Obsolescence Rents: Teamsters, Truckers, and Impending Innovations

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· **EXTENDED ABSTRACT** ·

The aftermath of negative labor demand shocks is well-studied in seminal work such as Dorn et al. (2009) and Autor, Dorn, and Hanson (2016). We focus our attention on a related, but nevertheless understudied topic: the behavior of labor markets when a demand shock is anticipated, but hasn't quite arrived.

We consider large, permanent shocks to individual occupations whose arrival date is uncertain. We are motivated by the (nearly) inevitable arrival of self-driving trucks, which will reduce demand for truck drivers dramatically. However, 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 years. Truck drivers seem (Shoag, Strain, and Veuger (2022)) to think that also, and we wish to study how this anticipation should impact their labor market.

We develop an overlapping generations (OLG) model in which the labor market is in steady-state before the announcement of a future technological change. The change will greatly reduce the demand for some occupation - say, widgeters. The exact arrival of the new technology is unknown but is believed to occur at a constant hazard. There are two phases of interest: the anticipatory stage before the shock arrives, and the adjustment stage after it arrives.

The results regarding the post-shock *aftermath* stage are standard. The sudden decline in demand for widgeters reduces widgeters' wage and those who can, take other jobs. As older widgeters retire, the wage rises towards a new steady state (although not necessarily approaching it monotonically), with lower employment and a lower wage than the initial one.[1]

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[1] Drawing informally on Cavounidis and Lang (2020), we anticipate that older widgeters will shift to closely related jobs that are less adversely affected by the new technology while younger widgeters will 'retrain' for the new jobs.

More importantly, in the *anticipatory dread* stage, young workers expect that the wage of widgeters may decline dramatically in their lifetime. With imperfect mobility, they must be compensated to become widgeters - receiving what we dub *obsolescence rents*. At the same time, the number of widgeters falls. The risk that the shock will hit is more costly for younger workers, who may find themselves stuck in a low-demand occupation for longer. Therefore, the age distribution of workers in the occupation shifts to the right.

We then apply the model to the effect of the arrival of motor trucks on teamsters, workers who drove vehicles drawn by teams of horses. These vehicles were the primary means for delivering goods locally. Long-distance freight was primarily handled by railroad.[2]

We draw on two sources for our data. First, the Bureau of Labor Statistics collected union wages in selected cities from 1913-1931. We compare two-horse teamsters with some close occupations and "all trades." Second, we identify teamsters in the decennial censuses from 1880-1930, except for the 1890 census, which was largely destroyed by fire. We use linked census data to follow workers who work as teamsters in either of two adjacent census years. Thus, conditional on a link between the two censuses, we can, for example, examine the 1920 occupations of individuals who were teamsters in 1910 and the 1910 occupations of individuals who were teamsters in 1920. The analysis we have conducted thus far largely confirms our expectations.

The American Trucking Associations (2021) trade group reports a current truck driver shortage of 'historic' proportions, along with both 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.

1 A model of shocks to occupational demand, and its predictions

Time is discrete $t \in \mathbb{Z}$ and, for simplicity, we posit that the future arrival of the shock is announced between periods 0 and 1. The shock then arrives at each $t \geq 1$ at constant hazard λ. We view λ as expressing the degree to which workers perceive they have advance notice of the shock.[3] We might think that water carriers had more advance notice of the aqueduct than teamsters had of the truck, who in turn had more time to react than travel agents had to booking websites.

Before the shock, widgeters' wage is set by the inverse demand function $w(\cdot, h) : \mathbb{R}_+ \to \mathbb{R}_+$, which maps the total number of widgeters, old and young, to the wage. After the shock, the wage is set by $w(\cdot, l)$. As we consider negative shocks, $w(\cdot, h) > w(\cdot, l)$; in other words, a widgeter's wage is strictly lower after the shock for a given number of

[2]It is likely that motor trucks also negatively affected demand for rail-related occupations although somewhat later, but we have not yet fully investigated whether there are suitable occupations for us to study.

[3]The assumption of stochastic, rather than deterministic, shock generates a Markovian environment to do our analysis in, which is more tractable.

widgeters. We assume both demand functions are strictly decreasing.

We think of workers as choosing occupations in search of good wages but also following their preferences. As a reduced-form way to model this, we treat non-widgeting wages as a constant outside option and assume that the number of young workers who become widgeters in time t is $g(w_t + E[w_{t+1}])$, where w_t and w_{t+1} are the wages for widgeters in the lifetime of the workers in question. We assume the widgeter labor supply function, g, satisfies $g > 0$, $g' > 0, g'' < 0$. Initially, workers' choice of a job in youth is assumed to be final; they cannot switch jobs in their second productive period. We relax this assumption later.

Our first finding is that, in the anticipatory dread stage, the number of widgeters falls and their wage increases. The reason is simple: in the aftermath stage, lower demand will lead to lower wages. Thus, workers must be paid a premium, an *obsolescence rent*, to commit to a job (learn a skill) that may soon pay little. As demand is downward-sloping, it must be that fewer workers are becoming widgeters. In the aftermath, wages collapse to below the original steady-state wage, and widgeter employment plummets below that in the anticipatory dread phase. Thus the overall dynamics are **a wage increase paired with a decrease in employment, followed by decreases in both wages and employment**.

We also find that if the hazard rate of the shock is higher, wages increase more in the period when the shock is announced. Moreover, wages in the anticipatory dread stage converge over time to a higher level.

Additionally, we show that older widgeters benefit from the announcement of a future shock. In particular, young workers are particularly wary of the risk of the shock. Therefore, fewer choose to become widgeters. This raises widgeter wages. If the shock is unlikely to arrive before older widgeters retire, they will benefit in expectation. Naturally, if the future shock might have hit during some a widgeter's lifetime, but doesn't, that worker is better off than if there were no shock anticipation - but this is an ex-post judgment.

We then extend the model to allow some, randomly chosen, workers to switch occupations every period.[4] This allows us to measure the effect of labor mobility on the wage and age composition of widgeters. We find that, in the anticipatory dread stage, there is a net inflow of older workers. Thus, **widgeting becomes 'grayer'** than other occupations. Further, increased worker mobility attenuates both the wage increase and the employment reduction for widgeters in the anticipatory dread stage. Thus, older widgeters benefit less as mobility increases.

When mobility is low, an increase in the mobility probability increases total employment in widgeting, but decreases the number of young widgeters. Simply, mobile old workers become widgeters once it is clear the shock won't hit before they retire; at that point, they can reap obsolescence rents without risk. This reduces obsolescence rents, in turn reducing the number of young widgeters. As the level of mobility increases further, eventually it is the case that being stuck as a widgeter in the aftermath is both less

[4]Each worker, every period, has a fixed probability of being able to change jobs, as though visited by a fairy much like the one in Calvo (1983).

common (as any individual worker has a good chance of being allowed to move) and less painful (as the aggregate movement out of widgeting will blunt the impact of the shock on wages). Thus, the age differential eventually dissipates as mobility becomes large.[5]

Though our OLG model is well-suited to studying the effects of the shock and its announcement by cohort, it is less apt to study the effect of foresight. To that end, we develop a perpetual-youth continuous-time model, in which workers are born, choose an occupation, and produce until they retire, which occurs at a constant hazard. We make the arrival of the shock deterministic. We study the effect of the shock on the lifetime wages of those who are widgeters today. We find that the loss to workers due to the shock is convex and decreasing in the shock's delay. A bit of foresight goes a long way. As younger cohorts choose other occupations, not only is the effect of the shock blunted, but also the recovery towards the steady state is made faster. Obsolescence rents initially rise, but eventually fall, as we push the shock's arrival date further into the future. Intuitively, current widgeters will gain no obsolescence rents from the announcement of the future shock if the announcement gives almost no advance notice of the shock. This is both because the anticipatory dread period won't last, and because the number of widgeters will not have enough time to collapse. But, if the announcement gives some genuine warning, existing widgeters will benefit from the wage rise as new potential widgeters are reluctant to enter the occupation. However, if the arrival time of the shock becomes infinitely distant, the discounted loss goes to zero and potential widgeters are (almost) as willing to enter the occupation as in the absence of the shock.

2 Historical context

The arrival of motor trucks 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). In fact, 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, that 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, it remained to be determined whether motor trucks would be driven by steam, electricity, or gasoline. 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 trucks in the United States grew rapidly in the first three decades of the 20th century, but, as shown in Figure 1, 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, with most of the increase in trucks occurring late in the decade. In 1929, on the eve of the Great Depression, there were 23 million cars and about 3.5 million

[5]We thus anticipate, and expect to prove, that the relation between mobility and graying is single-peaked.

trucks. By way of 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 automotive trucks. Still, in 1916, just before the U.S. entry into World War I, there were only 250,000 trucks. But the war was demonstrating 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)). Thousands of trucks were constructed. and the experience showed using trucks was feasible (Smiley (2004)). The end of the war meant that significant production capacity that had been created to meet the demands of the military was no longer needed for military purposes. 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 that would not be matched again until 1924.

By 1920, the rise of automotive trucks had not yet dramatically decreased demand for teamsters. The 1920 Census reports 383,787 teamsters compared with 480,135 in the 1910 Census. This is a notable decline, as predicted by our model, but contrasts markedly with occupations affected by the rise of passenger vehicles. Over the same period, the number of people employed as hostlers and stable hands 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.

However, 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 123,180, about 32% of 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 motor trucks. Five are very brief, mostly a single paragraph. The single exception is a 1909 article (Rogers (1909)) that argued that in New York City, motor trucks were superior to horse-drawn vehicles because they could cover more territory. Still, the article also warned that "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 related to 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, there were 96 articles that met our criteria, almost all of which appear to be about vehicles recognizable as motor trucks. A 1913 article comparing the cost of horse, electric trucks, and gasoline trucks (Ritchie (1913)), generally favored electric trucks but 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 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 purchase on an installment plan.

Our view is summarized by a 1918 article in *Scientific American* (the Washington Correspondent of the Scientific American (1918)). "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 went on to argue that American roads were woefully inadequate for truck traffic.

Our interpretation is that between 1910 and 1919, it became increasingly clear that automotive trucks were "on their way." The experience of World War I, including the direct observations of soldiers returning from the war, 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, and, although teamsters did not fully disappear from the Census until after 1970, they had, in fact, largely declined by 1930. However, the timing was uncertain since trucks required higher quality roads, which in turn 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. We have not yet determined whether railroad baggagemen and freight agents provide another opportunity to explore anticipatory dread.

3 Some very preliminary empirical results

We focus on employment and wages in the teamster labor market, to investigate the effect of the arrival of motor trucks. Employment data come from the decennial censuses from 1880-1930. We use linked census data, which link individuals' records between pairs of adjacent census years, to track workers' movements between teamsters and other occupations. We focus on the male labor force for the employment analysis as most teamsters are males.

The wage data for teamsters and other occupations are taken from the bulletins of the Bureau of Labor Statistics[6]. These bulletins report the union scale of wages annually in selected trades and cities. The BLS published teamsters' hourly wage from 1913-1931. We focus on Boston, Chicago, New York, St. Louis, and San Francisco due to data availability.

3.1 Employment

Table 1 shows teamster employment by decade in absolute numbers and as a fraction of male employment. Teamsters increased from 1880-1900, a period of rapid industrial expansion and population growth. Their employment remained stable from 1900 to 1910;

[6]We use 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.

the number of teamsters increased while the fraction decreased slightly. Teamster employment then decreased between 1910 and 1920 and collapsed between 1920 and 1930. These changes in employment are consistent with the distribution of trucks. According to the motor vehicle registration records shown in Figure 1, before 1910, very few trucks were available, and the number of teamsters remained stable between 1900 and 1910. In the late 1910s, the number of trucks began to increase. Presumably 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 would be replaced by truckers. Correspondingly, employment collapsed.

Aside from the aggregate employment change, our model also predicts that, when workers anticipate that an occupation will be negatively shocked, the age distribution of workers in that occupation shifts to the right, as the risk of being stuck in an occupation with low demand is more costly for young workers. Figure 2 examines this prediction. Each panel shows the ratio of teamsters to employed males at each age for one census (the solid line) and the following census (the dashed line).

Between 1880 and 1900, teamster employment increased. Teamsters were somewhat younger in 1900 than in 1880, but the difference is not large. Overall employment remained largely stable between 1900 and 1910, despite the growth of the labor force. We also observe a modest decrease in young workers, possibly reflecting a response to real warnings of the rise of the motor truck. Thus, the occupation aged even though competition from motor trucks was negligible, with only 10,000 trucks registered in the entire country. By 1920, the aging of the occupation even relative to 1910 is self-evident. In 1910, teamsters account for 1.85% of 25-year-old employed males, while in 1920, they account for only 1.22%, a decline of just over one-third. In contrast, teamsters share of employed males older than 55 decreased from 1.14% to .98%, a decline of only about one-seventh. From 1920 to 1930, as the number of trucks increased dramatically, teamster employment decreased further, with young workers decreasing more drastically than old workers. Despite the heavy physical demands, driving a team of horses had become an old man's job.

The shock and its anticipation both increased the age of new entrants and reduced the age of departing workers. Figure 3 shows the age distribution of workers entering and leaving work as a teamster between each pair of proximate censuses. The left panel shows the age composition for entrants, measured by the number of workers at that age who became teamsters (as a proportion of employed workers who were in other occupations and ten years younger in the previous census). The right panel shows number of workers of a given age who exited work as a teamster relative to the number of teamsters who were ten years younger in the previous census. The horizontal axis shows the age in the later year.[7] 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 three

[7]Thus, for example, we show the ratio of 35 year old teamsters in 1920 who were not teamsters in 1910 to the employed male population age 25 in 1910. Similarly, we show the ratio of 35 year olds who had been teamsters in 1910 at age 25 but were not teamsters in 1920 to the total number of 25-year-old teamsters in 1910.

panels.

Figure 3 confirms our predictions regarding the age composition of workers entering and leaving teamster work. Between 1900 and 1910, teamster employment was stable, and the age composition of movers mainly reflected age differences in mobility; young workers are more mobile than old workers, so both entrants and leavers are downward-sloping. Between the 1910 and 1920 periods, the teamsters' long-run prospects changed. Our model predicts that because being stuck in a sunset industry is particularly costly for younger workers. their entry into the occupation should be curtailed, while entry by older workers should decline less or even increase. This prediction is confirmed by the left panel. Compared with 1900-1910, the entry of young workers between 1910 and 1920 decreased significantly, while the entry of old workers decreased but to a lesser extent. Between 1920 and 1930, teamster employment collapsed, and the entry of workers of all ages further decreased with young workers decreasing more than old workers. In the right panel, there is a uniform increase in exit among teamsters of different ages over time, except for very old workers between 1900-1910 and 1910-1920.

As shown above, during these periods there were flows both into and out of teamster employment. In ongoing work, we are analyzing where workers came from and where they moved and how this varies by age group.

3.2 Wages

From 1913 to 1931, the Bureau of Labor Statistics gathered data on union wages in selected trades and cities. Our first comparison group consists of "close trades." These trades are occupations for which we have union wage data and are either 1) carpenters or laborers in the building trades, because our mobility data show that of the trades for which we have wage data, carpenters and laborers (not necessarily in the building trades) are the most common origins or destinations of workers moving into or out of working as a teamster, or 2) occupations that, before 1900, had wages close to teamster wages. Among the trades covered in the BLS bulletins, hod carriers, inside wiremen, painters in building trades, and two types of press feeders satisfy the second condition.[8] We also compare teamsters with "All trades," which is the average of all the selected trades and cities covered in each BLS bulletin. All trades is more stable and covers more cities and occupations. However, since complete wage data for teamsters are only available for five cities, they are not directly comparable with the wages of "all trades." Additionally, as the coverage of trades and cities change over time, "all trades" itself is not consistent from year to year.

[8]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; press feeders, cylinder are those who load paper into the feeding tray of a printing press using cylinder press; press feeders, platen are those who loads paper into the feeding tray of a printing press using platen press.

Figure 4 shows the average wage levels for two-horse teamsters relative to close trades in the five cities and teamsters' wages relative to "all trades".

The results for most occupations are consistent with our expectations. In the period leading up to the take-off of motor trucking, teamster wages rose relative to workers in most occupations except for building trades laborers. This rise in wages is explicable as *obsolescence rents*, as predicted by the theory. Teamsters require a wage premium to stay in the occupation, given the prospect of the arrival of a shock due to the roll-out of trucks. Then, as the use of trucks increased dramatically, their relative wages fell precipitously, before - once enough teamsters moved to other jobs or retired - they began to rise again. Figure 5 further confirms the patterns in Figure 4 using the average wages of the close trades. Compared to close trades, the teamster wage began to increase in 1916, peaked around 1918-1919, collapsed after 1919, and then slightly recovered after 1927. Teamsters' wages relative to all trades have a similar pattern but peaked in 1920. The wage differential versus close trades was slightly lower in 1931 than in 1913, while being essentially equal for all trades. We would not, however, defend the claim that the only reason for relative wage changes between 1929 and 1931 was the long-run response to the arrival of motor trucks. Not only was there a major economic shock in late 1929, but our wage measures do not control for any effect of age or other factors affecting worker quality, which would have been affected by changing mobility into and out of teamster employment.

To test the significance of the changes, we estimate the following equation:

$$\begin{aligned} lnhourlywage_{ict} = & \sum_{y=1917}^{1921} \beta_y Teamster_i \times \mathbb{1}\{Year = y\}_t \\ & + \beta_{1922-1926} Teamster_i \times \mathbb{1}\{1922 \leq Year \leq 1926\}_t \\ & + \beta_{1927-1931} Teamster_i \times \mathbb{1}\{1927 \leq Year \leq 1931\}_t + \mu_{ct} + \gamma_{ci} \end{aligned} \tag{1}$$

where $lnhourlywage_{ict}$ is the log hourly wage for occupation i in city c in year t, μ_{ct} are city-year fixed effects, and γ_{ci} are city-occupation fixed effects. βs are the coefficients of interest. Period 1913-1916 is taken as the reference period. β_y (y = 1917, ..., 1921) measures the deviation of the teamster wage in year y from the aggregate wage trend, which can be attributed to some time-varying idiosyncratic shocks faced only by teamsters. $\beta_{1922-1926}$ and $\beta_{1927-1931}$ reflect the wage deviations in a similar sense for the period 1922-1926 and 1927-1931.

Figure 6 shows the results of this exercise. Consistent with the previous figures, teamsters' relative wages began to increase in 1917. By 1919, their relative wage had increased statistically significantly compared to 1913-1916. After 1920, teamster wages were lower than they had been in the reference period. Contrary to our expectation, we see no evidence of recovery by the end of the period for which we have data.

4 Planned Future work

4.1 Differential patterns of occupation-switching by age

We will use workers moving out of employment as teamsters between 1900 and 1910 as our baseline. We will compare occupational mobility between 1910 and 1920 and between 1920 and 1930 with mobility in the earlier period. Drawing informally on Cavounidis and Lang (2020), our hypothesis is that older teamsters will tend to move into other similar low-pay jobs but that have not been as affected by the technology while younger teamsters will move to jobs that, while requiring additional skill investment, take advantage of their existing proficiencies: say, trucking.

4.2 Other occupations

We are currently seeking other examples of occupations that experienced large adverse technological shocks that were sufficiently foreseeable for our model to be broadly applicable. Some occupations, like travel agents, probably did not have sufficient forewarning of the coming shock to experience the temporary rise in wages we predict. We see two likely occupations.

Employment of milliners, dressmakers and seamstresses outside of factories declined dramatically early in the 20th century. In 1900, dressmaking was the third largest female occupation in the United States. Most dressmakers were single proprietors. Employment of dressmakers and seamstresses fell by over one-third between 1910 and 1920 while employment of milliners fell by almost one half. The shift to factory output was facilitated by the development of standardized patterns that enabled low-skill workers to do the cutting for apparel. By 1930, almost all women bought factory-made dresses in department stores. We are still investigating the nature of the available data and the history of the technical innovation.

In a somewhat more recent period, the employment of compositors and typesetters fell from 191,000 in 1970 to 80,500 in 1980. In 1960, most typesetters worked on linotype machines which resembled complicated typewriters. During the 1970s and 1980s, these were replaced with phototypesetting equipment. While phototypesetting still required skilled typesetters, each typesetter could do more work, and, so, demand fell substantially. Phototypesetting was quickly followed by computerized typesetting, which further reduced the demand for skilled typesetters. While offset printing was invented in 1949, it currently appears to us that its potential to disrupt the industry would not have been evident until the mid-1960s. We are exploring the availability of data.

4.3 Truck Drivers

We drop the adjective 'motor' since it is no longer likely that anyone will confuse truck drivers with individuals who drive teams of horses. Our analysis is highly preliminary, but we see indications that the situation facing long-haul drivers today is akin to that of their counterparts around 1912. There have been large advances in the technology. There are claims that self-driving trucks will be available by next year. But, even if

the technology develops that quickly, there will be a shortage of infrastructure since the anticipated technology would require human drivers to take trucks to and from interstate highways. Truck driving requires some training, but many companies will pay for the training if a driver remains with them for some predetermined period. Still, anyone who enters truck driving now must anticipate losing out on the occupation-specific or other skills they would acquire if they were employed elsewhere.

Shoag et al. (2022) report that 15% of their sample of drivers are very worried and 29% somewhat worried about the development of driverless vehicles. The median respondent believes that autonomous vehicles will become the dominant vehicles on the road in ten to fifty years although relatively few believe it will happen within 10 years. Still, 24% believe there will be "a lot fewer" trucking jobs within 10 years. 29% report at least one of being 'very concerned,' believing that autonomous vehicles will dominate within 10 years, or believing there will be a lot fewer trucking jobs within ten years

Employers (American Trucking Associations (2021)) report a dramatic shortage of drivers even though the relative wages of drivers are higher than at any point in at least the last decade. Figure 7 shows the 5-month moving averages of the wage and employment of truck transportation and total private nonfarm industries in the last decade. Figure 8 shows the relative wage and employment comparing truckers to total private nonfarm employment. Relative employment lies below its prepandemic peak, and the relative wage is substantially above its level in January 2020. While, at this point, we cannot rule out the standard view that the current high wages are simply the product of the pandemic, these facts are not fully compatible with that story. We plan to assess the alternative explanation that the current high wages reflect the reluctance of truck drivers to enter an occupation that will soon be hit with a massive adverse shock.

We will use matched workers from the Current Population Surveys to examine movements into and out of truck driving over the last 20 years. We will also use data from these surveys to look at employment and wages adjusted for demographic characteristics.

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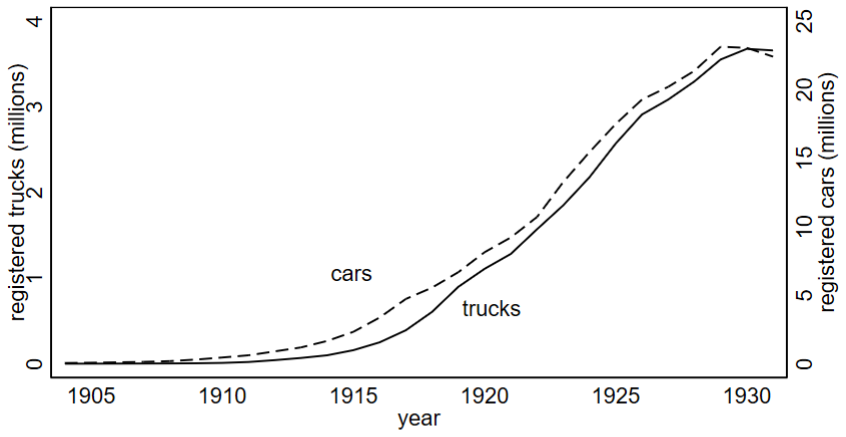
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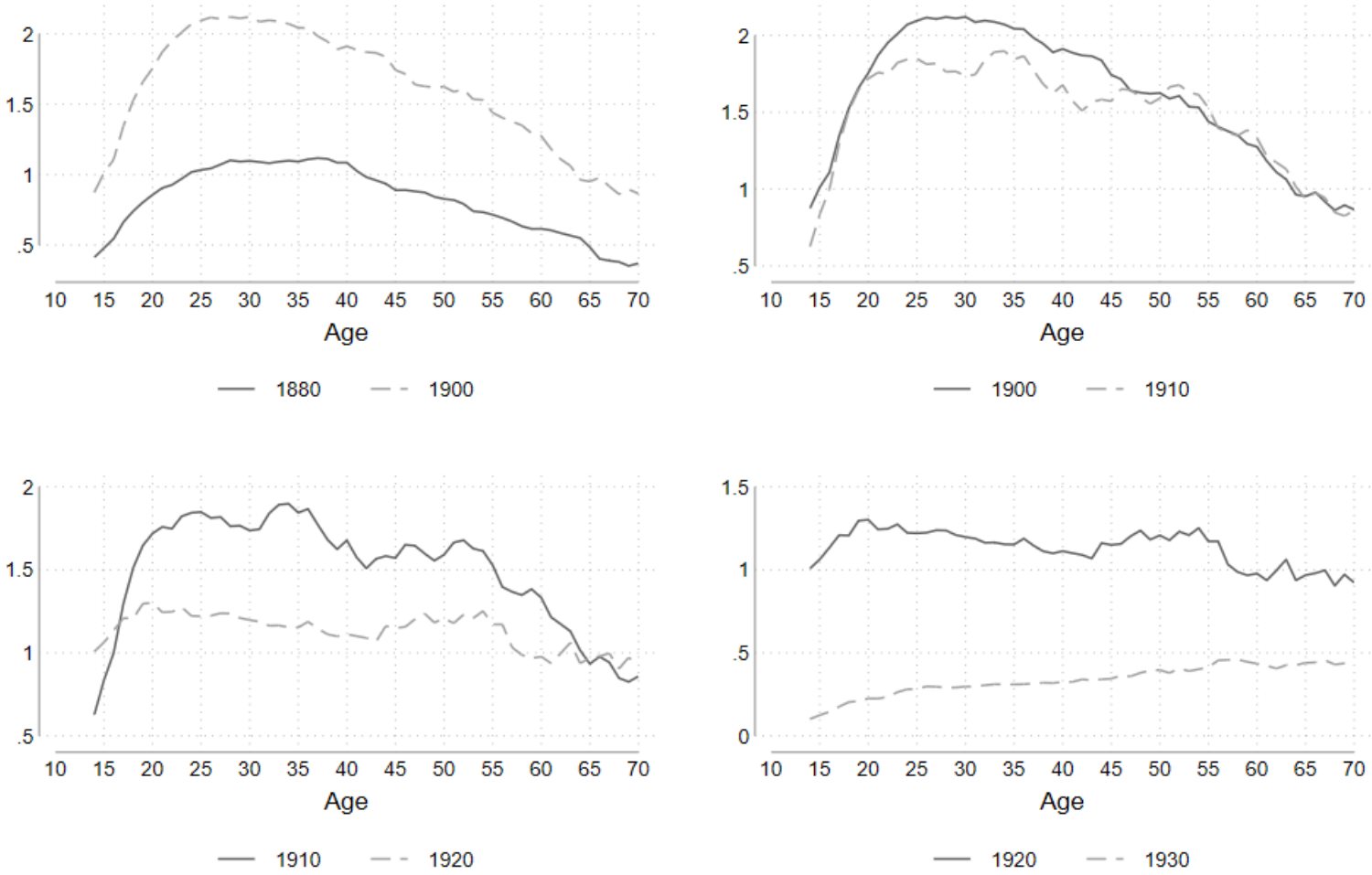
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Figure 1: Registrations of Automobiles and Trucks: 1904-1931



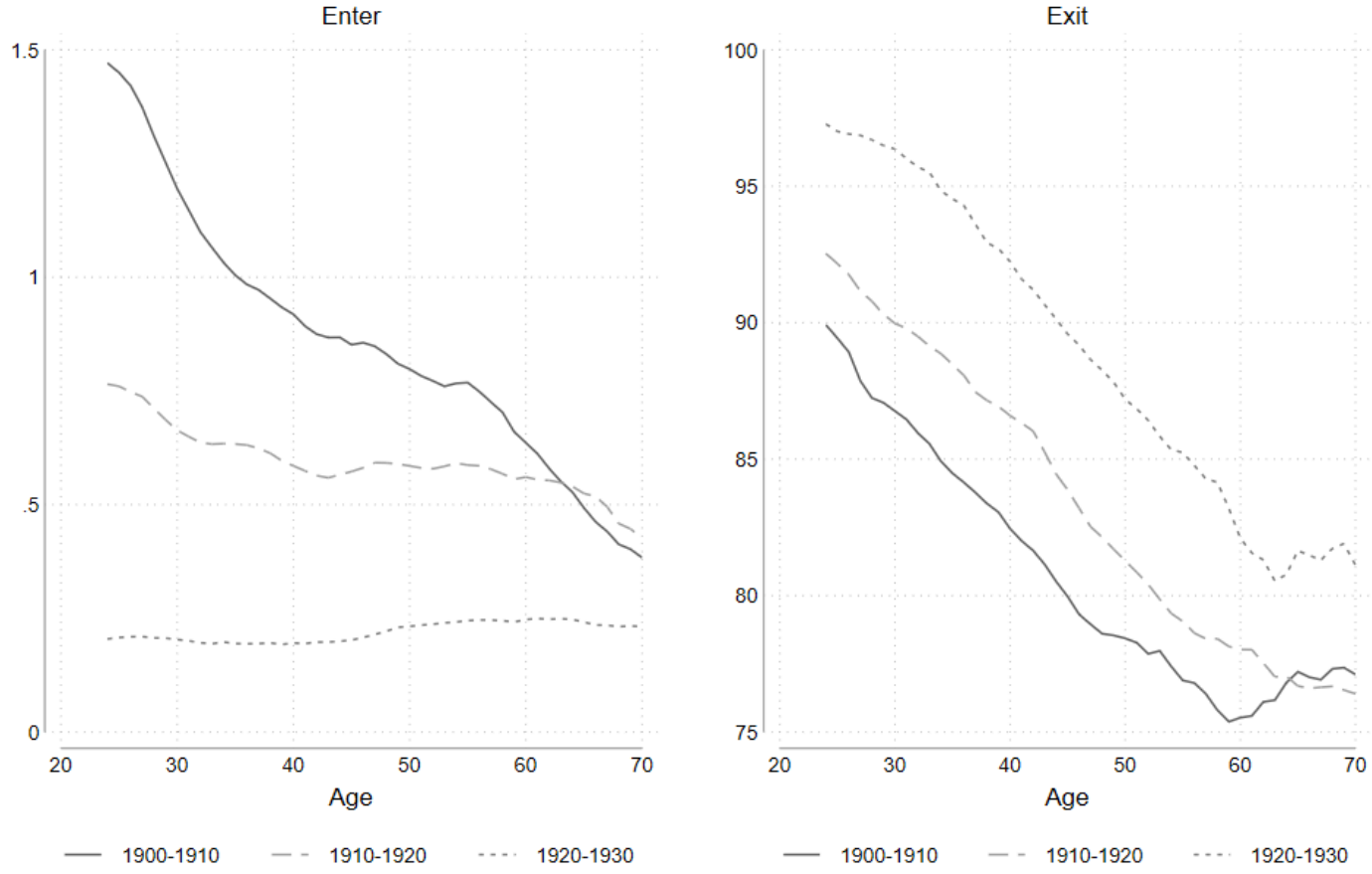
Source: Federal Highways Administration, State Motor Vehicle Registrations, by Years, 1900 - 1995
https//www.fhwa.dot.gov/ohim/summary95/mv201.pdf, accessed 8/21/2022

Figure 2: Teamster Age Composition: 1880-1930



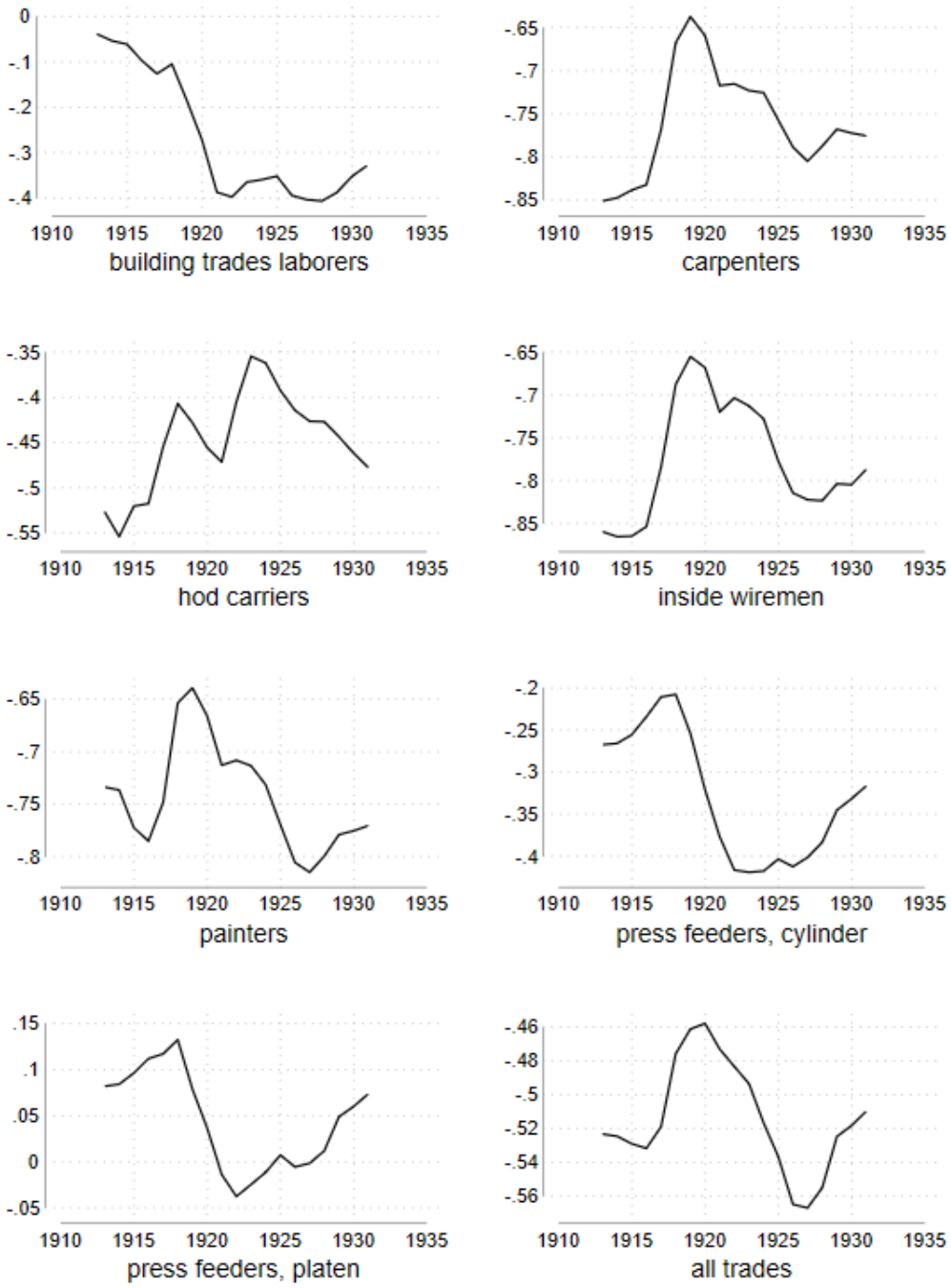
Notes: The figure shows the teamster share in employed males by age. Sample includes teamsters and employed males of age 14-70. The lines are smoothed using 5-year moving averages.

Figure 3: Entering and Exiting Teamster Age Composition: 1900-1930



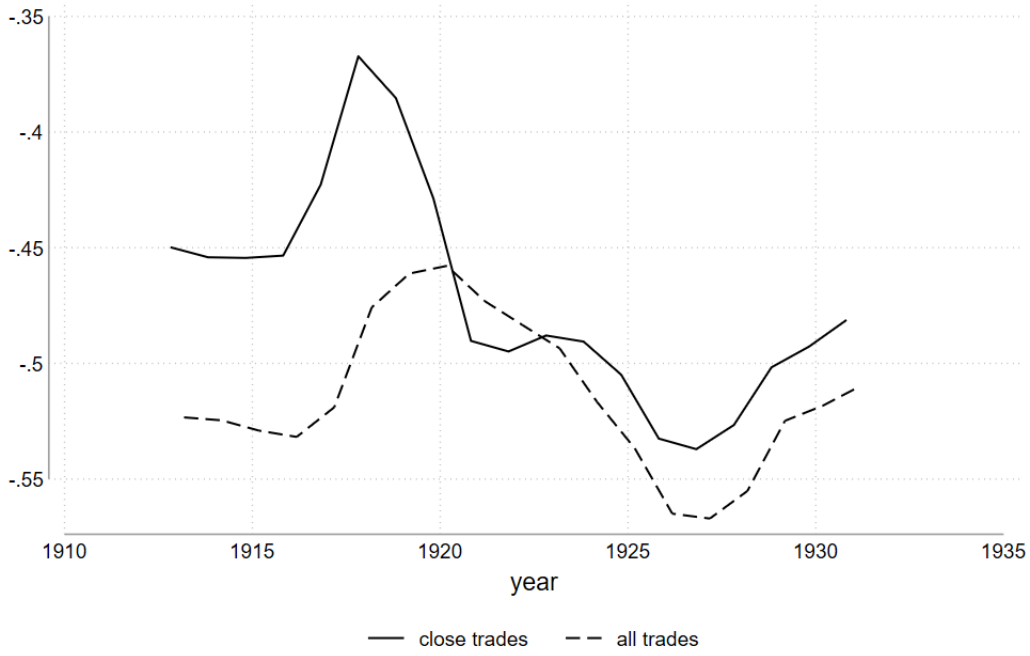
Notes: The figure shows the teamster age composition for workers who entered and exited the teamster occupation over the adjacent census years. The left panel shows the age composition for entrants measured by the number of workers of a certain age who moved from other occupations to teamsters divided by workers of that age who could enter, i.e. who had other occupations in the former year. The right panel shows the age composition for teamsters who exited measured by workers of a certain age who moved from teamsters to other occupations divided by workers of that age who could exit, i.e. workers who were teamsters in the former year. The sample is restricted to workers with age 14-60 in the former year (age 24-70 in the later year). The X-axis shows the age in the later year: e.g. for 1900-1910, x-axis shows age in 1910. 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 three panels. The lines are smoothed using 5-year moving averages.

Figure 4: $\ln w_{\text{teamster}} - \ln w_{\text{other}}$



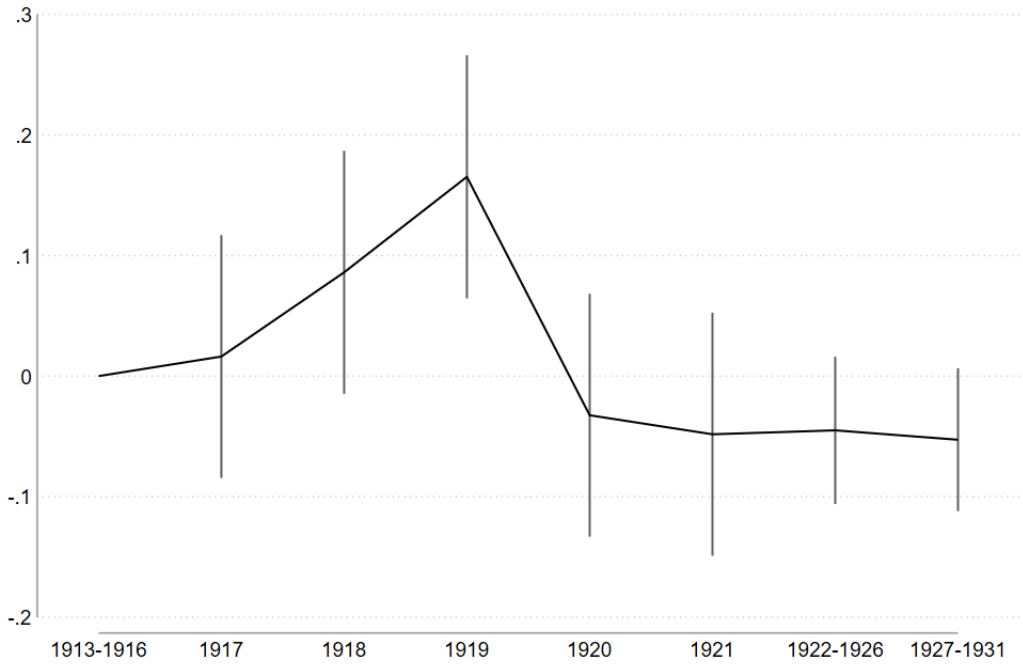
Notes: The figures show differences in wages between teamsters and other occupations. Wage differences are city averages weighted by cities' male labor force. Lines are smoothed using 3-year moving averages. Aside from all trades, other occupations are "close trades" for which 1) wages are close to teamsters in 1896-1900, 2) have data for at least 4 cities of interest, and 3) have available data in 1913-1931. New York has no data on hod carriers, and Boston has no data on press feeders, platen. The lines are smoothed using 3-year moving averages.

Figure 5: Wage differences between teamsters and other occupations (averages)



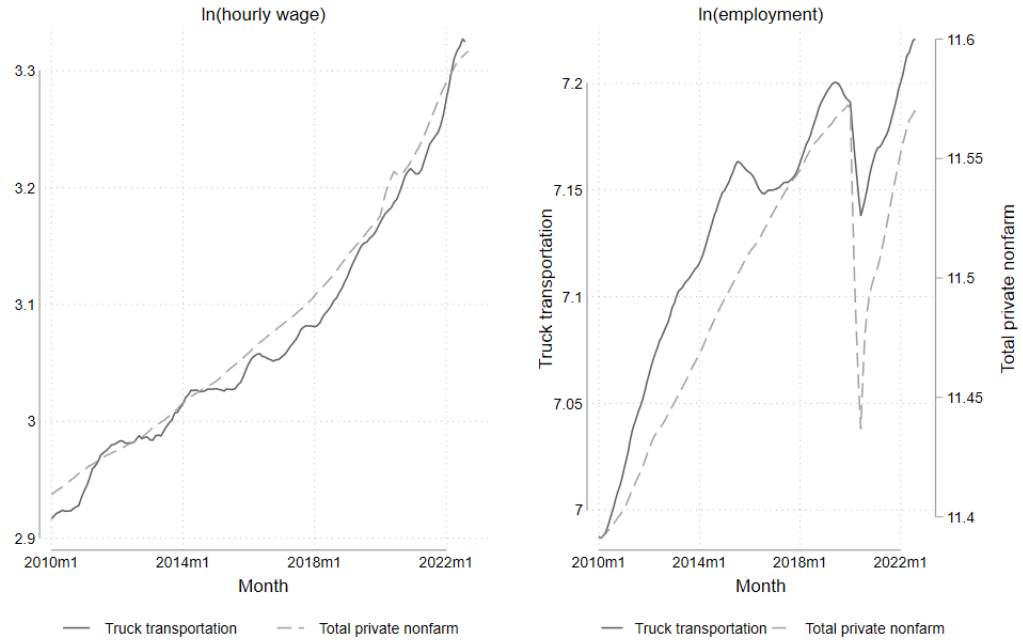
Notes: Wage differences are measured by subtracting the log hourly wage of close trades or all trades from the log hourly wage of teamsters. "Close trades" is the simple average of the log wage of all the close trades: building trade laborers, carpenters, hod carriers, inside wiremen, painters in building trades, and the two types of press feeders. The lines are smoothed using 3-year moving averages.

Figure 6: Wage differences between teamsters and other occupations



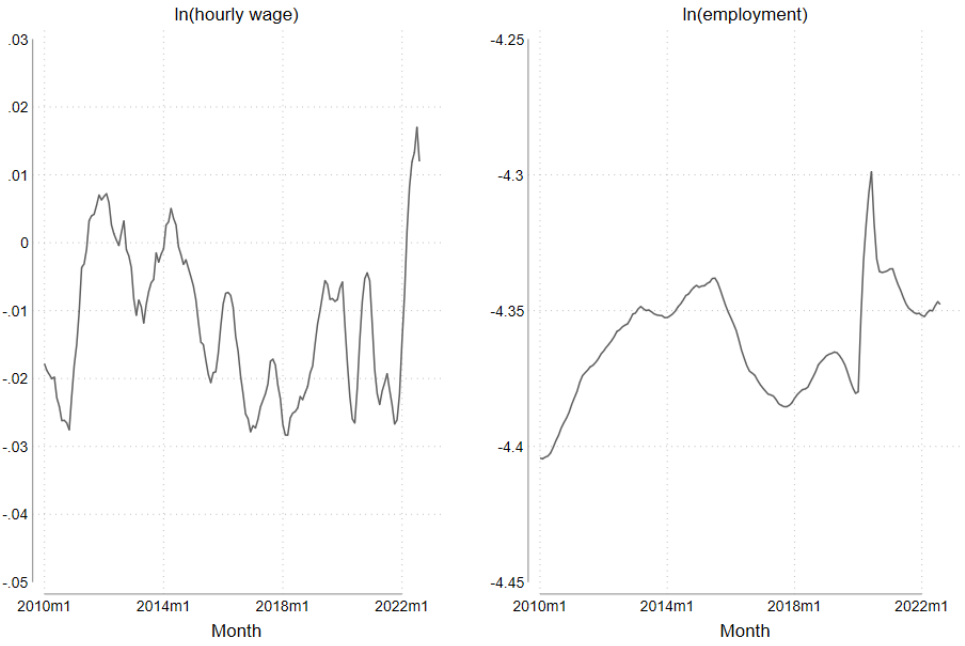
Notes: The Figure shows the estimation results using Equation (1). Bars reflect 95% confidence intervals.

Figure 7: Wage and employment of truck transportation and total private nonfarm industries: 2010-2022



Notes: The Figures show the 5-month moving averages of log hourly wage and log employment for truck transportation and total private nonfarm industries during 2010-2022.
Source: Current Employment Statistics (CES)

Figure 8: Relative wage and employment of truck transportation compared to total private nonfarm industries: 2010-2022



Notes: The Figures show the 5-month moving averages of log hourly wage and log employment for truck transportation subtracted by those of total private nonfarm industries during 2010-2022.
Source: Current Employment Statistics (CES)

Table 1: Teamster Employement: 1880-1930

Year	1880	1900	1910	1920	1930
Male teamsters	134,274	409,904	480,135	383,787	123,180
Employed males	15,163,724	23,860,604	30,347,136	33,139,452	38,181,932
Fraction (%)	0.89	1.72	1.58	1.16	0.32

Notes: Both teamsters and employed males are for 10 years old and over.
Source: US Census