

Conclusion

This study provides novel insights into the impact of generative artificial intelligence (GAI) on employment and wages, using data covering all wage earners from Finland. Our analysis, employing a synthetic difference-in-differences approach, reveals several key findings. First, contrary to concerns about AI displacing workers, we find a positive wage effect in occupations that are most exposed to GAI. Second, our analysis does not detect statistically significant changes in employment levels between more and less exposed occupations. This suggests that, in the short term, GAI has not led to widespread job losses in highly exposed occupations. Both professionals (ISCO major group 2) and technicians and associate professionals (ISCO major group 3) showed positive wage effects, although their magnitudes and statistical significances differ.

These findings contrast with some previous studies, particularly those focused on online labor markets, which have reported negative impacts on employment and earnings in AI-exposed occupations. Our results align more closely with studies using nationally representative data, which have found neutral or positive effects of AI exposure on employment shares and wages.

The positive wage effect observed in AI-exposed occupations could indicate that GAI is primarily complementing rather than substituting human labor, potentially increasing productivity in these roles. However, the lack of significant employment effects suggests that the impact of GAI on job creation or destruction may take longer to materialize or may be offset by other factors in the labor market. It is important to note that this study captures short-term effects, and the long-term impact of GAI on labor markets may evolve as the technology advances and becomes more widely adopted.

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