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OBSOLESCENCE RENTS:
TEAMSTERS, TRUCKERS, AND IMPENDING INNOVATIONS

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September 25, 2023

Abstract

We consider large, permanent shocks to individual occupations whose arrival date is uncertain. We are motivated by the advent of self-driving trucks, which will dramatically reduce demand for truck drivers. Using a bare-bones overlapping generations model, we examine an occupation facing obsolescence. We show that workers must be compensated to enter the occupation - receiving what we dub *obsolescence rents* - with fewer and older workers remaining in the occupation. We investigate the market for teamsters at the dawn of the automotive truck as an à propos parallel to truckers themselves, as self-driving trucks crest the horizon. As widespread adoption of trucks drew nearer, the number of teamsters fell, the occupation became 'grayer', and teamster wages rose, as predicted by the model.

1 Introduction

Self-driving trucks now seem all but inevitable. They will dramatically reduce demand for truck drivers, but their exact arrival date is uncertain. The aftermath

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of such negative labor demand shocks is well studied in seminal work such as Dorn et al. (2009) and Autor et al. (2016). However, the *prospect* of such shocks should also affect worker behavior. We study labor markets for which a demand shock has been portended but has not yet arrived.

In the next section, we model a labor market with an impending shock where occupational choices are hard to reverse. We show that during the anticipatory-dread stage, the stretch of time when young workers expect that demand for an occupation may decline dramatically in their lifetime, those entering the occupation receive an *obsolescence rent.* When the shock's arrival date is uncertain, as in our model, this can be viewed as a risk premium for occupation-specific human capital. In a model without uncertainty, it would simply be compensation. Wages are lowest immediately after the shock. The shock's anticipation reduces employment; its arrival reduces it further. The occupation's workforce is older during the anticipatory-dread stage than either before the shock's announcement or after the dust settles. However, unsurprisingly, it may be the oldest right after the shock hits. Drawing informally on Cavounidis and Lang (2020), we anticipate that once the shock hits, older affected workers will shift to closely related jobs that are less adversely affected by the shock. In contrast, younger ones will 'retrain' for ascendant jobs.

Section 3 investigates the model's predictions by studying the market for teamsters around the time motor trucks were developed. Teamsters drove teams of horses that pulled wagons and were the antecedents of today's truck drivers.

The rise of motor trucks had become predictable by roughly 1910, but the shock did not really hit until after World War I. Subject to inevitable data limitations, our results are broadly consistent with our predictions. We find that teamsters' wages rose before the shock and then plummeted. Employment fell even while wages rose and then collapsed further when wages crashed. The proportion of new teamsters who were young fell, while the proportion of exiting teamsters who were young rose. Former teamsters were much more likely to take up motor truck driving if they were young.

Section 4 considers a different case of technological obsolescence, that of dressmakers and milliners. In their case, the culprits were department stores and ready-made dresses whose arrival shifted garment-making from small independent shops to factories. In the decades before 1900, employment of dressmakers and milliners outside factories grew rapidly but leveled off between 1900 and 1910 before collapsing during the next decade. While we lack wage data, we document a similar aging process.

Section 5 considers the modern trucking industry. We cannot establish definitively that overall employment is already declining in anticipation of automation. However, we provide decisive evidence that the occupation is aging rapidly, indicating that young workers are reluctant to become or remain truckers.

More broadly, our findings establish that an increase in an occupation's wages is sometimes not a testament to its strong demand but rather an ill omen for its future. A better indicator of an occupation's health may be the age profile of the workers it attracts.

Our model is related to macroeconomic models of labor supply decisions with forward-looking agents in the context of structural change. Like us, Hobijn et al. (2019) studies the effect of retraining frictions. We also use idiosyncratic preferences (or skills) for occupations like Lagakos and Waugh (2013), and our agents pick jobs taking into account current and future wages, as in Bárány and Siegel (2018).

In studying the fates of workers of different vintages using an overlapping generations model, our model is most similar to Chari and Hopenhayn (1991). However, they analyze the steady-state dynamics of technology adoption across generations on a deterministic balanced growth path. Instead, we study a model in which a one-off technological change arrives at an uncertain time.

Like Acemoglu and Restrepo (2018), we are interested in the wage dynamics caused by technology shocks, although our shocks are fundamentally microeconomic. Finally, our paper relates to those studying how technological change affects selection into occupations, such as Ocampo (2022).

2 A Model of an Occupation Passing Into Obsolescence

We begin with a simple overlapping generations (OLG) model in which each individual lives and works for two periods. Initially, we assume workers choose their occupation in the first period and cannot move following a shock. Later, we allow for limited occupational mobility. We use a two-period OLG model because it allows us to distinguish young and old workers straightforwardly while remaining tractable. However, tractability comes with costs. The stark assumption that large groups of workers are born and die together makes convergence to steady-state employment and wages non-monotonic. Consequently, most of our results focus on the steady-state in each stage of obsolescence rather than the dynamics.

2.1 Wages and Employment with No Mobility

We first solve a model where individuals pick a job for life. A unit measure of workers is born each period, and each worker lives for two periods. Workers choose an occupation when born, which they keep for both periods they are alive. We focus on a single occupation, which we dub 'widgeting'.

2.1.1 Setup

We take as a primitive the inverse demand or *wage function* for widgeting. We denote the wage function before the shock arrives by $w_h(\cdot)$ and after it arrives by $w_l(\cdot)$. Young and old widgeters are equally productive perfect substitutes. Therefore, the widgeting wage is a function of the total number of widgeters. The shock is a negative one, so wages are lower after the shock: $w_l(x) < w_h(x)$ for all x. We assume that the wage functions are differentiable and downwards-sloping so that $w_h' < 0$ and $w_l' < 0$. For convenience, we assume that $w_h(0) \leq 1$ and that $w_l(2) \geq 0$ so that the wage always lies between 0 and 1.

We investigate three stages: the 'no-shock' (N) stage, in which workers believe the wage function will remain w_h forever; the 'anticipatory dread' (D) stage in which workers believe the wage function will transition from w_h to w_l at a constant hazard λ; and the 'aftermath' (A) stage, in which workers believe the wage function will remain w_l forever. These correspond to the three phases of obsolescence: before the risk of obsolescence is perceived, once it is on the horizon but perceived to arrive at an uncertain time, and after its arrival.

To model a continuous widgeting labor supply, we endow workers with 'preferences' for widgeting. Formally, when workers are born, they receive a random draw, ϑ, of the *per-period disutility from widgeting.* Without loss of generality, we set utility from the outside option to 0. Thus, a worker born at t with a draw ϑ chooses to be a widgeter if

$$(w_t - \vartheta) + \delta(E[w_{t+1}] - \vartheta) > 0 \tag{1}$$

where the widgeting wage today is w_t, $\delta \in (0, 1)$ is the common discount factor, and the expected widgeting wage tomorrow is $E[w_{t+1}]$.

We assume that *lifetime* widgeting disutility $(1 + \delta)\vartheta$ follows CDF F, which is continuous and strictly increasing on $[0, 1 + \delta]$. Effectively, F maps the expected net present value of wages from widgeting to the fraction of young workers who become widgeters or, equivalently, the number of young widgeters. In other words, when the widgeting wage today is w_t and the expected widgeting wage tomorrow is $E[w_{t+1}]$, the number of young widgeters today ought to be $F(w_t + \delta E[w_{t+1}])$.

To summarize, our model posits that more young workers choose to become widgeters when they expect higher lifetime wages, that widgeter wages, in turn, decrease in the total number of widgeters, and that the arrival of the shock transitions the market to a lower demand function.

2.1.2 Steady-States: No Shock, Anticipation, and Post-Shock

A solution to the model is a triple of continuous functions (V_N, V_D, V_A), one for each stage, mapping the number of old widgeters today to the expected lifetime discounted earnings of a young widgeter. For instance, in the no-shock stage, when there are o old widgeters, a young widgeter expects to earn $V_N(o)$. Thus, the proportion (number) of young workers who become widgeters is $F\left(V_N\left(o\right)\right)$. In the next period, there will be $F(V_N(o))$ old and $F(V_N(F(V_N(o)))) = (F \circ V_N)^2(o)$ young widgeters. The new generation enters widgeting based on their expected discounted earnings given the number of old widgeters, who had, in turn, become young widgeters based on the previous generation of old widgeters, and so on.

Thus, recalling that wages depend on the sum of young and old widgeters, for each $o \in [0, 1]$, a solution must satisfy

$$V_N(o) = \underbrace{w_h(o + F(V_N(o)))}_{\text{wage today}} + \delta \underbrace{w_h(F(V_N(o)) + (F \circ V_N)^2(o))}_{\text{wage tomorrow}} \tag{2}$$

$$V_A(o) = \underbrace{w_l(o + F(V_A(o)))}_{\text{wage today}} + \delta \underbrace{w_l(F(V_A(o)) + (F \circ V_A)^2(o))}_{\text{wage tomorrow}} \tag{3}$$

$$V_D(o) = \underbrace{w_h(o + F(V_D(o)))}_{\text{wage today}} + \delta[\lambda \underbrace{w_l(F(V_D(o)) + (F \circ V_A \circ F \circ V_D)(o))}_{\text{shocked wage tomorrow}} \tag{4}$$

$$+ (1 - \lambda) \underbrace{w_h(F(V_D(o)) + (F \circ V_D)^2(o))}_{\text{not-shocked wage tomorrow}}].$$

Given a solution,[1] we can define steady-states in the number of old widgeters $\{o_N^*, o_A^*, o_D^*\}$ in the no shock, aftermath, and dread stages, respectively. Steady-states must satisfy

[1]We assume a solution exists; while this is easy to verify in certain (e.g., linear) setups, deriving necessary and sufficient conditions is beyond the scope of this paper.

$$F(V_N(o_N^*)) = \qquad F((1+\delta)w_h(2o_N^*)) = \quad o_N^* \tag{5}$$
$$F(V_A(o_A^*)) = \qquad F((1+\delta)w_l(2o_A^*)) = \quad o_A^* \tag{6}$$
$$F(V_D(o_D^*)) = \quad F((1+\delta(1-\lambda))w_h(2o_D^*) + \delta\lambda w_l(o_D^* + F(V_A(o_D^*)))) = \quad o_D^* \tag{7}$$

For a given solution, existence and uniqueness of steady-states o_N^* and o_A^* is immediate from the fact that w is strictly decreasing, while F is strictly increasing. We now use this to show that the solution must be unique.

Proposition 1. *The solution* (V_N, V_A, V_D) *is unique.*

Proof. All proofs are in Appendix A. □

The intuition for the result is as follows. If there were two solutions, they would specify different wages for some number of old workers, given equilibrium entry into widgeting. The solution with higher wages in the first period must specify *less* entry that period, but this is only rationalizable by a larger difference in wages the next period, in the opposite direction. That difference can, in turn, only be rationalized by an even larger wage difference the following period, and so on, with a lower bound on wage differences that grows exponentially. As wages are bounded, this leads to a contradiction.

As the solution is continuous, $F \circ V_D$ is also continuous, so that the existence of an anticipatory-dread steady-state o_D^* follows from Brouwer. Showing that o_D^* is also unique takes a bit of work.

Proposition 2. $F(V_D(\cdot))$ *has a unique steady-state* o_D^*.

2.1.3 Wages and Employment in the Three Steady-States

The uniqueness of the three steady-states allows us to rank their wages and employment levels. The following proposition encompasses two facts. First, widgeter employment is highest in the no-shock steady-state, followed by the anticipatory-dread steady-state, which in turn features more widgeters than the aftermath steady-state. Second, wages in the anticipatory-dread steady-state are higher than wages in the no-shock steady-state, which are, in turn, higher than wages in the aftermath steady-state.

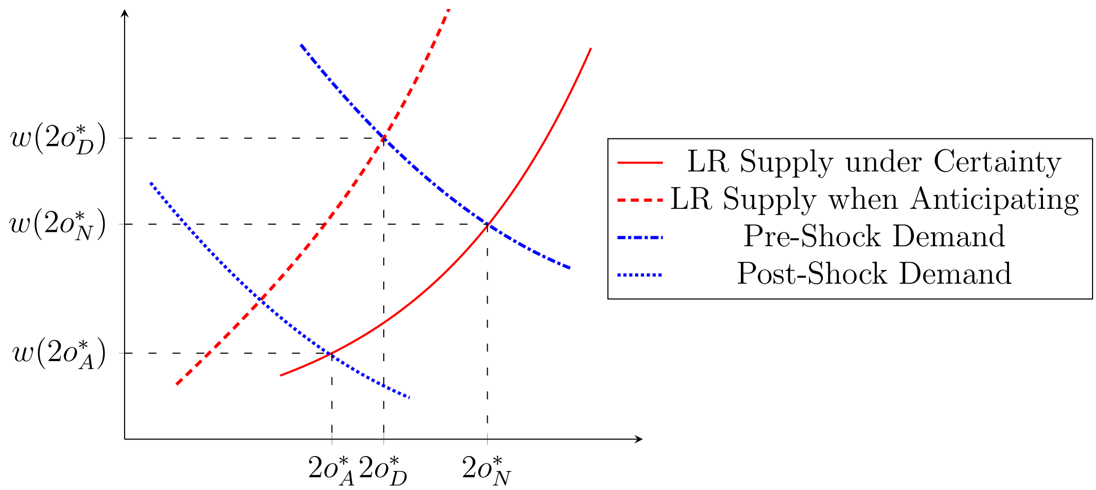
Proposition 3. *The steady-state numbers of old workers satisfy* $o_N^* > o_D^* > o_A^*$ *and* $w_h(2o_D^*) > w_h(2o_N^*) > w_l(2o_A^*)$.

In addition, when the shock arrives in the anticipatory-dread steady-state, wages in the short run drop to below the aftermath steady-state wage.

Proposition 4. $w_l(2o_A^*) > w_l(o_D^* + F(V_A(o_D^*)))$.

Less formally, the supply curve depends on both the current and expected future wage. This is not an issue in the no-shock and post-shock steady-state; workers expect the wage to remain constant. However, in the anticipatory-dread steady-state, workers know that there is a chance that the wage will fall. Consequently, they become more reluctant to enter widgeting at any current wage. Therefore, as in Figure 1, the widgeter supply curve shifts to the left, and the wage rises while employment falls. When the shock arrives, demand shifts sharply to the left, causing the wage to fall, while the supply curve eventually shifts back to its original location because, in the new steady-state, workers again expect the wage to be constant. Steady-state is restored with fewer workers and lower wages as the new marginal worker is less averse to working as a teamster than the previous marginal workers were.

Figure 1: Demand for and long-run supply of widgeters in the no-shock, anticipatory dread, and aftermath stages, highlighting steady-states.



2.2 The Model with Worker Mobility

We now augment the model to allow us to explain changes in worker age profiles. We do this by introducing a probability π that a given worker can change jobs when they turn old. This opportunity arises after workers observe whether the potential transition from the anticipatory-dread stage to the aftermath stage occurred. Thus, if the shock arrives, mobile widgeters may switch to a different occupation. Conversely, if the shock doesn't arrive, mobile non-widgeters may take up widgeting in their second productive period.

If $\pi = 0$, no worker can move, and things are as above. If $\pi = 1$, every living worker can choose a new job in every period, and thus the steady-states in the no-shock and aftermath stages are reached immediately. There is no risk of getting 'stuck' as a widgeter. Therefore, the anticipatory-dread steady state coincides with the no-shock steady-state. In both the $\pi = 0$ and the $\pi = 1$ cases, in each steady-state, the numbers of young and old widgeters are equal. This also applies in the no-shock and aftermath steady-states when $\pi \in (0, 1)$, as the wage is constant and there is no uncertainty.

However, when $\pi \in (0, 1)$, in the anticipatory-dread steady-state, the number of young widgeters is less than the number of old widgeters. To see this, note that when the present widgeting wage is w_t and the next period's widgeting wage w_{t+1} is believed to be stochastic (depending on shock arrival), a worker with per-period widgeting disutility ϑ becomes a widgeter if

$$\overbrace{\underbrace{w_t - \vartheta}_{\text{today}} + \delta \underbrace{(1-\pi)E[w_{t+1} - \vartheta]}_{\text{tomorrow, immobile}} + \delta \underbrace{\pi E \max\{0, w_{t+1} - \vartheta\}}_{\text{tomorrow, mobile}}}^{\text{payoff, starting as a widgeter}} \geq \overbrace{\underbrace{0}_{\text{o.o.}} + \delta \underbrace{\pi E \max\{0, w_{t+1} - \vartheta\}}_{\text{tomorrow, mobile}}}^{\text{payoff, starting at outside option}} \tag{8}$$

or simply

$$\vartheta \leq \frac{w_t + \delta(1-\pi)E[w_{t+1}]}{1 + \delta(1-\pi)}. \tag{9}$$

Thus, the number of young widgeters is

$$y_t = F\left((1+\delta)\frac{w_t + \delta(1-\pi)E[w_{t+1}]}{1 + \delta(1-\pi)}\right). \tag{10}$$

Correspondingly, mobile old workers choose to be widgeters when

$$\vartheta \leq w_t, \tag{11}$$

so that a fraction

$$F((1+\delta)w_t) \tag{12}$$

widgets. Thus, the total number of old widgeters is

$$(1-\pi)y_{t-1} + \pi F((1+\delta)w_t). \tag{13}$$

Therefore, there are more old widgeters than young if

$$(1-\pi)y_{t-1} + \pi F((1+\delta)w_t) > y_t. \tag{14}$$

In the anticipatory-dread steady-state, $y_t = y_{t-1}$ so using (10) this reduces to

$$F((1+\delta)w_t) > F\left((1+\delta)\frac{w_t + \delta(1-\pi)E[w_{t+1}]}{1+\delta(1-\pi)}\right), \tag{15}$$

which we know to be true from the fact that F is strictly increasing and $w_t > E[w_{t+1}]$ due to (an analog of) Proposition 4. Thus, in the anticipatory-dread steady-state, there are more old than young workers.

2.3 A Summary of our Empirical Predictions

In the following sections, we use the theory to study the effect of pending arrivals of motor trucks on teamsters, of ready-to-wear women's clothing on dressmakers and milliners, and - speculatively - of autonomous trucks on truckers. In each case, we attempt to establish that there is a period during which the new technology has not been widely adopted but workers in legacy occupations are aware of its pending arrival. We also identify when the shock hit (for motor trucks and ready-to-wear clothing).[2]

Our model makes several testable predictions about the behavior of the labor market as it transitions to 'anticipatory dread', which we proceed to test where the data allow. Our main predictions revolve around three observables: wages (section 3.6), aggregate employment (section 3.3), and the age distribution of workers (section 3.4). We predict that (i) wages rise, creating an "obsolescence rent"(tested on teamsters), that (ii) employment falls (on teamsters), and that (iii) the age distribution of workers shifts to the right (on truckers and milliners and dressmakers), due to (a) younger workers in other occupations reducing their entry more sharply than older workers (on teamsters), and (b) younger workers in the affected occupation increasing their exit rate more sharply (on teamsters).

To the best of our knowledge, none of the papers on adjustment to technological shocks has focused on these predictions. The summary statistics in Feigenbaum and Gross (2022) show that as AT&T adopted mechanical switching technology, the proportion of female operators in the telephone industry who were 16-25 fell from 80% in 1910 to 30% in 1940. Bessen et al. (2023) find that older workers

[2] In reality, there is, of course, no single moment when the shock hits, but we look for historical accounts of sharp shifts in the use of the new technology.

are hurt more when their firm introduces automation; this statement is related to, but not equivalent to, our predictions regarding mobility. Similarly, Porzio et al. (2022) documents the "greying" of the agricultural industry with the decreased entry of younger workers. Our study identifies a different mechanism and allows for the possible increased entry of older workers.

We will also draw loosely on Cavounidis and Lang (2020) to predict that, relative to older workers in the negatively shocked occupation, younger workers are more likely to move towards occupations positively affected by technological change and less likely to move to other low-skill occupations.

3 Teamsters

3.1 Historical Context

Our model assumes a competitive labor market, but teamsters unionized early in response to low pay and miserable conditions.[3] Therefore, it is important for us to consider whether teamster pay was likely to respond to the pressures in our model. Over half of the members of the early union were located in Chicago, where the union was most contentious and regarded by some commentators as highly corrupt. In 1905, a strike by Chicago teamsters left them "utterly defeated and crushed" (Leiter 1957, p. 28).

By the time our wage data begin, the union president, Daniel Tobin, was well aware of market pressures:

> The relatively conservative attitude of Tobin is reflected in his notions concerning wages. In 1915, he wrote: "... it is impossible for unions to go on year after year endeavoring or expecting to obtain an increase in wages and shortening of working hours" since many workers are getting "... as much as the industry can afford to pay." He subsequently adhered to this position when he had to take part in the bargaining negotiations of some IBT locals." (Leiter 1957, p. 44)

We recognize that the situation remained distinct in Chicago, where many unions remained separate from the International Brotherhood of Teamsters (IBT). Especially towards the end of our period (1928-1935), there was considerable concern about the extent of racketeering and gangster control, including Al Capone's

[3] This subsection draws almost entirely on Leiter (1957).

gang, of some of the independent unions. It is not clear that these unions were focused on members' wages.

We conclude that, with the possible exception of the Chicago unions, the teamsters union was responsive to economic conditions. Therefore, we should expect patterns similar to those we derive from a competitive model. Moreover, we note that even in 1920, IBT membership, which included occupations other than teamsters, was less than 30 percent of our estimate of the number of teamsters. There was a substantial nonunion group that would have influenced the IBT's negotiations. Nevertheless, for robustness, we experiment with excluding Chicago from some of our estimates.

3.2 The Rise of Motor Trucks

The arrival of motor trucks (or 'trucks' when there is no risk of confusion) was heralded long before they became widely available and used. In 1895 Thomas Edison declared that it was "... only a question of time when the carriages and trucks in every larger city will be run with motors." (quoted in Montville (1971), p. 378) The first commercial truck was purchased in 1897 (ibid p. 382), but it was not until much later that the use of motor trucks became widespread. The issue was not whether motor trucks could be built, which had certainly been demonstrated by the end of the 19th century, but if and when they would become commercially viable for local freight hauling. Moreover, whether motor trucks would be driven by steam, electricity, or gasoline remained to be determined. Steam lost out early, but competition between electricity and gasoline continued well into the 20th century (Mom and Kirsch 2001).

The use of both cars and motor trucks in the United States grew rapidly in the first three decades of the 20th century, but, as shown in Figure 2, the rise of cars preceded (gasoline and electric) trucks. In 1910, there were almost 460,000 registered cars but only about 10,000 registered trucks. By 1920, there were over eight million cars but just over one million trucks. In 1929, on the eve of the Great Depression, there were 23 million cars and about 3.5 million trucks. In comparison, in 1995, the ratio of registered cars to trucks was about 1.8.

Of course, there was no single year in which transportation of people and freight in the U.S. moved from horse-drawn vehicles to motor trucks. Still, in 1916, just before the U.S. entry into World War I, there were only 250,000 trucks. But the war demonstrated their value. France and Britain purchased large quantities of trucks from American manufacturers, and the United States followed a crash course in designing standardized trucks for military use (Utz 1919). Industry produced thousands of trucks. The experience showed using trucks was feasible (Smiley 2004). The war's end meant the military no longer needed significant production capacity created to meet its demands. Moreover, many military trucks were sold for civilian use and glutted the market until 1921 (Mom and Kirsch 2001). Between 1918 and 1919, registrations increased by almost 300,000, a gain not matched again until 1924.

By 1920, the rise of motor trucks had not yet dramatically decreased demand for teamsters. By our calculation, the 1910 Census includes 421,983 teamsters compared with 350,657 in the 1920 Census. This contrasts markedly with occupations affected by the rise of passenger vehicles. Over the same period, the number of people employed as hostlers and stablehands fell from 63,000 to 19,000, and carriage and hack drivers fell from 35,000 to 10,000. In contrast, chauffeurs increased from 46,000 to 285,000. Consistent with Cavounidis and Lang (2020), among workers who left carriage and hack driving, those who became teamsters were disproportionately older workers.[4]

The sharp decrease in teamster employment occurred between 1920 and 1930. By 1930, helped by the development of pneumatic truck tires, the rise of trucks had dramatically reduced the number of workers employed as teamsters. The number of teamsters collapsed to 177,815, about half the number in 1920.

We searched *Scientific American* for articles with 'truck' in their title and 'motor' in the body or title. From 1901 through 1910, this produced 11 articles, of which we judge only 6 to be about what we would recognize as trucks. Five are very brief, mostly a single paragraph. The exception is a 1909 article (Rogers 1909) arguing that motor trucks were superior to horse-drawn trucks in New York City because they could cover more territory. Still, the article also warned, "Two weeks at the factory is not sufficient to change a stable hand into a competent driver," and stressed the importance of proper maintenance, the risks of overloading, and issues with roads. Only an adventurous businessman would come away from reading the article with a feeling that it was time to purchase a fleet of motor trucks.

Between 1911 and 1920, 96 articles met our criteria, almost all about vehicles recognizable as motor trucks. A 1913 article comparing the cost of horses, electric trucks, and gasoline trucks (Ritchie 1913) generally favored electric trucks. Still, it stressed that "It is practically impossible to pre-determine what will be the total annual cost of operating a truck at given rating without knowing what will

[4] Carriage and hack driver was a very small occupation; workers moving from carriage and hack drivers to teamsters accounted for less than 1% of the total entry to teamsters.

be the requirements of the service, the nature of the road and the general method of handling and repairing for the cars." Horses pulling 1/2 ton and 2 tons could go further on $1 of expense than the same size gasoline truck, although not as far as the equivalent electric truck. Helford (1914) argued that, since they might have difficulty raising the requisite funds to purchase a motor truck, businessmen might want to buy on an installment plan.

A 1918 article in *Scientific American* (the Washington Correspondent of the Scientific American 1918) captures our view. "Prior to the war, the motor truck was making steady progress towards ultimate complete employment. ... But the war accelerated its adoption, perhaps by twenty years." The article further argued that American roads were woefully inadequate for truck traffic.

To complement our investigation into the evolution of anticipation for trucks, we analyzed newspaper articles from the 1910s and 1920s, as newspapers cater to a different readership than *Scientific American*. The timing of shifts in anticipation reflected in newspapers is consistent with what we find in *Scientific American*: the attitudes towards replacing horses with trucks remained largely conservative until the end of World War I. For instance, an article from 1915 still considered the possibility of employing a "mixed system of horses and motors" to replace horses (Boston Evening Transcript 1915). It was not until the war's end that a marked shift in attitudes towards trucks became evident in newspapers. In a 1919 article, the founder of a tire company explicitly stated that "it was the war which really roused manufacturers to the value of the motor truck for ordinary transport"(Firestone 1919). Articles published during this period displayed a more receptive and optimistic attitude toward trucks.

Our interpretation is that between 1910 and 1919, it became increasingly clear that motor trucks were "on their way." The experience of World War I, including the direct observations of returning soldiers and the injection of trucks into the civilian market, should have made it apparent that trucks would supplant horse-drawn vehicles in local freight markets. By 1930, they had largely done so. However, the timing was uncertain since trucks required higher quality roads, which depended on local governments' willingness to undertake the expense. Ultimately, trucks would displace trains in the intercity market, but that transition occurred later. In 1929, intercity trucking accounted for somewhat more than one percent of the ton-miles of freight hauled, but it was growing at 18 percent per year (Smiley 2004).

3.3 Employment: Identifying Anticipatory Dread and the Aftermath

Based on the previous account, we see the no-shock period ending sometime around 1910. The shock arrived shortly after World War I, roughly in 1919. The anticipatory dread period fell in between. In contrast with our formal model, the arrival hazard of motor trucks was not constant but rose rapidly between 1910 and 1919, and, of course, the new technology was not adopted instantaneously. Unfortunately, we cannot date the collapse of teamster employment precisely. As we will see, teamster employment fell modestly between 1910 and 1920, consistent with what we anticipate in the anticipatory dread period, and then collapsed between 1920 and 1930 after the arrival of the shock.

We use the IPUMS 1880, 1900, 1910, 1920, and 1930 full-count census data to estimate teamster employment. Unfortunately, the occupation classification variable (*occ1950*) does not record teamsters consistently over this period.[5] We supplement *occ1950* with two additional variables: *occstr* and *ind1950*, which allow us to identify teamsters more accurately. The variable *occstr* reports the respondent's original (unedited) response, including terms like "teamster" or "teaming". *ind1950* provides consistent industry codes across census waves.

We combine these variables to obtain a more accurate count of teamsters. First, we include workers classified as teamsters using the *occ1950* variable. Then, we add workers whose *occstr* contains the keyword "team." Next, we include workers whose *occstr* contains terms like "driver", "wagoner", "drayman" etc., and who were employed in the "trucking service" industry according to the *ind1950* variable. Finally, we exclude workers whose *occstr* includes keywords such as "truck", "motor", "hostler", "stable", or "groom." [6]

Table 1 presents teamster employment by decade in absolute numbers and as a fraction of employed males. We focus on the male labor force for the teamster analysis as almost all teamsters were males during this period. Column 2 shows the teamster employment copied directly from the census report (Edwards 1943), while the remaining columns exhibit our own calculations using the full-count censuses. Our estimates closely align with the official reports. The census report documents 361,308 draymen, teamsters, and carriage drivers in 1900 and 443,735 in 1910, while our inferred teamster employment is 407,747 in 1900 and

[5]For instance, starting from 1910, teamsters in certain industries were coded as 'laborers' or 'deliverymen,' which resulted in a reduced number of teamsters compared to previous years (Ruggles et al. 2021, 2022).

[6]Stablemen, hostlers, and grooms are workers who care for horses but do not use them to pull vehicles as a principal element of their work.

Table 1: Teamster Employment: 1880-1930

Year	Edwards (1943) male teamsters	Male teamsters	Employed males	Fraction (%)
1880	119,131	153,852	15,119,401	1.02
1890	246,095			
1900	361,308	407,747	23,364,086	1.75
1910	443,735	421,983	30,515,530	1.38
1920	419,450	350,657	32,906,318	1.07
1930	111,178	177,815	38,058,536	0.47

Notes: All the numbers are for males 10 years old and over. Column 'Edwards (1943) male teamsters' is copied from Edwards (1943). Other columns are from authors' calculations based on full-count censuses. Our approach to identifying teamsters differs from that of Edwards (1943). For example, our estimates include workers classified as "deliverymen in stores" as teamsters while Edwards (1943) does not.

Source: US Census

421,983 in 1910. The census report and our calculations show similar patterns of teamster employment over time. Teamsters increased from 1880-1900 when the economy experienced radical industrial expansion and population growth. Teamster employment was stable from 1900 to 1910, with a slight increase in numbers and a slight decrease in their fraction of all employed males. Absolute teamster employment decreased from 1910 to 1920 and collapsed from 1920 to 1930.

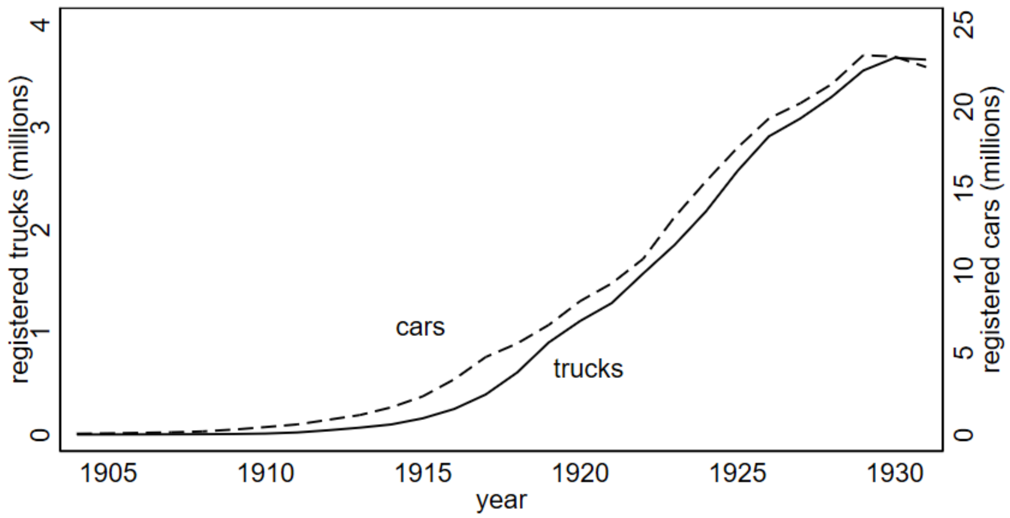
These employment changes are consistent with the distribution of trucks. According to the motor vehicle registration records shown in Figure 2, before 1910, very few trucks were available, and the number of teamsters grew between 1900 and 1910, although teamsters declined as a proportion of the labor force. In the late 1910s, the number of trucks began to increase. Some teamsters felt the threat and changed their occupation, but most stayed. From 1920 to 1930, trucks increased dramatically, and it became clear that teamsters were a poor substitute for truckers. Correspondingly, employment collapsed.

In our model's terminology, the period of 'anticipatory dread' began around 1910. The effects of anticipation intensified over the following decade, with the predicted decline in employment (prediction (ii) in section 2.3). The shock finally arrived at the end of the decade, causing employment to crater in the 1920s.

3.4 The Aging of Teamsters: Entrants Got Older, Leavers Younger

As our model predicts (prediction (iii) in section 2.3), during the period of anticipatory dread, the age distribution of workers in the occupation shifted to the

Figure 2: Registrations of Automobiles and Trucks: 1904-1931



Source: Federal Highways Administration, State Motor Vehicle Registrations, by Years, 1900 - 1995 https//www.fhwa.dot.gov/ohim/summary95/mv201.pdf, accessed 8/21/2022.

right, as being stuck in an occupation with low demand is more costly for young workers. Importantly, again as predicted, this shift began *before* employment collapsed because younger workers bear a higher risk that the shock will arrive while they are still working and will have more work years remaining if it does. Figure B.1 in the appendix shows how the age composition of individuals employed as teamsters changed in anticipation of the shock and after the shock.

We observe some aging of the occupation between 1900 and 1910 when we also observe the first indications that motor trucks are on the horizon. Thus, the occupation began to age even though competition from motor trucks was negligible, with only 10,000 trucks registered nationwide. By 1920, the aging of the occupation, even relative to 1910, was self-evident. From 1920 to 1930, as the number of trucks dramatically increased, employment decreased sharply in both absolute and relative terms, with young workers decreasing more than older workers. Despite the heavy physical demands, driving a team of horses had become an older man's job. Our formal model further implies that after the shock has been in place for a sufficiently long time, the proportion of workers in the occupation should be independent of age in the new steady-state. While we do not wish to read too much into the age distribution of the small population of teamsters, we note that this prediction is quite accurate for teamsters in 1960 (see Figure B.2 in the appendix).

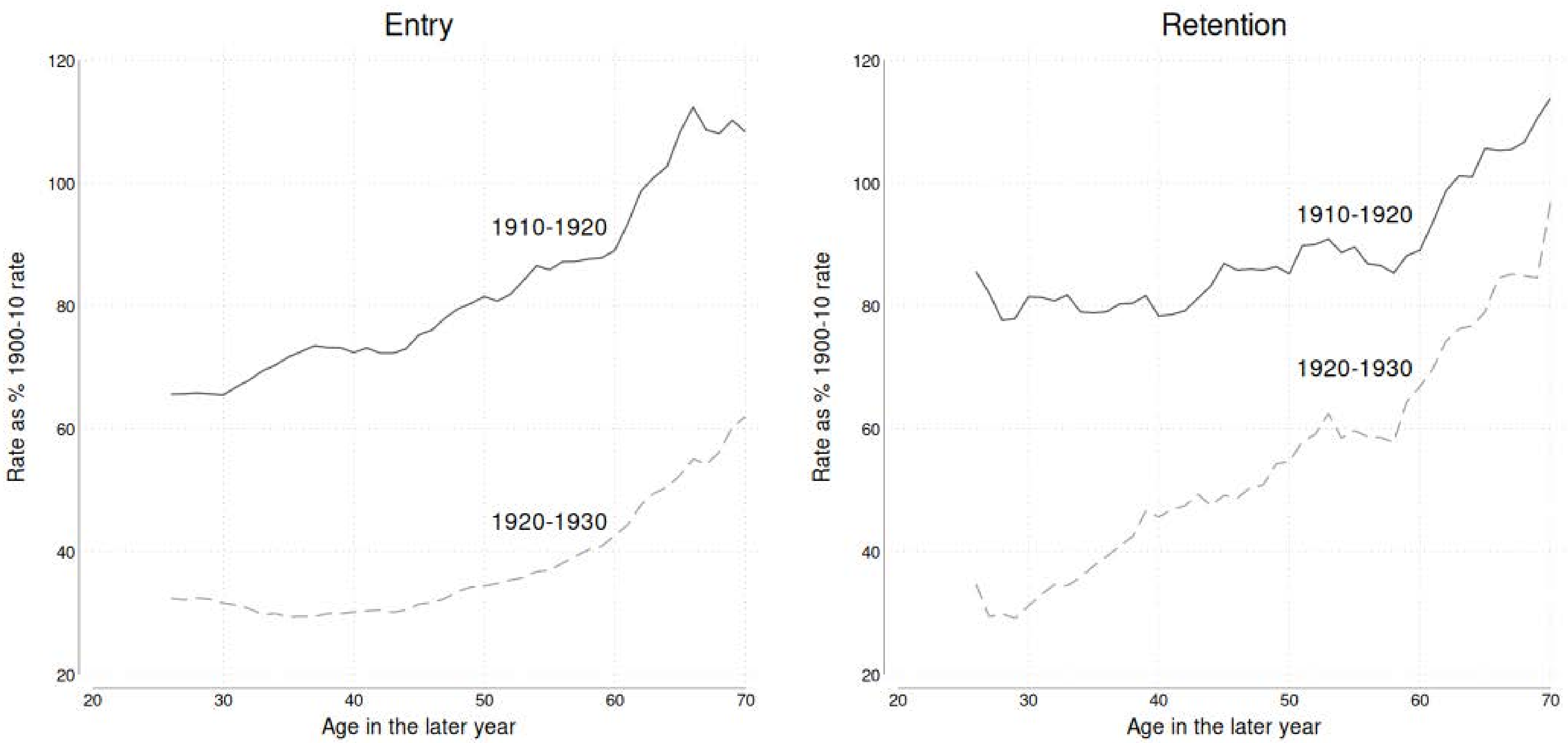
The aging of the occupation might be mechanical once we account for reduced entry. If fewer workers enter an occupation, those who remain get older. To address this concern, we examine the age distribution of workers entering and remaining in employment as teamsters (predictions (iiia) and (iiib) in section 2.3). For this exercise, we use the linkage data described in Abramitzky et al. (2022) to link the full-count censuses.

We take 1900-1910 as the reference for movements during a 10-year period and compare these movements to those in 1910-1920 and 1920-1930. For each age, we calculate the number of workers who transitioned from other occupations to teamsters between two consecutive census years. We divide this number by the number of workers who were not teamsters in the earlier census, providing us with the proportion of non-teamsters entering teamster employment for each period. Similarly, for each of the three 10-year periods, we calculate the number of workers who remained as teamsters and divide by the number of teamsters in the earlier census year who remained employed anywhere in the later period. Then, we calculate the entry and retention rates by age as a *proportion* of the rate between 1900 and 1910. In other words, we calculate $rate^a_{j,t}/rate^a_{j,1900-1910}$ where $j = entry$ or $retention$, a denotes age, and $t = 1910 - 1920$ or $1920 - 1930$. We choose the proportions because the declines in entry and retention rates are sufficiently large and baseline levels sufficiently different that it is implausible that the counterfactual is a common percentage point decline.

We anticipate that the resulting proportion will be less than 1 but increase with age. While most workers should have become less likely to start as teamsters and more likely to exit, the decreased entry and increased exit should be more pronounced for young workers, as they find being stuck in a sunset industry more costly. Similar logic applies to the 1920-1930 period, but the difference from 1900-1910 should be larger since teamster employment collapsed during this period, deterring more workers from entering and encouraging greater exit.

Figure 3 shows the results of this exercise and confirms the model's predictions. The left panel shows the entry rate by age in the anticipatory-dread and post-shock periods relative to the earliest period in our data. The right panel is analogous, except that it shows the retention rate. In each case, the horizontal axis shows the age in the later census. For example, age 30 refers to someone 20 years old in the earlier census. We do not include the movements between the 1880 and 1900 censuses because it covers a twenty-year period and, thus, is not comparable to the other periods.

Figure 3: Teamster Entry and Retention by Age: Relative to 1900-1910



Notes: For each period, this figure shows the entry rate (left panel) from non-teamster employment to teamster employment divided by this rate between 1900 and 1910 (in percent). The entry rate is defined as the proportion of employed workers in jobs other than teamsters in year t-10 who were employed as teamsters in period t. The right panel shows the retention rate of teamsters divided by this rate between 1900 and 1910 (in percent). The retention rate is the number of workers employed as teamsters in both t and t-10 divided by the number of workers employed as teamsters in t-10 who were employed in any occupation in t. The figures show the rates for male workers aged 16-60 in the former year (aged 26-70 in the later year) and who could be matched across censuses. The rates presented in the figures are 5-year moving averages.

Thus, compared with 1900-1910, in the anticipatory-dread period (1910-1920), the entry rate of 30-year-old workers (20 at the beginning of the decade) to teamster employment is about 66% of the baseline. As expected, the relative rate is less than 100% for most age groups. It is striking that the oldest workers actually increase their entry rate during this period. They may have anticipated earning high wages and retiring before obsolescence. Similarly, retention of 30-year-old workers (20 years old in 1910) is only about 80% of its baseline rate, but this rate rises and passes 100% among the oldest workers. Surprisingly, there is a small range among the youngest workers during which the relative retention rate slopes downwards.

After the shock hit (1920-1930), entry and retention decreased further relative to the 1900-1910 baseline. As expected, the relative rates are all below 100%. Again, except for the very youngest group, the relative rates increase with age.

3.5 Moving to Opportunity or Moving to What's Left?

Cavounidis and Lang (2020) analyze the reaction of individual workers to a shock that lowers the value of one skill and raises that of another. Older workers employed in occupations that are intensive in the negatively shocked skill move away from that skill relatively slowly. Young workers move towards positively shocked occupations relatively rapidly. That model is distinct from the one in this paper. Nevertheless, we draw on that model's intuition to explore mobility patterns into and, especially, out of employment as a teamster. In our context, the negatively shocked occupation is self-evidently teamster. The positively shocked occupation is truck driver.

We note that there has been some research on reemployment of workers following a technology shock at their firm. Feigenbaum and Gross (2022) are closest to us in looking at outcomes by age, but since their age groups are 16-20, 21-25, and 26+, it is not clear that the time horizon considerations in Cavounidis and Lang apply. Cavounidis and Lang discuss an 'inertia' effect, which they argue should strengthen rapidly early in one's career, as optimal skill investment is front-loaded. Bessen et al. (2023) find much clearer evidence of adverse effects on workers age 50 and up when their employer automates, but this comes primarily through nonemployment. Bessen et al. do not address occupation changes among reemployed workers.

Workers who entered employment as a teamster from another occupation came primarily from employment as laborers (not elsewhere classified [n.e.c.]), farm laborers who are wage workers, and farmers (owners and tenants). These are the top three source occupations for all age groups (26-35, 36-45, 46-55, 56-65) and all periods (1900-10, 1910-20, 1920-30) except that in 1910-1920, workers aged 26-35 are more likely to enter from unpaid family farm labor than from paid farm labor, and workers aged 56-65 are more likely to enter from managers, proprietors and officials (n.e.c.). In each age/year, these three occupations account for 44-66% of workers entering teamster employment from another occupation.

Workers who leave employment as a teamster for other employment exit primarily to laborers (n.e.c.), farmers (owners and tenants), truck and tractor drivers, managers, proprietors, and officials (n.e.c.) (see Table 2). These four occupations are the four most common exit occupations, except that few teamsters moved to work as truck and tractor drivers between 1900 and 1910. They account for 38% to 57% of workers leaving teamster employment in all age groups, with higher proportions at older ages.

Table 2: Primary Destination Occupations of Workers Leaving Employment as Teamsters

	Laborer (nec)	Farmers owners & tenants	Truck/Tractor Drivers	Mangers, Officials Proprietors (nec)	Total	N
1910-1920						
26-35	12.36	14.99	5.31	5.24	37.9	21,284
36-45	14.16	20.5	4.33	6.63	45.62	19,102
46-55	18.63	21.57	3.33	7.14	50.67	12,473
56-65	21.71	22.51	2.1	7.37	53.69	7,111
1920-1930						
26-35	15.33	9.41	12.84	5.99	43.57	19,870
36-45	17.77	14.46	11.17	8.05	51.45	19,010
46-55	22.52	17.24	8.27	8.19	56.22	13,168
56-65	24.9	19	4.93	7.72	56.55	8,269

Notes: nec = not elsewhere classified.

Source: Authors' calculations based on pairwise matched Census data.

As predicted by Cavounidis and Lang (2020), we observe a strong negative age gradient in the proportion of exiting teamsters who enter the new occupation. Recall that this gradient is on top of the higher rate of exit by young teamsters. In 1910-20, 5% of the youngest group but only 2% of the oldest who exited became truck or tractor drivers. In the last decade, the youngest group was eight percentage points more likely than the oldest to exit this way.

It is also striking that the age gradient for moving to a declining occupation, farmer, increased. Between 1910 and 1920, among exiters, movement to farming shows a slight positive age gradient. Between 1920 and 1930, there is a clear upward slope.

3.6 Wages Rose and then Fell

To investigate prediction (i) in section 2.3, we obtain the wage data for teamsters and other occupations from bulletins of the Bureau of Labor Statistics.[7] These bulletins report the union scale of wages annually in selected trades and cities. Neither the set of trades nor the cities covered are consistent across years. We focus on the weekly wage of teamsters from 1913-1931 in Boston, Chicago, New York, St. Louis, and San Francisco, each of which has a complete time-series for two-horse teamsters.[8] We note that Leiter (1957) used only Boston, New York, St. Louis, and San Francisco, presumably because Chicago had some militant and corrupt unions. We show that our results remain robust when Chicago is excluded (see Figures B.4 and B.5 in the Appendix). Unfortunately, the BLS did not collect wage data for teamsters between 1901 and 1912, and the data before 1901 are not comparable to the later data. Similarly, we have no wage data for 1932-1939, and the later data are not comparable to those we use.

We use "all trades" and "close trades" to compare the wages of teamsters and other workers. All trades, the average of all the trades and cities covered in each BLS bulletin, has the advantage of being more stable and reflecting an aggregate trend covering more cities and occupations. On the other hand, complete teamster wage data are only available for the five cities, wages of all trades include additional cities, and the wages in some included trades are not directly comparable to those of teamsters. Also, the sets of trades and cities are inconsistent over time for "all trades".

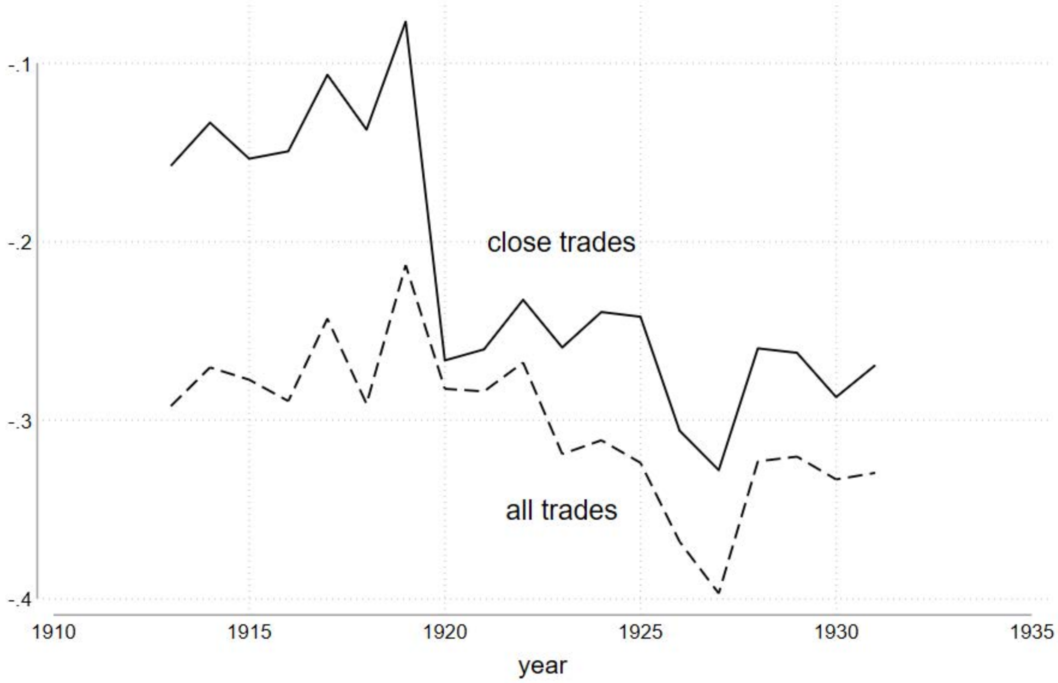
For close trades, we used occupations with wages close to teamster wages in 1896-1900 that had data for at least four of our five cities for the entire period. We define 'close' as a daily rate below $3 in 1896-1900. The highest daily rate for teamsters in that period was $2.74 in New York in 1898. Teamsters earned close to the lowest wages among those for whom we have wage data, so this restriction mainly eliminates higher-pay occupations. The resulting occupations are building trades laborers, carpenters, hod carriers, inside wiremen, painters in the building

[7] The Bulletin of the United States Bureau of Labor Statistics Nos. 143, 171, 194, 214, 245, 259, 274, 286, 302, 325, 354, 388, 404, 431, 457, 482, 515, 540, and 566.

[8] Cincinnati, Ohio and Philadelphia, PA also have complete time-series. Cincinnati was too small, while data on Philadelphia consists of two types of two-horse teamsters (general teamsters before 1921 and lumber drivers from 1921). Hence, its data are not comparable over time and thus excluded.

trades, and platen and cylinder press feeders.[9]

Figure 4: Wage differences between teamsters and other occupations (averages)



Notes: The figure shows wage differences between teamsters and the average wages of close trades or all trades. Wage differences are measured by subtracting the log weekly wage of close trades or all trades from the log weekly wage of teamsters. "Close trades" is the simple average of the log wage of all the close trades: building trade laborers, carpenters, hod carriers, inside wiremen, painters in building trades, and the two types of press feeders. These occupations are used as comparisons because 1) their wages were close to teamsters in 1896-1900, 2) they have data for at least 4 cities of interest, and 3) they have available data in 1913-1931. "All trades" is the average of all the selected trades and cities covered in each BLS bulletin. The sets of trades and cities are inconsistent over time for "all trades".

Figure 4 shows the city average wage levels for two-horse teamsters relative to close trades in the five cities. Compared to close trades, the teamster wage began increasing in 1917, peaked in 1919, collapsed after 1919, and then slightly

[9]Based on descriptions from the Bureau of Labor Statistics, building trades laborers are those who perform tasks involving physical labor in building trades; carpenters are those who construct, erect, install, or repair structures and fixtures made of wood and comparable materials; hod carriers are those who carry supplies to masons or bricklayers; inside wiremen are those who install, maintain, and repair electrical wiring, equipment, and fixtures indoors; painters (building trades) are those who apply paint, stain, and coatings to walls and ceilings, buildings, large machinery and equipment, and bridges and other structures; cylinder press feeders are those who load paper into the feeding tray of a printing press using a cylinder press; platen press feeders are those who load paper into the feeding tray of a printing press using a platen press.

recovered after 1927. Teamsters' wages relative to all trades have a similar pattern. The relative wage in 1931 was slightly lower than in 1913 for all trades and much lower for close trades. We do not, however, claim that the only reason for relative wage changes between 1929 and 1931 was the long-run response to the arrival of motor trucks. Apart from economy-wide events, teamsters' age composition changes could also have played a role.[10]

To examine the statistical significance of the changes, we estimate the equation below:

$$\begin{aligned} \ln weeklywage_{jct} = & \sum_{\tau=1917}^{1921} \beta_\tau Teamster \times \mathbb{1}\{\tau = t\} + \\ & \beta_{1922-26} Teamster \times \mathbb{1}\{1922 \leq t \leq 1926\} + \\ & \beta_{1927-31} Teamster \times \mathbb{1}\{1927 \leq t \leq 1931\} + \\ & \mu_{ct} + \gamma_{cj} + \eta_{jct} \end{aligned} \tag{16}$$

where $lnweeklywage_{jct}$ is the log weekly wage for occupation j in city c in year t, μ_{ct} are city-year fixed effects, and γ_{cj} are city-occupation fixed effects. βs are the coefficients of interest. 1913-1916 is the reference period. β_t (t = 1917, ..., 1921) measures the deviation of the teamster wage in year t from the aggregate wage trend, which can be attributed to some time-variant idiosyncratic shocks faced only by teamsters. $\beta_{1922-1926}$ and $\beta_{1927-1931}$ reflect the wage deviations in a similar sense for 1922-1926 and 1927-1931.

Figure 5 shows the estimation results. Consistent with the previous figures, teamsters' relative wages increased after 1917. In 1919, the wage increase was positive and marginally significant compared to 1913-1916. After 1920, teamster wages were lower than the reference period and showed no obvious recovery in the later periods.

Of course, it would be foolish to suggest that the wage increases in 1917-1919 can be explained only by teamsters' fear of obsolescence. For example, the run-up to the U.S. entry into World War I and the return of military equipment after the war might have increased demand for teamsters to haul military-related goods and equipment. To address this concern, we examine "revenue-tons of

[10]Figure B.3 in the appendix shows the results by occupation relative to close trades in Boston, Chicago, New York, St. Louis, and San Francisco, when reported by the BLS, and all trades in the full set of cities surveyed by the BLS, again subject to the caveat that the trades and cities are inconsistent from year to year. New York has no data on hod carriers; San Francisco has no data on inside wiremen in 1921; St. Louis has no data on press feeders (platen) in 1918-1919, and Boston has no data on press feeders (platen). The results for most individual occupations are consistent with our expectations except for building trades laborers.

Figure 5: Wage differences between teamsters and other occupations

Notes: The Figure shows the estimation results using Equation (1). Bars reflect 95% confidence intervals. The regression is weighted by the cities' male labor force.

railroad freight." Essentially, this counts the total tons of freight shipped by rail but does not double-count freight transferred from one train to another. The amount shipped was essentially flat from 1916 through 1920, except for a dip in 1919 (U.S. Bureau of the Census 1960) (p. 431). It is hard to reconcile the 1916-19 run-up of wages and their collapse in 1920 with the pattern for freight shipment.

4 Dressmakers and Milliners

While we have less data about dressmakers and milliners, they represent a useful supplementary occupation for our analysis because most dressmakers and milliners were women, unlike teamsters. Due to data limitations, our focus is on occupational mobility. We have no consistent data on earnings. In this section, we focus on the female labor force, as almost all dressmakers and milliners were females during the period of interest.

4.1 Historical Context

In 1900, almost 10% of the female labor force were dressmakers or milliners. Before the rise of ready-to-wear women's clothing, frequently sold in department stores, women's dresses and hats were custom-made in dress shops that were run and managed primarily by women who also mainly employed women. Since workers frequently switched between dressmaking and millinery, we combine the two occupations in the following analysis.

According to Gamber (1997), on which this subsection is based almost entirely, women's employment as dressmakers and milliners grew rapidly in the latter part of the 19th century. By 1870, dressmakers were the fourth largest female occupation, behind domestic servants, agricultural laborers, and seamstresses. In 1876, of 650 female proprietors in Boston, 191 were dressmakers, and 80 were milliners. In the later part of the century, women owned 95% of the dressmaking and millinery shops. By 1900, dressmakers were the third largest female occupation, and milliners ranked fourteenth. Significantly, dressmakers and milliners were skilled workers, unlike domestic servants, agricultural laborers, and seamstresses, who primarily sewed together pre-cut cloth for ready-to-wear men's clothing. The labor market valued the ability to cut the fabric to fit the individual woman who would wear the dress or hat. In 1913, expert milliners made $10-12/week, trimmers made $15-25/week, and designers $40-75/week. At the same time, two-horse male teamsters, as low-skilled workers, made $10-17/week. Milliners earned slightly lower wages, while trimmers and designers earned much higher wages than male teamsters. Milliners tended to have somewhat higher wages than dressmakers, which may have reflected the greater seasonality of their work.

Throughout the second half of the 19th century, numerous inventors developed 'scientific' methods designed to remove much of the skill needed for cutting dresses. Still, custom dressmaking declined only in the early 20th century. These methods typically allowed individuals to cut material and sew dresses based on simplified patterns. By 1900, these developments had increased home production, but dressmaking shops remained dominant. Perhaps more significantly, they appear to have paved the way toward a shift to ready-to-wear women's clothing. The rise of department stores after 1890 further contributed to this shift. Anecdotal evidence from the period suggests that the ready-made industry for women's clothing began to expand noticeably in the early 1900s and went on to supersede the custom dressmaking industry (Picken 1917).

We identify dressmakers and milliners in the census data using the following

Table 3: Dressmakers and Milliners Employment: 1860-1940

Year	Female dressmakers and milliners	Employed females	Fraction (%)
1860	55,485	1,201,704	4.62
1870	92,087	1,787,041	5.15
1880	202,871	3,844,357	5.28
1900	409,403	4,985,449	8.21
1910	434,791	8,297,956	5.24
1920	234,790	8,513,135	2.76
1930	149,172	10,864,060	1.37
1940	107,560	12,991,358	0.83

Notes : Table includes employed females who were 15 years old and over. Comparable census data in 1890 is not available.

Source: US Census

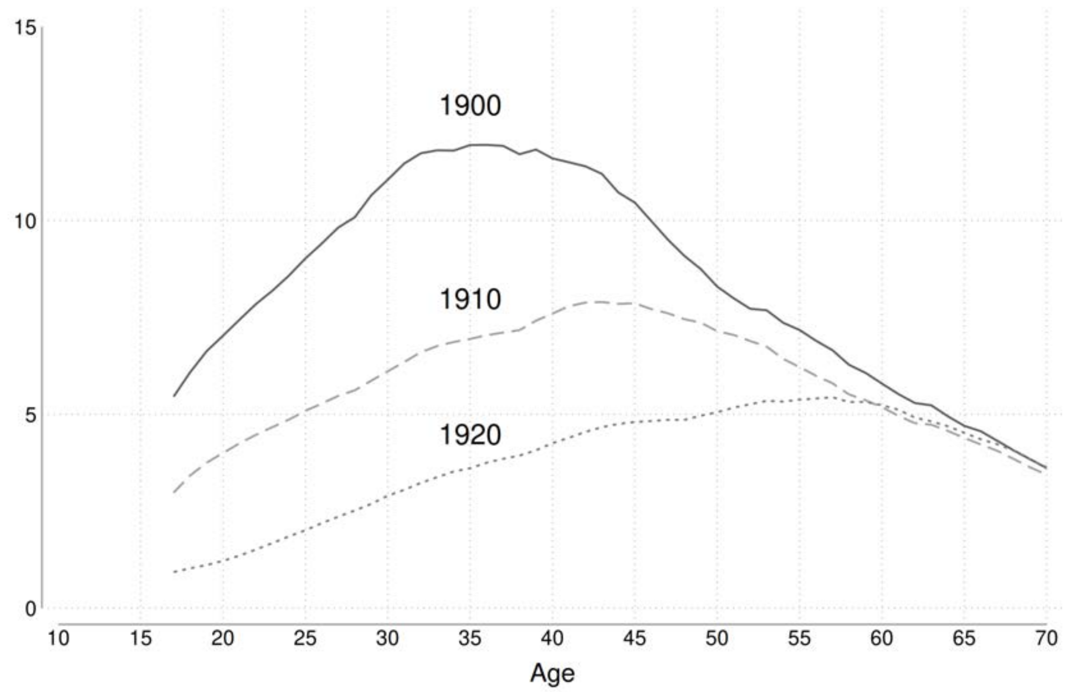
approach. First, we code dressmakers and milliners based on *occ1950,* the occupation classification variable in the full-count census. However, *occ1950* includes seamstresses, who are less skilled, in the same category as dressmakers. To accurately identify dressmakers and milliners, we exclude workers with keywords such as "seam" or "trim" in *occstr* except that we keep workers with "trim" if they are coded as milliners. Additionally, we add female workers whose *occstr* contains "dress" or "milliner" and drop workers whose *occstr* contain keywords such as "shoe" or "sale" who are likely to be shoemakers or saleswomen.

Table 3 shows dressmakers and milliners' employment in the early 20th century. Between 1860 and 1870, their employment increased in absolute numbers and as a proportion of female employment. Between 1870 and 1880, dressmakers and milliners expanded in absolute terms while remaining stable as a proportion of the female workforce. Employment increased dramatically in numbers and as a proportion between 1880 and 1900. Between 1900 and 1910, absolute employment increased slightly but declined as a proportion of the growing female labor force. After 1910, employment declined precipitously. Based on the discussion in Gamber (1997) and this evidence, we view 1900-10, or perhaps a bit later, as the anticipatory dread period. We place the arrival of the shock between 1910 and 1920.

4.2 The Aging of the Dressmaking & Millinery Workforce

Figure 6 shows the age distribution in dressmaking and millinery relative to the female workforce. Notably, although absolute employment grew between 1900 and 1910, the anticipatory dread period, the occupation began to age relative to the female workforce and continued aging through at least 1920, consistent with prediction (iii) in section 2.3. Dressmakers and milliners made up 8.59% of employed 25-year-old women in 1900 but just 5.01% in 1910, a decrease of roughly 42%. In comparison, the percentage of employed women over 55 who were dressmakers and milliners dropped from 5.27% to 4.82% or less than one-tenth. The aging of the occupation strengthened from 1910 to 1920. Dressmaking and millinery had become old women's jobs. Unfortunately, because we do not have access to the 1890 individual data, we cannot compare actual movement in the later period with the baseline. Nevertheless, the figure is strongly suggestive of the pattern we observed among teamsters. The shock likely increased the age of both new entrants and those remaining as dressmakers or milliners.

Figure 6: Dressmakers and Milliners Age Composition: 1900-1920



e

Notes : The figure shows the dressmakers and milliners share in employed females by age. We restrict ages to 17-70. The lines are smoothed using 5-year moving averages. Comparable census data in 1890 is not available.

5 Broader Lessons: The Predicament of Current Truckers

We find very mixed evidence regarding the current state of trucking employment. Different sources suggest different conclusions about whether we have entered the anticipatory dread period, but the clear aging of entrants and those remaining in the occupation suggests we have.

The American Trucking Associations (2021) trade group reports a current truck driver shortage of 'historic' proportions, significant increases in driver pay, and a high average age of current drivers. Our model can explain these movements within the framework of the anticipated arrival of a future shock to demand, which we associate with self-driving trucks. From this perspective, we appear to be in the anticipatory-dread stage of our model.

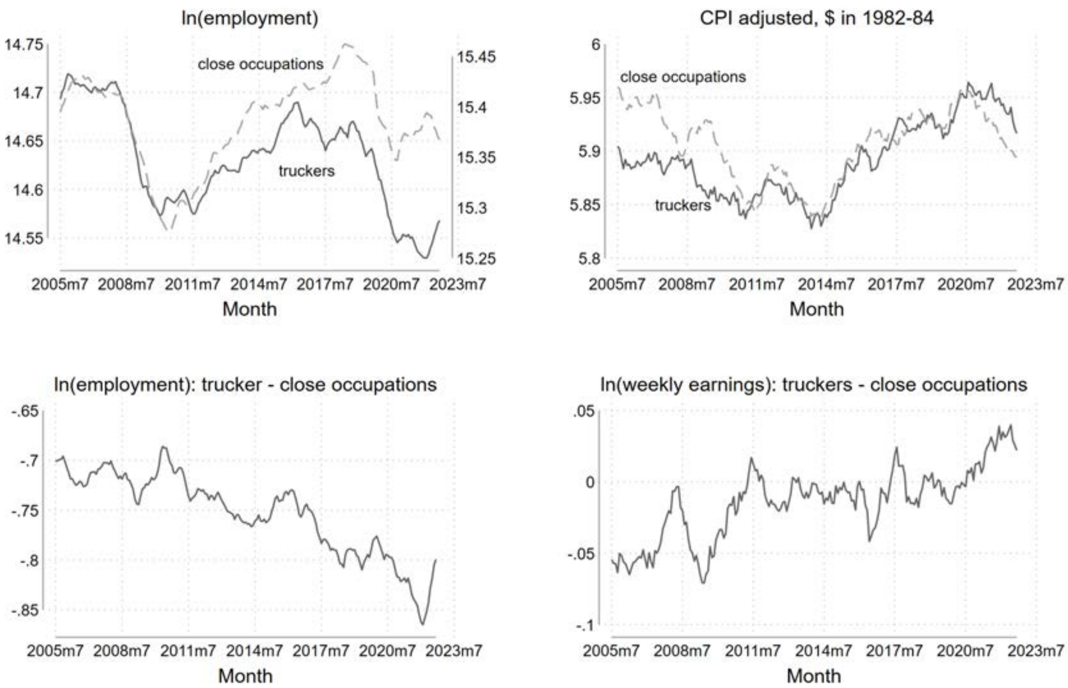
When commercially viable self-driving trucks will truly be readily available is highly uncertain. It seems to us that they have been "five years away" for a decade. Truck drivers seem to think that their arrival is sufficiently distant that self-driving trucks may be irrelevant for all but the youngest drivers (Shoag et al. 2022). Of course, while not in our model, implicitly, the workers who enter an occupation during the anticipatory-dread state should be those who view the arrival probability, λ, as low. Therefore, the views of current drivers may be misleading.

Whether truckers' wages are currently unusually high and their employment low depends on whom we include in the occupation, with whom we compare truckers, and which data source we rely on. If we rely on the Current Population Surveys (CPS), our preferred source because we can track movement in and out of the occupation, we see weak evidence consistent with recent entry into the anticipatory-dread stage.

Figure 7 uses the CPS data to show the employment and real weekly earnings for male truckers compared to the male labor force in close occupations. We define close occupations as those that truckers move from or to most frequently.[11] The sample only includes private employees and excludes the self-employed because they lack weekly earnings data. It suggests that while truckers' relative employment kept decreasing over time, a significant drop occurred around January 2020, just before the start of the pandemic, while their relative weekly earnings simul-

[11] Close occupations are 1) Laborers and Freight, Stock, and Material Movers, Hand, 2) Construction Laborers, 3) Retail Salespersons, and 4) First-Line Supervisors of Sales Workers. These occupations are among the top six occupations that truckers move from or to. We exclude Couriers and Messengers because it is a sufficiently small occupation that trucker flows might significantly affect earnings. We also exclude Managers (not elsewhere classified) because the average wage is much higher than trucker wages, making it not "close" to truckers.

Figure 7: Employment and Real Weekly Earnings for Truckers: 2005 - 2022



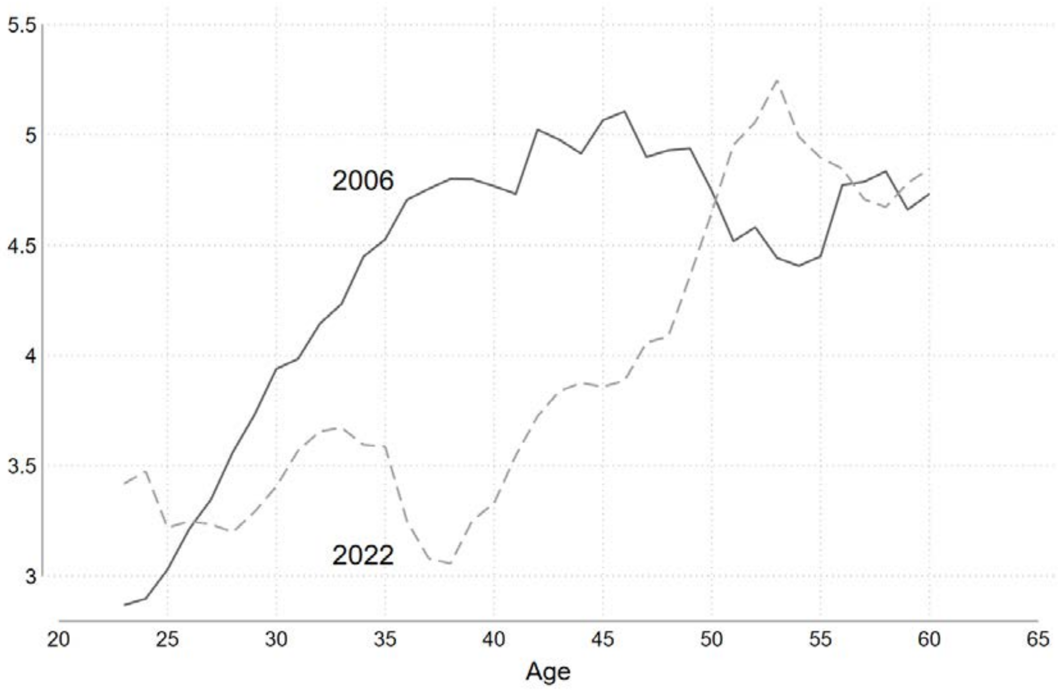
Notes: The figure shows the employment and real weekly earnings for truckers from July 2005 to September 2022. Sample includes male truckers in all industries (not restricted to the trucking industry) and male labor force in close occupations aged 23-60. The lines are smoothed using 13-month moving averages. Labor force excludes public sector workers, those working unpaid in a family business, and the self-employed (because weekly earnings are unavailable.

Source: CPS

taneously began to increase. Subsequently, around January 2022, there was a noticeable recovery in relative employment, but earnings did not decline until July 2022. The relative wages at the end of our period were close to the peak over the entire period. We can certainly read the recent data as suggesting the onset of anticipatory dread, the ongoing effects of the pandemic, or a blip.

Moreover, different choices lead to different results. For example, if we restrict truckers to those in the trucking industry, their employment remains stable in recent years, with a small peak around 2020. If we use Current Employment Statistics data and compare truckers with all workers in non-farm private employment, relative employment of truckers appears stable except for a peak in 2020 during the pandemic. If we use data from the American Community Surveys, we can show increasing trucker employment.

Figure 8: Current Trucker Age Composition: 2006 and 2022



Notes : The figure shows the trucker share in employed males by age. The sample includes truckers and male workers aged 23-60. The lines are smoothed using 5-year moving averages.
Source: CPS

Returning to the CPS, in Figure 8, we compare the age distributions of truckers in 2006 and 2022. We choose the former as it clearly precedes widespread expectations of the arrival of self-driving trucks and avoids any effects from the financial crisis and great recession. The figure visually confirms the industry report that the occupation has aged, consistent with prediction (iii) in section 2.3.

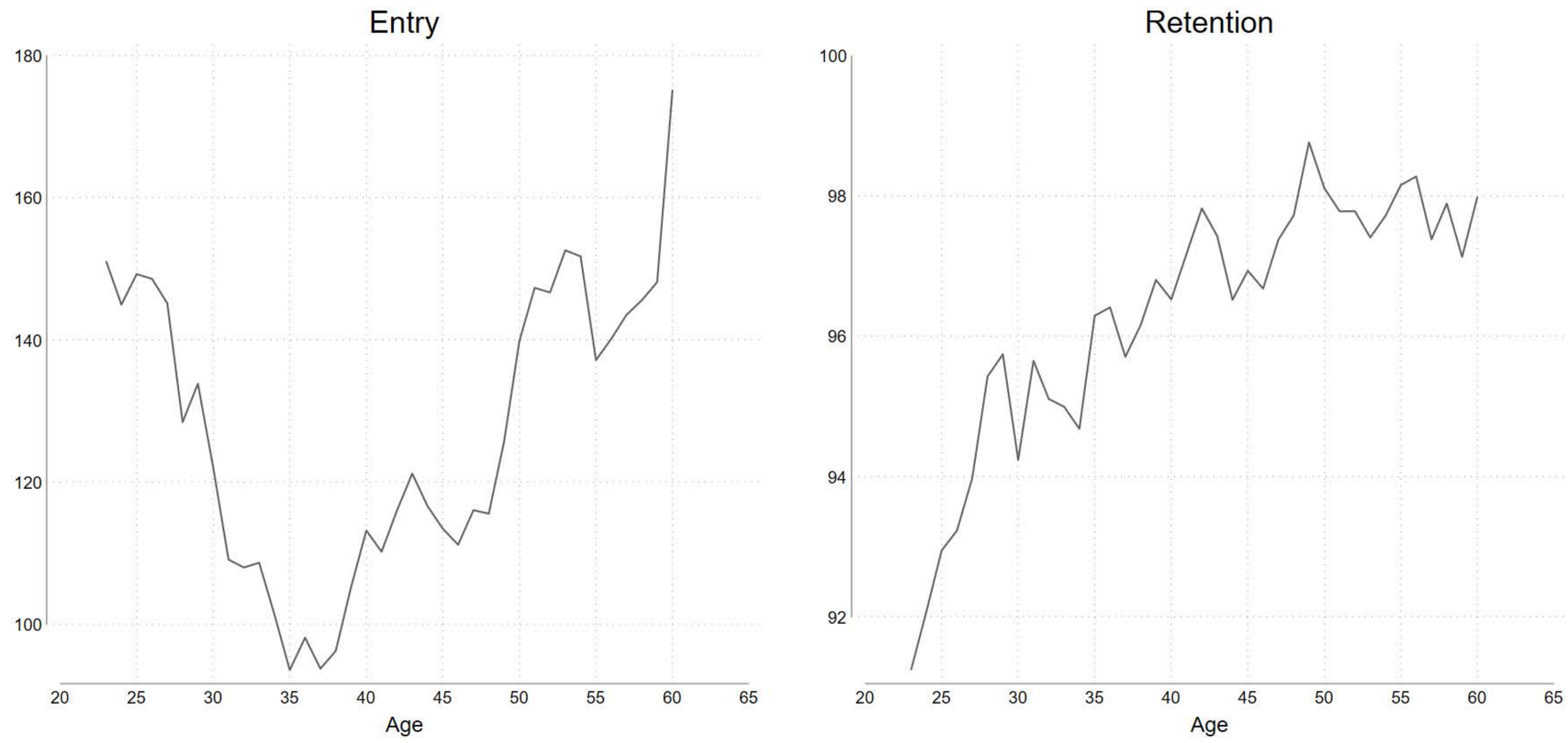
We use the linked CPS to examine entry to and retention in truck driving.[12] We compare entry and retention in May 2004 - April 2006 with those in May 2020 - April 2022. Figure 9 shows the results of this exercise. The entry rates notably exceed 100, while the retention rates are closer to 100. This distinction arises because entry is a flow value, thus more prone to fluctuations, whereas retention

[12]Our measures of age composition for workers who entered into and remained in truck driving are generated in a similar way as for teamsters and dressmakers and milliners. The main difference is that, here, aligning with the CPS data's structure, the movements are measured based on consecutive surveyed months, taking the former month as the reference month. For example, if a worker is observed to have a non-trucker occupation in January 2005, and the next time he is observed with an occupation is in March 2006, reporting to be a trucker, the worker will be coded as an entrant for January 2005.

is more stable as a stock value. The left panel suggests some aging of new entrants. The entry rates increase in age for workers older than 38, suggesting that more old workers enter the occupation. The average age of entrants increased by roughly 1.5 years between the two periods. Surprisingly, among the younger workers, the relative entry rate slopes downwards. On the other hand, the retention in the right panel shows a clear pattern of aging of the workers who remained in the occupation. While it would be premature to conclude definitively that we have entered a period of anticipatory dread, the aging of entry and retention adds credibility to this conclusion.

In sum, our model shows promise for understanding employment and earnings when technological change is on the horizon, a state that seems to be increasingly significant. Foresighted workers are reluctant to enter occupations at risk of obsolescence and receive a wage premium for doing so. Therefore, wages rise and employment falls while the age distribution shifts right in anticipation of the shock. These predictions are broadly consistent with the available data for teamsters at the dawn of the motor truck and dressmakers and milliners at the advent of ready-made clothing.

Figure 9: Trucker Entry and Retention by Age: May 2020 - Apr 2022 Relative to May 2004 - Apr 2006



Notes: The figure depicts the age composition of male truckers who either entered or remained in the trucker occupation during consecutive survey months. Specifically, it presents the average occupational transitions for individuals in each month, detailing the changes between the current survey month and the subsequent one when the same individual is re-interviewed. The figure is generated using the CPS data, and it's worth noting that the two months under investigation for occupation changes may not always be consecutive calendar months, aligning with the CPS data's structure. The left panel shows the entry rate from non-trucker to trucker occupation over consecutive survey months, averaged throughout May 2020 - April 2022, then divided by the corresponding rate in May 2004 - April 2006 (in percent). The entry rate is defined as the proportion of workers who transitioned into the trucker occupation in the following survey month, having been employed in occupations other than trucking in the current month while remaining employed in any occupation in the subsequent month. The right panel shows the retention rate of truckers over consecutive months, averaged throughout May 2020 - April 2022, then divided by the corresponding rate in May 2004 - April 2006 (in percent). The retention rate is the number of workers in the trucker occupation in both the current month and the next survey month divided by the number of truckers in the current month who were employed in any occupation in the next survey month. The sample is restricted to employed males aged 23-60 who could be matched over consecutive survey months. The lines are smoothed using 5-year moving averages.

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A Appendix: Proofs for Section 2

Before proving our main results, we need a few lemmata. First, we show that for any solution (V_N, V_D, V_A), the steady-states o_N^* and o_A^* are global attractors of $F \circ V_N$ and $F \circ V_A$ respectively.

Lemma 1. *For* $s \in \{N, A\}$*,* $o \underset{(>)}{<} o_s^* \implies (F \circ V_s)^2(o) \underset{(<)}{>} o$

Proof. We show that $o{<}o_s^* \implies (F \circ V_s)^2(o){>}o$; the other case is proven symmetrically. Define $z : [0,1] \to [0,1]$ via $z(o) = (F \circ V)^2(o) - o$ and claim for contradiction that there is an $o' < o^*$ such that $z(o') < 0$. Because the range of F is $[0,1]$, $z(0) \geq 0$. Thus from continuity of z and the intermediate value theorem there must be some $x \in [0, o']$ such that $z(x) = 0$. Which would mean that $(F \circ V)^2(x) = x$. But then for any $n > 0$, $w((F \circ V)^n(x) + (F \circ V)^{n-1}(x))) = w(F(V(x)) + x)$ so that the wage is constant. As the wage is constant, so is the number of entrants $F(V(x))$, and hence x is a steady-state. But since $x < o' < o^*$ and since o^* is the unique steady-state, we have a contradiction. □

Lemma 2. *For* $s \in \{N, A\}$*,* $o \underset{(>)}{<} o_s^* \implies (F \circ V_s)^2(o) \underset{(>)}{<} o_s^*$

Proof. We show that $o < o_s^* \implies (F \circ V_s)^2(o) < o_s^*$; the other case is proven symmetrically. We proceed by contradiction again, via two sub-cases.

(Case A.) Suppose $o < o^*$, $F(V(o)) < o^*$ and $(F \circ V)^2(o) > o^*$. From o^* being the steady-state, we have that $V(o^*) = (1+\delta)w(2o^*)$. From F strictly increasing and $F(V(o)) < o^*$, we have

$$w(o + F(V(o))) + \delta w(F(V(o)) + (F \circ V)^2(o)) < (1+\delta)w(2o^*). \tag{17}$$

From F strictly increasing and $(F \circ V)^2(o) > o^*$, we have

$$w((F \circ V)^2(o) + F(V(o))) + \delta w((F \circ V)^3(o) + (F \circ V)^2(o)) > (1+\delta)w(2o^*). \tag{18}$$

From Lemma 1 and $F(V(o)) < o^*$ we have that $(F \circ V)^3(o) > F(V(o))$. From this and the strictly decreasing nature of w, we have

$$w((F \circ V)^3(o)) + (F \circ V)^2(o)) < w(F(V(o)) + (F \circ V)^2(o)). \tag{19}$$

Combining this with (18), we obtain

$$w(F(V(o)) + (F \circ V)^2(o)) > w(2o^*). \tag{20}$$

Now, we can use this and (17) to derive

$$w(o + F(V(o))) < w(2o^*). \tag{21}$$

However, ex hypothesi both $o < o^*$ and $F(V(o)) < o^*$, so that given that w is strictly decreasing, we have a contradiction.

(Case B.) Suppose $o < o^*$, $F(V(o)) > o^*$ and $(F \circ V)^2(o) > o^*$. From $F(V(o)) > o^*$, the strictly increasing nature of F, and $V(o^*) = (1 + \delta)w(2o^*)$, we have

$$w(o + F(V(o))) + \delta w(F(V(o)) + (F \circ V)^2(o)) > (1 + \delta)w(2o^*). \tag{22}$$

From $(F \circ V)^2(o) > o^*$ and similar reasoning, we have

$$w(F(V(o)) + (F \circ V)^2(o)) + \delta w((F \circ V)^2(o) + (F \circ V)^3(o)) > (1 + \delta)w(2o^*). \tag{23}$$

As ex hypothesi $F(V(o)) > o^*$ and $(F \circ V)^2(o)) > o^*$, and w is a strictly decreasing function, 23 implies that $(F \circ V)^3(o)) < o^*$. In other words, from the fact that F is strictly increasing,

$$w((F \circ V)^2(o) + (F \circ V)^3(o)) + \delta w((F \circ V)^3(o) + (F \circ V)^4(o)) < (1 + \delta)w(2o^*). \tag{24}$$

Now, we use Lemma 1 and $F(V(o)) > o^*$ to obtain

$$(F \circ V)^3(o) < F(V(o)) \tag{25}$$

and similarly Lemma 1 and $(F \circ V)^2(o) > o^*$ to obtain

$$(F \circ V)^4(o) < (F \circ V)^2(o). \tag{26}$$

Thus from the fact that w is strictly decreasing,

$$w((F \circ V)^3(o) + (F \circ V)^4(o)) > w(F(V(o)) + (F \circ V)^2(o)). \tag{27}$$

Now, from combining (23), (24), and (27), we have

$$(1 - \delta)w((F \circ V)^2(o) + (F \circ V)^3(o)) < (1 - \delta)w(F(V(o)) + (F \circ V)^2(o)) \tag{28}$$

which, from the fact that w is strictly decreasing implies $(F \circ V)^3(o) > F(V(o))$, contradicting (25). □

Lemmata 1 and 2 along with continuity make o_N^*, o_A^* global attractors. Moreover, it is easy to see that $F(V_N(\cdot))$ and $F(V_A(\cdot))$ are injective. As a consequence, $F(V_N(\cdot))$ and $F(V_A(\cdot))$ are strictly decreasing and so are V_N and V_A.

Lemma 3. *For $s \in \{N, A\}$, $o \underset{(>)}{<} o_s^* \implies F(V_s(o)) \underset{(<)}{>} o_s^*$*

Proof. Again, we show that $o<o_s^* \implies F(V_s(o))>o_s^*$ and leave the case with the reversed inequalities to the reader. Suppose $o < o^*$ and $F(V(o)) < o^*$ for contradiction. From Lemma 2, we have $(F \circ V)^2(o) < o^*$. Therefore, from w decreasing, we have

$$V(o) = w(o+F(V(o)) + \delta w(F(V(o) + (F \circ V)^2(o)) > (1+\delta)w(2o^*) = V(o^*) \quad (29)$$

and therefore, from F increasing, $F(V(o)) > F(V(o^*)) = o^*$, a contradiction. □

Lemma 4. *In the no-shock and aftermath cases, wages are decreasing as a function of old workers: $w_s(o + F(V_s(o)))$ decreases in o.*

Proof. Suppose for contradiction that $o_1 > o_2$ and $w(o_1 + F(V(o_1))) > w(o_2 + F(V(o_2)))$. Then, from the fact $F \circ V$ is strictly decreasing, $(F \circ V)^n(o_1) < (>)(F \circ V)^n(o_2)$ for n odd (even). From $w(o_1 + F(V(o_1))) > w(o_2 + F(V(o_2)))$ and $F(V(o_1)) < F(V(o_2))$, which implies

$$\begin{aligned} &w(o_1 + F(V(o_1))) + \delta w(F(V(o_1)) + (F \circ V)^2(o_1)) \\ &< w(o_2 + F(V(o_2))) + \delta w(F(V(o_2)) + (F \circ V)^2(o_2)). \end{aligned} \quad (30)$$

Via rearrangement, we have

$$\begin{aligned} &w(o_1 + F(V(o_1))) - w(o_2 + F(V(o_2))) \\ &< \delta[w(F(V(o_2))) + (F \circ V)^2(o_2))) - w(F(V(o_1) + (F \circ V)^2(o_1)))] \end{aligned} \quad (31)$$

which generalizes via an inductive argument to

$$\begin{aligned} &0 < w(o_1 + F(V(o_1))) - w(o_2 + F(V(o_2))) \\ &< \delta^n[w((F \circ V)^n(o_2) + (F \circ V)^{n+1}(o_2)) - w((F \circ V)^n(o_1) + (F \circ V)^{n+1}(o_1))] \end{aligned} \quad (32)$$

for all n odd, which (eventually) contradicts the bounded range of w. □

Lemma 4 plays a role in Propositions 1 and then 2. Proposition 1 is proven by showing that if there were two solutions, wage differences *today* can only be sustained if *future* wage differences explode, contradicting the assumption of bounded wages.[13]

Proposition 1. *The solution* (V_N, V_A, V_D) *is unique.*

Proof. Suppose for contradiction that V_N and $\hat{V}_N$ solve (2), and that wlog $V_N(o) > \hat{V}_N(o)$ for some $o \in [0,1]$. Then by F strictly increasing, $F(V_N(o)) > F(\hat{V}_N(o))$. By w_h strictly decreasing, $w_h(o + F(V_N(o))) < w_h(o + F(\hat{V}_N(o)))$, and therefore to satisfy $V_N(o) > \hat{V}_N(o)$, using (2),

$$\begin{aligned} &w_h(F(V_N(o)) + (F \circ V_N)^2(o)) - w_h(F(\hat{V}_N(o)) + (F \circ \hat{V}_N)^2(o)) > \\ &\frac{1}{\delta}\left[w_h(o + F(\hat{V}_N(o))) - w_h(o + F(V_N(o)))\right] > 0. \end{aligned} \tag{33}$$

From w_h strictly decreasing, then, $F(V_N(o)) + (F \circ V_N)^2(o) < F(\hat{V}_N(o)) + (F \circ \hat{V}_N)^2(o)$. From $V_N(o) > \hat{V}_N(o)$, and F strictly decreasing, we have $(F \circ V_N)^2(o) < (F \circ \hat{V}_N)^2(o)$, and thus $V_N(F(V_N(o))) < \hat{V}_N(F(\hat{V}_N(o)))$. Using (2), we have

$$\begin{aligned} &w_h((F \circ \hat{V}_N)^2(o) + (F \circ \hat{V}_N)^3(o)) - w_h((F \circ V_N)^2(o) + (F \circ V_N)^3(o)) > \\ &\frac{1}{\delta}\left[w_h(F(V_N(o)) + (F \circ V_N)^2(o)) - w_h(F(\hat{V}_N(o)) + (F \circ \hat{V}_N)^2(o))\right] > \\ &\left(\frac{1}{\delta}\right)^2\left[w_h(o + F(\hat{V}_N(o))) - w_h(o + F(V_N(o)))\right] > 0, \end{aligned} \tag{34}$$

where the second inequality follows from (33).

More generally, $w_h((F \circ \hat{V}_N)^{2n}(o) + (F \circ \hat{V}_N)^{2n+1}(o)) - w_h((F \circ V_N)^{2n}(o) + (F \circ V_N)^{2n+1}(o)) > \left(\frac{1}{\delta}\right)^{2n}\left[w_h(o + F(\hat{V}_N(o))) - w_h(o + F(V_N(o)))\right] \to \infty$ which contradicts the bounded domain of w_h. The same argument shows V_A is unique as well. To apply the argument to V_D, we simply make use of Lemma 4 and the uniqueness of V_A to get monotonicity of the wage in the aftermath stage. □

We can now prove Proposition 2:

Proposition 2. $F(V_D(\cdot))$ *has a unique steady-state* o_D^*.

Proof. As $F(V_A(\cdot))$ is decreasing, and from Lemma 4 so are aftermath wages $w_l(o + F(V_A(o)))$ as a function of o, the steady-state equation for $F(V_D(\cdot))$,

$$F(V_D(o)) = F((1 + \delta(1 - \lambda))w_h(2o) + \lambda\delta w_l(o + F(V_A(o)))) = o, \tag{35}$$

[13] In fact, wages being bounded below by 0 is sufficient for our results; we only assume an upper bound for convenience.

has a LHS decreasing in o and a RHS increasing in o. Thus, by continuity, it has a unique solution o^*_D. $\square$

Lemma 5. *There are more workers in the anticipatory-dread steady-state than in the aftermath steady-state: $o^*_D > o^*_A$. Furthermore, the steady-state wage is higher in the anticipatory-dread steady state: $w_h(2o^*_D) > w_l(2o^*_A)$.*

Proof. For the first part, suppose for contradiction $o^*_A > o^*_D$. From (6), (7), and F increasing, this implies

$$(1+\delta(1-\lambda))w_h(2o^*_D) + \lambda\delta w_l(o^*_D + F(V_A(o^*_D))) < (1+\delta)w_l(2o^*_A). \tag{36}$$

From $o^*_A > o^*_D$ and Lemma 4,

$$w_l(2o^*_A) < w_l(o^*_D + F(V_A(o^*_D))). \tag{37}$$

From $o^*_A > o^*_D$ and Lemma 3 we have that

$$F(V_A(o^*_D)) > o^*_A > o^*_D, \tag{38}$$

so that from w_l decreasing we have

$$w_l(F(V_A(o^*_D)) + o^*_D) < w_l(2o^*_D). \tag{39}$$

From $w_h > w_l$ and (37), we have $w_l(2o^*_A) < w_l(2o^*_D) < w_h(2o^*_D)$. Combining this with (37) we arrive at a contradiction to (36).

For the second part of the statement, notice that $o^*_D > o^*_A$ implies $F(V_D(o^*_D)) > F(V_A(o^*_A))$. This and the fact F is strictly decreasing in turn give us

$$(1+(1-\lambda)\delta)w_h(o^*_D) + \lambda\delta w_l(o^*_D + F(V_A(o^*_D))) > (1+\delta)w_l(2o^*_A). \tag{40}$$

From $o^*_D > o^*_A$ and Lemma 4, $w_l(o^*_D + F(V_D(o^*))) < w_l(2o^*_A)$. From this and (40), we have that $w^*_h(2o^*_D) > w_l(2o^*_A)$. $\square$

Lemma 6. $w_h(2o^*_D) > w_l(o^*_D + F(V_A(o^*_D)))$.

Proof. From Lemma 5 $o^*_D > o^*_A$; from Lemma 4 and this, $w_l(o^*_D + F(V_A(o^*_D))) < w(2o^*_A)$. From the second part of Lemma 5, $w^*_h(2o^*_D) > w_l(2o^*_A)$, and thus $w_h(2o^*_D) > w_l(o^*_D + F(V_A(o^*_D)))$. $\square$

We can now use Lemma 6 to prove Proposition 3:

Proposition 3. *The steady-state numbers of old workers satisfy* $o_N^* > o_D^* > o_A^*$ *and* $w_h(2o_D^*) > w_h(2o_N^*) > w_l(2o_A^*)$.

Proof. We begin with wages, and proceed separately for each of the two inequalities. First, from F increasing, $w_h > w_l$, w_h and w_l strictly decreasing, we have that $w_l(2o_A^*) < w_h(2o_N^*)$. Now suppose for contradiction that $w_h(2o_D^*) \leq w_h(2o_N^*)$. Then, $o_D^* \geq o_N^*$ from the fact that w_h is strictly decreasing. Using (5) and (7), as well as the fact F is strictly increasing, we deduce

$$(1+\delta)w_h(2o_N^*) \leq (1+\delta(1-\lambda))w_h(2o_D^*)+\lambda\delta w_l(o_D^*+F(V_D(o_D^*))) < (1+\delta)w_h(2o_D^*), \tag{41}$$

where the last bit follows from Lemma 6's implication that $w_h(2o_D^*) > w_l(o_D^* + F(V_D(o_D^*)))$, yielding a contradiction. Thus $w_h(2o_D^*) > w_h(2o_N^*) > w_l(2o_A^*)$.

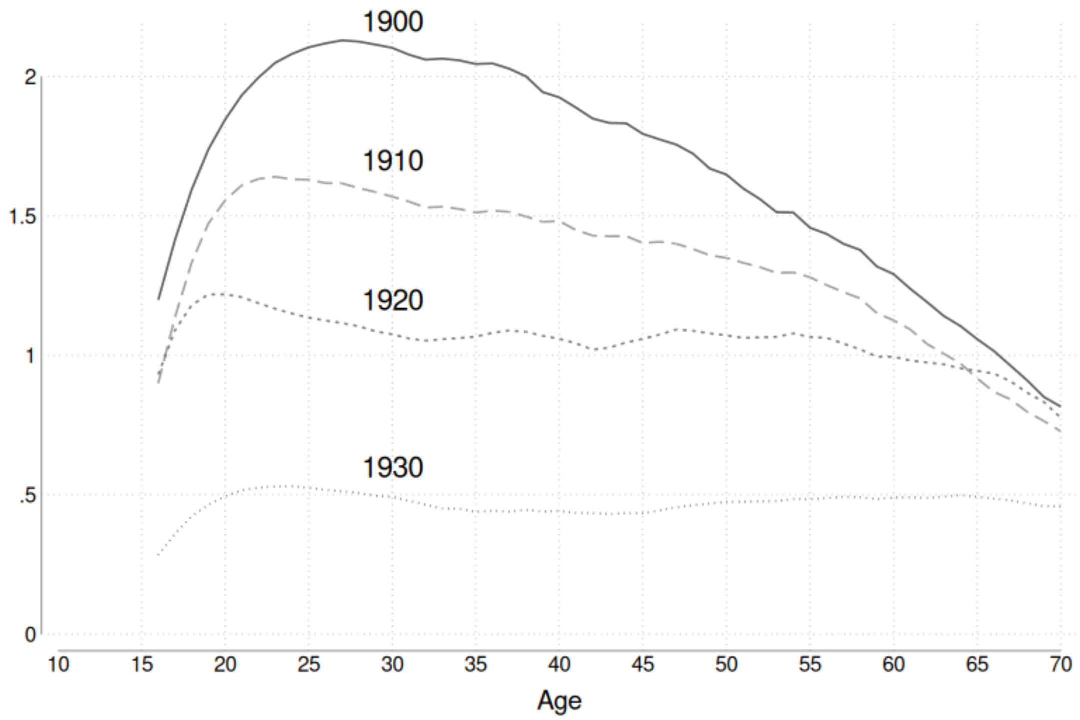
To show that $o_N^* > o_D^* > o_A^*$, we have but to use the monotonicity of w_h and $w_h(2o_D^*) > w_h(2o_N^*)$ for the first inequality, and Lemma 5 for the second one. □

Proposition 4. $w_l(2o_A^*) > w_l(o_D^* + F(V_A(o_D^*)))$.

Proof. From Lemma 4, $w_l(o+F(V_A(o)))$ is decreasing in o, so that from w_l decreasing, $o+F(V_A(o))$ is increasing in o. From Proposition 3, $o_A^* < o_D^*$. Combining these facts, $o_D^* + F(V_A(o_D^*)) > 2o_A^*$. Thus, from w_l decreasing, $w_l(o_D^* + F(V_A(o_D^*))) < w_l(2o_A^*)$. □

B Appendix: Supplementary Figures

Figure B.1: Teamster Age Composition: 1900-1930

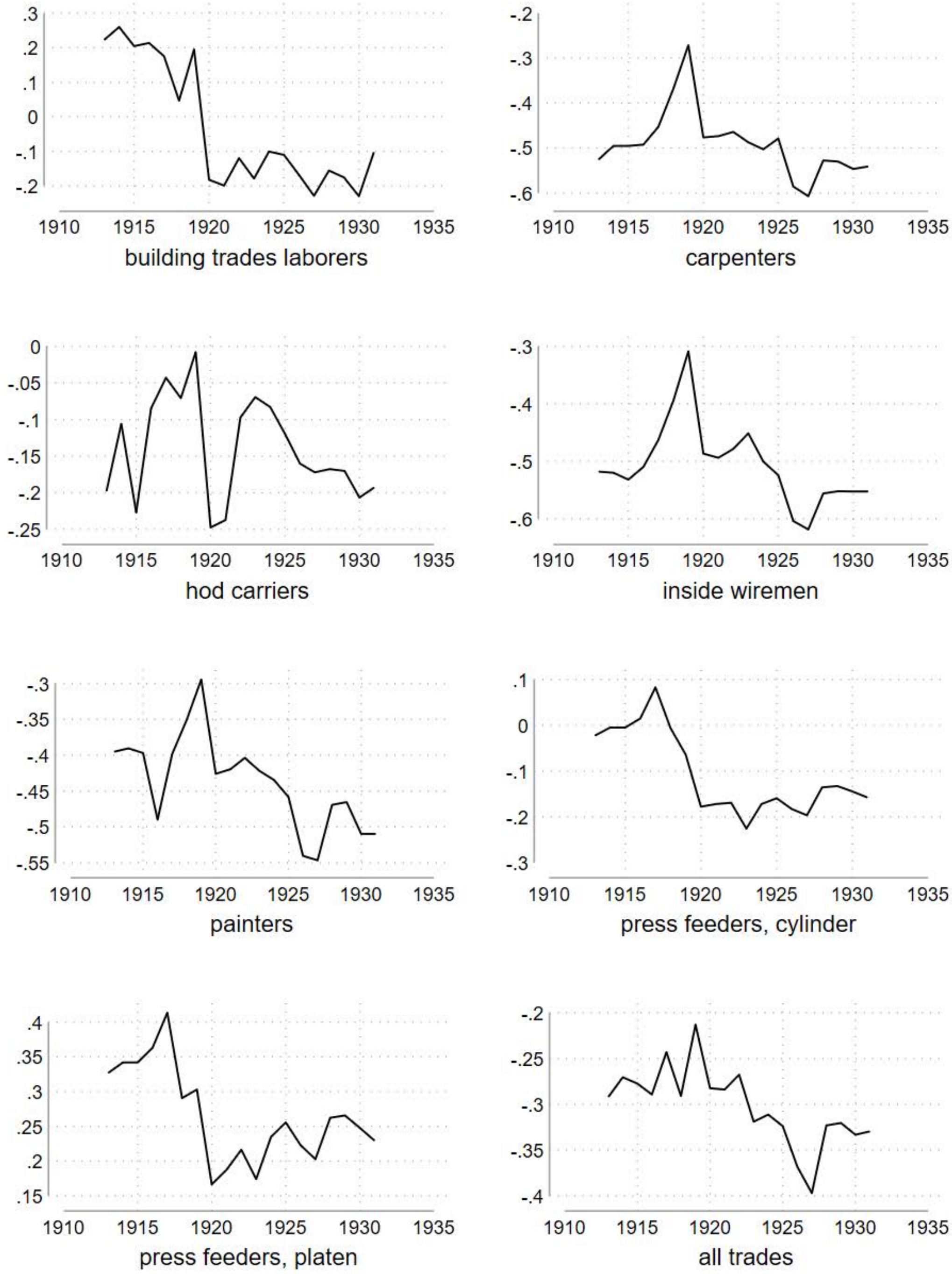


Notes: The figure shows the teamster share in employed males by age. We restrict ages to 16-70. The lines are smoothed using 5-year moving averages.

Figure B.2: Teamster Age Composition: 1960

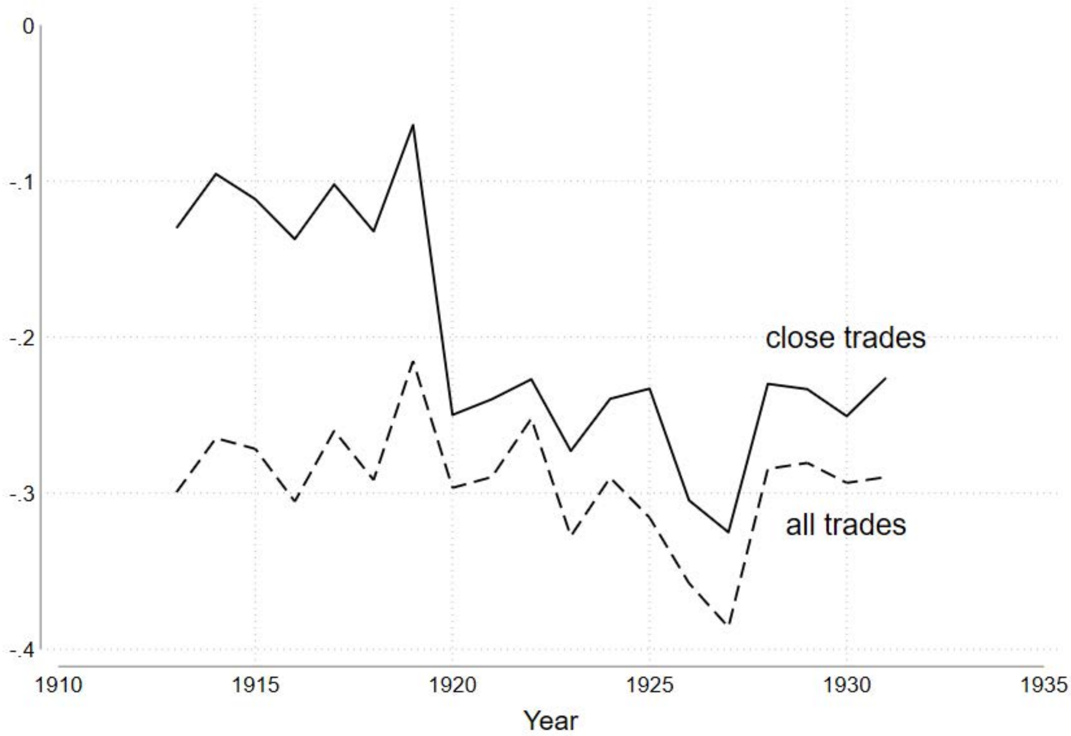
Notes : The figure shows the teamster share in employed males by age generated using the IPUMS census sample 1960 (5%). The 1960 census sample does not have the variable *occstr*, so we have to use only *occ1950* to identify teamsters. We restrict ages to 16-70. The lines are smoothed using 5-year moving averages.

Figure B.3: $\ln w_{\text{teamster}} - \ln w_{\text{other}}$



Notes : The figures show wage differences between teamsters and other occupations. Wage differences are measured by subtracting the log weekly wages of close trades or all trades from the log weekly wages of teamsters. The differences are then weighted by cities male labor force to get an average. Aside from "all trades" in the last panel, other occupations are used as comparisons because they are close occupations to teamsters. Occupations are used for comparison if 1) their wages are close to teamsters in 1896-1900, 2) they have data for at least 4 cities of interest, and 3) they have available data in 1913-1931. For the last panel, "all trades" is the average of all the selected trades and cities covered in each BLS bulletin. The sets of trades and cities are inconsistent over time for "all trades".

Figure B.4: Wage differences between teamsters and other occupations (averages): Excluding Chicago



Notes: The figure shows wage differences between teamsters and the average wages of close trades or all trades. Chicago is dropped from the analysis to avoid potential disruption from their strong union. Wage differences are measured by subtracting the log weekly wage of close trades or all trades from the log weekly wage of teamsters. "Close trades" is the simple average of the log wage of all the close trades: building trade laborers, carpenters, hod carriers, inside wiremen, painters in building trades, and the two types of press feeders. These occupations are used as comparisons because 1) their wages are close to teamsters in 1896-1900, 2) they have data for at least 4 cities of interest, and 3) they have available data in 1913-1931. "All trades" is the average of all the selected trades and cities covered in each BLS bulletin. The sets of trades and cities are inconsistent over time for "all trades".

Figure B.5: Wage differences between teamsters and other occupations: Excluding Chicago

Notes : The Figure shows the estimation results using Equation (1). Chicago is dropped from the analysis to avoid potential disruption from their strong union. Bars reflect 95% confidence intervals. The regression is weighted by the cities' male labor force.