Rise of the Machines: Evidence from the Container Revolution

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Abstract

The invention of the shipping container significantly reduced the demand for manual labor at ports. This paper uses regional data to study the effect of the container revolution on labor market outcomes in US ports. Across all ports, the introduction of new technologies had negative impact on the share of workers employed as longshoreman. The declines in the share of longshoremen was larger in bigger ports. Despite this direct negative effect, such ports also experienced larger declines in the unemployment rate. These findings indicate that economic opportunities created by the arrival of new technologies were large enough to outstrip the direct negative effect.

Introduction

The first container shipment took place in 1956. However, there were significant obstacles hindering the widespread adoption and use of new technologies (labor unions, established transportation chains).

In 1960 the International Longshore and Warehouse Union agreed to sign the Mechanization and Modernization Agreement which opened the way for the widespread adoption of container technologies across ports. The adoption process was rather slow and continued until 1980.

Container technologies exhibit increasing returns to scale. In this situation larger ports were more likely to be affected by containerization.

The key advantage of the container revolution is that dock-work was an especially labor intensive task and new technologies mainly substituted labor rather than complemented it. In the case of other technological revolutions both effects may be strong which complicates the analysis.

Empirical Strategy and Data

I estimate the following specification:

$$\Delta Y_{it} = \beta_1 Longshore_{it_0} + \beta_2 (Longshore_{it_0} \cdot d_t) + X'_{it_0} \beta_3 + \delta_t + \gamma_i + \varepsilon_{it}$$

where ΔY_{it} denotes the change in the share of workers employed as longshoreman in location i over the time period $t=[t_0,t_1]$, d_t is a dummy that takes a value of 1 after 1960, which is the start of containerization period, $Longshore_{it}$ denotes the initial number of workers employed as longshoreman in location i, at the beginning of each period.

To construct regional data for employment I closely follow Autor and Dorn (2013) and use Census Integrated Public Use Micro Samples for the years 1950, 1960, 1970 and 1980. Based on these data I identify 55 port cities (Commuting Zones) which have workers employed as longshoreman in the water transportation industry.

Table 1. The effect of containerization on longshoremen.

	(1)	(2)	(3)	(4)
Longshoremen·d_t	-0.037***	-0.034***	-0.052**	-0.065**
	(0.014)	(0.008)	(0.023)	(0.031)
Longshoremen	-0.010	-0.023**	-0.007	-0.003
	(0.011)	(0.010)	(0.015)	(0.016)
Controls	No	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
State fixed effects	No	No	Yes	No
CZ fixed effects	No	No	No	Yes
R-squared	0.210	0.260	0.371	0.453
N	165	165	165	165

Results

I expect the coefficient on the interaction between containerization dummy longshoremen to be negative because larger ports were more likely to be affected by container technologies and the number of longshore workers is a good proxy for port size.

Figure 1 depicts the relationship between net changes in the ratio of workers employed as a longshoreman and their initial level. There was no relationship before the containerization period. The relationship becomes negative after 1960.

Estimations presented in table 1 also confirm these expectations. The results are robust to the inclusion of fixed effects, demographic and industry controls.

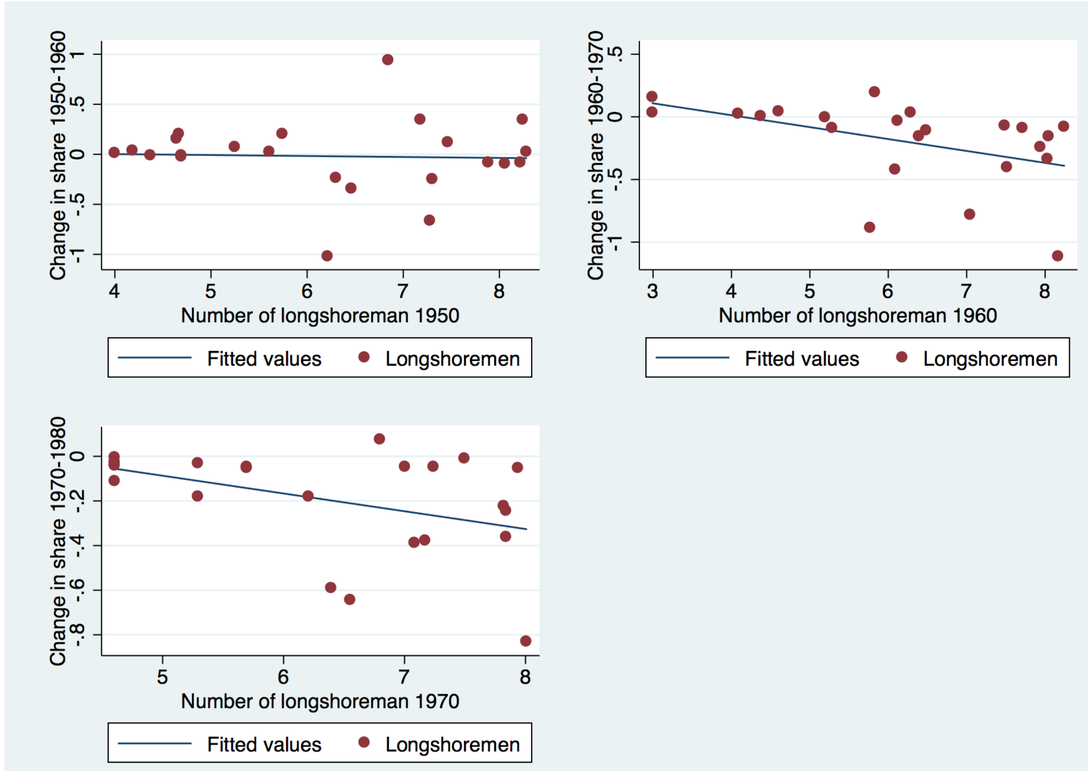

Figure 1. Changes in the share of workers employed as longshoreman before and after containerization.

Additional Results

Despite the negative effect of containerization on longshoremen, the overall effect on unemployment was negative, i.e. it decreased (table 2).

This means that containerization destroyed jobs in a specific sector, however it created opportunities in other industries. Containerization did not have effect on city size

There is also weak evidence that containerization decreased the share of low-skill workers in larger ports.

I fail to establish a link between containerization and the share of employment in the manufacturing or services sectors. This indicates that indirect jobs created by containerization were distributed evenly across sectors.

Table 2. The effect of containerization on the development of regions.

	Unempl	Size	Low-Skill
Longshoremen·d_t	-0.169*	-0.002	-0.372
	(0.090)	(0.003)	(0.234)
Longshoremen	0.112	0.005*	0.176
	(0.096)	(0.003)	(0.201)
R-squared	0.210	0.260	0.371

Notes. All specifications are estimated following column (4) in table 1 with the same set of controls and fixed effects.

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