Car Ownership: A study of Employment and Earnings

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Abstract

This paper examines whether the positive relationship between car ownership and employment outcomes reflects a causal effect of car ownership. With this purpose using state-level data on gas prices to micro-data sample containing information on car ownership and employment outcomes is developed. This study shows that there is a large difference in employment rates, weekly working hours and annual wages between those with and without cars. The similar study has been made by Raphael and Rice (2002) and the employment probability and hours findings suggest important causal effects of car ownership on employment outcomes. But they found a negative car ownership effect on wages.

Introduction

This paper is based on the idea that having a car is likely to afford tangible advantages in locating and maintaining employment. Raphael and Rice (2002) find in their research by using OLS regressions that controlling for observable demographic and human capital variables, there is a large difference in employment rates, weekly hours worked and hourly wages for those with and without cars. They threat gas taxes and insurance premiums as instrumental variables instead of the more common gas prices and insurance premiums. Instrumenting car ownership on insurance and gas tax costs yields estimates of the employment and hours and effects of car ownership is close to the OLS

estimates. Despite the fact that the wage outcomes are not a good indicator of this relation, the probability of being employed and working hours per week results suggest significant causal effect of car ownership on employment outcomes.

While their findings are consistent with causal effects of car ownership, there are also several alternative explanations related to Raphael and Rice research. For example the cause-effect relation may be in the opposite direction which means those with jobs can afford cars. They also mention that car ownership may be determined in part by unobserved factors that also effect employability, skills or motivation.

Empirical Strategy and Data Description

This study observes the effect of car ownership on three employment outcomes: the probability of being employed, weekly hours and annual wages conditional on being employed. To identify the causal effects of car ownership, I employed state-level gas prices. Since consumers' responsiveness against gas prices seems more likely to be higher then the gas taxes, I used gas prices for auto-ownership cost. This is an instrument for car ownership.

$$\text{Employment outcome}_{ij} = \beta X_{ij} + \gamma \text{Car}_{ij} + \varepsilon_{ij} \quad (1)$$

$$\text{Car}_{ij} = \alpha X_{ij} + \theta \text{Gas Price}_{j} + \eta_{ij} \quad (2)$$

Where i indexes individuals and j indexes states, Employment outcome_{ij} is one of the three outcomes analyzed, X_{ij} is a vector of demographic and human capital variables, Car_{ij} is a dummy variable indicating a car owners, Gas Price_{j} is the average state gas price

per gallon, β, γ, α and θ are parameters, and ε_{ij}, η_{ij} are normally distributed error terms. In equation (1\2), car ownership is modeled empirically with a linear probability model.

To be suitable instruments, gas prices must not affect employment outcomes other than through the effects of these variables on the probability of owning a car, i.e., so the gas price must be correlated with Car_{ij} and be uncorrelated with ε_{ij} . To assess if these conditions hold, one needs to investigate the processes that determine inter-state differences in gasoline prices and evaluate whether the determinants of these variables have direct effects on the second-stage employment outcomes.

Data Description

The data for this paper are drawn from several sources. Micro-data on employment outcomes, car ownership and basic demographic and human capital characteristics comes from 1985 Panel Study of Income Dynamics (PSID). This data contains the information about car ownership status, number of cars per household, including the households' annual miles traveled.

Data on State gasoline prices as of 1985 is assembled by the Statistical Abstract of the United States / Prepared by the chief of the Bureau of Statistics, Treasury Department and is measured in cents per gallon paid at the pump.

Empirical Results:

Descriptive Statistics

Table 1 presents the basic statistics of the difference in employment outcomes between those who own cars and those who do not. We see the mean employment outcomes from the entire sample, individuals by car ownership status, and the differences between those with and without cars. Employment rates and weekly hours have been calculated using the entire sample while mean log wages pertain to employed individuals only. I present separate calculations for the entire sample and the sample stratified by gender.

TABLE 1. Means employment, work hours and wages by gender and car ownership status.

		All	Standart Error	With cars	Standart Error	Without Cars	Standart Error
ALL							
	Employed	0.870939	0.00449	0.930714	0.003731	0.575693	0.01615
	Work hours	37.43134	0.29147	40.48629	0.293934	22.34222	0.77306
N		5571		4633		938	
	Log wages*	*3.894132*	*0.0158*	*3.924112*	*0.017112*	*3.654733*	*0.03706*
N		*4852*		*4312*		*540*	
MEN							
	Employed	0.926485	0.00407	0.942925	0.00378	0.744868	0.02364
	Work hours	40.82936	0.31472	41.66684	0.319378	31.57771	1.28774
N		4108		3767		341	
	Log wages*	*3.920338*	*0.01896*	*3.937417*	*0.01976*	*3.68151*	*0.06414*
N		*3806*		*3552*		*254*	
WOMEN							
	Employed	0.714969	0.01181	0.877598	0.011144	0.479062	0.02046
	Work hours	27.88995	0.60558	35.35104	0.711248	17.067	0.89858
N		1463		866		597	
	Log wages*	*3.798776*	*0.0246*	*3.861932*	*0.029881*	*3.630951*	*0.04071*
N		*1046*		*760*		*286*	

* **Conditional on being employed**

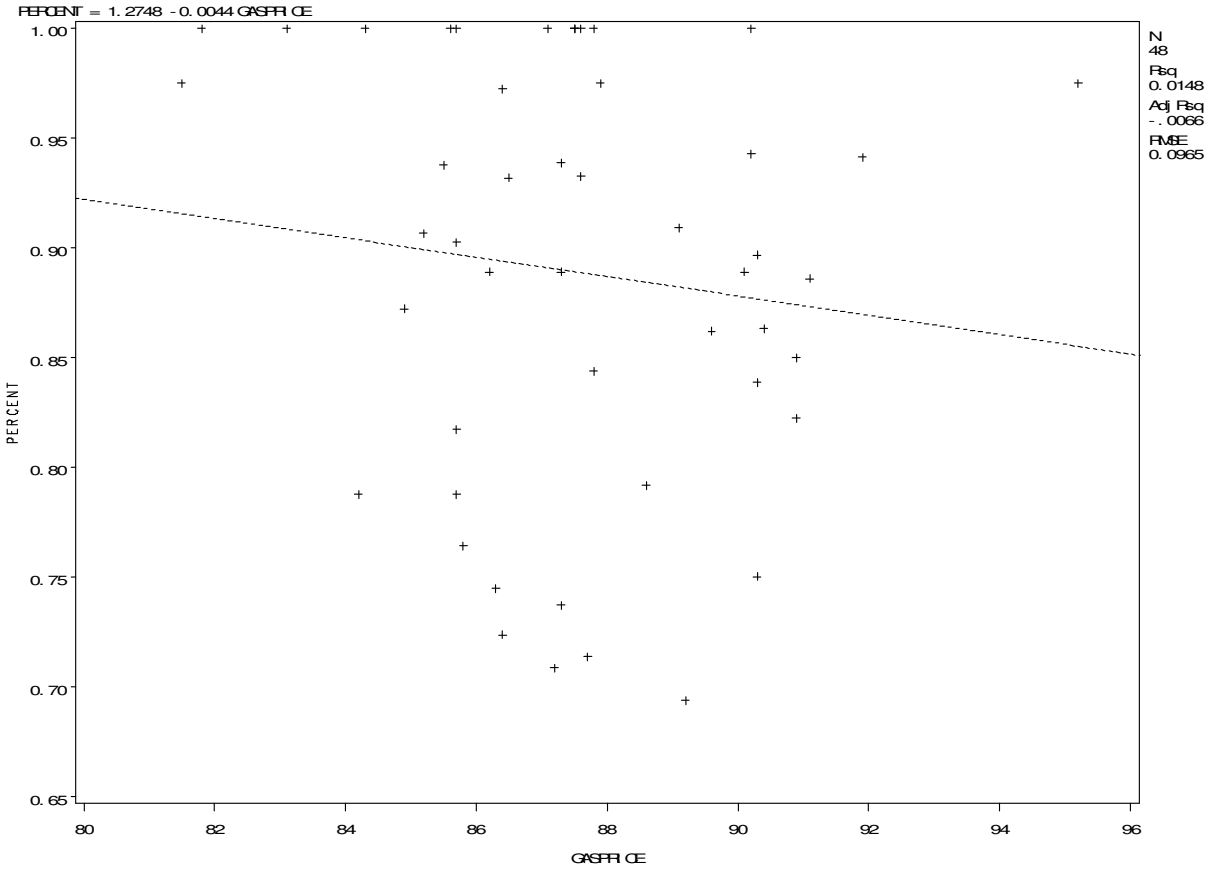
When we look at the results, it is quite obvious that there are large statistical significant differences on employment outcomes for both the entire sample and with gender. When we look at the employment rates we see that there is an approximately 35 percentage points overall difference between individuals with cars and those without, with a slightly higher difference for women (approximately 40 percentage point) than for men (approximately 20 percentage point). Concerning hours, those with cars work 10 to 18 hours more than those without cars. Again the work hours differentials for women exceed that for men. Finally there are substantial difference in the log of annual earnings between car owners and non-car owners. For the overall sample the difference in the log wages is approximately 0.27 with a difference of 0.26 for males and 0.23 for females.

To be sure, differences in observable demographic and human capital characteristics are likely to explain much of the differences in employment outcomes between car owners and non-car owners. For instance, the descriptive statistics in Appendix A shows those individuals without cars are more likely to be female and black but less likely to be white and unionized, than individuals with car. We also see that there is no substantial age difference between those with and without cars.

As a first pass evaluation of the strength of our instrument (gas price), Figure 1 presents a scatter plot of state car ownership rates for 1985 against state per-gallon gas prices. The regression between car ownership rate and gas prices across states shows that just looking at the estimates of gas price effect on car ownership can easily says the variation across individual units of observation is very large. Unexplained variation in car ownership rates remains even though one can expect that the gas prices across states are a very good explanatory variable. (On the other hand what we will see in the forthcoming

estimation is when we regress the probability of having car with gas prices and demographic variables; this model gives better results in terms of the efficiency of gas prices as an explanatory variable of car ownership).

Figure 1



When we look at the literature, we encounter the research which has been made by Kayser (2000) about gasoline demand and car choices. This article is a very direct proof that there is an indirect relationship between car ownership decision (whether or not having a car) and gasoline prices. He also shows that household's burdens from higher gasoline prices are closely linked to observable characteristics of the household. Beside that he relates the car portfolio decision with gasoline demand which means that

people may choose economic cars because of the high gas prices. However, this preference may not affect the quantity of the car ownership but the quality of the car in that area. Related with this argument our data indicates that car ownership is not significantly high in the low gas price states and not significantly low in the high gas price states. In addition to that, total miles have done in a year by household is also not very high in low gas price states and vice verse (Table 2).

Table 2 - Means of demographic and background characterictics for the total sample and for the sample stratified by the values of the state gas prices.

	TOTAL SAMPLE	LOW-GAS PRICE STATES	HIGH-GAS PRICE STATES
CAR-OWNER	0.8316	0.8548	0.8222
EMPLOYMENT	0.8709	0.8910	0.8628
LOG WAGES*	3.8941	3.8450	3.9147
FEMALE	0.2626	0.2573	0.2648
MALE	0.7374	0.7427	0.7353
WHITE	0.6169	0.5352	0.6500
BLACK	0.3674	0.4498	0.3341
AGE	37.3850	37.2598	37.4357
GAS PRICE**	87.5492	84.8604	88.6373
HOURS	37.4313	37.8991	37.2421
UNION*	0.2172	0.1678	0.2379
MILE	18927.6000	20851.5600	18149.0000

*** Conditional on being employed**
****Gas prices are mean prices per gallon in cents.**

When Raphael and Rice (2002)[a] regress gas taxes with car ownership they got a very good fit .We see that explanatory variable tells most of the variation in car ownership ratio. In addition to that they also regress car ownership rates and insurance premiums and this regression also gives a significant result in their model.

Certainly, the first stage relationship evident in the figures may be driven by interstate differences in demographics or economic conditions. To explore this possibility, Table 2 presents means for the variables in our sample after stratifying the data into observations in states with above and below average gas prices.

When we look at the means of car ownership, employment probability and working hours, difference in these means are indicative of the reduced form relationship between our instruments. These results also give us a very important clue about the structure of our data sample. First of all when we look at the results we see that the employment rate is lower in the high gas price states than in the low gas price states and wages are higher. What we observe in this pattern is the high gas price states represent the high cost areas. Because of that, employers in high cost states must pay compensating differentials to workers. We also see in Table 2 that working hours per week is quite similar, so this indicates that people must work as much as low cost states to be able to pay their life expenses other than spending their time with leisure. The differentials in car-ownership rates evident in Table 2 are consistent with patterns observed in Figure 1. We observed that there is a negative but insignificant relationship between car ownership rates and gas prices before and Table 2 indicates that even though car ownership in low gas price states are higher, it is not very different then high gas price states. (I observe the car ownership difference between low and high gas price states is just 3% in Table 2.)

There are also several differences in other variables. For example employment rates are 3% points higher in the low gas price states and not surprisingly the car ownership rates are also 3% points more that high gas price states. These results are very good explanatory for the nature of our data sample. This proportion of the data may be the representative of unemployed non-car owners. Since that proportion has no job, they might have not enough money to buy a car and maintaining car ownership. So one can say that being unemployed also has a direct effect on car ownership.

The reduced form effects observed for three employment outcomes are suggestive of a real causal effect of car ownership on one's employment prospective.

In the next section we will see the OLS and 2SLS estimates of the impact of the car access on employment outcomes that account for the patterns observed in Table 2.

OLS and 2SLS Results

Table 3 presents OLS and 2SLS estimates of the effect of car ownership on each of the three employment outcomes for entire sample. For each outcome, the table first presents the OLS results followed by the second-stage parameters from the 2SLS model. The first stage car ownership regression results are presented in Appendix B.

Starting with the OLS results, controlling for the covariates listed in Table 2 explains a considerable portion of the unadjusted differences in employment, hours and wages. Nonetheless, substantial effects remain. After adjusting for observable characteristics there is a 27.62 percentage point difference in the employment rates between car owners and non-car owners compared with an unadjusted difference from Table 1 of 35.5 percentage points. In addition to that the OLS results indicate that owning

car increases work hours by 13 hours and wages by 22% compared with unadjusted effects of 18 and 26% respectively. What we also see with OLS results are that age doesn't have an effect on employment probability. Besides that age also doesn't have as significant effect in the hours worked per week model as much as in log wages model.

TABLE 3. OLS and 2SLS estimates of the effect of car ownership on employment, work hours, and wages.

	EMPLOYED		HOURS		LOG-WAGES*	
	OLS	**2SLS**	**OLS**	**2SLS**	**OLS**	**2SLS**
AGE	0.000703	-0.003112	0.116851 *	0.1327 *	0.019894 ***	0.0143 ***
Sandard Error	*0.00091*	*0.005274*	*0.062184*	*0.0715*	*0.00362*	*0.001494*
FEMALE	-0.08695 ***	-0.435 ***	-6.99292 ***	-8.3957 ***	-0.03112	-0.2292 ***
Sandard Error	0.00973	0.0567	0.66348	0.766	0.039218	0.0149
UNION	0.124836 ***	7.0706	3.663495 ***	5.067 ***	0.481709 ***	0.1625 ***
Sandard Error	*0.01011*	*4519*	*0.689004*	*0.7828*	*0.037639*	*0.0142*
BLACK	-0.05827 ***	-0.3828 ***	-3.1314 ***	-3.8388 ***	-0.01559	-0.1405 ***
Sandard Error	*0.00884*	*0.0569*	*0.602858*	*0.6922*	*0.034744*	*0.0133*
AGE2	-0.00007 ***	-0.00029 ***	-0.00503 ***	-0.006162 ***	-0.00033 ***	-0.000174 ***
Sandard Error	*1.1E-05*	*6.09E-05*	*0.000748*	*0.000862*	*0.000044*	*1.82E-05*
OWN	0.276164 ***	1.0619 ***	13.07229 ***	17.2739 ***	0.226733 ***	0.2592 ***
Sandard Error	*0.01197*	*0.0635*	*0.815945*	*0.96*	*0.052723*	*0.02*
R-SQUARE	0.24285		0.16377		0.05395	
N	5571	5571	5571	5571	4852	4852
F-STATISTIC	297.44		181.61		46.05	
P-value	<.0001		<.0001		<.0001	
Likelihood Ratio (R)		1329.9				
McKelvey-Zavoina		0.8942				

*** Conditional on being employed**

One of the more surprising results is that in this data sample we see that being female and being black don't have a significant effect on log wages. But in contrast, other variables in the OLS regressions are significant at the one percent level.

Before turning the 2SLS results, a brief discussion of the first-stage regression reported in Appendix B is necessary. For all models, the gas price instrument exerts a negative and significant effect on the probability of owning a car. In the first stage results for the employment and hours model likelihood ratio is 1307.9 $>X^2_{0005,6}=18.55$. There fore even with a 0.5% significance level the likelihood ratio statistics fail to accept the null hypothesis that all slope parameters are zero. But in the log-wages model, the likelihood ratio is substantially smaller but still significant at 0.5% level ($629.14>X^2_{0005,6}=18.55$). We accept that all slope parameters are non-zero. What we observe here is that the gas price instrument has an almost 5 % level of significance in the first stage model.

Turning back to the results in Table 3 the 2SLS estimate (0.2762) the effect of car ownership on the probability of being employed is not close to OLS estimates (1.0619). Moreover the point estimates are significant at 1 % level. (The employment model result doesn't make any sense to me but when I run the model in the SAS with the direction of SAS help, I got these results with PROC QLIM. I reported my results what I got in the SAS program. As we know that PROC QLIM is an experimental procedure and it gives some errors when one runs the model. I'm still searching what the problem is in the program and after the connection with SAS INSTITUTE they are also working on this program error and so far they couldn't come up the solution yet.) The 2SLS results for hours yield a significant positive effect of car ownership on work hours of approximately

17.5 hours the point estimate is somewhat larger than the OLS estimate of 13 hours. When we look at the standard error for both point estimates in the hours model, we see that this deviation may be due in large part to the imprecision of these point estimates. Concerning the 2SLS results for log-wages instrumenting on gas prices yields a positive and significant effect on wages. I assume that this result is the most important result in this paper since Raphael and Rice (2002) found a negative and significant effect on wages. Their result weakens their hypothesis that car ownership directly and significantly affects the employment outcomes.

TABLE 4. OLS and 2SLS estimates of the effect of car ownership on employment, hours work and wages.

	EMPLOYED		HOURS		LOG-WAGES*	
	OLS	2SLS	OLS	2SLS	OLS	2SLS
			A.ALL			
Car owners	0.355021 ***	1.2902 ***	18.14408 ***	23.4185 ***	0.26938	0.4169 ***
Sandart Error	*0.011023*	*0.0498*	*0.740073*	*0.8842*	*0.050105*	*0.0199*
R-SQUARE	0.15701	-----	0.09742	-----	0.00592	-----
F-VALUE	1037.24 ***	-----	601.06 ***	-----	28.9 ***	-----
Likelihood Ratio (R)	-----	673.37	-----		-----	-----
Schwartz Criterion	-----	3629	-----	45707	-----	5185
McKelvey-Zavoina	-----	0.189	-----	-----	-----	-----
			B.MEN			
Car owner	0.198057 ***	0.9214 ***	10.08913 ***	12.1586 ***	0.255906 ***	0.3586 ***
Sandart Error	*0.014435*	*0.0806*	*1.129958*	*1.243*	*0.07586*	*0.0264*
R-SQUARE	0.04384	-----	0.01905	-----	0.00298	-----
F-VALUE	188.25 ***	-----	79.72 ***	-----	11.38 ***	-----
Likelihood Ratio (R)	-----	121.77	-----	-----	-----	-----
Schwartz Criterion	-----	2053	-----	34813	-----	3472
McKelvey-Zavoina	-----	0.0607	-----	-----	-----	-----
			C.WOMEN			
Car owners	0.398536 ***	1.2156 ***	18.28404 ***	27.4018 ***	0.230981 ***	0.2869 ***
Sandart Error	*0.021651*	*0.0752*	*1.135974*	*1.6415*	*0.054744*	*0.0333*
R-SQUARE	0.18826	-----	0.15061	-----	0.01677	-----
F-VALUE	338.84 ***	-----	259.06 ***	-----	11.38 ***	-----
Likelihood Ratio (R)	-----	278.37	-----	-----	-----	-----
Schwartz Criterion	-----	1485	-----	10579	-----	1393
McKelvey-Zavoina	-----	0.263	-----	-----	-----	-----

* Conditional on being employed

With respect to other variables in the model, most of the point estimates are what one would expect. Blacks are less likely to be employed than whites and earn less considerably less per hours. I observe a similar pattern for females. Table 4 presents comparable results where we estimate each model separately by gender.

Again, for both men and women the point estimates of the effect of car ownership on the probability of being employed are not close for the OLS and 2SLS models. What we observe especially in hours model is the standard errors become considerably high and it causes bias between OLS and 2SLS estimates.

In summary the OLS and 2SLS results both indicates a strong positive effect on car ownership for all employment outcomes.

Conclusion

The results of this paper indicate that having access to a car is an important determinant of labor market outcomes. I found a strong effect of car ownership on the probability of employment weekly working hours and annual wages. Even though difficulties about prediction made this research less reliable, it helps readers and researchers to work on these problems and make more progress on this hypothesis.

Appendix A. Mean demographic characteristics of individuals with and without car.

	TOTAL SAMPLE	WITH CAR	WITHOUT CAR
WAGES*	3.894132	3.924112	3.654733
WORKING HOUR	42.97815	43.50023	38.80926
FEMALE	0.26261	0.18692	0.636461
BLACK	0.367439	0.287071	0.764392
WHITE	0.616945	0.696741	0.222814
AGE	37.38503	37.55493	36.54584
UNION*	0.18692	0.204835	0.11194

*** Conditional on being employed**

APPENDIX B. First-stage results from regressions of car ownership on state-level instruments and demographic characteristics.

	RESULTS FROM EMPLOYMENT RESULT		RESULTS FROM HOURS RESULT		RESULTS FROM LOG-WAGE RESULT	
	First SLS	Standart Errors	First SLS	Standart Errors	First SLS	Standart Errors
GAS PRICE	-0.0285	0.0104	-0.0285	0.0104	-0.0227	0.0119
AGE	0.0224	0.00486	0.0224	0.00486	0.0221	0.005446
FEMALE	-0.9895	0.0469	-0.9895	0.0469	-0.7976	0.0551
UNION	0.4142	0.0665	0.4142	0.0665	0.1746	0.0672
BLACK	-1.0634	0.0477	-1.0634	0.0477	-0.9291	0.0544
AGE2	-0.000234	0.0000588	-0.000234	0.0000588	-0.000209	0.0000663
Schwartz Criterion	3803		3803		2819	
McKelvey-Zavoina	0.3785		0.3785		0.2679	
N	5571		5571		4852	

References:

[1] RAPHAEL S., RICE L. 'Car ownership, employment and earnings'. Journal of Urban Economics 52 (2002) 109-130.

[2] Kayser H. 'Gasoline demand and car choice: estimating gasoline demand using household information'. Energy Economics 22 (2000) 331-348.

[3] PINDYCK R., RUBINFELD D. 'Econometrics models and econometric forecast' 1997. ISBN 0-07-050208-0

[4] Dargay J. 'The effect of income on car ownership: evidence of asymmetry'. Transportation Research Part A 35 (2001) 807-821

[5] SAS Online Help.

[6] KIM M. SAS Institute Inc., Cary, NY 'Quantitative and Limited Dependent Variable Models Using the New Qlim Procedure'