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Abstract

To control problems of congestion and air pollution, Beijing restricts vehicle ownership, allowing only winners of a license plate lottery to add a vehicle. Using the quasi-experimental variation provided by this lottery, we examine the unintended consequences of preventing women from buying cars on their employment rates and work hours. Consistent with theory, effects differ sharply depending on whether the woman has a child. Among women without children, adding a vehicle causes large increases in the employment rate and hours worked. For women with children, adding a car has a negative though statistically insignificant impact on both employment rate and work hours. For women overall, restricting vehicles has a negative net impact on employment rates.

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1 Introduction

Policy analysts have focused on female labor supply because of its important bearing on social and economic outcomes. When women in India are exposed to labor market opportunities, they not only increase employment but also increase enrollment in educational programs and have better health outcomes (Jensen 2012). Increased female income in post-Mao China improves survival rates for girls and helps close the gender gap in birthrates (Qian 2008). Closing the gap between male and female employment rates has large macroeconomic consequences, with both economic growth and income inequality at stake.[1] A large number of policies have been aimed at reducing the obstacles to female labor force participation, particularly those connected with the greater household labor that women usually provide.[2]

In this paper, we ask how vehicle restrictions, increasingly prevalent in developing countries, have affected female labor supply. We exploit the quasi-experimental variation provided by the Beijing license plate lottery to examine how cars influence womens' employment, hours of work, and daily activities. Our results suggest that restricting vehicles in Beijing has had a large unintended consequence: decreasing the employment rate for women who do not win.

Our study points out the key role that transportation policy can have on female labor supply. We provide empirical evidence consistent with theoretical models of gender and labor supply, while also expanding the growing set of empirical results aimed at understanding the complex effects of vehicle restrictions. Our results have direct policy relevance for the increasing number of cities who have restricted vehicles or are considering new vehicle restrictions, and indirect relevance for localities trying to understand the broader effects of expanding transportation on labor markets.

The setting for our study is the city of Beijing. In an effort to curb notorious problems of air

[1] See recent literature reviews at IMF (2013), OECD-ILO-IMF-WBG (2014), and IZA (2014).

[2] These include maternal leave policies, increased access to child care, and improved benefits and flexibility for part-time workers. United Nations (2009), Blau (1995), and Duflo (2012) review the literature of these topics.

pollution[3] and vehicle congestion,[4] Beijing's government imposed sharp restrictions on vehicle purchases. Before adding a car, a household must first win a license plate in a lottery. Lotteries are held monthly, and the lottery is heavily oversubscribed. The chance of winning a vehicle fell under 1 percent per month by the end of 2014.

Using data from this lottery, we examine the causal effect of cars on female labor supply. We outline a theoretical model of gender and labor supply, which suggests that cars can play an important role in whether a woman enters the labor force, and that the presence of a child can significantly alter the effect of the car. Testing this intuition requires addressing the possible endogeneity of car ownership and children.

Conditional on entering, winning the lottery is randomly assigned, making lottery status a natural instrumental variable (IV) on the number of cars in a household. After examining the relevance and validity of this instrument, we estimate the effect of car ownership on female employment outcomes. Specifically, we regress whether a female lottery entrant reported working on the number of household vehicles, using the lottery outcome to instrument for the number of vehicles. We find that, among all women, each car increases employment rates by 5.4 percentage points, about 7 percent over the mean employment rate for lottery losers. However, this effect is sharply different among women who have children and women who do not have children before the advent of the lottery. Women who do not have children increase employment by 9.9 percentage points per car, a large and statistically significant effect. Women who have children decrease employment by 4.1 percentage points, but this number is statistically indistinguishable from zero.

We examine the effect of cars on the number of hours worked by each woman. We find that winning a car causes statistically significant increases of about 11 percent among women who do not have children, and negative though statistically insignificant decreases among women

[3]Air-quality index levels below 100 are considered "satisfactory" by the US Environmental Protection Agency (EPA). However, four-fifths of all days in Beijing between 2008 and 2014 had AQI levels above this level. "Beijing's Bad-Air Days, Finally Counted," *The Wall Street Journal*, April 14, 2014.

[4]TomTom, a maker of GPS devices, compiles data on vehicle congestion. Beijing was the 14th most congested city in the world in 2015, with daily travel delays averaging 38 percent.

who have children. The net effect of cars on hours worked is positive but statistically insignificant.

The employment effects suggest that vehicle restrictions cause an increase in the gender employment gap. We calculate that the gap in employment rate between men and women is increased by vehicle restrictions from 16.9 percentage points to 17.1 percentage points, or 1.1 percent.

These results are large and can be compared with some of the most important policy interventions that have been empirically demonstrated to affect female labor force participation. Jensen (2012) experimentally assigns recruiters from an industry that employs high numbers of women to villages in India, finding that women aged 15 to 21 in villages increase employment by 2.4 percentage points, about 11 percent over the control mean. Dinkelman (2011) shows how rural electrification in South Africa increased both employment and hours of work for women, attributing gains to how electricity releases them from household labor. Electrification increased female employment by 9 to 9.5 percentage points, 30-35 percent over baseline.

Our point estimate suggests that each car increases hours worked for women by 22.7 minutes per day,[5] translating to an increase of 94.6 hours worked per year. By comparison, Bailey (2006) shows how contraception increased female labor supply, finding that access to the contraceptive pill increased labor market participation in American women aged 26 to 30 years old by 68 hours per year. In comparing our results with the literature, we note that female employment of Beijing lottery entrants starts from a relatively higher level.

In addition to documenting the effects of cars on employment and labor supply, we report results consistent with the intuition from the theoretical model that home production is a crucial component of labor market responses to cars. We examine the number and types of tasks that women do when they add cars to their households. Women with children use cars to increase the number of home labor tasks, particularly picking up and dropping off others. Women with no children show no such increase in home production. These women do not show any statistically

[5]See table 5. Although our estimate for all women is statistically indistinguishable from zero, our estimates of the effect of cars on ranges of hours worked in table 6 gives us confidence in the direction of our point estimate.

significant differences in individual tasks when they obtain cars, although the largest change is an increase in trips to work.

Contrasting with the effects of cars on women, we find that none of the above findings hold for men. Male employment and male labor supply is essentially unaffected by cars. Our results complement Angrist and Evans (1998), who show that additional children reduce labor supply for women but not for men. In our study, children are an important mediating variable that determine the effect of cars on female labor supply.

Our results relate to a growing body of literature on the effects of policies restricting vehicle use and ownership. Davis (2008), Wang et al (2013), and Viard and Fu (2014) examine the effects of usage restrictions, focusing on outcomes such as pollution, car mileage, and economic activity. As of 2014, five Chinese cities along with Singapore restricted ownership, with many more considering some form of these restrictions (Yang et al. 2014). The literature on this subject is more sparse. Li (2016) compares the allocative cost of the Beijing vehicle lottery with Shanghai's license plate auction system. Yang et al. (2016) examine the effect of the Beijing lottery on travel behavior. They find that cars did not cause shifts in the distance traveled or in commute distance, but did cause large changes in the mode of transportation, with people obtaining cars moving between 30 and 60 percent of the travel into cars.[6]

Our study is the first to look at the labor market consequences of vehicle restrictions. As such, it is relevant to a growing literature tracing gender inequality to underlying economic causes.[7] We show in this paper that restricting cars has created costs that have been borne disproportionately on women, a distributional consequence that policy makers should consider as more vehicle restriction policies are contemplated. In cities implementing vehicle restriction policies, our results suggest that they should be combined with policies mitigating their

[6]The findings of this present work are largely consistent with those of Yang et al. (2016) because we also find no overall effect of cars on labor markets when men and women are combined. Most effects of statistical significance are limited to women without children.

[7]Duflo (2012) reviews the literature and points out some of the most important dimensions of gender inequality, from school enrollment rates to labor supply and time use. She notes the interconnection between development and gender inequality: increased development causes female empowerment, and empowering women may improve development.

unintended effects on those who want cars; one possibility might be the improvement of public transportation access to sectors and businesses that employ women without children.

2 Background and Data

Beijing began its license plate lottery in January 2011. Winners of the lottery receive electronic certificates that they can bring to new or used car dealers to purchase cars. While individuals who already had cars may retain their license plates and trade their existing vehicles for new ones, additional cars may not be purchased without first winning the lottery.

The license plate lottery was sharply restrictive. In 2010, 76,000 cars were sold each month in Beijing; the lottery has held new vehicle registrations to under 20,000 per month (Yang et al. 2014). When the first lottery was held, there were 10 times as many applicants as license plates. As more people have continued to apply to the license plate lottery, the number of new vehicle registrations permitted has remained fixed. As a result, the probability of winning a car has fallen, and the chance of winning a new car at the end of 2014 was less than 1 percent per month.

Our data consist of a large representative survey of Beijing's residents. This survey is conducted once every few years by the Beijing Transportation Research Commission (BTRC), a government agency that conducts research on how to improve Beijing's transportation systems. The survey consists of about 40,000 households, selected randomly and drawn in proportion to population from Beijing's 16 districts. It was conducted between September and November 2014.

The survey consists of three types of questions. First, it asks household level questions, such as the number of members in the household, the type of housing the household occupies, and the number of vehicles it has. We know the relationship of each household member to the head of household.

Second, it asks individual level questions, such as the year of birth and gender of each

respondent. At our request, the BTRC incorporated questions about the Beijing vehicle lottery. Individuals report whether they entered the Beijing vehicle lottery, whether they won, and when they won. About 20 percent of households in the BTRC sample had at least one member participate in the lottery.

Importantly, we observe each household member's employment status, which is a primary outcome variable for our study. All household members report whether they work, whether they go to school, whether they are retired, or whether they have another primary activity. We count those individuals who report working as employed.

The third section of the survey is comprised of detailed travel diaries. Travel diaries consist of 24-hour reports of where individuals went, when they went there, and what transportation modes they took. For example, a person might start the day at home, wait for the bus at 8:00 a.m., take the bus to work between 8:05 a.m. and 8:25 a.m., then go home using the bus at 5:25 p.m.

Each element of a person's daily travel is reported, including the destination location and the purpose for the trip. We use these travel diaries to measure the number of trips people take, the purposes of those trips, and how long they spend at their destination. We calculate labor supply as the time elapsed between arriving at and departing from work.

This estimate of labor supply is imperfect in that people may do other activities when they are at work. However, this method is more likely to yield an accurate result than asking people to report how many hours they worked in a day; respondents may be unable to recall exactly how many hours they worked and are more likely to report round number estimates ("I worked 8 hours today") when asked about their work hours directly.

A travel diary is likely to capture a daily activity when the individual travels for the purposes of the activity, but a diary may be poor at capturing an activity if multiple activities occur at a single location. For example, a visit to the mall may be not only a trip to purchase goods but also a form of child care.

3 Methodology

3.1 Theory of Vehicles and Labor Supply

In this subsection, we examine how restrictions on vehicle ownership fit into a standard model of labor supply. We adapt a stylized framework from the labor economics literature,[8] considering both the extensive margin (whether an individual has a job) and the intensive margin (how many hours the individual works per week, conditional on having a job). As in prior empirical work, we focus on female labor supply. While female labor supply can be sensitive to policy (Eissa and Liebman 1996), studies such as Triest (1990) have found that male labor supply is invariant, even to variables such as the wage. The prior literature has found that commuting time is negatively correlated with female labor force participation rates, suggesting that women are more likely to withdraw from the labor force as a result of increased commutes (Black et al. 2014).

Our framework relies primarily on Cogan (1981) and is summarized in figure 1. Suppose that each individual has a time endowment H, an income endowment Y, and two types of fixed costs of entering the labor market: time τ, and non time M. The time cost could include the time spent commuting to work. Non time costs are broader and could include both direct monetary costs such as bus fare and indirect costs such as the disutility of commuting. Tasks in home production that would be omitted if the individual works are treated as fixed non monetary opportunity costs of working. The figure shows that at the reservation wage w_R, the individual is indifferent between working at leisure l^* and not working at leisure H. At the reservation wage, the hours of work supplied will be $H - \tau - l^*$. We define the market wage as the wage the individual earns upon entering the labor market, and the individual chooses to work only if the market wage is greater than or equal to the reservation wage.

Obtaining a car can affect the market wage as well as the fixed costs of entering the market; we discuss first the effect on the market wage. Cars can expand the set of job opportunities

[8] Killingsworth and Heckman (1986) and Blundell and MaCurdy (1999) present reviews of the labor supply literature, including differences in labor supply between men and women.

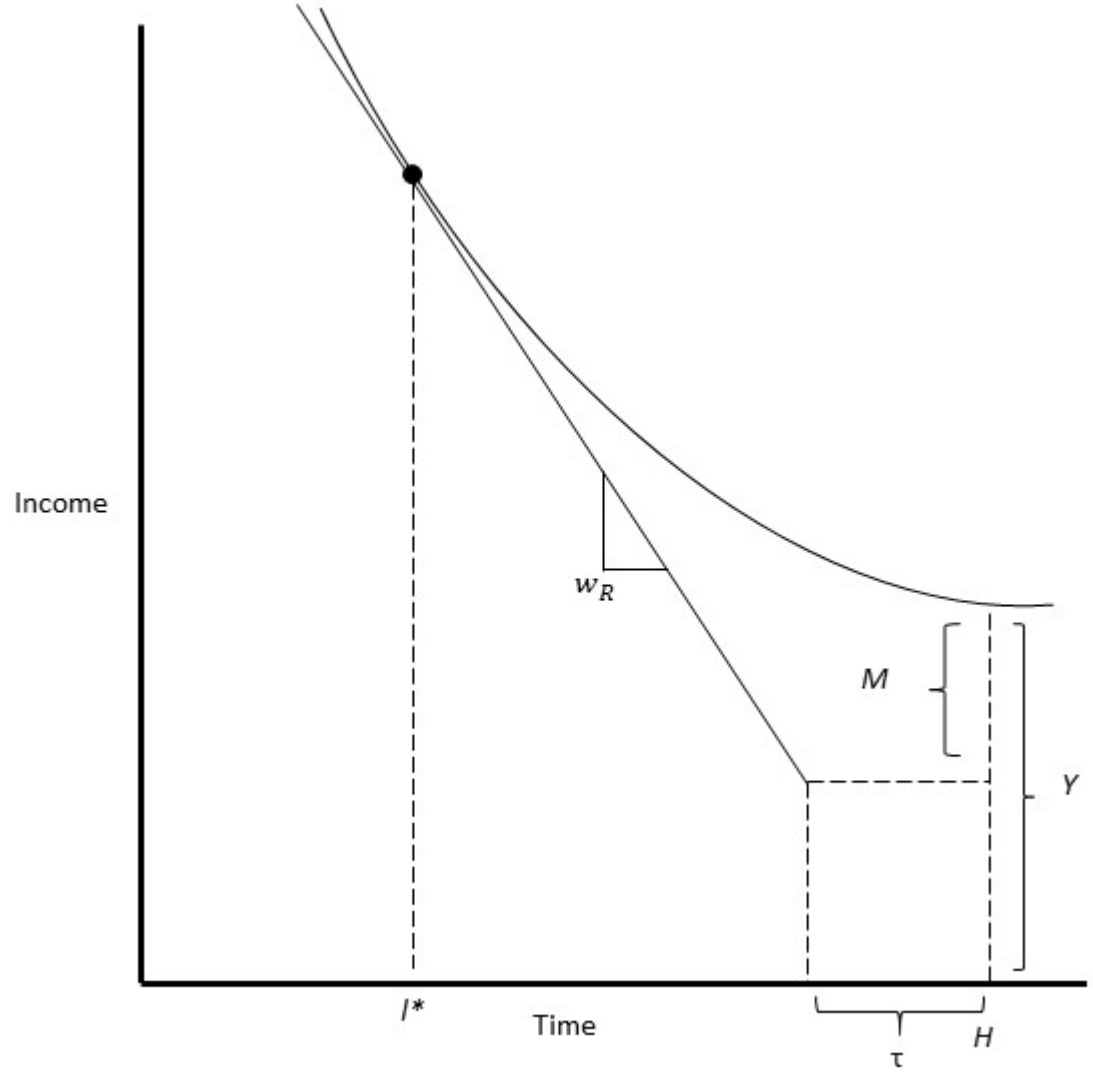

Figure 1: Diagram analyzing time and income decision in the presence of entry costs for labor. Diagram from Cogan (1981).

and increase the market wage by reducing the time cost of traveling to a high wage job that is located far from public transportation. An increase in the market wage causes the solid budget line in figure 1 to rotate clockwise, pushing the market wage past the reservation wage for some individuals and causing them to choose to work. However, the effect on hours of work is ambiguous and depends on the relative strengths of the income and substitution effects induced by the wage change (not shown).

Obtaining a car can also affect the fixed costs of entering the labor market, particularly if it affects commuting cost.[9] The commute is an important part of the fixed cost of entering the labor market, and reducing commuting time directly reduces τ. In addition, a car may reduce M because it decreases the disutility associated with commuting if the individual prefers driving a car to using crowded public transportation.[10]

If either τ or M decrease, the reservation wage unambiguously decreases, and the employment rate will increase as a result. Reductions in commute time also increase hours worked conditional on commuting because they increase the amount of time available for both work and leisure.

The presence of a child can sharply alter the effects of cars for women. Cars can increase the productivity of home production tasks such as child care by reducing the costs of taking children to lessons or to recreational activities outside the home. If we assume that women have a comparative advantage over men in child care (a common assumption in the prior literature such as Black et al. 2014), then these improved opportunities for time use apart from work can *increase* the fixed cost from work M. The value of home production forgone when the woman goes to work is raised when a child is present.

In summary, we see a variety of effects of cars on the fixed costs of going to work M and τ. If the primary effect of cars is on the commute to work, they will result in decreases in

[9]We note that cars not only affect commuting costs, but also can affect the cost of outside alternatives to working, such as leisure travel. In this case, they might raise M.

[10]Yang et al. (2016) find that residents of Beijing obtaining a car choose to commute by car over other travel modes even if using the car does not substantially reduce total travel time. This suggests that typical Beijing commuters prefer commuting by car over other modes, in which case obtaining a car would decrease the disutility of commuting and reduce the reservation wage.

these fixed costs for all women, increasing labor force participation with an ambiguous effect on hours worked. If the woman has a child, cars may increase M through the opportunity cost of improved child care. This will decrease labor force participation with ambiguous effects on hours worked.[11]

The standard labor supply model suggests a variety of offsetting effects and does not reveal which of these effects is larger in magnitude, yielding an ambiguous answer as to the effects of cars on labor supply. As a result, we turn to empirical analysis of these effects.

3.2 Empirical Strategy

The objective is to estimate the effect of owning an additional car on labor market outcomes such as employment and labor supply. Ordinary least squares (OLS) estimation of this effect is likely to be biased, because of unobservable confounding factors. For example, individuals with strong unobserved job opportunities may have more reason to purchase a car. Reverse causality is also likely to be a problem, because individuals who work more have more money and are more likely to purchase a car.

As a result, we rely on the quasi experimental variation provided by the Beijing vehicle lottery. Specifically, we instrument for the number of cars in a lottery entrant's household by lottery status. We estimate the following equations using an instrumental variables (IV) strategy:

$$Y_i = \mu + \alpha \widehat{Cars}_i + \eta_i + X_i\gamma + \varepsilon_i \tag{1}$$

$$Cars_i = \lambda + \beta \left(Won the lottery\right)_i + \eta_i + X_i\chi + \mu_i \tag{2}$$

In these equations, Y_i is the outcome of interest for individual i, such as her employment

[11] One final consideration is that for two-adult households, car ownership and employment decisions of one adult can affect the reservation wage and employment decisions of the other adult. For example, if a two-adult household obtains a car and one adult uses the car to commute to work, this adult could increase hours worked and total household income. The resulting income effect could raise the reservation wage of the other adult, reducing employment on the extensive or intensive margins. This effect would thus mitigate the employment effects discussed above.

status or labor supply. $Cars_i$ represents the number of cars in the household of individual i;[12] we insert the fitted value of $Cars_i$ from equation 2 into equation 1 and adjust the standard errors to account for the fact that we use the predicted rather than observed values. X_i represent a set of covariates.

We include all observed covariates that could plausibly affect travel behavior and are determined prior to the events of the lottery. Specifically, we include age and the square of age in our regressions, because middle-aged people are likely to supply more labor than the young or the old. We include fixed effects for the day of the week of the interview, because work schedules may vary by weekday, particularly on Fridays and weekends. We also include fixed effects for the education level of the lottery entrant, because job hours may vary with education level.

Finally, we include η_i, a set of fixed effects for each entrant's lottery entry date. These are important to include because earlier entrants have more chances to win the lottery and may have stronger unobservable need for cars. The presence of this covariate implies that we compare lottery winners and losers who entered at the same time, controlling for possible unobserved factors correlating with entry date.

3.3 The Comparability of Winners and Losers

In natural experiments such as the Beijing lottery, the control group (lottery losers) represents a valid counterfactual for the treatment group (lottery winners). In expectation, both observed and unobserved characteristics that are unaffected by winning the lottery should be identical for these groups.

Yang et al. (2016) show that the overall samples of winners and losers are comparable. Individuals who won the lottery and individuals who lost have statistically indistinguishable gender compositions, birth years, and education levels. Moreover, heads of households and other household members are also statistically indistinguishable in these characteristics.

[12] In this specification, our results are interpreted as the effect of adding a car, even if the household is adding a second vehicle. We also test separately the effects of households moving from zero to one car and from one car to more than one car in our robustness checks in section 4.5. Surprisingly, both have similar effects in all outcomes.

In this paper, we are interested in outcomes for women and men separately, and within those groups by whether the household has children. However, Liu et al. (2017) found results suggesting that winning a car may influence the number of children in the family. Winners have about 30 percent more children born after 2011 than losers, suggesting that the presence of a car in a family increases childbearing.

As a result, to ensure that the effects we find are causal, we also divide our sample according to whether the woman had a child born before 2011, the year the lottery was implemented. The number of children born before 2011 is a predetermined characteristic that should not be affected by the result of the lottery; the presence of children in a household can still play an important role in labor outcomes.

Results from these tests of comparability are presented in table 1, examining observable characteristics that should be unaffected by the lottery among those who won and those who lost the lottery. We can see that these characteristics are largely balanced in every subgroup we examine.[13] In summary, we find no evidence of ineffective randomization for any characteristic examined.

To provide context for our IV estimation results, we also provide means of some of our important outcome variables in table 2. For all groups of women, lottery winners have more cars. We note that women with no children increase their vehicles by more than women who have children. This difference appears to stem primarily from differences in the number of vehicles between lottery losers who do and do not have children. Lottery losers who have children may exert more effort in attempting to obtain vehicles through other means. For example, there is some evidence of a black market for license plates in Beijing; some residents also rent license plates illegally from automobile dealers (Yang et al. 2014).

Among women who have children, lottery winners and losers are employed at identical rates and work similar hours. For women who have no children, lottery winners are employed

[13]It is not unusual for statistically significant differences in means to appear in tests of balance. For every 20 characteristics, even random variables centered around the same mean will have one characteristic appear different at the 5 percent level of statistical significance.

Table 1: Comparability of Women Winning and Not Winning the Lottery for Variables Unaffected by the Lottery

	Has a Child (N = 1,285)		No Child (N = 1,997)	
	Losers	Difference: Winners - Losers	Losers	Difference: Winners - Losers
Birth year	1978.2	-0.6	1977.7	0.9
Has finished high school	0.901	0.012	0.924	-0.015
Has finished college	0.703	0.023	0.721	0.011
Is head of household (HoH)	0.411	0.013	0.387	-0.040
Is wife of HoH	0.366	-0.006	0.232	-0.019
N	1,146		1,833	
	Has a Prelottery Child (N = 906)		No Prelottery Child (N = 2,376)	
	Losers	Difference: Winners - Losers	Losers	Difference: Winners - Losers
Birth year	1976.5	-0.4	1978.4	0.7
Has finished high school	0.880	0.010	0.928	-0.007
Has finished college	0.653	0.017	0.738	0.022
Is head of household (HoH)	0.434	0.036	0.382	-0.043
Is wife of HoH	0.395	-0.035	0.243	-0.001
N	806		2,173	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

about 8 percentage points more than those who lost. Lottery winners without children also supply 41 more minutes of labor supply, a large increase of 11 percent over lottery losers. Among lottery winners who have no child, the largest change in tasks is an increase in the number of business tasks. Winners who have children do significantly more housework tasks than losers. Thus we find employment and labor supply patterns in the raw data that are consistent with the estimation results reported in the next section.

Table 2: Comparability of Women Winning and Not Winning the Lottery for Key Outcomes

	Has a Child (N = 1,285)		No Child (N = 1,997)	
	Losers	Difference: Winners - Losers	Losers	Difference: Winners - Losers
Number of cars owned	0.776	0.526***	0.602	0.630***
Is employed	0.809	-0.010	0.751	0.084*
Minutes of work time	371.2	-12.1	370.7	40.8*
All tasks	1.411	0.114	1.113	0.031
Business tasks	0.848	-0.064	0.793	0.061
Housework tasks	0.469	0.222***	0.189	-0.036
Recreation tasks	0.094	-0.044	0.146	0.006
N	1,146		1,833	
	Has a Prelottery Child (N = 906)		No Prelottery Child (N = 2,376)	
	Losers	Difference: Winners - Losers	Losers	Difference: Winners - Losers
Number of cars owned	0.767	0.519***	0.625	0.628***
Is employed	0.825	-0.025	0.750	0.078*
Minutes of work time	390.0	-18.8	362.5	33.5*
All tasks	1.586	0.094	1.107	0.045
Business tasks	0.914	-0.094	0.777	0.046
Housework tasks	0.583	0.227***	0.190	0.007
Recreation tasks	0.088	-0.038	0.140	-0.007
N	806		2,173	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: First-Stage Regressions on the Number of Cars in the Household

	All Women	No Child	With Child	No Prelottery Child	With Prelottery Child
Won the lottery	0.575***	0.627***	0.512***	0.618***	0.507***
	(0.050)	(0.070)	(0.049)	(0.070)	(0.062)
Age of member	0.013	-0.003	-0.021*	-0.005***	-0.023
	(0.009)	(0.012)	(0.013)	(0.012)	(0.015)
(Age * Age)	-0.000	0.000	0.000*	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
N	3,282	1,997	1,285	2,376	906
R^2	0.104	0.116	0.112	0.113	0.162

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Regressions include only lottery entrants. All regressions include fixed effects for the day of the week of the interview, for the education level of the entrant, and for the month of entering the lottery. Standard errors are robust and clustered at the level of age bracket interacted with education level.

3.4 First-Stage Estimates

We show in this section that lottery status is an important predictor of the number of household cars. Among all lottery entrants, Yang et al. (2016) show that winning the lottery increases the number of household vehicles owned by 0.656, an estimate significant at the 1 percent level.

First stage estimates of the effect of lottery status on cars for the populations of women of interest to this study are presented in table 3. Winning the lottery has a large effect on the number of cars owned in the households of female entrants, reducing concerns about weak instruments bias. Similar to our tables of summary statistics, we find that lottery winners with no children appear to add more cars than women with children.

4 The Effect of Cars on Female Labor Supply

4.1 Effects on Employment

We report the effects of adding a car on employment status in table 4. In these regressions, the dependent variable is whether the lottery entrant was working.

These regressions show that gaining a car has a strong effect on female employment. Among all women, employment increases by 5.4 percentage points with each additional vehicle. Since each lottery win results in 0.575 additional cars, female employment would be (5.4*0.575) = 3.1 percentage points higher in the absence of lottery restrictions, an increase of 4 percent from the actual 77.3 percent employment rate of lottery losers.

However, this change is not uniform across all women. Cars increase employment for women with no children but have limited or possibly negative effects on employment for women with children. Women without children see their employment rates rise by 9.9 percentage points when they add a car, while women with children see their employment rates fall by 4.1 percentage points, although this is statistically indistinguishable from 0.

Since some women may choose to have children in response to winning a car, we confirm our result by examining women with no children born before 2011. For these women, obtaining a car raises employment rates 8.2 percentage points. Notice that the effect for women with no prelottery children is somewhat smaller than the effect for women with no children, because the former includes some women who have children in response to winning cars. For women who have prelottery children, employment rates drop 7.3 percentage points, a large point estimate that we cannot distinguish from 0 with the sample size available. At the end of this section we use these employment effects to estimate the aggregate effect of the lottery on the gender gap.

4.2 Effects on Work Hours

In table 5, we report the effects of adding a car on labor supply, which is measured by hours worked. In these regressions, the dependent variable is the number of minutes spent at work,

Table 4: IV Regressions on Full-Time Female Employment

	All Women	No Child	With Child	No Prelottery Child	With Prelottery Child
Number of cars	0.054***	0.099**	-0.041	0.082***	-0.073
	(0.014)	(0.041)	(0.053)	(0.019)	(0.047)
Age of member	0.069***	0.089***	0.041**	0.084***	0.021
	(0.010)	(0.016)	(0.019)	(0.014)	(0.013)
(Age * Age)	-0.001***	-0.001***	-0.001**	-0.001***	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
N	3,282	1,997	1,285	2,376	906
R^2	0.220	0.181	0.280	0.272	0.141

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Regressions include only lottery entrants. All regressions include fixed effects for the day of the week of the interview, for the education level of the entrant, and for the month of entering the lottery. Standard errors are robust and clustered at the level of age bracket interacted with education level.

measured by the time elapsed between arriving at and departing from work.

Column 1 of this table includes all women and suggests that adding a car has a positive but statistically insignificant effect on time spent working. However, we again find that cars have sharply different effects on women with no child and women with children. Column 2 suggests that each car causes a 55-minute increase in labor supply when the woman has no child. Column 4 suggests a slightly smaller increase in work time of 36 minutes for those women with no prelottery children. Although this result is statistically indistinguishable from zero, there is a clear pattern when we examine shifts in the distribution of hours worked. For women with children, there are negative and statistically insignificant effects, consistent with our results on employment status.

In table 6, we examine the effect of winning a car on the distribution of hours worked by women. We can see clear shifts in the composition of work hours for women with no children and women with no prelottery children. For women with no children, each coefficient in the

Table 5: IV Regressions on Minutes of Work for Women

	All Women	No Child	With Child	No Prelottery Child	With Prelottery Child
Number of cars	22.689	55.139**	-32.495	35.651	-29.201
	(20.756)	(21.984)	(49.639)	(25.401)	(38.451)
Age of member	24.045***	32.000***	22.603**	29.061***	4.935
	(4.583)	(4.980)	(11.238)	(3.942)	(9.083)
(Age * Age)	-0.351***	-0.453***	-0.306**	-0.412***	-0.117
	(0.054)	(0.062)	(0.145)	(0.047)	(0.111)
N	3,176	1,905	1,271	2,280	896
R^2	0.152	0.205	0.101	0.176	0.147

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The dependent variable in these regressions is minutes spent working. Regressions include only lottery entrants. All regressions include fixed effects for the day of the week of the interview, for the education level of the entrant, and for the month of entering the lottery. Standard errors are robust and clustered at the level of age bracket interacted with education level.

three ranges between 0 hours and 4 hours worked is negative, suggesting that women move out of these ranges. There is a statistically significant negative shift from working 0 hours, supporting our earlier finding on employment rates. Each coefficient in work ranges between 4 hours and 10 hours is positive, suggesting that women move into these more full-time work ranges. All of these coefficients clearly support the idea that women without children work longer hours.

There is no clear pattern among women who have children. The largest shifts for these groups occur out of the groups working 8 to 10 hours and into the groups working 0 hours and above 10 hours, but these coefficients are generally statistically insignificant.

Table 6: IV Regressions on Hours Worked Ranges for Women

	All Women	No Child	With Child	No Prelottery Child	With Prelottery Child
0 hours	-0.020	-0.093**	0.106	-0.050	0.095
	(0.033)	(0.038)	(0.080)	(0.033)	(0.082)
0 to 2 hours	-0.012**	-0.006	-0.022	-0.012*	-0.005
	(0.005)	(0.004)	(0.015)	(0.006)	(0.006)
2 to 4 hours	-0.010	-0.013*	-0.005	-0.002	-0.026***
	(0.008)	(0.007)	(0.011)	(0.010)	(0.010)
4 to 6 hours	0.031*	0.033	0.019	0.028*	0.032
	(0.017)	(0.023)	(0.030)	(0.015)	(0.029)
6 to 8 hours	0.002	0.017	-0.009	0.022	-0.047
	(0.022)	(0.031)	(0.057)	(0.026)	(0.055)
8 to 10 hours	-0.008	0.059	-0.159	0.014	-0.113
	(0.037)	(0.048)	(0.101)	(0.045)	(0.095)
More than 10 hours	0.015	0.001	0.063	-0.003	0.064
	(0.028)	(0.039)	(0.050)	(0.035)	(0.058)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Each entry in this table is the coefficient of interest α from equation 1. The dependent variable in each regression is a dummy indicating whether the respondent worked hours in the reported range. Regressions include only entrants. All regressions include covariates of the age and age-squared of the entrant, as well as fixed effects for the day of the week of the interview, for the education level of the entrant, and for the month of entering the lottery. Standard errors are robust and clustered at the level of age bracket interacted with education level.

4.3 Effects on Distribution of Activities

Our theory suggests that employment is just one type of potential activity that can be adjusted when women win cars. As a result, we examine the daily activities reported in the travel diaries of these women in this section.

We report the effects of an additional car on the number and types of daily activities in table 7. For these regressions, the dependent variable is the number of activities where the purpose specified by the respondent falls into the category in the row titles.[14]

We can see from this table that cars cause sharply different changes in activities for women with no children and women with children. Women with no children do roughly the same number of activities each day, with the largest point increases for business tasks, although these coefficients are not statistically different from zero.

By contrast, women with children change their behavior most in the category of household tasks. We also see a negative but statistically insignificant change in other tasks. When we break out specifically the task of picking up and dropping off others, we confirm that this is the largest change in activity pattern for women with children. It is intuitive that parents with children would use their cars to pick up and drop off their children; this appears to be the primary activity that lottery winners do when they obtain cars and reallocate their daily tasks. To summarize the estimation results, we find that the effects of cars on female labor market outcomes and trip types depend on whether the women have children.

4.4 Other Effects of Vehicle Restrictions

4.4.1 Effects of Vehicle Restrictions on Men

We examine the effects of winning cars for men in the appendix tables. In general, cars do not change the work patterns of men in any visible way. We summarize our earlier results on

[14] The purposes "work," "business trip," and "attend school" are labeled "business tasks." The purposes "personal affair (such as seeing doctor)," "housework/take care of others," "shopping," "pick up/drop off passenger," and "pick up/drop off goods" are labeled "Housework Tasks." The purposes "sleep/rest," "meal," "recreation," "community/social," and "accompany other" are labeled "Recreation Tasks."

Table 7: IV Regressions on Types of Activities

	All Women	No Child	With Child	No Prelottery Child	With Prelottery Child
All tasks	0.130	0.062	0.164	0.075	0.140
	(0.147)	(0.095)	(0.273)	(0.100)	(0.283)
Business tasks	-0.010	0.080	-0.162	0.039	-0.161
	(0.045)	(0.070)	(0.127)	(0.047)	(0.146)
Housework tasks	0.179**	-0.039	0.409*	0.035	0.391*
	(0.090)	(0.036)	(0.219)	(0.037)	(0.206)
- Pickup and dropoff	0.186***	-0.010	0.380**	0.035	0.410***
	(0.072)	(0.014)	(0.165)	(0.029)	(0.150)
Recreation tasks	-0.039	0.021	-0.083	0.001	-0.089*
	(0.038)	(0.043)	(0.055)	(0.042)	(0.048)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Each entry in this table is the coefficient of interest α from equation 1. The dependent variable in each regression is a dummy indicating whether the respondent worked hours in the reported range. Regressions include only entrants. All regressions include covariates of the age and age-squared of the entrant, as well as fixed effects for the day of the week of the interview, for the education level of the entrant, and for the month of entering the lottery. Standard errors are robust and clustered at the level of age bracket interacted with education level.

women alongside those for men in table 8.

As this table shows, we find that cars have virtually no effect on male employment or male labor supply. In contrast with female lottery entrants, male lottery winners have nearly the same employment rates and work hours as losers, regardless of whether they have children.

For men, the only change from adding a car is in the number of tasks: men who win the lottery do slightly more tasks than male losers. The largest increase in tasks when men win cars comes in the category of household tasks. Specifically, men tend to shop more when they have cars.

4.4.2 Effects for Women When Other Members in the Household Win the Lottery

In models of household decision making such as those outlined by Chiappori and Mazzocco (forthcoming) , family labor supply and consumption are jointly determined. In this literature, labor force participation is the result of bargaining, and gains by one member can influence the work of the other. This is not an important issue for our setting, because while 303 women won the lottery on their own entry, only an additional 53 had other household members who won. When we examine the effects of any member winning the lottery on female employment in the appendix tables, we see the same patterns of effects on female labor supply.

4.4.3 Effects on the Gender Gap

In this section, we estimate the effect of our findings on the overall gender labor force participation gap. We assume that the behavior of losers would have been the same if there were no vehicle restrictions; we also assume that women who did not enter the lottery would not have changed behavior.

Our first-stage estimates suggest that lottery losers would have purchased 0.575 more cars; our IV estimates suggest that each car raises employment by 5.4 percentage points. This implies that the employment rate for lottery losers would have been (0.575*5.4) = 3.1 percentage points higher in the absence of vehicle restrictions. Since 2,979 women participated in the lottery but

Table 8: Comparison of the Effect of Cars on Women and Men

	All Women	No Child	With Child	Men	No Child	With Child
Employment	0.054***	0.099***	-0.041	0.000	0.003	0.014
	(0.014)	(0.041)	(0.053)	(0.022)	(0.030)	(0.028)
Minutes of work	22.689	55.139**	-32.495	3.156	4.989	6.731
	(20.756)	(21.984)	(49.639)	(14.535)	(20.645)	(20.058)
All tasks	0.130	0.062	0.164	0.098*	0.095	0.079
	(0.147)	(0.095)	(0.273)	(0.055)	(0.087)	(0.091)
Business tasks	-0.010	0.080	-0.162	-0.015	-0.029	-0.022
	(0.045)	(0.070)	(0.127)	(0.027)	(0.055)	(0.055)
Housework tasks	0.179**	-0.039	0.409*	0.083*	0.067	0.112
	(0.090)	(0.036)	(0.219)	(0.046)	(0.044)	(0.089)
- Pickup and dropoff	0.186***	-0.010	0.380**	0.020	0.007	0.022
	(0.072)	(0.014)	(0.165)	(0.024)	(0.014)	(0.058)
Recreation tasks	-0.039	0.021	-0.083	0.031	0.056	-0.011
	(0.038)	(0.043)	(0.055)	(0.035)	(0.054)	(0.030)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Each entry in this table is the coefficient of interest α from equation 1. The dependent variable in each regression is a dummy indicating whether the respondent worked hours in the reported range. Regressions include only entrants. All regressions include covariates of the age and age-squared of the entrant, as well as fixed effects for the day of the week of the interview, for the education level of the entrant, and for the month of entering the lottery. Standard errors are robust and clustered at the level of age bracket interacted with education level.

never won, this implies that 92.5 of these women do not work because of vehicle restrictions.

In the larger BTRC survey, 20,296 out of 47,319 women age 18 and older report being employed, an employment rate of 42.9 percent. In a counterfactual world with no vehicle restrictions, an additional 92.5 of these women would have been employed, resulting in an employment rate of 43.1 percent. As a result, we can say that vehicle restrictions decreased total female employment in the city of Beijing by 0.2 percentage points, or 0.5 percent.

Among men surveyed, 26,201 out of 43,679 men age 18 and older enter the lottery, an employment rate of 60.0 percent. The initial gender gap in employment is 17.1 percent. If the lottery did not exist, the gap would have been 16.9 percent, a decrease in this gap of 0.2 percentage points (1.1 percent).

This calculation suggests that, even though cars clearly affect female labor supply, the gender labor gap is so large that vehicle policies can only close a small portion of it.

4.5 Other Robustness Checks

We relegate the following robustness checks to appendix tables.

The primary independent variable in equation 1 is the number of cars, and the coefficient on this variable has a natural interpretation as the effect of an additional car on the dependent variable. We also test whether it is the household's first car or an additional car that affects labor market outcomes. We find that the first car and an additional car show similar patterns, with cars causing significant increases in the employment rates and minutes worked for women without children.

When the lottery policy was originally planned, failed entries could remain in the lottery pool indefinitely and be eligible for the each subsequent lottery. However, this policy was changed (Yang et al. 2014) so that applications had to be renewed every six months. Since renewing the application could represent a form of endogeneity if applicants who had more use for cars renewed their lottery entries more diligently than those who did not, we also test our empirical specification based on whether the woman reports winning the lottery within six

months of first entry. This also does not change the basic pattern of results.

Since most women with children in China are married, we test whether our results stem from marriage rather than the presence of a child. We caution that marriage is potentially endogenous to the number of cars, so these results would not be suitable for a main specification. We find that married women with children experience negative effects on labor market participation and hours worked, while married women without children have large increases in labor supply. These results suggest that the labor market effects of car ownership stem from having a child, rather than marriage.[15]

5 Conclusion

As policy makers consider restricting vehicle ownership or use, it is important to remember that the policies' primary purpose is to improve environmental quality and reduce traffic congestion. Yang et al. (2016) show that in Beijing, the license plate lottery reduced car ownership by 20 percent, vehicle distance traveled by 15 percent, and travel during peak congestion hours by 15 percent. This policy undoubtedly has large social benefits from reducing congestion, pollution, and greenhouse gas emissions. However, this paper demonstrates the unintended consequences of this policy on female labor in Beijing. Female lottery losers are employed significantly less than lottery winners.

Several Chinese cities have imitated Beijing by allocating all or part of their license plates via lottery. Other cities, such as Shanghai and Singapore, restrict vehicles through an auction. This alternative mechanism may also exacerbate the gender labor supply gap, because cars are allocated to the wealthy, and men are likely to have higher incomes than women.

We observe a female labor supply response in Beijing, a densely populated city with an extensive bus and subway network. In these types of cities, the time savings from cars are

[15] We note that single women often live on their own, in which case they work regardless of having cars. They also may live with their parents, in which case adding cars may not affect work.

likely to be smallest,[16] suggesting that vehicles are valued enough to have a strong influence on behavior even when other transportation options are readily available. The effects of restricting car ownership on female labor market outcomes could be larger in cities with lower quality public transportation.

The most important policy implication of this work is that the labor market effects of vehicle restrictions be mitigated, most directly through policies targeted at the primary group affected: women without children. For example, expansions in public transportation could be directed at areas with businesses employing concentrations of these women. Alternatively, labor tax incentives could be deployed precisely targeting those women without cars or children.

[16] Yang et al. (2016) document that car owners spend roughly the same amount of time and travel the same distances as those who take subways and buses.

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Appendix Table 1: IV Regressions on Whether the Woman Has a Car

	All Women	No Child	With Child	No Prelottery Child	With Prelottery Child
Employment	0.093***	0.162**	-0.077	0.135***	-0.140
	(0.024)	(0.068)	(0.099)	(0.029)	(0.089)
Minutes of work	39.850	91.897**	-61.003	60.083	-55.829
	(36.381)	(36.347)	(91.850)	(41.179)	(73.800)
All tasks	0.226	0.102	0.310	0.124	0.270
	(0.254)	(0.154)	(0.508)	(0.165)	(0.535)
Business tasks	-0.017	0.130	-0.305	0.064	-0.309
	(0.078)	(0.114)	(0.247)	(0.077)	(0.292)
Housework tasks	0.310**	-0.063	0.772*	0.059	0.750*
	(0.155)	(0.058)	(0.405)	(0.062)	(0.383)
Recreation tasks	-0.067	0.034	-0.156	0.001	-0.171*
	(0.065)	(0.070)	(0.106)	(0.070)	(0.094)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Each entry in this table is the coefficient of interest α from equation 1 when the variable being instrumented is whether the household of the woman has a car. The dependent variable in each regression is a dummy indicated in the row titles. Regressions include only entrants. All regressions include fixed effects for the day of the week of the interview, for the education level of the entrant, and for the month of entering the lottery. Standard errors are robust and clustered at the level of age bracket interacted with education level.

Appendix Table 2: IV Regressions, When the Instrument Is Winning an Additional Car

	All Women	No Child	With Child	No Prelottery Child	With Prelottery Child
Employment	0.088***	0.113***	0.047	0.105***	0.013
	(0.017)	(0.023)	(0.031)	(0.027)	(0.040)
Minutes of work	34.580**	43.218**	14.148	46.626**	-18.305
	(15.631)	(21.478)	(36.289)	(23.061)	(37.717)
All tasks	0.210*	0.160*	0.219	0.159**	0.191
	(0.121)	(0.095)	(0.192)	(0.078)	(0.220)
Business tasks	0.123***	0.139***	0.086	0.150***	0.008
	(0.032)	(0.032)	(0.090)	(0.029)	(0.107)
Housework tasks	0.108	-0.004	0.177	0.016	0.213
	(0.081)	(0.040)	(0.128)	(0.040)	(0.164)
Recreation tasks	-0.021	0.025	-0.044	-0.007	-0.030
	(0.027)	(0.056)	(0.028)	(0.044)	(0.027)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Each entry in this table is the coefficient of interest α from equation 1 when the variable being instrumented is whether the household of the woman has a car. The dependent variable in each regression is a dummy indicated in the row titles. Regressions include only entrants. All regressions include fixed effects for the day of the week of the interview, for the education level of the entrant, and for the month of entering the lottery. Standard errors are robust and clustered at the level of age bracket interacted with education level.

Appendix Table 3: IV Regressions, Divided by Marriage Status

	All Women	Single Women	Married Women, No Child	Married Women, with Child
Employment	0.054***	-0.011	0.144***	-0.086*
	(0.014)	(0.037)	(0.051)	(0.052)
Minutes of work	22.689	-5.442	81.727**	-52.561
	(20.756)	(18.980)	(37.810)	(35.641)
All tasks	0.130	0.157	-0.001	0.091
	(0.147)	(0.111)	(0.158)	(0.325)
Business tasks	-0.010	-0.009	0.084	-0.226
	(0.045)	(0.049)	(0.069)	(0.144)
Housework tasks	0.179**	0.065	0.034	0.414**
	(0.090)	(0.066)	(0.085)	(0.207)
Recreation tasks	-0.039	0.101	-0.119**	-0.098*
	(0.038)	(0.062)	(0.047)	(0.055)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Each entry in this table is the coefficient of interest α from equation 1 when the variable being instrumented is whether the household of the woman has a car. The dependent variable in each regression is a dummy indicated in the row titles. Regressions include only entrants. All regressions include fixed effects for the day of the week of the interview, for the education level of the entrant, and for the month of entering the lottery. Standard errors are robust and clustered at the level of age bracket interacted with education level.

Appendix Table 4: IV Regressions on All Dependent Variables, When Instrument Is Winning the Lottery within 6 Months of Entry

	All Women	No Child	With Child	No Prelottery Child	With Prelottery Child
Employment	0.055	0.148**	-0.034	0.114**	-0.058
	(0.033)	(0.070)	(0.046)	(0.052)	(0.058)
Minutes of work	16.927	81.315**	-30.885	42.046	-21.206
	(24.715)	(35.453)	(51.500)	(35.620)	(43.980)
All tasks	0.201	0.101	0.190	0.080	0.242
	(0.171)	(0.132)	(0.291)	(0.131)	(0.294)
Business tasks	0.028	0.141	-0.067	0.053	-0.003
	(0.077)	(0.113)	(0.146)	(0.087)	(0.140)
Housework tasks	0.233**	0.010	0.294**	0.075	0.288*
	(0.090)	(0.054)	(0.140)	(0.070)	(0.174)
Recreation tasks	-0.060	-0.051	-0.037	-0.048	-0.043
	(0.047)	(0.057)	(0.061)	(0.047)	(0.066)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Each entry in this table is the coefficient of interest α from equation 1 when the instrument is whether the woman won the lottery within 6 months of entry. The dependent variable in each regression is a dummy indicated in the row titles. Regressions include only entrants. All regressions include fixed effects for the day of the week of the interview, for the education level of the entrant, and for the month of entering the lottery. Standard errors are robust and clustered at the level of age bracket interacted with education level.

Appendix Table 5: IV Regressions on All Dependent Variables, for Lottery Entrants, When Instrument Is Whether Anyone in the Household Won the Lottery

	All Women	No Child	With Child	No Prelottery Child	With Prelottery Child
Employment	0.047**	0.073*	-0.021	0.063**	-0.053
	(0.021)	(0.042)	(0.048)	(0.026)	(0.048)
Minutes of work	37.396	66.894**	-16.145	44.871	-7.599
	(25.498)	(28.564)	(42.843)	(29.796)	(36.295)
All tasks	0.185	0.146	0.186	0.135	0.236
	(0.133)	(0.120)	(0.216)	(0.117)	(0.247)
Business tasks	0.041	0.116	-0.108	0.071	-0.078
	(0.053)	(0.088)	(0.101)	(0.060)	(0.126)
Housework tasks	0.132**	-0.064**	0.373**	-0.001	0.419**
	(0.057)	(0.029)	(0.169)	(0.026)	(0.189)
Recreation tasks	0.012	0.094	-0.079	0.065	-0.105**
	(0.056)	(0.070)	(0.059)	(0.071)	(0.049)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Each entry in this table is the coefficient of interest α from equation 1 when the instrument is whether the woman won the lottery within 6 months of entry. The dependent variable in each regression is a dummy indicated in the row titles. Regressions include only entrants. All regressions include fixed effects for the day of the week of the interview, for the education level of the entrant, and for the month of entering the lottery. Standard errors are robust and clustered at the level of age bracket interacted with education level.

Appendix Table 6: IV Regressions on Specific Activity for Women

	All Women	No Child	With Child	No Prelot-tery Child	With Prelot-tery Child
	Business tasks				
Work	0.022	0.100	-0.117	0.075	-0.131
	(0.045)	(0.074)	(0.125)	(0.052)	(0.137)
Business trip	-0.010	-0.009	-0.010*	-0.009	-0.008
	(0.006)	(0.010)	(0.006)	(0.009)	(0.006)
Attend school	-0.021***	-0.026***	-0.014*	-0.024***	-0.018
	(0.003)	(0.006)	(0.008)	(0.006)	(0.012)
	Household tasks				
Personal affair (such as doctor)	0.024	0.015	0.036	0.023	0.024
	(0.017)	(0.018)	(0.025)	(0.017)	(0.036)
Housework/take care of others	-0.007*	-0.009*	-0.002	-0.008	-0.002
	(0.004)	(0.006)	(0.002)	(0.005)	(0.002)
Shopping	-0.025	-0.038	-0.001	-0.017	-0.037
	(0.034)	(0.034)	(0.077)	(0.027)	(0.099)
Pick up/drop off passenger	0.186***	-0.010	0.388**	0.025	0.426***
	(0.072)	(0.015)	(0.165)	(0.025)	(0.148)
Pick up/drop off goods	0.001	0.006	-0.007*	0.004	-0.008
	(0.006)	(0.010)	(0.004)	(0.009)	(0.006)
	Recreation tasks				
Sleep/rest	0.007	0.007	0.007	0.014	-0.005
	(0.009)	(0.011)	(0.015)	(0.013)	(0.004)
Meal	-0.016	-0.014	-0.003	-0.013	-0.012
	(0.014)	(0.017)	(0.015)	(0.017)	(0.014)
Recreation	-0.021	0.018	-0.052	0.002	-0.041
	(0.029)	(0.038)	(0.032)	(0.036)	(0.034)
Community/social	-0.016	-0.002	-0.034***	-0.009	-0.024**
	(0.015)	(0.022)	(0.012)	(0.017)	(0.011)
Accompany others	0.008	0.014	-0.004	0.013	-0.005
	(0.008)	(0.012)	(0.003)	(0.011)	(0.004)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Each entry in this table is the coefficient of interest α from equation 1. The dependent variable in each regression is a dummy indicating the number of tasks from the category specified in the row titles. Regressions include only entrants. All regressions include fixed effects for the day of the week of the interview, for the education level of the entrant, and for the month of entering the lottery. Standard errors are robust and clustered at the level of age bracket interacted with education level.

Appendix Table 7: Comparability of Men Winning and Not Winning the Lottery

	Has a Child (N = 1,506)		No Child (N = 3,190)	
	Losers	Difference: Winners - Losers	Losers	Difference: Winners - Losers
Birth year	1975.4	-0.5	1973.8	0.2
Has finished high school	0.850	-0.031	0.809	-0.009
Has finished college	0.590	-0.022	0.547	-0.013
Is head of household (HoH)	0.437	0.023	0.431	0.009
Is husband of HoH	0.346	-0.040	0.243	-0.013
Birth year of HoH	1970.9	-0.616	1966.4	-0.1
HoH has finished high school	0.741	-0.031	0.692	0.005
HoH has finished college	0.507	-0.029	0.380	0.020
Is employed	0.895	-0.026	0.805	0.005
Minutes of work time	450.2	-18.6	401.8	0.3
Number of cars owned	0.561	0.689***	0.602	0.630***
N	1,342		2,890	
	Has a Prelottery Child (N = 1,185)		No Prelottery Child (N = 3,590)	
	Losers	Difference: Winners - Losers	Losers	Difference: Winners - Losers
Birth year	1974.3	-1.3*	1974.4	0.5
Has finished high school	0.841	-0.064*	0.816	0.001
Has finished college	0.566	-0.053	0.560	0.020
Is head of household (HoH)	0.450	0.013	0.428	0.015
Is wife of HoH	0.370	-0.048	0.246	-0.009
Birth year of HoH	1970.6	-2.1*	1966.9	0.5
HoH has finished high school	0.740	-0.070*	0.698	0.015
HoH has finished college	0.500	-0.062	0.396	0.029
Is employed	0.896	0.028	0.814	0.005
Minutes of work time	453.5.0	-7.2	405.9	-4.2
Number of cars owned	0.537	0.720***	0.461	0.686***
N	1,064		3,235	

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix Table 8: First-Stage Regressions on the Number of Cars in the Household for Men

	All Women	No Child	With Child	No Prelottery Child	With Prelottery Child
Won the lottery	0.679***	0.668**	0.649***	0.658***	0.710***
	(0.029)	(0.034)	(0.057)	(0.033)	(0.064)
Age of member	-0.006	-0.009	-0.008***	-0.008	-0.063***
	(0.005)	(0.007)	(0.017)	(0.007)	(0.022)
(Age * Age)	0.000	0.000	0.000***	0.000	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
N	4,775	3,190	1,585	3,590	1,185
R^2	0.128	0.133	0.167	0.136	0.181

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Regressions include only lottery entrants. All regressions include fixed effects for the day of the week of the interview, for the education level of the entrant, and for the month of entering the lottery. Standard errors are robust and clustered at the level of age bracket interacted with education level.

Appendix Table 9: IV Regressions on Full-Time Male Employment

	All Men	No Child	With Child	No Prelottery Child	With Prelottery Child
Number of cars	0.000	0.003	0.014	-0.000	0.012
	(0.022)	(0.030)	(0.028)	(0.030)	(0.029)
Age of member	0.045***	0.042***	0.077***	0.042***	0.082***
	(0.012)	(0.013)	(0.008)	(0.014)	(0.011)
(Age * Age)	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
N	4,775	3,190	1,585	3,590	1,185
R^2	0.201	0.181	0.280	0.192	0.267

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Regressions include only lottery entrants. All regressions include fixed effects for the day of the week of the interview, for the education level of the entrant, and for the month of entering the lottery. Standard errors are robust and clustered at the level of age bracket interacted with education level.

Appendix Table 10: IV Regressions on Male Labor Supply

	All Men	No Child	With Child	No Prelottery Child	With Prelottery Child
Number of cars	3.156	4.989	6.731	-4.391	31.673
	(14.535)	(20.645)	(20.058)	(19.085)	(23.522)
Age of member	16.572***	14.567**	33.782***	14.959**	30.049***
	(6.047)	(6.551)	(4.712)	(6.664)	(7.903)
(Age * Age)	-0.250***	-0.221***	-0.475***	-0.227***	-0.431***
	(0.071)	(0.076)	(0.055)	(0.077)	(0.088)
N	4,538	3,032	1,506	3,416	1,122
R^2	0.122	0.125	0.143	0.130	0.121

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The dependent variable in these regressions is minutes spent working. Regressions include only lottery entrants. All regressions include fixed effects for the day of the week of the interview, for the education level of the entrant, and for the month of entering the lottery. Standard errors are robust and clustered at the level of age bracket interacted with education level.

Appendix Table 11: IV Regressions on Hours Worked Ranges for Men

	All Men	No Child	With Child	No Prelottery Child	With Prelottery Child
0 hours	0.006	0.006	-0.004	0.020	-0.048
	(0.022)	(0.034)	(0.037)	(0.030)	(0.038)
0 to 2 hours	-0.005	-0.005	-0.005	-0.002	-0.007*
	(0.008)	(0.012)	(0.013)	(0.011)	(0.004)
2 to 4 hours	-0.009	-0.018***	0.001	-0.021***	0.020*
	(0.007)	(0.005)	(0.008)	(0.005)	(0.011)
4 to 6 hours	0.004	0.013	-0.012	0.011	-0.014
	(0.009)	(0.014)	(0.007)	(0.012)	(0.012)
6 to 8 hours	0.028	0.031	0.031	0.031	0.036
	(0.020)	(0.028)	(0.034)	(0.024)	(0.046)
8 to 10 hours	-0.025	-0.045	0.011	-0.042	0.027
	(0.026)	(0.040)	(0.037)	(0.037)	(0.056)
More than 10 hours	-0.000	0.017	-0.024	0.003	-0.013
	(0.024)	(0.030)	(0.032)	(0.021)	(0.057)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Each entry in this table is the coefficient of interest α from equation 1. The dependent variable in each regression is a dummy indicating whether the respondent worked hours in the reported range. Regressions include only entrants. All regressions include fixed effects for the day of the week of the interview, for the education level of the entrant, and for the month of entering the lottery. Standard errors are robust and clustered at the level of age bracket interacted with education level.

Appendix Table 12: IV Regressions on Types of Activities for Men

	All Men	No Child	With Child	No Prelottery Child	With Prelottery Child
All tasks	0.098*	0.095	0.079	0.100	0.098
	(0.055)	(0.087)	(0.091)	(0.063)	(0.119)
Business tasks	-0.015	-0.029	-0.022	-0.030	0.039
	(0.027)	(0.055)	(0.055)	(0.046)	(0.066)
Housework tasks	0.083*	0.067	0.112	0.076**	0.102
	(0.046)	(0.044)	(0.089)	(0.035)	(0.105)
Recreation tasks	0.031	0.056	-0.011	0.054	-0.043
	(0.035)	(0.054)	(0.030)	(0.055)	(0.047)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Each entry in this table is the coefficient of interest α from equation 1. The dependent variable in each regression is a dummy indicating the number of tasks from the category specified in the row titles. Regressions include only entrants. All regressions include fixed effects for the day of the week of the interview, for the education level of the entrant, and for the month of entering the lottery. Standard errors are robust and clustered at the level of age bracket interacted with education level.

Appendix Table 13: IV Regressions on Specific Activity for Men

	All Men	No Child	With Child	No Prelot-tery Child	With Prelot-tery Child
	Business tasks				
Work	-0.002	0.002	0.004	-0.000	0.017
	(0.032)	(0.052)	(0.057)	(0.048)	(0.071)
Business trip	-0.017**	-0.021***	-0.012	-0.019***	-0.017
	(0.007)	(0.004)	(0.018)	(0.005)	(0.022)
Attend school	0.004	-0.012*	0.032	-0.011*	0.039
	(0.009)	(0.007)	(0.023)	(0.006)	(0.029)
	Households tasks				
Personal affair (like doctor)	0.001	-0.007	0.022	0.000	0.011
	(0.015)	(0.014)	(0.021)	(0.015)	(0.025)
Housework/take care of others	0.004	0.008	-0.001	0.006	n/a
	(0.005)	(0.009)	(0.001)	(0.007)	n/a
Shopping	0.043*	0.049	0.034	0.040	0.058*
	(0.025)	(0.033)	(0.031)	(0.030)	(0.034)
Pick up/drop off passenger	0.020	0.007	0.033	0.010	0.032
	(0.024)	(0.014)	(0.065)	(0.019)	(0.072)
Pick up/drop off goods	0.014	0.010	0.024	0.020*	0.001
	(0.010)	(0.011)	(0.022)	(0.012)	(0.013)
	Recreation tasks				
Sleep/rest	-0.007***	-0.005***	-0.010**	-0.008***	-0.009*
	(0.002)	(0.002)	(0.005)	(0.002)	(0.005)
Meal	0.011	0.039*	-0.032**	0.030	-0.034**
	(0.016)	(0.022)	(0.015)	(0.019)	(0.017)
Recreation	0.015	-0.002	0.031	0.011	0.010
	(0.030)	(0.042)	(0.033)	(0.040)	(0.041)
Community/social	0.012	0.027	-0.016*	0.024	-0.020*
	(0.016)	(0.027)	(0.008)	(0.023)	(0.012)
Accompany others	0.001	-0.001	0.004	-0.003	0.010
	(0.004)	(0.005)	(0.010)	(0.005)	(0.011)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Each entry in this table is the coefficient of interest α from equation 1. The dependent variable in each regression is a dummy indicating the number of tasks from the category specified in the row titles. Regressions include only entrants. All regressions include fixed effects for the day of the week of the interview, for the education level of the entrant, and for the month of entering the lottery. Standard errors are robust and clustered at the level of age bracket interacted with education level.