



## Short communication

## County-level job automation risk and health: Evidence from the United States

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## ABSTRACT

**Rationale:** Previous studies have observed a positive association between automation risk and employment loss. Based on the job insecurity-health risk hypothesis, greater exposure to automation risk could also be negatively associated with health outcomes.

**Objective:** The main objective of this paper is to investigate the county-level association between prevalence of workers in jobs exposed to automation risk and general, physical, and mental health outcomes.

**Methods:** As a preliminary assessment of the job insecurity-health risk hypothesis (automation risk → job insecurity → poorer health), a structural equation model was used based on individual-level data in the two cross-sectional waves (2012 and 2014) of General Social Survey (GSS). Next, using county-level data from County Health Rankings 2017, American Community Survey (ACS) 2015, and Statistics of US Businesses 2014, Two Stage Least Squares (2SLS) regression models were fitted to predict county-level health outcomes.

**Results:** Using the 2012 and 2014 waves of the GSS, employees in occupational classes at higher risk of automation reported more job insecurity, that, in turn, was associated with poorer health. The 2SLS estimates show that a 10% increase in automation risk at county-level is associated with 2.38, 0.8, and 0.6 percentage point lower general, physical, and mental health, respectively.

**Conclusion:** Evidence suggests that exposure to automation risk may be negatively associated with health outcomes, plausibly through perceptions of poorer job security. More research is needed on interventions aimed at mitigating negative influence of automation risk on health.

## 1. Introduction

In recent decades, workers in the United States have faced a growing sense of uncertainty about their future employment (Kalleberg and Marsden, 2013). Automation is an important aspect of the changing nature of work in the US, and it poses a significant threat to the job security of workers. While estimates of potential job losses due to automation vary for the US population, with high estimates topping 47% (Frey and Osborne, 2017), most would agree that automation risk is significant and growing. While most automation studies focus on labor market impacts (Autor, 2015; Ford, 2015; Frey and Osborne, 2017; Hicks and Devaraj, 2015), other potential impacts remain largely unexplored, including the effect of automation risk on health outcomes.

Our theoretical basis is the job insecurity-health risk hypothesis (De Witte et al., 2016), and our preliminary model tests whether higher automation risk results in worse health outcomes with perceived job

insecurity as a mediator: automation risk → job insecurity → poorer health. Related to the automation risk fueling job insecurity (automation risk → job insecurity), automation fuels fear and anxiety of job loss (Reichert and Tauchmann, 2017). Expectations of reduced wages and higher unemployment from automation increase perceptions of job insecurity. Automation may compound anxiety over job insecurity (Chui et al., 2015; Frey and Osborne, 2017). Related to job insecurity leading to poorer health (job insecurity → poorer health), in a recent review of 57 longitudinal studies on job insecurity and health/well-being outcomes, De Witte et al. (2016) conclude that “job insecurity affects health and wellbeing on the long term, rather than the other way round” (pp 18). Other studies have found that anxiety associated with prospects of job loss deteriorates mental health and wellbeing (Khubchandani and Price, 2017; Reichert and Tauchmann, 2017), and significantly increases negative mental health indicators, including depression (Burgard et al., 2009; Meltzer et al., 2010; Strazdins et al.,

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2011) and exhaustion/burnout (De Witte et al., 2016). Additionally, automation and the corresponding expectation of reduced wages and higher unemployment increases perceptions of job insecurity, and fuels fear and anxiety of job loss (Reichert and Tauchmann, 2017). Overall, we expect that the concerns of exposure to automation may induce job insecurity, which in turn, negatively influences health outcomes.

While the core analytic focus of this paper is on the county-level association between the prevalence of workers exposed to automation risk and health outcomes, and given that job insecurity data is not available at the county-level, to provide baseline support for job insecurity-health risk hypothesis, a mediation effect (automation risk → job insecurity → poorer health) is tested using the two waves of General Social Survey (GSS, 2012 and 2014).

In the second step, based on the preliminary support for job insecurity-health risk hypothesis from GSS data, this paper investigates whether the higher prevalence of workers exposed to automation risk at the county-level is negatively associated with county-level health outcomes. The proposed county-level association could be explained as follows: the anticipation of job loss to automation threatens fundamental benefits provided by a job – the need for survival, social relatedness, and self-determination (Blustein, 2008); automation risk reduces wages, fuels job losses, exacerbates family stress, and promotes social withdrawal. In these indirect ways, the negative social and economic environment created by the reduced quality of life could drive county-level prevalence of negative health. The actual and felt threats from automation may not immediately manifest into morbidities, but the increasing prevalence of poorer self-reported health and feelings of deteriorating physical and mental health can have a direct and lasting impact on individuals, families, and communities. While we cannot fully unpack the black box between county-level automation risk and health, nevertheless, it is important for policymakers to understand the health effects of automation risk.

To our knowledge, this is the first study exploring the association between automation risk in a region and health. We find support for a negative association between county-level automation risk and general, physical, and mental health. A 10-percentage point increase in automation risk at the county-level worsens general, physical, and mental health by 2.38 percentage point, 0.8 percentage point, and 0.6 percentage point, respectively.

## 2. An exploratory test of job insecurity-health risk hypothesis

Based on the job insecurity-health risk hypothesis, we assess whether people in occupations exposed to higher automation risk report more job insecurity and whether that, in turn, is associated with negative health outcomes.

We use the General Social Survey 2012, 2014 cross-sections, and match the individual occupational membership codes to the Frey and Osborne (2017) study on the probability of occupational automation. The descriptions of the variables and definitions are listed in Online Appendix A.

The structural equation model estimates (*sem* routine in Stata 15) presented in Table 1 show that workers in occupations facing higher levels of automation probability report lower job security, and that, in turn, is associated with poorer health ( $p = 0.043$ ).

We now turn to our main analysis on the association between county-level automation risk and health outcomes.

## 3. Methods

### 3.1. Study sample

We merge three datasets – County Health Rankings (CHR) 2017, Frey and Osborne's (2017) occupational automation probabilities aggregated at the county-level using American Community Survey (ACS) 2015, and Statistics of US businesses 2014.

**Table 1**  
Structural equation model (SEM) estimates.

	Coef.	s.e.	z	p-value	[95% C.I.]	
Automation Risk → Job Security	0.001	0.001	2.36	0.018	0.000	0.003
_cons	1.548	0.038	40.68	< 0.001	1.473	1.622
Job Security → Poorer Health	0.101	0.026	3.92	< 0.000	0.050	0.151
Automation Risk → Poorer Health	0.002	0.001	3.27	0.001	0.001	0.003
Education → Poorer Health	-0.038	0.008	-4.89	< 0.000	-0.054	-0.023
Sex → Poorer Health	-0.024	0.041	-0.57	0.566	-0.104	0.057
Black → Poorer Health	0.019	0.059	0.33	0.741	-0.096	0.135
Other Race → Poorer Health	-0.022	0.067	-0.33	0.739	-0.153	0.109
Widowed → Poorer Health	0.064	0.123	0.52	0.601	-0.177	0.306
Divorced → Poorer Health	0.038	0.060	0.64	0.525	-0.079	0.156
Separated → Poorer Health	0.005	0.111	0.05	0.962	-0.212	0.222
Never Married → Poorer Health	0.092	0.056	1.65	0.098	-0.017	0.202
Number of Children → Poorer Health	-0.017	0.016	-1.05	0.294	-0.049	0.015
Age → Poorer Health	0.004	0.002	1.93	0.054	0.000	0.007
Total Family Income → Poorer Health	-0.015	0.012	-1.26	0.207	-0.039	0.009
Year	-0.012	0.020	-0.58	0.561	-0.051	0.028
_cons	25.943	40.784	0.64	0.525	-53.992	105.878
var (e.Job Security)	0.620	0.025	0.573	0.671		
var (e.Poorer Health)	0.495	0.020	0.457	0.536		
<b>Model Statistics</b>						
Log likelihood	-24714.2					
LR test of baseline vs. saturated:	$\chi^2(27) = 116.131$ , Prob > $\chi^2 < 0.001$					
Root mean squared error of approximation (RMSEA)	0.02 [90% C.I.: 0.000, 0.038]					
Standardized root mean squared residual (SRMR)	0.013					
Coefficient of determination (CD)	0.064					
<b>Indirect effect</b>						
Automation Risk → Job Security → Poorer Health:	0.0014 × 0.101 = 0.0001431 [s.e. = .0000709], p-value = 0.043					

Note. Number of respondents = 1224.

The CHR 2017 rankings are based on county-level data during 2013 and 2015, the period around Frey and Osborne's (2017) measure of occupational automation risk.

Using the occupation level probabilities identified in Frey and Osborne (2017), Devaraj et al. (2017) used occupational data at county-level to estimate a weighted measure of relative risk of automation across all counties in the US (Online Appendix B provides additional details on this measurement). The Statistics of US Businesses (SUSB) 2014 data provides details on local business activity, including new firm establishment and closures, and employment growth from new firms.

### 3.2. Specification

The endogeneity between automation risk and county health could stem from the error term influencing both automation risk and county

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