Occupational and Industrial Mobility among U.S. Truck Drivers:

Are Truckers Different from other Blue Collar Workers?

Stephen V. Burks[1,2,3]
Kristen Monaco[4]

12/03/2014

Abstract:
We examine the occupational mobility of truck drivers over the period from 2000 to 2013, using "short panels" constructed from the Current Population Survey to examine individuals who enter truck driving and incumbents who leave it over one-year time horizons. We find that the occupational mobility of truckers is typical for a blue collar occupation. We also find that the usual suspects, wages and hours, are key predictors of the propensity to switch. This initially appears to counter claims by trucking industry analysts and major trucking industry firms is that the market for drivers of heavy and tractor-trailer trucks is quite distinctive, exhibiting a "shortage" that is evidenced in relatively high firm-level turnover and unfilled truck seats. We identify reasons that managers in particular parts of the trucking industry might perceive their labor market in this way, and why these underlying factors would not show up at the level of an occupational mobility analysis using CPS data, so our evidence does not directly contradict industry perceptions. However, we conclude by observing that the CPS suggests that truckers as a whole are not distinctive; the labor market works about as well to allocate trucking labor in response to changes in wages and hours as it does for other large blue-collar occupations.

Keywords: occupational mobility, industrial mobility, trucking, truckload, motor freight, private carriage, turnover, truck driver, trucker, driver shortage, secondary labor market segment

JEL Categories: J62, J49, R49, J24

[1] Division of Social Science, University of Minnesota, Morris
[2] Institute for the Study of Labor (IZA), Bonn, DE
[3] Center for Decision Research and Experimental Economics (CeDEX), University of Nottingham, UK
[4] Office of Compensation and Working Conditions, Bureau of Labor Statistics (BLS), 2 Massachusetts Avenue NE, Washington, DC 20212, (corresponding author at: 202-691-7527, Monaco.Kristen@bls.gov)

1. Introduction

In this paper we examine the occupational mobility of truck drivers over the period from 2000 to 2013, using short panels constructed from the Current Population Survey (CPS) to examine individuals who enter trucking and incumbents who leave it over one year time horizons. We ask, in terms of occupations and industries, where do new truckers come from, and where do departing truckers go? We analyze individual- and job-level variables available in the CPS for their value in predicting entry into and exit from trucking as an occupation. And we compare what we find to the stylized facts about occupational mobility in the US workforce as a whole, and in its blue-collar components.

Trade associations for the trucking industry frequently argue that the labor market for heavy and tractor-trailer truck drivers is quite distinctive, in that it faces a continuing supply shortage.[5] We cannot directly evaluate this claim because the CPS truck driving occupational category is broad, grouping driver/sales workers and light truck and delivery drivers together with heavy and tractor-trailer truck drivers. However, at the level of detail permitted by CPS data, we find that occupational stability and occupational migration in the labor market for truckers looks quite similar to that for other blue collar jobs with similar human capital characteristics (Kambourov and Manovskii 2008). The patterns of industries and occupations from which truckers enter and to which ex-truckers exit exhibit some interesting details, but are not surprising in context. And regression analysis suggests that economic factors (wages and hours) play a sensible role in explaining occupational entry and exit, implying that working conditions play the expected role in allocating labor resources to and from this occupation.

After reviewing our findings about truck driver occupational migration as revealed in CPS data, we return in our discussion to the trade association viewpoint, and provide some discussion of how real business challenges faced by managers in specific parts of the for-hire motor freight industry could lead them to perceive a labor shortage for heavy and tractor-trailer truck drivers, when a labor economist

[5] Standard occupation code (SOC) 53-3032; see details in section 2

might not use the same description. We suggest that the truck driver labor market is segmented, with the secondary segment marked by high turnover arising from optimal business decisions, and that the level of turnover in this segment rises and falls, with lags, in response to demand shocks.

We also argue that we don't observe indicators of this situation in the CPS data for two reasons. One is that the secondary labor market segment is not the whole of the labor market (neither in CPS terms nor managerial terms), and the other is that firm-specific turnover is only indirectly visible in the CPS. Finally, we point out that—managerial perceptions of a labor shortage in the secondary segment notwithstanding—the labor market does appear to work about as well overall to allocate labor in response to wage signals for the large CPS category of truck drivers as it does in other large blue collar occupations.

2. Occupational Context and Occupational Migration

Truck driving is a large, low education, predominantly male occupation with distinctive rules governing the terms of employment for many in the occupation. There were approximately 1.6 million heavy-truck/tractor-trailer employee drivers in the US in 2012, along with 769,010 light-truck/delivery employee drivers, and an additional 394,110 driver/sales workers. The projected growth from 2012 to 2020 of these occupational segments is 464,700, 166,600, and 105,900, respectively (Bureau of Labor Statistics 2014). All three of these are grouped together in the CPS, which reports census occupation codes, not SOCs.[6] These numbers omit owner operators, self-employed truck drivers, who comprise between 10% and 15% of the heavy truck driving labor force (Burks, Belzer et al. 2010). The occupation is characterized by modest levels of education; the mode is a high school degree (Belman, Monaco et al. 2005; Occupational Information Network 2014). There appear to be low returns to additional education and to firm tenure for heavy and tractor-trailer truck drivers (Belman, Monaco et al. 2005).

Drivers who are engaged in any aspect of interstate transportation (whether working in one locality or across state lines) are not subject to the overtime provisions of the Fair Labor Standards Act which govern the majority of other private and public sector occupations; their hours are governed by the Federal Hours of Service regulations, which limit drivers to approximately 60 hours of work over a seven day period (FMCSA 2003). Most tractor-trailer drivers work far in excess of 40 hours per week (Belman, Monaco et al. 2005; Occupational Information Network 2014).

Truck driving is important not only because it is a large occupation, but because the services provided by truck drivers are critically important to the U.S. economy. In 2012 the for-hire trucking industry comprised 31% of transportation gross output and 1.14% of private industry gross output (Burea of Economic Analysis 2014). This figure actually understates the importance of trucking services,

[6] Heavy and tractor-trailer truck drivers are Standard Occupational Code (SOC) 53-3032, light truck or delivery service drivers are SOC 53-3033, and driver/sales workers are SOC 53-3031 (Occupational Information Network 2014).

since roughly half of trucking activities are classified as "private carriage" (firms hauling their own freight; more formally, firms who provide trucking services internally and whose primary business is not trucking) which are not captured in trucking industry-level figures, since federal statistical agencies assign industry codes according to the firm's primary line of business (Burks, Belzer et al. 2010). In the past, truck users were surveyed directly as part of the Vehicle Inventory and Use Survey (VIUS), which permitted direct measurement of private carriage. The Vehicle Inventory and Use Survey (VIUS) was last conducted in 2002, however an analysis of historical VIUS data estimates that the total production of trucking services in private carriage was similar in order of magnitude to that of for-hire carriage (Burks, Monaco et al. 2004).[7] This suggests that the value of the gross output of all trucking services accounts for more than 2% of private industry's gross output in the US. Trucking is the primary mode of transportation within the U.S., with trucks carrying 73.7% of cargo by value in 2012 and truck-rail/truck-water intermodal accounting for an additional 1.9% (Bureau of Transportation Statistics, Commodity Flow Survey 2012)[8]. In addition to moving goods produced and consumed within the U.S., trucking is a crucial component of international trade. In 2013 57% of the value of goods transported between the U.S. and its border countries (Canada and Mexico) was carried by truck (Bureau of Transportation Statistics 2014).

How does the labor market for truck drivers compare to the labor markets for other blue-collar occupations with similar human capital requirements? The most prominent story about this market is that told by the American Trucking Associations (ATA)[9], which represent firms that are central industry participants. ATA claims the market is broken because there is a persistent shortage of truck drivers.

[7] According to the same analysis, during the period before 2000, private carriers tended to have a higher proportion of smaller trucks and operate them a smaller number of annual miles than did for-hire carriers.

[8] http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/commodity_flow_survey/2012/united_states/table1.html need to include this in citations.

[9] The American Trucking Associations is a federation of 50 state trucking associations, which also has several cross-cutting subgroups that cover specific industry segments (e.g. the Automobile Carriers Conference) and specific professional functions within the industry (e.g. the Technology and Maintenance Council).

For instance, a front page article reporting on the ATA's 2014 annual convention in *Transport Topics* (the industry's "trade journal of record") was headlined "Driver Shortage Hits Critical Level as Executives Fear Loss of Business" (Reiskin 2014). Digging a little deeper into industry background and into the ATA's own publications over recent years, however, produces a more complex story.

Trucking in the US has several distinct business segments that are separated by organizational, technical, and geographic characteristics ("Four Ways to Categorize the Trucking Industry", p. 9, Burks, Belzer et al. 2010). Managerial perception of a shortage is focused on one specific segment, long-distance full-truckload (TL) for-hire carriers, who employ heavy and tractor-trailer truck drivers and whose labor market is characterized by high turnover at the firm level. According to the ATA's survey of member carriers, the annualized turnover rate at large (> $30 million annual revenue) firms in this segment had never dropped below 100% per year since the survey was begun, until the great recession (Watson 2009). The rate bottomed out at 39% in the first quarter of 2010 (Watson 2010), and it has now risen again in 2014 to 100% or above (Watson 2014a). During the same time frame, annualized turnover rates at firms also employing heavy and tractor-trailer truck drivers in another type of long-distance for-hire service, the less-than-truckload segment, was quite similar to that of other blue collar jobs, in the high single digits to low double digits (Watson 2009; PR Newswire 2013), and that reported by the National Private Truck council, the trade association representing private carriers, was similar (Petty 2006; Penske Logisitics 2012).

In section 6 we will provide some conjectures about why the long distance TL segment has such high turnover rates in comparison to other parts of the labor market for heavy and tractor-trailer truck drivers, leading managers to perceive a labor shortage. We will suggest that the labor market is segmented in a pattern that roughly matches the segmentation of the intercity for-hire part of trucking into distinct lines of business. But first we turn to a conventional economic analysis of the reasons that

workers may switch jobs, and ask how these may show up in CPS data on the broad category of truck drivers.

There is a great deal of literature that addresses the question of why workers switch jobs. While the types of switching and models vary between papers, job switching is generally linked to individual preferences, individual abilities, and available opportunities (Bartel and Borjas 1981; Mincer and Jovanovic 1981; Light and McGarry 1998; Neal 1999; Munasinghe and Sigman 2004; James 2011). The tendency of job switchers to experience wage decreases after switching jobs is typically seen as either evidence of a poor initial match (the worker is low ability) or the result of disruptions in tenure lowering wage (in a typical human capital model). The latter is often dismissed in models that find that firm or industry tenure is less important for earnings than total occupational experience (Kambourov and Manovskii, 2009; Neal 1999).

There is limited work in the literature specifically on truck drivers. Two prior non-academic studies for the ATA on labor supply of truck drivers (Christenson, Aames et al. 1997; Global Insight Inc. 2005) focused on the role of alternative job opportunities, such as in unskilled construction work, but this has not been well-examined within the academic literature. Beilock (2005) provided a study of a relatively small number of long-haul drivers of refrigerated trucks, and suggested that the tenure of truck drivers, while relatively short, is not unlike individuals in other jobs with similar qualifications. This has some support in more general models of occupational switching. James (2011) models multiple scenarios using data from the NLSY97, including occupational clustering and occupational cycling, and finds that there is correlation between laborer and driver jobs within transportation.

Our procedure will be to examine the patterns of industry and occupational mobility visible in CPS data on truck drivers, and then analyze the predictive power of typical factors such as wages and hours to predict moves into and out of the occupation.

3. Data Description

We use data from the CPS Outgoing Rotation Groups (ORG) files from 2000-2013. Individuals in the CPS are surveyed for four consecutive months and asked the key labor questions (such as industry and occupation) in the fourth month. They leave the survey for eight months at which point they are picked up for another four months, and again asked key labor questions in the fourth month. Thus, though the CPS is technically a cross-sectional data set, short panels that contain information on earnings, hours, occupation and industry can be constructed by matching individuals in their fourth month of their first and second spells (exactly one year apart).

There are two main shortcomings of using the CPS ORG files. First, we see individuals in only two periods. While we can observe the occupations and industries from which individuals enter truck driving, and to which individuals go when exiting truck driving, we cannot use these data to identify how many individuals migrate back and forth from driving (e.g. initially a driver, then working in a different occupation, subsequently returning to driving). A finding that the set of occupations and industries from which drivers arrive and to which drivers exit are similar would be consistent with a process of cycling into and out of trucking, but will not be direct evidence of such a flow pattern. The second shortcoming is that the ORG files have no information on an individual's tenure with their current employer. Thus, not only are we unable to observe the distribution of firm tenure in each cross section, but if an individual reports being a truck driver in both periods we do not know whether he has changed firms. This is the major reason that firm-level turnover is not directly visible in these data.

There are additional technical issues that arise when matching CPS data files. Though the CPS data files can be used to exploit the longitudinal information, because the survey is not intended to be a panel and relatively little effort is made to deal with non-response in the second period. There is a significant amount of attrition in the data after the first observation of each individual in the ORG, resulting from non-response, death, and relocation (Madrian and Lefgren 1999). Because individuals are

not uniquely identified in the data, one needs to be cautious when matching. Following prior studies we use HHID, HHNUM, LINENO, STATE and MONTH variables to identify potential matches and then check for inconsistencies in sex, race, and age across the two periods to identify and eliminate false matches. Doing this we are able to match roughly 70% of period 1 respondents in the data, in line with Neumark and Kawaguchi (2004).

Neumark and Kawaguchi (2004) compare attrition in the CPS to the SIPP and generally find relatively small amounts of attrition bias. Given that we are focused on working age males, we think that the amount of potential attrition bias is relatively low. There should be relatively low mortality among 21-65 year olds (Madrian and Lefgren (1999) find the highest rates of mortality attrition at substantially higher ages). Adverse economic experiences (such as layoff/firing) might lead to attrition, but, since our analysis focuses on those employed in both periods, this should have minimal effect on our empirical models.

Our matched files from 2000-13 contain information on approximately 477,000 males, aged 21-65. We use 21 years of age as the lower bound as this is the minimum age for an individual to qualify for a commercial driver's license. We use only males, as the occupation has a very small share of females (less than 5% over the time period in question). Of the sample of males, there are approximately 26,000 reporting the occupation of truck driver, slightly over 4% of the total sample.

4. Patterns of Occupational and Industrial Mobility for Truck Drivers

Truck drivers are less likely than other males in the sample to be employed in both periods. Among all males employed in during their first spell in the CPS, one year later 93% were still employed, 3% were unemployed, and 4% were not in the labor force. The corresponding percentages for those who were truck drivers in the first period were 89%, 4.3% and 6.3%.

Table 1 shows the industrial distribution of individuals who report truck driving as an occupation during their first spell in the CPS.

As previously mentioned, there is a distinction between drivers employed in the trucking industry (for-hire) and those employed outside of trucking (private carriage). While it is relatively easy to capture for-hire drivers in the CPS data by defining them as all drivers employed in the three-digit trucking industry code, private carriage is not as obvious. As noted in section 2, private carriers are firms that have their own fleet of trucks and whose primary business is something other than trucking services.

In table 1, the largest share of drivers are seen in the trucking industry (39.9%). After for-hire trucking, retail and wholesale trade drivers comprise the next largest portion and this is logical given that firms involved in these sectors will often own their fleet of trucks (e.g. WalMart). Our concern, however, is that others who report the occupation of truck driver are likely to be misclassified based on their industry, as some industries are incredibly

Table 1: Complete Industry Distribution of Truck Drivers	
Agriculture	1.5%
Mining	1.7%
Utilities	0.4%
Construction	7.0%
Manufacturing	8.2%
Wholesale Trade	11.2%
Retail Trade	10.1%
Nontruck Transport	7.2%
Trucking (for-hire)	39.9%
Information	0.5%
Finance, insurance & real estate	0.8%
Professional, technical & managerial	0.3%
Administration and waste	4.6%
Educational Services	0.3%
Health Care	0.6%
Food, hotel & entertainment	3.6%
Other services	1.2%
Public administration	0.7%

unlikely to contain firms with their own fleet (e.g. educational services). While it could be that there are driver/sales workers, who are included in the CPS category of truck driver, in these industries, we are interested primarily in the subset of CPS truck drivers who come from the other two SOC categories that are included (see section 2), so we use data on the incidence of actual trucks by industry from the 2002 Vehicle Inventory and Use Survey (VIUS) to clean our data.

The VIUS (mentioned above in section 2) is basically a weighted sample of all vehicles in use at the time of the survey, of which commercial vehicles are a subset. The data set has information on the industry of use for commercial trucks, which we use to identify industries, other than trucking, that contain a substantial number of trucks. We find almost no trucks in the following industries: public administration; information; finance, insurance and real estate; health care; educational services; professional, technical and managerial; and other services.

Thus, we eliminate drivers in these industries from our analysis and are left with the following distribution of industries (see Table 2) and are fairly confident in our ability to refer to the non-trucking industries that remain in the sample as "private carriage."

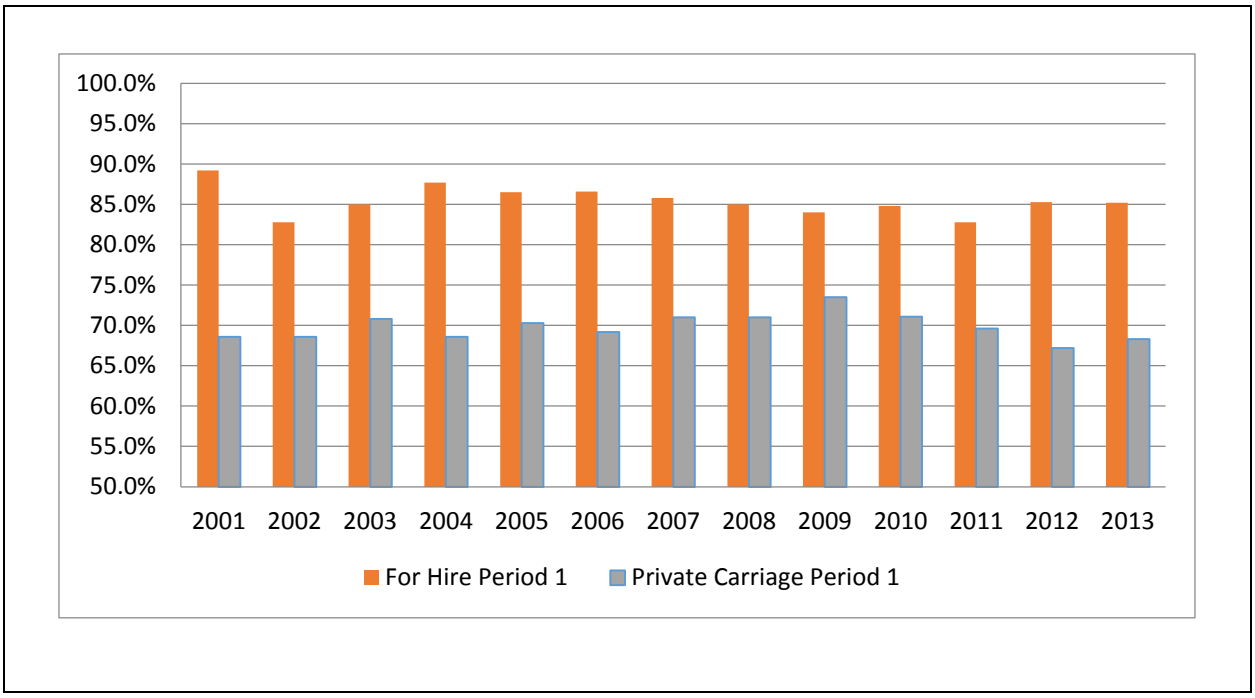
Table 2: Industry Distribution of Final Sample	
Agriculture	1.5%
Mining	1.8%
Utilities	0.5%
Construction	7.4%
Manufacturing	8.6%
Wholesale trade	11.7%
Retail trade	10.6%
Nontruck transport	7.6%
Trucking	41.7%
Admin & waste	4.8%
Food, hotel & entertainment	3.8%

We next examine general trends with respect to occupational migration among truck drivers. All of our analysis will consider for-hire and private carriage drivers separately, since there are systematic differences between the two groups. For-hire drivers are more likely to be engaged in long-haul trucking and those in private carriage are more likely to be engaged in short-haul trucking (Burks, Monaco et al. 2004). As can be seen in Table 3, the characteristics of these drivers

in terms of hours and earnings are substantially different (comparing drivers who are employed full-time).

Table 3: Characteristics of Those Who Initially Report Employment as a Truck Driver		
	Truck Drivers in Period 1	
Variable	For-Hire	Private Carriage
real hourly wage	$ 19.87	$ 18.78
usual hours	50.3	44.4
Union	15.0%	21.3%
White	83.6%	84.3%
Black	13.7%	12.1%
American Indian	0.6%	0.9%
Asian	1.5%	2.5%
Hispanic	14.8%	17.6%
Multiple Races	0.9%	1.0%
Less than High School Diploma	17.7%	17.7%
High School Degree	55.8%	53.7%
Associate or Vocational Degree	6.1%	6.3%
Some College	16.3%	17.6%
College Degree or Higher	4.4%	4.7%

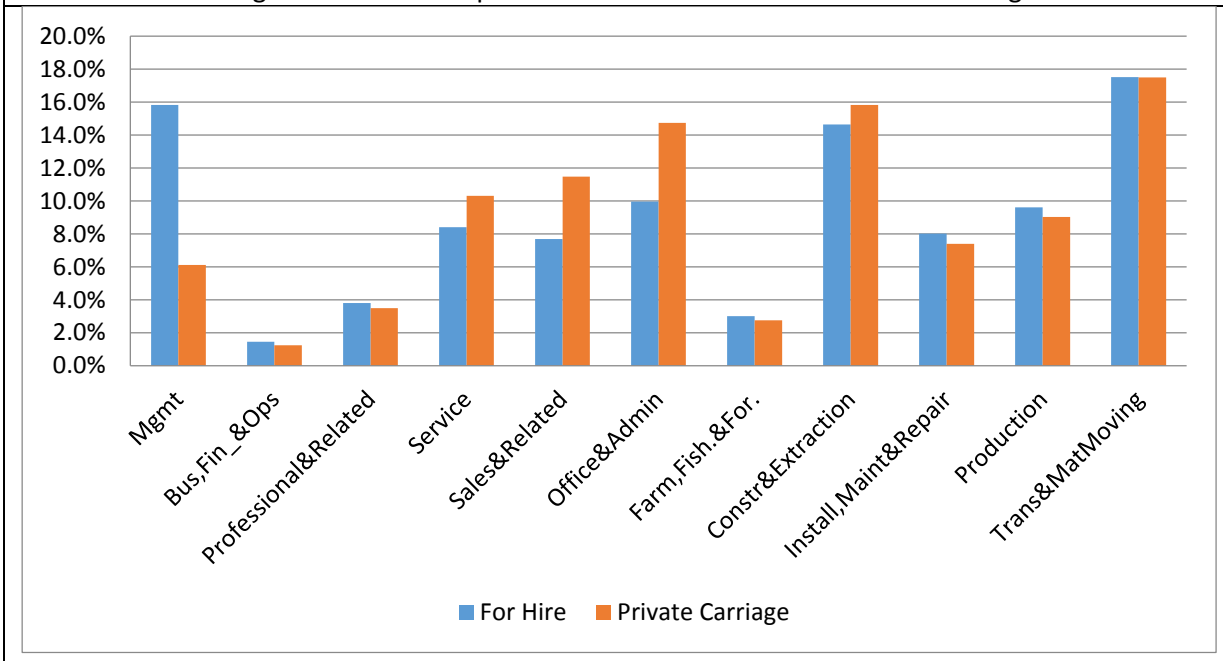
Figure 1: Percentage of Truck Drivers who Retain their Occupation in Period 2



As Figure 1 demonstrates, there is substantially different migration in the two segments. Truck drivers who are employed in private carriage in period 1 are substantially less likely to remain truck drivers in period 2 than are for-hire drivers. The trend over time, predictably, shows much more occupational stability during and after the 2007-8 recession than in the boom of the early 2000s. Over the entire decade, we see that roughly 87% of those who were for-hire truck drivers in period 1 remained for-hire truck drivers in the second period. The corresponding figure for private carriage drivers is 72%. Across all drivers in the sample the one year occupational migration rate is 22%. This is in line with Kambourov and Manovski (2008) who find three digit occupational mobility of 18% at the three digit level, using PSID data across all workers for an earlier period (169-1997). Further restricting their findings to workers with demographics similar to truck drivers – high school education or lower and aged 35-40 – the three digit occupational migration is still 18%, indicating that that what we see across all drivers is roughly similar to workers economy-wide as well as those with similar levels of education.

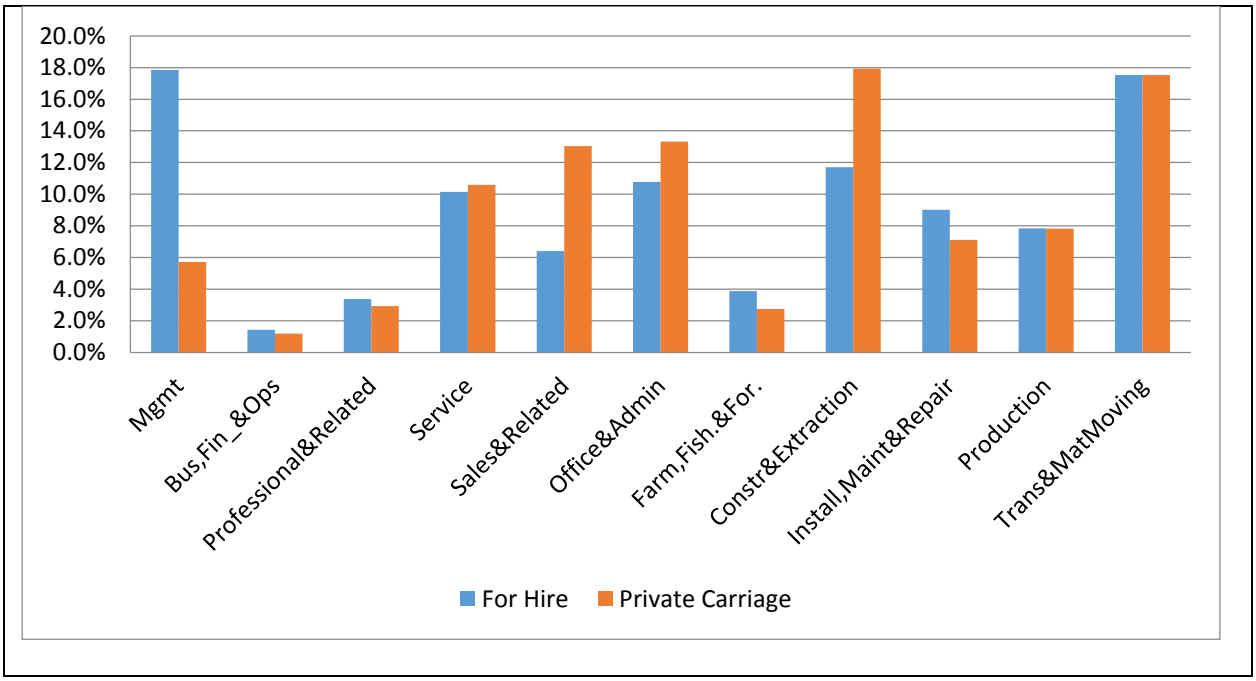
For-hire and private carriage appear to draw truck drivers from similar occupations (Figure 2).

Figure 2: Initial Occupation Left for Those Who Enter Truck Driving



Approximately 10% of individuals who become drivers in the second period come from manufacturing occupations and another 15% from construction and extraction occupations. Another major occupation is non-trucking transportation and material movers (roughly 18%); this is not surprising given that freight handlers are more likely to come into contact with truck drivers, making them more familiar with the occupation. Somewhat surprising is the number of truck drivers who are originally managers/executives (especially among for-hire drivers). The largest single three-digit occupation reported within this group is "managers, all other", followed by farm managers, construction managers, and transportation managers. They also most commonly came from trucking, non-trucking transportation, construction, and agriculture industries.

Figure 3: Occupational Destination of those Who Leave Truck Driving



The occupations to which truck drivers exit are similar in profile (Figure 3). The fact that the alternate occupations among those who leave and enter are similar leads us to believe that these jobs (particularly those in production, construction, and transportation and material moving occupations) represent a reasonable set of jobs from which potential drivers could be recruited and also may serve as a benchmark for the level of pay and hours that might attract workers into truck driving. Thus, if the labor market is operating normally we will expect that differences in wages and hours will be among the things that will predict switches between these occupations and truck driving.

We next examine the industries associated with in- and out-migration. The origination and destination industries are markedly different for for-hire and private carriage (Figure 4 and Figure 5; note that only the largest industries with respect to in- and out-migration were included in the charts).

Figure 4: Initial Industry for Those Who Enter Truck Driving in Period 2

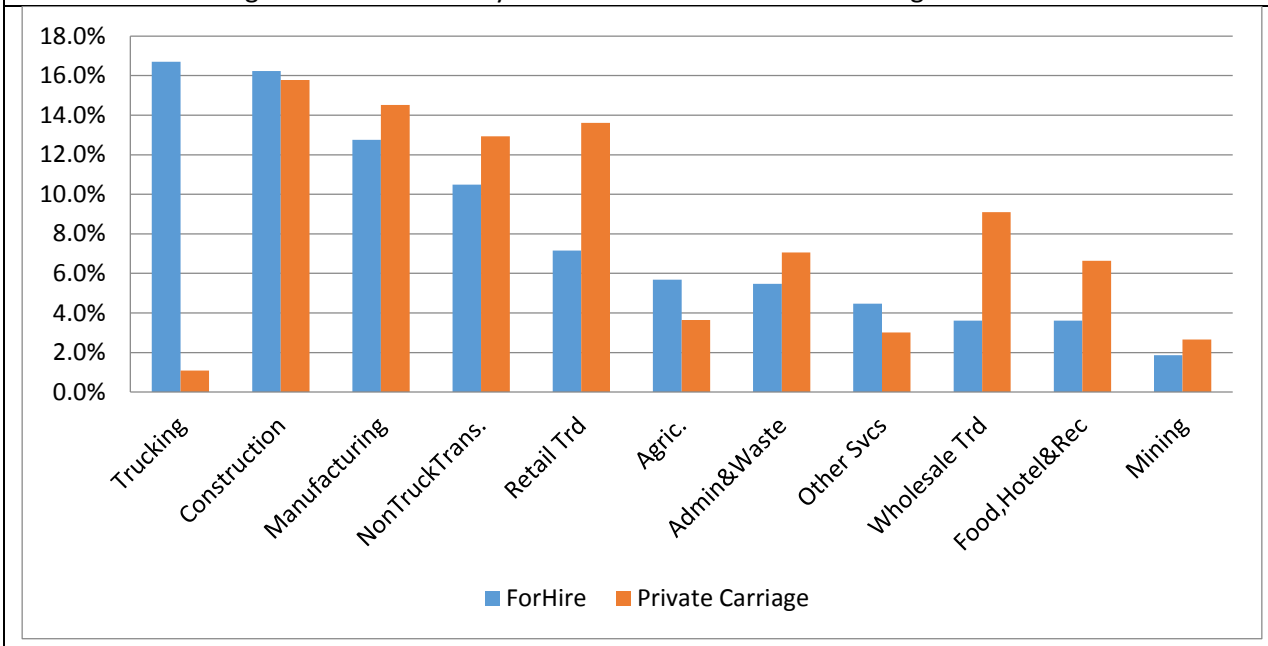
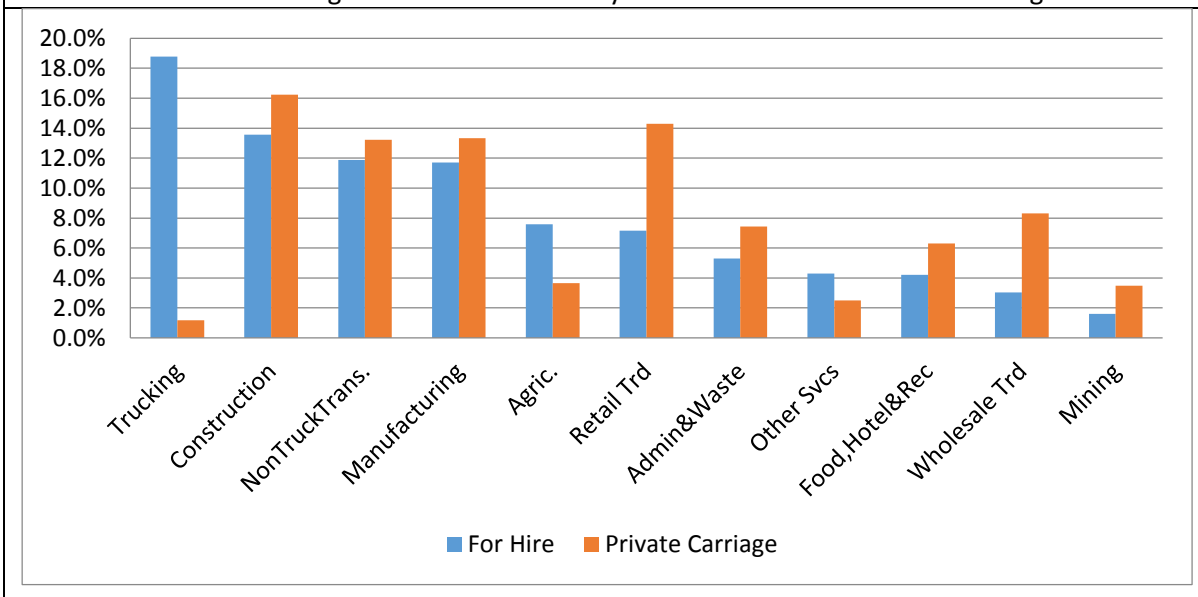


Figure 5: Period 2 Industry for Those Who Leave Truck Driving



Not surprisingly, nearly one-fifth of the entry into for-hire truck driving come from individuals who originally worked in another occupation within the trucking industry. The occupations within the trucking industry from which these individuals enter include laborers, transportation

managers/supervisors, dispatchers and mechanics (these total approximately 55% of the three-digit occupational codes). For those leaving for-hire truck driving for another occupation, the distribution of occupations to which the worker moves is remarkably similar. It appears that firms in the for-hire segment might most productively recruit from other areas within their firm or those of their competitors (i.e. workers handling freight at terminals or docks in the trucking industry).

Private carriage draws many drivers from wholesale and retail trade. The detailed occupations from retail trade include: sales persons, cashiers, stock clerks, and laborers. The occupations of laborers and stock handlers appear sensible as job alternatives for truck driving, as private carriage drivers, laborers, and stock handlers would often interact at loading docks.

The construction and manufacturing industries combined account for approximately another quarter of entries into both for-hire and private carriage. The detailed construction and manufacturing occupations to and from which individuals move out and in of truck driving are similar for both for-hire and private carriage. The construction jobs include carpenters, operating engineers, laborers, highway maintenance workers, and supervisors. The manufacturing jobs include supervisors, machinists, assemblers, welders, shipping and receiving clerks, industrial truck operators, and laborers.

Table 4: Distribution of Truck Drivers by Major Labor Market Segment and Period of Observation

		PERIOD 2		
		FOR HIRE	PRIVATE CARRIAGE	
PERIOD 1	FOR HIRE	42.9%	6.3%	49.2%
	PRIVATE CARRIAGE	5.1%	45.7%	50.8%
		48.0%	52.0%	

Finally, we examine the extent of migration between for-hire and private carriage. That is, among individuals who report working as truck drivers in both periods, how many of them change

industry segments (Table 4)? The answer is that there is very little inter-industry migration of truck drivers. Eight-seven percent of individuals who were employed in the for-hire segment in period 1 and who remain truck drivers, are still working on the for-hire segment in period 2. The figure for private carriage drivers remaining in private carriage is close to 90%.[10]

5. Models of In- and Out-Migration of Truck Drivers

We now turn to the question of whether differences in wages and hours predict changes of occupation and industry for truck drivers in the manner we would expect in CPS short panels if the labor market is operating in a normal fashion.

5.1. Exit from Truck Driving

We first examine truck driver occupational out-migration, by modeling the probability that an individual employed as a truck driver in the first period is no longer working as a driver in the second period. We only consider those who are employed in both periods. The dependent variable is binary and takes a value of 1 if the individual has left the truck driving occupation and 0 otherwise. Explanatory variables include standardized age and its square, marital status (married, and separated, divorced or widowed, with single as the reference group), race and ethnicity (Black, Asian, Hispanic, and Native American, with White as the reference group), union (either a union member or covered by a collective bargaining agreement), education (with less than high school as the reference group), Census region (with New England as the reference group), and fixed effects for year. The private carriage estimation also includes 2-digit NAICS industry controls (with non-trucking transportation as the reference group) and the percent of heavy trucks used in the industry (calculated from the 2002 VIUS data). This last variable is a proxy for the likelihood that the individual is employed as a heavy and tractor-trailer truck

[10] Divide the relevant cell amount by the accompanying row total.

driver, as opposed to a light or delivery service driver, or as a driver-sales worker, both of whom are included in the CPS truck driver category (section 2).

We are also interested in the role of earnings and hours in the probability of leaving the occupation. These regressions include a number test variables as well as controls. First, we include standardized real weekly wage and usual hours, both from period one, as explanatory variables (we trim the top and bottom 1% of weekly wages from the sample). We hypothesize that individuals will be more likely to leave trucking to find a better combination of hours and pay elsewhere. We then replace these variables with the change in earnings and the change in hours between the two periods.[11] Both approaches seem relevant: a truck driver may leave the occupation due to wage dissatisfaction and get another job, only to find that the job does not pay more. Thus, controlling for the initial conditions is important. Under the assumption that workers switching occupations have sufficient information, the difference in wages and hours will more completely identify workers who are leaving to achieve better outcomes.

Table 5: Probability of Exiting Truck Driving Occupation in Period 2				
	for-hire		private carriage	
standardized usual hours	0.817***		0.886***	
	(-4.140)		(-3.294)	
standardized weekly wage	0.700***		0.823***	
	(-2.973)		(-2.821)	
difference realweeklywage		1.000***		1.000***
		(2.616)		(3.558)
difference in usual hours		0.979***		0.987***
		(-3.748)		(-2.920)
standardized percent heavy trucks			0.505***	0.500***
			(-11.00)	(-10.40)
Observations	4,240	3,564	7,835	7,245
Robust z-statistics in parentheses	(N's reflect the number of truck drivers in the sample)			
*** p<0.01, ** p<0.05, * p<0.1				

[11] Change is defined as period 2 – period 1

The estimated odds ratios for the earnings and hours measures are presented in Table 5.[12] Those with higher initial weekly wages are less likely to leave driving in the second period; those with weekly wages one standard deviation above the mean are 70% percent as likely to leave truck driving. The relationship between hours and the probability of leaving driving is also negative – a one standard deviation increase in initial weekly hours makes an individual 82% as likely to leave. Private carriage driver results are roughly equivalent to those in the for-hire case – drivers with one standard deviation higher weekly wages are 82% as likely to leave and those with one standard deviation higher weekly hours are 89% as likely to leave truck driving. Additionally for private carriage truck drivers, there is less likelihood of leaving if the driver is in an industry with a higher percentage of heavy trucks - those working in an industry with heavy trucks one standard deviation higher than the mean are only half as likely to leave truck driving – suggesting heavy and tractor-trailer truck drivers are less likely to leave the broad CPS category of trucking than light and delivery service drivers, or than driver-sales workers.

The difference in usual hours is negatively related to the likelihood of leaving trucking for both for-hire and private carriage drivers (columns 2 and 4, respectively). Those leaving for-hire driving experience lower hours in their new occupation. Finally, though there is a statistically significant relationship between change in weekly wages and the likelihood of leaving for-hire and private carriage driving, the coefficients are only slightly larger than one and therefore do not meet the criterion of practical significance. There is a negative relationship between wages and the probability of leaving private carriage. Briefly looking at the relationship between demographics and the probability of exit (Appendix A), older individuals are less likely to leave driving and there is no statistical relationship between education and exit from driving.

[12] Full regression results are presented in Appendix A; we also consider models that use hourly wage rather than weekly wage; the results are nearly identical so are not presented here

5.2. Entry into Truck Driving

We next turn to estimating the probability of entering truck driving. The sample is different than that of the exit model. We only include those workers who changed occupations between periods ("movers"). To find these workers in the CPS, we compare 3 digit occupations between the two periods and designate those who change codes as movers. Some of the movers may, in fact, be those who still work the same job, but were coded differently in both periods. To overcome this, we consider "large" occupations (those with at least 1000 workers). Our assumption is that more common jobs are less likely to be misdescribed/miscoded in the CPS.

We first estimate a logit model of changing occupations, to get a sense of whether truck drivers are more likely to be movers (due to the size of the output, results are not presented in this paper and are available from the authors upon request). We include the same controls as in the exit model along with a series of 3 digit occupational dummies, with truck driver as the omitted group. Somewhat surprisingly, we find that most occupational coefficients are positive, indicating that males working as truck drivers in the first period are, in fact, less likely to leave their occupation in period 2 than those in other occupations. We then restrict the sample to those with a high school education or less (as these workers may be less likely to migrate between jobs due to reduced opportunities). Again, we find that truck drivers are less likely than most occupations to leave their jobs. This provides additional evidence that the mobility patterns of truck drivers are not out of step with other blue collar jobs – while some parts of the occupation may have high firm-specific turnover, as a large occupational group truck drivers appear to have higher, not lower, levels of occupational attachment than other occupations requiring similar human capital.

Last, we estimate the probability of individuals entering truck driving, conditioned on the fact that they changed jobs between the two periods (among the sample of movers). Again, we estimate the models separately for for-hire and private carriage. The specification is similar to the exit model –

explanatory variables include individual characteristics, location, and industry controls. The focus, again, is on the role of earnings and hours in the likelihood of entering the truck driving occupation. Results for key variables of interest are presented in Table 6 (and full results presented in Appendix B).

Table 6: Probability of Entering Truck Driving in Period 2				
	for-hire		private carriage	
standardized usual hours	1.194***		1.126***	
	(4.141)		(3.763)	
standardized weekly wage	0.620***		0.650***	
	(-6.228)		(-8.292)	
Difference in real weekly wage		1.000		1.000***
		(-0.843)		(-6.348)
difference in usual hours		1.000***		1.007
		(4.753)		(1.531)
Observations	95,070	87,839	95,557	88,339
z-statistics in parentheses	(Ns reflect the total number of occupation changers)			
*** p<0.01, ** p<0.05, * p<0.1				

There is a negative relationship between initial pay and likelihood of entering truck driving and a positive relationship between initial hours and entry for both for-hire and private carriage specifications. Those entering truck driving likely see it as an avenue to income increase and were initially working longer hours, which may make the long hours of driving less unappealing. The difference in earnings and hours are not significant for either sector (the coefficients that are statistically significant are not large enough to be practically significant). Turning to individual demographic characteristics, those with relatively low levels of education were more likely to enter truck driving.

6. Why Do Many Trucking Managers Think the Market for Truck Drivers is Broken?

So far we have observed that the labor market for truck drivers, insofar as it can be analyzed using short panels from the CPS, appears to operate in a normal fashion. Exit and entry rates are in the range of typical blue-collar occupations, wage and hours differences have the expected predictive power, and the occupations and industries from which truck drivers are drawn and to which truck drivers depart appear sensible. How can we understand the perception of many trucking firm managers that the market is broken (section 2)?

We already suggested one important part of the answer: if we use high firm-level turnover as the defining marker, according to the ATA's surveys of its member firms over the years (Watson 2009; Watson 2014a), the apparent shortage is only severe with regard to heavy and tractor-trailer truck drivers in one key segment of the for-hire motor freight industry. This is the long-distance truckload (TL) part of for-hire motor freight. As we noted in section 2, the survey results from the ATA and its member associations show that other major segments of for-hire motor freight appear to have more modest firm-level turnover rates, which may be somewhat higher than those of the twentieth century (Kambourov and Manovskii 2008), but that are typical of many blue collar occupations in the twenty-first century (Petty 2006; Watson 2009; Penske Logisitics 2012; PR Newswire 2013).

Why should turnover rates be so persistently high in long distance TL motor freight, as compared to other parts of for-hire motor freight? There appear to be some straightforward economic answers. Long distance motor freight is shaped by the need to keep over-the-road units fully loaded in order to keep costs competitive. This leads to "line of business" specialization in long distance for-hire trucking by shipment size, and distinguishes the TL carriers, who primarily provide point-to-point full load service from the less-than-truckload (LTL) carriers, who use local terminals to aggregate and disaggregate

middle-sized and smaller shipments into full loads for inter-terminal (and hence inter-city) movement.[13] The key economic point is that terminal networks impose an entry barrier, while point-to-point service has essentially no barriers to entry.[14] The lack of entry barriers in long distance TL creates a supply side composed of tens of thousands of firms[15] with sharp price competition and a labor cost ceiling (Burks, Belzer et al. 2010).

High turnover, as a specific marker of driver employment in this segment, appears to be the aggregate result of individual firm TL labor cost minimization choices. There are three components to the cost of TL labor, all of which trade off against each other. The first is productivity costs: running trucks efficiently creates long and irregular work hours with limited time at home; running them less productively reduces these disamenities. A second is wage costs: paying a sufficient compensating differential will offset disamenities. The third is turnover costs, the costs of recruiting and training new drivers, and the fact that new drivers are initially less safe and less productive. Arguably, the history of the TL segment since the economic deregulation of 1980 shows that the least cost mixture of these components is to operate trucks very productively, pay a modest compensating differential, but only for drivers that acquire significant tenure, and have high turnover (Burks, Carpenter et al. 2008). In other

[13] From the standpoint of the economics involved, LTL is similar to long distance parcel service by truck, which handles a huge volume of very small shipments using a much denser terminal network than in the LTL case. However, in NAICS terms firms in this line of business are not part of trucking, but are in the category 492 Couriers and Messengers.

[14] The barrier for LTL is not the capital cost of terminals, which can be rented, but the fact that beginning a service that requires a flow of shipments over a network incurs the sunk costs of maintaining competitive service (hence, running partly empty) while establishing sufficient network density to be competitive on costs. To become a TL carrier one can start with an insurance certificate, an operating authority, and a telephone number, since initial freight movements can be subcontracted; the total cost is quite small (on the order of $10,000).

[15] Counting both specialized and general freight long distance truckload firms, in North American Industrial Classification System (NAICS) categories 4841210 and 4842300, there are more than 36,000 firms in the TL segment. The distribution is highly skewed—almost all firms are small, but there are a few hundreds of middle-sized firms, and a few dozen very large ones (US Census Bureau 2009).

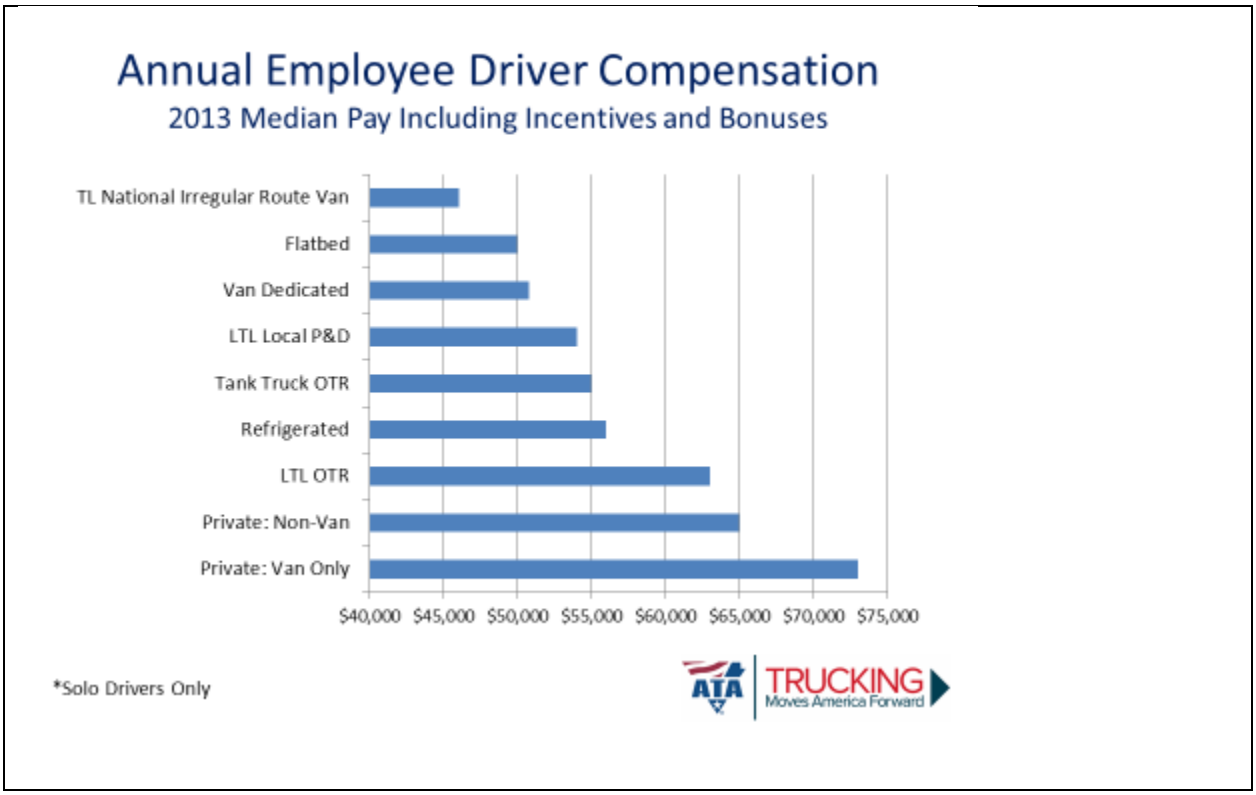
words, the competitive conditions create here a what used to be called a "secondary labor market segment," marked by persistent and high turnover at the margin (Cain 1976; Dickens and Lang 1993).[16]

None of this is to say that any individual firm could choose to behave differently. In a marketplace with nearly zero entry barriers and little ability to differentiate products and sustain higher than average prices, deviating from cost minimization is not viable. One large TL firm tried this in 1995, reasoning that a high enough compensating differential, though costly, would on net pay off in lower accidents, higher productivity, and lower turnover. Initial indications were positive (Rodriguez, Targa et al. 2006), but eventually it switched back to a higher turnover model (Waxler 1997). Thus, managers of TL firms face a significant business problem in maintaining their workforce.

A reasonable conjecture about what is going on in the TL part of the driver labor market is that new-to-the-industry heavy and tractor-trailer truck drivers tend to enter the occupation with a TL firm, since these firms almost always have openings for inexperienced drivers. Then, if they decide to stay with the occupation after learning how to succeed in driving, a large fraction move to other segments of the labor market (moves which may show up as moves of industry in the CPS data, but are not occupational changes). There is very little statistical evidence that directly addresses this point, but what is available is suggestive. The ATA periodically performs a study of compensation practices among member firms, and a slide from a presentation of the most recent one is shown in Figure 6.

Figure 6: Heavy and Tractor-Trailer Compensation by Occupational Segment,
2014 American Trucking Association Compensation Study (Dupré, Leitner et al. 2014)

[16] For an analysis of the use of training contracts for new-to-the-industry drivers by a TL firm, see Hoffman and Burks (2014).



While this survey is not nationally representative, it undoubtedly includes many of the larger employers of drivers in both for-hire and private carriage. These appear to be compensation differences sufficient to induce at least some successful heavy and tractor-trailer drivers to switch labor market segments.

A similar picture is painted by a study of TL driver turnover among new-to-the-industry drivers who were under a training contract that made their debt for driver training null after twelve months of on-the-job service. Exit survey data were collected from those who departed during the study period; two-thirds of the entering cohort did not complete the year, and a significant fraction who did exited soon after (Burks, Carpenter et al. 2008; Hoffman and Burks 2014). There was approximately a 25% response rate. Results are shown in Table 7. About 40% of those responding stayed in the truck driver occupation, but switched to a type of job with fewer disamenities, and only 10% stayed in long haul over-the-road work.

Table 7: Exit Survey Results for a Population of New-to-the-industry TL Drivers.
(Source: 2005-2008 TL Driver Study)

	Voluntary Quit (75%)	Discharged (25%)	Total
OTR Long Haul	8%	17%	10.3%
OTR Regionally	18%	3%	14.3%
Driving Locally	29%	6%	23.3%
Non-Driving	24%	31%	25.8%
Unemployed	15%	41%	21.5%
Missing Data	6%	2%	5.0%

If this high-turnover "entry to the occupation" story is a long-term equilibrium situation, why was there such concern at the ATA's 2014 annual conference, which led to the headline mentioned in section 2, "Driver Shortage Hits Critical Level as Executives Fear Loss of Business" (Reiskin 2014)? There appears to be a straightforward economic answer. There is a lag between a positive demand shock in the market for motor freight and the upward adjustment of wages needed to attract more drivers to the TL industry segment. TL pricing is highly disaggregated due to the tens of thousands of different geographic lanes, tens of thousands of distinct customers, and tens of thousands of distinct commodities being hauled. Freight moved for large shippers (e.g. Fortune 1000 firms) is often under year-long rate contracts, so while the spot market immediately reflects an increase in demand, average industry prices move more slowly (Transport Topics 2014). The price rigidity and low margins in TL make it difficult for firms to quickly adjust wages when demand increases, resulting in an increase in turnover. The turnover rate acts as a kind of short-term buffer, and when it spikes (Watson 2014a) it signals future

driver pay increases, a change which industry sources note is taking place (Watson 2014b).[17] The business problem facing TL firm managers gets more difficult to solve when freight demand increases.

7. Why Doesn't High Turnover Show Up in CPS Data?

Having identified the factors behind the managerial concern with labor market conditions in long distance TL motor freight, why don't we see any evidence of the persistent firm-level turnover that is the underlying issue in the CPS data? We previewed the answers in section 2. One reason is that the TL segment, while employing the largest single group of heavy and tractor-trailer truck drivers (SOC 53-3032), still makes up only about one third of the total employment of this group.[18] And the CPS lumps these drivers with two other groups (see section 2), so that heavy and tractor-trailer truck drivers make up only about 60% of the total. Thus, even though we filtered some of the drivers in other categories from our data (section 3, using VIUS data on the distribution of heavy trucks by industry), the drivers in the TL segment most likely make up only about 20% of our sample.

The second reason is also important--CPS data only gives us an indirect look at firm-specific turnover (section 3), as there is no job tenure variable the only firm exits seen in the data are those that are also either occupation or industry exits. For both these reasons we should not be surprised that high firm-level turnover in the TL segment of for-hire motor freight does not show up in our analysis of CPS data.

8. Conclusion

The trucking industry trade press often portrays truck driving as an occupation beset by high levels of turnover and persistent "labor shortages". Using data from the CPS, we model exit from and entry to

[17] None of this denies that managers are face a significant business challenge in recruiting and retaining drivers—it is just not what economists would call a "shortage," as wages are not persistently held below the market-clearing level.

[18] The one-third estimate is derived by taking 75% of the total employment at firms in NAICS categories 4841210 and 4842300 according to the 2007 quinquennial Economic Census (U.S. Census Bureau 2007); 2007 is at the midpoint of the CPS data utilized, and is also the latest available at the time of writing.

the occupation and find that occupational migration among drivers is similar to other blue collar occupations (Kambourov and Manovskii 2008). From the short panels available in the CPS data, we cannot see cycling in and out of occupations for an individual over his career, nor can we see firm-level turnover that does not involve a change of either occupation or industry. However, the occupations from which drivers enter and to which they leave are similar – construction, production, and non-trucking transportation jobs – providing evidence that drivers consider wages/hours of these jobs as alternatives to trucking.

Econometric models of in and out-migration of drivers support this. Drivers with higher wages and hours in period 1 are less likely to leave driving in period 2. Those who enter driving in period 2 tend to have lower wages and higher hours in their initial job. Perhaps most surprising, a basic model of moving between occupations shows that truck drivers have lower occupational migration than other workers with similar education levels. This suggests that in the aggregate, the labor market for truck drivers works about as well as labor markets for other blue collar occupations. Whether one thinks that is a satisfactory outcome depends on one's view of the evolution of wages and conditions in other blue collar labor markets in the US over the relevant time period, a topic which is beyond the scope of the present paper.

How, then, do we reconcile the finding that truck driving is a relatively stable occupational choice with migration driven in a predictable way by wages and hours with the view from managers in the industry that the market is broken? We suggest that the truck driving occupation is actually a composite of driving labor market segments, and that one segment in particular, long distance TL, is a "secondary market" (Cain, 1976; Dickens and Lang, 1993). Long distance TL is characterized by high levels of competition and very limited ability to differentiate prices in the product market, resulting a labor market equilibrium on the input side in which individual firms are forced to accept high turnover as a

cost-minimizing response to their competitive position in the market for their outputs. This faces managers in the TL segment with a real business problem, managing recruitment and retention under such circumstances, and that problem becomes harder to solve when the industry has a lagged pricing response to a positive demand shock, as has happened in 2014. But economists would not regard this as either a shortage (since wages rise, with a lag, when product market and then the derived demand for labor increases), nor a "broken market," except to the extent that one might use that term for a secondary labor market segment due to its high turnover. Thus, our finding that the labor market for truck drivers (as that occupation is broadly construed by the CPS) functions normally is consistent with about a sixth of that market having secondary labor market characteristics (such as high turnover at the firm level) which are only partially visible in the CPS.

References

Bartel, A. P. and G. J. Borjas (1981). Wage Growth and Job Turnover: An Empirical Analysis. Studies in Labor Markets. S. Rosen, University of Chicago Press**:** 65-90.

Belman, D. L., K. Monaco, et al. (2005). Sailors of the Concrete Sea: A Portrait of Truck Drivers' Work and Lives. Lansing, MI, Michigan State University Press.

Burea of Economic Analysis (2014). GDP by Industry Online Database. Washington, DC, U.S. Department of Commerce.

Bureau of Transportation Statistics (2014). Press Release BTS 10-14: Three of Five Modes Carried More U.S.-NAFTA Trade in December 2013 than in December 2013. Washington, DC, U.S. Department of Transportation.

Burks, S. V., M. Belzer, et al. (2010) "Trucking 101: An Industry Primer." Transportation Research Board, Transportation Research Circular Number E-C146.

Burks, S. V., J. Carpenter, et al. (2008). Using Behavioral Economic Field Experiments at a Firm: The Context and Design of the Truckers and Turnover Project. The Analysis of Firms and Employees: Quantitative and Qualitative Approaches. S. Bender, J. Lane, K. Shaw, F. Andersson and T. von Wachter. Chicago and London, NBER and University of Chicago Press**:** 45-106.

Burks, S. V., K. Monaco, et al. (2004). "The Balance between Private and For-Hire Carriage and Trends in the Use of Large Trucks (1977 to 1997)." Journal of the Transportation Research Forum 43(2): 159-171.

Cain, G. G. (1976). "The Challenge of Segmented Labor Market Theories to Orthodox Theory: A Survey." Journal of Economic Literature 11(4): 1215-1257.

Christenson, D., R. Aames, et al. (1997). Empty Seats and Musical Chairs: Critical Success Factors in Truck Driver Retention. Washington, DC, Gallup Organization for the ATA Foundation.

Dickens, W. T. and K. Lang (1993). Labor Market Segmentation Theory: Reconsidering the Evidence. Labor Economics: Problems in Analyzing Labor Markets. W. Darity, Jr. Norwell, MA, Kluwer Academic**:** 141-180.

Dupré, R., L. Leitner, et al. (2014). "(Un)common Compensation: New Trends in Driver Pay." ATA Driver Compensation Study 2014 Preview(ATA Economics Department).

FMCSA (2003). 49 CFR Parts 385, 390, and 395; Hours of Service of Drivers; Driver Rest and Sleep for Safe Operations; Final Rule, USDOT**:** 22457-22517.

Global Insight Inc. (2005). The U.S. Truck Driver Shortage: Analysis and Forecasts.

Hoffman, M. and S. V. Burks (2014). Training Contracts and Worker Overconfidence. University of Toronto Working Paper.

James, J. (2011). Ability matching and occupational choice, Federal Reserve Bank of Cleveland, Working Paper: 1125**:** 66 p.

Kambourov, G. and I. Manovskii (2008). "Rising Occupational and Industry Mobility in the United States: 1968-97." International Economic Review 49(1): 41-79.

Light, A. and K. McGarry (1998). "Job Change Patterns and the Wages of Young Men." Review of Economics and Statistics 80(2): 276-286.

Madrian, B. C. and L. J. Lefgren (1999). A Note on Longitudinally Matching Current Population Survey (CPS) Respondents. NBER Technical Working Papers #247. Cambridge, MA, National Bureau of Economic Research.

Mincer, J. and B. Jovanovic (1981). Labor Mobility and Wages. Studies in Labor Markets. S. Rosen. Chicago, IL, University of Chicago Press**:** 21-64.

Munasinghe, L. and K. Sigman (2004). "A Hobo Syndrome? Mobility, Wages, and Job Turnover." Labour Economics 11(2): 191-218.
Neal, D. (1999). "The Complexity of Job Mobility among Young Men." Journal of Labor Economics 17(2): 237-261.
Neumark, D. and D. Kawaguchi (2004). "Attrition Bias in Labor Economics Research Using Matched CPS Files." Journal of Economic and Social Measurement 29(4): 445-472.
Occupational Information Network (2014). Online Database of Occupational Information. O*NET Online, US Department of Labor/Employment and Training Administration.
Penske Logisitics (2012). "Carriers Seek Ways to Combat Truck Driver Shortage." Move Ahead 2014.
Petty, G. (2006). "Two-percent turnover." Fleet Owner 101(1): 38-38.
PR Newswire (2013) "ATA's Survey-Truckload and LTL Driver Turnover Rises in First Quarter of 2013." PR Newswire Report.
Reiskin, J. S. (2014). Driver Shortage Hits Critical Level as Executives Fear Loss of Business. Transport Topics. Alexandria, VA, American Trucking Associations**:** 1& 69.
Rodriguez, D. A., F. Targa, et al. (2006). "Pay Incentives and Truck Driver Safety: A Case Study." Industrial and Labor Relations Review 59(2): 205-225.
Transport Topics (2014) "Spot Freight Rates Rise to Record, DAT Reports." Transport Topics Online.
US Census Bureau (2009). Transportation and Warehousing: Industry Series: Preliminary Summary Statistics for the United States: 2007. 2007 Economic Census. Sector 48: EC0748I1.
Watson, R. (2009). TL Driver Turnover Rates Fall to Historic Lows, ATA Reports. Transport Topics. Arlington, VA, American Trucking Associations. Sept. 28**:** 1.
Watson, R. (2010). Driver Turnover Rate Rises. Transport Topics. Alexandria, VA, American Trucking Associations. Sept. 27**:** 1.
Watson, R. (2014a). 2Q Truckload Driver Turnover Hits 2-Year High, ATA Reports. Transport Topics. Alexandria, VA, American Trucking Associations**:** 7 & 69.
Watson, R. (2014b). "Pace of Driver-Pay Increases Quickens In Reaction to Tight Capacity, Demand." Transport Topics(September 1).
Waxler, C. (1997). "J.B.Hunt Transport shares may drop further." Forbes 159(8): 382-383.

Appendix A: Truck Driving Exit Estimation Results

	for hire		private carriage	
Standardized usual hours	0.817***		0.886***	
	(-4.140)		(-3.294)	
Standardized weekly wage	0.700***		0.823***	
	(-2.973)		(-2.821)	
Standardized percent heavy trucks			0.505***	0.500***
			(-11.00)	(-10.40)
Difference in real weekly wage		1.000***		1.000***
		(2.616)		(3.558)
Difference in usual hours		0.979***		0.987***
		(-3.748)		(-2.920)
agriculture			0.364***	0.347***
			(-4.383)	(-4.229)
mining			0.589**	0.493***
			(-2.421)	(-3.156)
utilities			0.436***	0.465**
			(-2.642)	(-2.363)
construction			0.286***	0.288***
			(-7.174)	(-6.675)
manufacturing			0.195***	0.195***
			(-9.869)	(-9.285)
Wholesale trade			0.145***	0.143***
			(-11.81)	(-11.15)
Retail trade			0.160***	0.160***
			(-10.51)	(-9.859)
Administrative and waste services			0.249***	0.233***
			(-8.128)	(-7.984)
Food, hotel, and recreation			0.257***	0.270***
			(-6.217)	(-5.716)
Standardized age	0.721***	0.664***	0.795***	0.773***
	(-4.974)	(-5.632)	(-6.805)	(-7.333)
Standardized age squares	1.015	0.990	1.177***	1.200***
	(0.276)	(-0.155)	(5.452)	(5.826)
union	0.805	0.792	0.904	0.849*
	(-1.356)	(-1.310)	(-1.219)	(-1.945)
high school	0.856	0.909	0.902	0.861
	(-0.991)	(-0.544)	(-1.181)	(-1.642)

some college	0.957	1.011	1.078	1.021
	(-0.229)	(0.0523)	(0.692)	(0.183)
associates/vocational	1.287	1.298	1.197	1.121
	(1.046)	(0.987)	(1.228)	(0.762)
college degree or higher	1.413	1.447	1.736***	1.574***
	(1.153)	(1.117)	(3.675)	(2.889)
region 2	1.036	0.910	1.152	1.150
	(0.106)	(-0.260)	(0.988)	(0.925)
region 3	0.855	0.736	1.011	0.993
	(-0.497)	(-0.887)	(0.0827)	(-0.0517)
region 4	0.699	0.539*	0.992	0.963
	(-1.076)	(-1.651)	(-0.0551)	(-0.245)
region 5	0.873	0.707	0.942	0.919
	(-0.429)	(-1.002)	(-0.430)	(-0.583)
region 6	0.811	0.605	0.902	0.923
	(-0.594)	(-1.310)	(-0.614)	(-0.456)
region 7	0.941	0.821	1.029	1.003
	(-0.183)	(-0.547)	(0.190)	(0.0195)
region 8	1.270	0.898	1.132	1.099
	(0.704)	(-0.291)	(0.835)	(0.610)
region 9	1.013	0.996	0.933	0.940
	(0.0378)	(-0.00974)	(-0.479)	(-0.400)
Black	1.331*	1.658***	1.254**	1.356***
	(1.733)	(2.849)	(2.121)	(2.730)
Hispanic	0.844	1.046	1.394***	1.473***
	(-0.927)	(0.234)	(3.567)	(3.981)
Native American	0.357	0.272	0.808	0.818
	(-1.335)	(-1.573)	(-0.521)	(-0.485)
Asian	3.915***	5.224***	1.173	1.271
	(3.309)	(3.645)	(0.639)	(0.944)
Multi Race	0.751	0.574	1.130	1.137
	(-0.460)	(-0.752)	(0.432)	(0.436)
Married	0.854	0.800	0.929	0.908
	(-0.912)	(-1.220)	(-0.805)	(-1.011)
Separated, divorced, widowed	0.999	0.940	0.864	0.867
	(-0.00644)	(-0.260)	(-1.195)	(-1.111)
period 2 2002	1.755**	1.425	0.931	0.918
	(1.968)	(1.138)	(-0.476)	(-0.540)
period 2 2003	1.534	1.250	0.904	0.819
	(1.412)	(0.656)	(-0.670)	(-1.259)
period 2 2004	1.371	1.567	1.100	1.063
	(1.012)	(1.359)	(0.629)	(0.386)
period 2 2005	1.542	1.012	0.955	0.909
	(1.441)	(0.0347)	(-0.290)	(-0.571)

period 2 2006	1.185	1.014	1.162	1.137
	(0.561)	(0.0434)	(0.997)	(0.819)
period 2 2007	2.190***	2.139**	1.046	1.045
	(2.685)	(2.401)	(0.298)	(0.280)
period 2 2008	1.638*	1.278	1.033	1.039
	(1.683)	(0.764)	(0.213)	(0.243)
period 2 2009	1.525	1.335	0.952	0.940
	(1.382)	(0.878)	(-0.310)	(-0.380)
period 2 2010	1.555	1.468	1.040	1.027
	(1.419)	(1.134)	(0.250)	(0.166)
period 2 2011	1.390	1.375	1.053	1.050
	(1.047)	(0.934)	(0.330)	(0.302)
period 2 2012	1.275	1.149	1.121	1.091
	(0.743)	(0.399)	(0.732)	(0.529)
period 2 2013	1.413	1.397	1.140	1.173
	(1.109)	(1.009)	(0.855)	(1.007)
Constant	0.123***	0.149***	0.750	0.851
	(-4.837)	(-4.057)	(-1.318)	(-0.707)
Observations	4,240	3,564	7,835	7,245

Robust z-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix B: Truck Driving Entry Estimation Results

VARIABLES	for-hire		private carriage	
Standardized usual hours	1.194***		1.126***	
	(4.141)		(3.763)	
Standardized weekly wage	0.620***		0.650***	
	(-6.228)		(-8.292)	
Difference in real weekly wage		1.000		1.000***
		(-0.843)		(-6.348)
Difference in usual hours		1.000***		1.007
		(4.753)		(1.531)
Standardized age	1.021	1.000	0.945*	0.911***
	(0.432)	(-1.091)	(-1.803)	(-2.848)
Standardized age squared	0.961	1.000	1.012	1.045
	(-0.957)	(-1.036)	(0.442)	(1.621)
union	0.934	1.000	1.412***	1.279***
	(-0.552)	(-0.253)	(4.296)	(2.949)
high school	1.490***	1.001**	0.991	0.944
	(2.650)	(2.145)	(-0.0996)	(-0.623)
some college	1.025	1.000	0.695***	0.621***
	(0.143)	(-0.268)	(-3.467)	(-4.348)
associates/vocational	0.768	0.999**	0.537***	0.446***
	(-1.261)	(-2.075)	(-4.677)	(-5.753)
college degree or higher	0.336***	0.996***	0.278***	0.193***
	(-4.901)	(-6.501)	(-9.154)	(-11.57)
Married	1.154	1.000	0.939	0.910
	(1.129)	(1.066)	(-0.798)	(-1.143)
Separated, divorced, widowed	1.171	1.000	1.062	1.016
	(0.940)	(0.427)	(0.558)	(0.135)
region 2	1.415	1.001	0.945	0.975
	(1.615)	(1.537)	(-0.426)	(-0.179)
region 3	1.510**	1.001	1.089	1.185
	(2.028)	(1.403)	(0.701)	(1.330)
region 4	1.420*	1.001	1.135	1.285*
	(1.681)	(1.047)	(1.033)	(1.942)
region 5	1.400*	1.001	1.173	1.205
	(1.708)	(1.278)	(1.370)	(1.501)
region 6	1.842***	1.002**	0.994	1.114
	(2.642)	(2.260)	(-0.0358)	(0.653)
region 7	1.753***	1.002**	0.964	1.056
	(2.627)	(2.444)	(-0.261)	(0.373)

region 8	1.476*	1.001	1.052	1.086
	(1.841)	(1.395)	(0.397)	(0.605)
region 9	1.128	1.000	0.886	0.887
	(0.537)	(-0.215)	(-0.909)	(-0.853)
Black	1.535***	1.002***	1.274**	1.350***
	(3.255)	(3.371)	(2.440)	(2.913)
Hispanic	0.870	1.000	0.930	0.984
	(-0.965)	(-0.620)	(-0.802)	(-0.173)
Native American	1.616	1.004	1.499	1.420
	(0.832)	(1.345)	(1.237)	(1.041)
Asian	0.564	0.998*	0.826	0.899
	(-1.574)	(-1.715)	(-0.965)	(-0.527)
Multi Race	0.953	1.000	0.855	0.879
	(-0.116)	(-0.0351)	(-0.529)	(-0.418)
period 2 2002	1.507**	1.003***	1.135	1.075
	(2.051)	(2.730)	(0.966)	(0.532)
period 2 2003	1.073	1.001	1.020	0.897
	(0.331)	(0.970)	(0.149)	(-0.778)
period 2 2004	1.076	1.001	0.972	0.865
	(0.338)	(0.811)	(-0.211)	(-1.014)
period 2 2005	1.154	1.001	0.813	0.751*
	(0.648)	(0.637)	(-1.404)	(-1.862)
period 2 2006	1.230	1.002*	1.015	0.984
	(0.984)	(1.714)	(0.109)	(-0.113)
period 2 2007	0.960	1.001	0.966	0.948
	(-0.185)	(0.820)	(-0.256)	(-0.381)
period 2 2008	1.228	1.002*	0.815	0.775*
	(0.986)	(1.730)	(-1.441)	(-1.738)
period 2 2009	0.888	1.000	0.856	0.833
	(-0.509)	(0.369)	(-1.067)	(-1.225)
period 2 2010	0.860	1.000	0.752*	0.669**
	(-0.632)	(0.272)	(-1.860)	(-2.495)
period 2 2011	0.898	1.000	0.797	0.755*
	(-0.470)	(0.0885)	(-1.550)	(-1.857)
period 2 2012	1.150	1.002*	0.897	0.830
	(0.626)	(1.716)	(-0.729)	(-1.199)
period 2 2013	1.003	1.001	1.090	1.012
	(0.0124)	(0.875)	(0.617)	(0.0813)
agriculture	2.175**	1.003	4.442***	6.072***
	(2.470)	(1.621)	(5.713)	(6.734)
mining	0.883	0.998	4.531***	3.361***
	(-0.289)	(-1.239)	(5.572)	(4.127)
utilities	0.494	0.998**	1.403	1.114
	(-1.562)	(-2.104)	(1.094)	(0.326)
construction	1.092	1.000	2.996***	2.916***
	(0.394)	(0.0938)	(5.406)	(5.157)

manufacturing	0.541***	0.998***	1.707***	1.638**
	(-2.733)	(-2.939)	(2.639)	(2.385)
Wholesale trade	0.712	0.999	5.108***	5.348***
	(-1.237)	(-1.208)	(7.881)	(7.957)
Retail trade	0.677	0.999	2.903***	3.058***
	(-1.631)	(-1.270)	(5.202)	(5.348)
Transportation	3.936***	1.009***	2.868***	2.999***
	(6.406)	(6.169)	(4.782)	(4.890)
information	0.705	0.999	0.349**	0.200***
	(-0.944)	(-1.413)	(-2.161)	(-2.637)
Finance, insurance, real estate	0.820	0.999	0.647	0.604
	(-0.638)	(-0.750)	(-1.288)	(-1.440)
Professional, Technical, Managerial	0.642	0.998*	0.344**	0.275***
	(-1.298)	(-1.926)	(-2.509)	(-2.847)
Admin and Waste	1.395	1.001	3.210***	3.301***
	(1.266)	(0.803)	(5.169)	(5.144)
Education Services	0.866	0.999	0.748	0.634
	(-0.454)	(-0.950)	(-0.899)	(-1.268)
Health care	0.478	0.999	0.517	0.556
	(-1.632)	(-1.344)	(-1.460)	(-1.295)
Food, hotel recreation	0.847	1.000	2.266***	2.577***
	(-0.564)	(0.149)	(3.489)	(3.968)
Other services	1.679*	1.003**	2.293***	2.129***
	(1.946)	(2.425)	(3.295)	(2.846)
Observations	95,070	87,839	95,557	88,339

z-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1