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MARRIAGE MARKET MATCHING AND CONSPICUOUS CONSUMPTION IN CHINA

KEVIN B. GRIER, DANIEL L. HICKS and WEICI YUAN*

Visible expenditures which convey higher socioeconomic status may help individuals differentiate themselves in the marriage market when there is competition for partners and imperfect information. We examine a unique dataset of automobile purchasers in China to investigate the extent to which skewed sex ratios influence expenditure decisions for this highly visible commodity. Using a triple difference approach, we show that unmarried male consumers who face an unfavorable sex ratio purchase more expensive, luxury vehicles than their married peers. Lower income borrowers and those residing in regions with the worst sex ratios exhibit the largest relative degree of conspicuous consumption. In addition to the direct cost of consumption signaling, we demonstrate that this behavior generates negative externalities in the form of lower average fuel economy and higher average vehicle weight. As it has worsened sex ratios, status competition and the associated negative repercussions we identify represent unintended consequences of China's one child policy. (*JEL* O12, E21, J12)

I. INTRODUCTION

A preference for sons, coupled with the one child-policy, has combined to generate a relative shortage of females in China. Estimates from China's Population Census suggest that for cohorts born over the period 1970–2000, males have grown in share from 51% to 57% of the total population (Qian 2008, 1251). Estimates of the share of "missing women" in the country now exceed 40 million women (Bulte et al. 2011). Existing research has shown that these skewed sex ratios are producing widespread social and economic upheaval, including higher saving rates, ballooning housing prices (Wei and Zhang 2011; Wei et al. 2012), higher rates of bachelorhood (Guilmoto 2012), and reduced overall welfare (Bhaskar 2011). Recent research also suggests that spending on status goods appears to be growing in magnitude, even in poorer parts of rural China (Brown et al. 2011; Chen et al. 2012).

In this article, we investigate the extent to which skewed sex ratios influence expenditure decisions in a broad sample of roughly 24,000 automobile transactions across China over the period 2009–2011. Using a differences-in-differences-in-differences approach, we show that unmarried male consumers who reside in an area with an unfavorable sex ratio purchase more expensive vehicles than their married peers. We also identify specific luxury vehicle models and confirm that the cars purchased by these consumers are more likely to be classified as higher end models.

The pressure generated by skewed sex ratios on individuals to consume conspicuously may vary along a number of dimensions. We are able to explore two sources of heterogeneity in our sample. First, we show that the estimated relationship is both larger in magnitude and more precisely estimated among the quartile of individuals living in areas with the most highly skewed sex ratios. Second, we find that the poorest quartile of unmarried males in our sample exhibit the

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Grier: Department of Economics, University of Oklahoma, Norman, OK 73071. Phone (405) 325-3748, Fax (405) 325-5842, E-mail angus@ou.edu

Hicks: Department of Economics, University of Oklahoma, Norman, OK 73071. Phone (405) 325-7049, Fax (405) 325-5842, E-mail hicksd@ou.edu

Yuan: Department of Economics, University of Oklahoma, Norman, OK 73071. Phone (405) 795-1001, Fax (405) 325-5842, E-mail sullivanyuan@gmail.com

ABBREVIATIONS

FGLS: Feasible Generalized Least Squares
GDP: Gross Domestic Product
MPG: Miles Per Gallon

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largest changes in expenditure.[1] This result is consistent with a situation in which individuals of varying income (and potentially of varying reference groups) use different sets of commodities to signal wealth, as documented by Chai and Kaus (2012) for South African consumers. Finally, we investigate whether this behavior generates negative externalities in the form of lower average fuel economy and higher average vehicle weight, a factor that can significantly increase mortality in traffic accidents (Anderson and Auffhammer 2014). Our results suggest that consumption signaling skews the pool of purchased automobiles to lower gas mileage vehicles, but has little impact on overall vehicle weight.

The use of consumption expenditure to signal social status has attracted a great deal of attention in the economics literature. Recent work has focused on empirically identifying consumption visibility and exploring the determinants and motivations for signaling (Charles et al. 2009; Heffetz 2011). These efforts routinely classify automobiles as among the most conspicuous of purchases and a number of papers focus specifically on vehicle purchases. For instance, Grinblatt et al. (2008) show that Finnish consumers are directly influenced by the automobile purchases of their nearest neighbors, particularly for recent purchases.

Positional spending has also been studied in developing countries, with research highlighting the fact that the allocation of expenditure for this purpose has the potential to act as a poverty trap in this setting (Banerjee and Duflo 2007; Brown et al. 2011; Case et al. 2013; Kaus 2013; Moav and Neeman 2010, 2012). These effects appear to be amplified by marriage market conditions. For instance, Chen et al. (2012) show that relative to families with daughters, poor Chinese households with sons undertake higher levels of social gift-giving associated with maintaining *guanxi*, networks of influence in Chinese society.

Our analysis sample confers several unique advantages in this context. First, we examine expenditure on automobiles, a ubiquitous and highly visible commodity, with a range of purchase options, and for which signaling is often considered a major consumption motivation. Second, our study spans consumers across all of China, both rural and urban. Finally, because the data come from a financial lender, our data contain information about the products purchased as well as detailed records on the consumers themselves.

At the same time, because we are working with a very specific set of consumers and consumption decisions, the generalizability of the results we obtain may be limited. In particular, we are identifying a relationship between positional spending and marriage market competition within a subsample of Chinese car consumers, who are affluent enough to buy a car but both need to borrow to make their purchase and engage with this specific lender. Estimates from the 2011 Chinese Household Finance Survey suggest that roughly 27% of new car purchasers in China rely on credit. To the extent that richer households are less likely to need credit, our estimates are thus simply best interpreted as the impact of the sex ratio among the population of purchasers who choose to employ credit.

Rates of private car ownership in China are low but are increasing rapidly. While in 1985 the rate of ownership was only 0.27 for every 1,000 people, this rate has risen to 55 per 1,000 in 2011 (Feng and Li 2013). Rising affluence combined with growing automobile ownership suggests that the scope for status competition through vehicles and the effects that we observe may intensify in the future. The extent to which our findings apply more broadly depends on the extent to which this group is selected and to which motivations for consumption signaling could vary across other commodities, over time, or by income level.

Our article is organized as follows. Section II describes the construction of our dataset and presents summary statistics on the sample investigated. Section III undertakes the differences-in-differences analysis and discusses the implications of marriage market competition for consumption behavior in this setting. Section IV explores the potential for heterogeneity in the estimated relationship and examines several potential implications of consumption signaling behavior specific to the automobile industry. Finally Section V concludes.

II. DATA

The data are constructed from three principal sources. Information on automobile transactions and car purchasers themselves is provided by a large Chinese financial institution from 2009 through 2011. The source provides records on 24,134 individual loans and includes borrowers from all provinces of mainland China except Tibet. A key advantage of this data is the level

1. Our sample of car buyers is more affluent than the population at large. We explore the sample at length in Section II.

TABLE 1
Summary Statistics

	Observations	Mean	Standard Deviation
Panel A: borrower characteristics			
Age	24,133	35.62	7.91
Male	24,133	0.75	0.43
Earnings	24,133	98,027	51,608
Married	24,133	0.84	0.37
Educational attainment			
Illiterate	24,133	0.00	0.02
Elementary	24,133	0.10	0.30
High school	24,133	0.30	0.46
College	24,133	0.59	0.49
Graduate	24,133	0.01	0.11
Panel B: car characteristics			
Purchase price	24,133	1,31,071	46,724
Foreign	24,133	0.56	0.50
Luxury make	24,133	0.24	0.43
Fuel efficiency (Combined mpg)	24,133	29.35	3.31
Vehicle weight (lbs)	24,133	1,360	154
Panel C: prefecture characteristics			
Sex ratio (male/female × 100)	292	105.28	4.22
Income (GDP per capita)	254	45,324	29,611
Population (10,000)	254	135.40	152.47
Mean house price in January 2010 (per square meters)	97	7,037	4,556
Paved road area (per capita)	253	10.87	7.29
Buses (per 10,000 people)	254	7.72	7.75
Taxis (per 10,000 people)	254	22.26	18.20

Notes: Pooled sample spanning 2009–2011. Expenditures are deflated to real 2010 RMB prices using the CPI. Sample excludes individuals earning in excess of 250,000 RMB per year.

Source: Panels A and B: Authors' calculations using vehicle loan data detailed in Section IV; MPG information obtained from the Ministry of Industry and Information Technology of China (2014). Panel C: Most variables are obtained from China Economic Information Network (CEInet) Statistics Database. Sex ratios are derived from the provincial statistical yearbooks (2011) and mean house prices are obtained from www.elivecity.cn.

of detail contained on the vehicles purchased and on individual borrowers including information on marital status, age, gender, education, and earnings as well as on the geographic location of purchase. We also derive information on prefecture-level outcomes, which are obtained from both provincial statistical yearbooks and from the National Bureau of Statistics (CEInet 2015).

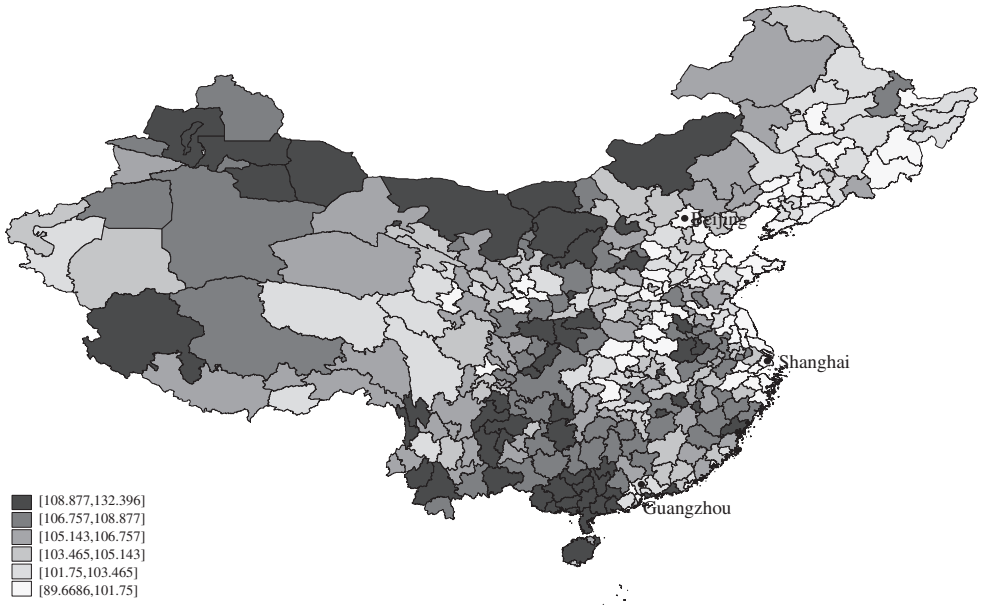
Panel A of Table 1 presents summary statistics on car buyer characteristics. One noticeable feature is that borrowers are comparatively rich, with average annual earnings of nearly 100,000 RMB, which is over $16,000. In contrast, average income per capita is roughly 35,100 RMB according to the National Bureau of Statistics of China, which highlights that the sample of car purchasers is highly selected.[2] Most purchasers are male, middle-aged, married, and have received at least a college education. Panel B provides detail on the cars purchased in the sample.[3] As can be seen from the table, over half of the cars are foreign brands and approximately one-fourth are luxury vehicles. The average miles per gallon (MPG) is city/highway combined and is slightly below 30.

Panel C reports prefecture-level characteristics. The dataset contains transactions occurring in some 292 of the 334 total prefectures in China, while we have prefecture-level economic statistics for roughly 254 regions. Across regions with data, average income is 45,324 RMB. The mean gross domestic product (GDP) per capita across prefectures in our sample is higher than China's GDP per capita in 2011 (35,100 RMB), a difference which reflects the fact that more automobile purchases are undertaken by inhabitants of wealthier regions and that this value is

2. Comparable estimates from the 2011 Chinese Household Finance Survey suggest that new car purchasers earn on average 65,000 RMB, which is closer to that found in our sample. The true difference may be even smaller as our data are not survey data, and it is well known that survey estimates of income, particularly in developing countries often understate mean income (Deaton 2005).

3. Expenditures have been deflated to real prices using a base month of September 2010 and the official consumer price index.

FIGURE 1
Sex Ratios by Prefecture



not population weighted. [4] The overall sex ratio, obtained from provincial statistical yearbooks, based primarily on Hukou-derived estimates, is roughly 1.05 males per female across all prefectures, although this value is more skewed for younger cohorts. We explore the robustness of our analysis to alternative measures of the sex ratio, such as those based on Census data, in Section III. Furthermore, this value masks substantial geographic heterogeneity; Figure 1 depicts the sex ratio by prefecture (measured as the ratio of males per 100 females). Although some of the most severely imbalanced gender ratios exist in rural areas, the issue is not limited to such areas. Overall, the sex ratio ranges from a low of 90 to a high of over 132 men per 100 women.

III. ANALYSIS

Estimating the relationship between the level of competition in the marriage market (here measured by the sex ratio) and positional spending (captured by the purchases of more luxurious automobiles) is complicated by a number of factors. For example, a primary concern is that the presence of a more skewed sex ratio may be correlated with other omitted factors such as variation in terms of average incomes, education levels, or even male/female gender roles in a region.

We attempt to mitigate this and related sources of endogeneity through the use of a triple differences approach. Specifically, we compare male and female car purchasers, who are and are not married, across low and high sex ratio regions. Our identification of the effects of high sex ratio on Chinese men's car-purchasing preference thus relies on the interaction between gender and marital status. In Chinese culture, the family of a groom is traditionally responsible for purchasing a house at the time of marriage, suggesting that males may also have a stronger incentive than females at this stage of their life to signal wealth through a range of visible expenditures (Wei et al. 2012). This pressure has intensified with increasing competition for brides and the incentive should act on the unmarried rather than on married men (Wei and Zhang 2011).

For illustrative purposes, we begin our analysis with an example triple difference mean estimate shown in Table 2. For simplicity we calculate means using the top and bottom quartiles

4. The financial institution may also be more likely to make loans to individuals in richer prefectures. In order to maintain a representative sample of Chinese consumers, we exclude those with annual incomes in excess of 250,000 RMB.

TABLE 2
Mean Differences in Differences of Car Price by Gender, Marital Status, and Sex Ratio

	Men		Women		Difference		Difference in Difference
	Unmarried	Married	Unmarried	Married	Unmarried	Married	
Sex ratio	(1)	(2)	(3)	(4)	(5) = (1)-(3)	(6) = (2)-(4)	(7) = (5)-(6)
Top quartile (most skewed)	1,31,084	1,42,438	1,24,059	1,41,627	7,025	811	6,214
	(47570)	(50763)	(41981)	(53044)			
Bottom quartile (least skewed)	1,19,417	1,30,114	1,15,302	1,25,003	4,115	5,111	−996
	(38078)	(44786)	(35841)	(43586)			
Difference-in-difference-in-difference							7,210

Notes: Pooled sample spanning 2009–2011. Expenditures are deflated to real 2010 RMB prices using the CPI. Sample excludes individuals earning in excess of 250,000 RMB per year. Standard deviations are in parentheses.

Source: Panels A and B: Authors' calculations using vehicle loan data detailed in Section IV; MPG information obtained from the Ministry of Industry and Information Technology of China (2014). Panel C: Most variables are obtained from China Economic Information Network (CEInet) Statistics Database. Sex ratios are derived from the provincial statistical yearbooks (2011) and mean house prices are obtained from www.elivecity.cn.

of sex ratio.[5] In the more imbalanced areas, unmarried men, on average, purchase cars that are 7,025 RMB (column (5)) more expensive than those unmarried women purchase. By contrast, for married individuals, men's automobiles are only 811 RMB (column (6)) more expensive than married women's purchases. The difference in difference is 6,214 RMB as is shown in the top of column (7).

Next we carry out the same analysis for the quartile of less skewed sex ratio provinces. We find that the mean difference-in-difference here is small but actually negative (−996 RMB as shown in the middle of column (7)), implying that there is no obvious car-related conspicuous consumption in this group. Finally, our triple difference estimate is simply the difference between these two double differences: 7,210 RMB, (or around $1,200) which is an economically important effect.

In what follows, we run regressions that implement a regression version of this basic triple-difference approach. Equation (1) presents this triple difference estimation strategy, with all component interactions included:

$$\begin{aligned}(1)\quad \text{Carprice} = {} & \alpha + \beta_1 \text{male} + \beta_2 \text{unmarried} + \beta_3 \text{sexratio} \\ & + \beta_4 \text{male} * \text{unmarried} + \beta_5 \text{male} * \text{sexratio} \\ & + \beta_6 \text{sexratio} * \text{unmarried} + \beta_7 \text{male} \\ & * \text{unmarried} * \text{sexratio} + \theta \boldsymbol{X} + \delta \boldsymbol{Z} + \eta + \varepsilon\end{aligned}$$

where $\boldsymbol{X}$ is a vector of borrower characteristics and $\boldsymbol{Z}$ is a vector of prefecture and province level controls. In theory, the coefficient on the triple interaction, β_7, should isolate the specific portion of consumption expenditure undertaken by the group with the highest motivation to signal status, unmarried males facing high levels of competition. In some specifications, we also include a set of province fixed effects, denoted by η.

The results of estimating Equation (1) are shown in Table 3 with each column (1)–(5) adding additional controls. Column (1) estimates the triple difference with no controls. Column (2) includes controls for borrower characteristics including age, age squared, earnings, and educational attainment, while column (3) additionally includes the prefecture characteristics listed in Table 1. Finally, column (4) includes province fixed effects, while column (5) incorporates a control for housing prices (for regions of China with available data) because houses have also been specifically shown to be a positional good in the Chinese case (Wei and Zhang 2011). We include controls for local housing prices only in some specifications because they dramatically limit the sample.

In all specifications, the coefficient estimate of interest on the triple interaction term is positive and statistically significant at the .10 level or better. The estimated impacts are economically meaningful as well. To put the magnitude of the coefficients in perspective, the estimated coefficient on the triple interaction in column (5) implies that if one were to go from a prefecture in which there is parity in the sex ratio to a prefecture with a sex ratio that is one standard deviation above the mean in favor of males, then the typical car purchased by an unmarried male would be 4,285 RMB more expensive. This

5. The mean sex ratios in these two groups are 100.6 and 110.5, respectively.

TABLE 3
The Impact of the Sex Ratio on the Automobile Purchase Price of Unmarried Males in China

	Dependent Variable: Automobile Sales Price					Probit: Luxury
	1	2	3	4	5	6
Male	36,586.87**	22,608.06	23,510.13	24,749.06*	29,546.31**	0.291***
	(16,194.21)	(16,433.08)	(16,586.20)	(13,530.58)	(14,436.89)	(0.088)
Unmarried	34,481.83**	38,869.18***	37,044.48***	36,511.51*	36,289.46*	0.406**
	(15,212.31)	(14,662.75)	(14,334.04)	(20,165.34)	(20,253.01)	(0.206)
Sex ratio	1,031.63***	849.15***	881.22***	600.83***	369.38**	0.004**
	(137.28)	(147.28)	(196.07)	(126.05)	(149.31)	(0.001)
Unmarried × Sex ratio	−432.94***	−497.56***	−479.39***	−473.88**	−469.93**	−0.004***
	(144.91)	(134.61)	(132.71)	(193.59)	(194.83)	(0.001)
Unmarried × Male	−42,378.37**	−42,168.00**	−36,111.73*	−37,093.93	−40,759.97	−0.247***
	(17,829.39)	(19,622.71)	(19,243.25)	(26,863.08)	(27,978.82)	(0.051)
Sex ratio × Male	−322.14**	−285.94*	−294.39*	−304.69**	−341.41**	−0.004***
	(147.77)	(148.89)	(150.44)	(129.99)	(139.07)	(0.001)
Sex ratio × Male × Unmarried	401.46**	505.32***	443.55**	451.32*	480.80*	0.005***
	(172.08)	(183.77)	(180.79)	(258.10)	(269.67)	(0.002)
Average prefecture houseprice					−0.33*	0.000
					(0.17)	(0.000)
Borrower characteristics	N	Y	Y	Y	Y	Y
Prefecture characteristics	N	N	Y	Y	Y	Y
Province fixed effects	N	N	N	Y	Y	Y
Mean of dependent variable	1,30,771	1,30,771	1,30,806	1,30,806	1,28,869	0.239
Number of observations	24,133	24,133	23,520	23,520	14,929	14,929
R^2	.017	.143	.144	.150	.156	.105

Notes: Pooled sample spanning 2009–2011. Expenditures are deflated to real 2010 RMB prices using the CPI. Sample excludes individuals earning in excess of 250,000 RMB per year. Borrower characteristics include age, age squared, earnings, and dummies for education level. Prefecture characteristics include income per capita, population, paved road area, buses, and taxis per capita. Standard errors are clustered at the province level in specifications (1)–(3) and reported in parenthesis, while columns (4) and (5) report Huber–White robust standard errors in parenthesis. Column (6) reports marginal effects from a probit regression with a dependent variable of an indicator for luxury car status.

Source: Panels A and B: Authors' calculations using vehicle loan data detailed in Section IV; MPG information obtained from the Ministry of Industry and Information Technology of China (2014). Panel C: Most variables are obtained from China Economic Information Network (CEInet) Statistics Database. Sex ratios are derived from the provincial statistical yearbooks (2011) and mean house prices are obtained from www.elivecity.cn.

*$p < .1$; **$p < .05$; ***$p < .01$.

change represents a 3.3% increase in the mean purchase price paid by this group of consumers.

An additional concern is that several large Chinese cities such as Beijing, Guangzhou, and Shanghai have also enacted vehicle ownership restrictions such as auctions and lotteries in an effort to curb congestion and pollution (Feng and Li 2013). Restrictions may alter the pool of individuals eligible to purchase cars and may limit the scope for status competition through consumption signaling in these regions. As a check, Table A1 demonstrates that the results we obtain are robust to the exclusion of these areas.

Higher purchase prices could reflect numerous car characteristics, not all of which may equally convey status. An advantage of studying automobiles is that vehicles are already classified as standard or as luxury models both across and within producers. As an alternative approach, we consider the likelihood that an individual purchases a car which is classified as luxury. To do this we estimate an equation as in (1), using a probit specification, with an outcome variable which is an indicator taking the value of 1 for luxury automobiles. The results of this exercise are shown in Column (6) of Table 3 and are reported as the marginal effect. Using the same comparison as in Column (5), the estimates suggest that unmarried male consumers in prefectures one standard deviation above the mean would be 4.8 percentage points more likely to purchase a luxury car than those in a balanced prefecture.

While the OLS results are instructive, the use of income as a regressor in the model makes it possible that there may be issues with heteroscedasticity.[6] We formally tested for this using the White test and a specific analysis focusing on

6. Heteroscedasticity related to scale is a classic case in the literature, and if the scale variable is also included as a regressor in the model, the efficiency gains from using GLS can be substantial. See Baum (2006, 144–47).

TABLE 4
FGLS Estimates (Variance as a Function of Earnings)

	Dependent Variable: Automobile Sales Price				
	1	**2**	**3**	**4**	**5**
Male	34,107.68**	17,855.65	17,966.41	19,163.70	23,896.85*
	(15,620.13)	(14,978.61)	(14,971.25)	(14,766.65)	(11,976.82)
Unmarried	32,572.44**	34,448.65**	31,942.09**	31,007.41**	30,952.79**
	(15,168.15)	(14,660.48)	(13,927.77)	(13,433.41)	(13,353.83)
Sex ratio	997.76***	786.94***	811.81***	564.03**	295.41*
	(134.73)	(146.99)	(186.80)	(238.57)	(171.11)
Unmarried × Sex ratio	−413.07***	−453.02***	−428.42***	−418.67***	−415.72***
	(144.78)	(135.53)	(129.54)	(125.18)	(123.11)
Unmarried × Male	−42,692.22**	−41,587.42**	−37,304.11*	−36,907.21*	−37,159.15**
	(17,202.17)	(18,340.38)	(18,947.05)	(18,983.67)	(16,071.10)
Sex ratio × Male	−301.05**	−241.49*	−242.67*	−252.89*	−289.10**
	(142.83)	(136.35)	(136.29)	(134.19)	(105.18)
Sex ratio × Male × Unmarried	405.43**	497.73***	454.43**	448.63**	444.43***
	(166.50)	(171.84)	(178.63)	(180.23)	(145.43)
Average prefecture houseprice					−0.29
Borrower characteristics	N	Y	Y	Y	Y
Prefecture characteristics	N	N	Y	Y	Y
Province fixed effects	N	N	N	Y	Y
Mean of dependent variable	1,30,771	1,30,771	1,30,806	1,30,806	1,28,869
Number of observations	24,133	24,133	23,520	23,520	14,929
R^2	.017	.143	.144	.150	.156

Notes: Pooled sample spanning 2009–2011. Expenditures are deflated to real 2010 RMB prices using the CPI. Sample excludes individuals earning in excess of 250,000 RMB per year. Borrower characteristics include age, age squared, earnings, and dummies for education level. Standard errors are clustered at the province level in specifications (1)–(3) and reported in parenthesis, while columns (4) and (5) report Huber–White robust standard errors in parenthesis.

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*$p < .1$; **$p < .05$; ***$p < .01$.

income using the Goldfeld–Quandt test, both of which decisively rejected the null of homoscedasticity at the 0.01 level (results not shown). As a result, we re-estimate our model in Table 4 using feasible generalized least squares (FGLS) where the error variance is proportional to income raised to an unknown exponent that we estimate in a first-stage regression using the OLS residuals. As can be seen, our coefficient of interest, the interaction of unmarried, male, and the sex ratio is fairly constant in size across the two approaches, but estimated much more precisely using FGLS. The estimates now point to statistical significance at the .05 level or better in all five specifications. We thus use the FGLS model approach for the subsequent analyses in Section IV.

As a final robustness check, we examine the sensitivity of our estimation results to alternative measures of the sex ratio. While our primary measure has the distinct advantage of having consistent data for a very large number of prefectures, alternative measures exist which can be used to disaggregate sex ratios by age group instead of those for the entire local populace. For instance, it is possible to calculate age-specific sex ratios for many prefectures using China's National Census from 2010. This can also be done at an aggregated level across all provinces. Because marriage market pressures should only be exerted by the presence of those of marriageable age, it is worthwhile to examine the local sex ratio of these groups specifically.

We reproduce our results using these alternative measures of local sex ratios in Table A2. Columns (1) and (4) reproduce our original OLS and FGLS results for comparison. We present results for the age range 20–49 years because most initial marriages fall within this range. We elect for this range because the legal age of marriage for women in China is 20 years.[7]

7. Reassuringly, the results are also not overly sensitive to this choice. In addition to those presented in the table, we additionally examined multiple windows of age specific sex ratios, ranging from more narrow (20–39) to broader (15–64), and this exercise generally produces results consistent with those in the text—although the magnitude and significance of the estimate coefficient varies slightly from specification to specification.

TABLE 5
Exploring Earnings Heterogeneity

	Dependent Variable: Automobile Sales Price				
	1	**2**	**3**	**4**	**5**
1st quartile (0, 60,000)	1,033***	920***	794***	769***	717**
	(251)	(255)	(241)	(260)	(277)
2nd quartile (60,000, 90,000)	−283	−239	−149	−94	−71
	(322)	(326)	(268)	(266)	(204)
3rd quartile (90,000, 12,000)	710	754*	658	739*	487
	(466)	(404)	(425)	(426)	(288)
4th quartile (12,000, 25,000)	499	550	511	479	954*
	(609)	(513)	(512)	(515)	(538)
Borrower characteristics	N	Y	Y	Y	Y
Prefecture characteristics	N	N	Y	Y	Y
Province fixed effects	N	N	N	Y	Y
Housing price controls	N	N	N	N	Y

Notes: Pooled sample spanning 2009–2011. Expenditures are deflated to real 2010 RMB prices using the CPI. Sample excludes individuals earning in excess of 250,000 RMB per year. Borrower characteristics include age, age squared, earnings, and dummies for education level. FGLS estimates of the triple interaction coefficient from Table 4. Overall sample is 24,133 split into quartiles. Standard errors are clustered at the province level in specifications (1)–(3) and reported in parenthesis, while columns (4) and (5) report Huber–White robust standard errors in parenthesis.

Source: Panels A and B: Authors' calculations using vehicle loan data detailed in Section IV; MPG information obtained from the Ministry of Industry and Information Technology of China (2014). Panel C: Most variables are obtained from China Economic Information Network (CEInet) Statistics Database. Sex ratios are derived from the provincial statistical yearbooks (2011) and mean house prices are obtained from www.elivecity.cn.

*$p < .1$; **$p < .05$; ***$p < .01$.

Results using data we extracted from the 2010 Chinese National Census are presented for the OLS and FGLS regressions in columns (2) and (5).[8,9] In both cases, the magnitude of the effect is slightly smaller, but the sign and significance of the estimated impacts remain consistent. We also reproduce the analysis using the overall provincial age-specific sex ratios obtained from statistical year book data. These are presented in columns (3) and (6). This alternative approach yields slightly larger estimated impacts, but is again consistent with the original results.

IV. EXTENSIONS

A. *Heterogeneous Effects*

Results presented in Tables 3 and 4 suggest a highly significant conspicuous consumption effect, where every one point increase in the sex ratio raises car spending by roughly 450 RMB for unmarried males relative to all other types of individuals. In this subsection, we consider two possible types of heterogeneity in this relationship. The first is heterogeneity across income levels. This is especially important in the context of conspicuous consumption where the positional goods used for signaling may vary for different reference groups and income levels (Chai and Kaus 2012). For example, in our context, it is quite possible that, at very high levels of income, unmarried males use ownership of houses or land to signal their worthiness to potential partners (as demonstrated by Wei and Zhang 2011) while those with lower income levels compete by signaling with relatively lower cost commodities such as automobiles.

To investigate, we split our data in quartiles of income and estimate a separate triple difference FGLS regression within each subgroup. These results are reported in Table 5 and strongly suggest that the use of cars as a signaling mechanism is concentrated primarily in the lower income quartile in our sample. Specifically, we document a highly significant average effect which is roughly 50%–100% larger than our average effect estimated for the full sample. Estimates for the second income quartile are small, negative, and not significantly different from zero. Those for the third and fourth income

8. This is perhaps not surprising as correlations between our population level measure and age-specific sex ratios are quite high (0.84 for the 20- to 49-year-old sample for example).

9. This data source is not available for as many prefectures as could be obtained from the provincial statistical yearbooks, particularly for less populated areas, so we apply the disaggregated age-specific sex ratios of the overarching province when this is unavailable.

TABLE 6
Exploring Regional Sex Ratio Heterogeneity

	Dependent Variable: Automobile Sales Price				
	1	**2**	**3**	**4**	**5**
1st quartile (89.67, 102.74)	−368	305	330	377	651
	(542)	(440)	(418)	(364)	(490)
2nd quartile (102.74, 105.14)	2,098	5,442	6,481*	6,654*	5,015
	(3,640)	(3,526)	(3,487)	(3,465)	(2,990)
3rd quartile (105.14, 107.75)	282	−2,536	−1,491	−1,016	−4,405
	(4,661)	(2,556)	(2,504)	(2,852)	(2,950)
4th quartile (107.75, 132.40)	724***	403**	374**	353**	280
	(189)	(150)	(161)	(147)	(210)
Borrower characteristics	N	Y	Y	Y	Y
Prefecture characteristics	N	N	Y	Y	Y
Province fixed effects	N	N	N	Y	Y
Housing price controls	N	N	N	N	Y

Notes: Pooled sample spanning 2009–2011. Expenditures are deflated to real 2010 RMB prices using the CPI. Sample excludes individuals earning in excess of 250,000 RMB per year. Borrower characteristics include age, age squared, earnings, and dummies for education level. FGLS estimates of the triple interaction coefficient from Table 4. Overall sample is 24,133 split into quartiles. Standard errors are clustered at the province level in specifications (1)–(3) and reported in parenthesis, while columns (4) and (5) report Huber–White robust standard errors in parenthesis.

Source: Panels A and B: Authors' calculations using vehicle loan data detailed in Section IV; MPG information obtained from the Ministry of Industry and Information Technology of China (2014). Panel C: Most variables are obtained from China Economic Information Network (CEInet) Statistics Database. Sex ratios are derived from the provincial statistical yearbooks (2011) and mean house prices are obtained from www.elivecity.cn.

*$p < .1$; **$p < .05$; ***$p < .01$.

quartiles also show effects larger than our full sample estimates, but they are generally not precisely estimated, only occasionally reaching significance at the .10 level.

A second possibility we investigate is that pressure for consumption signaling may vary in a nonlinear manner across regions as a function of the relative shortage of women. For example, it may be that a one unit change in the sex ratio in highly skewed regions may not have the same effect on the consumption pattern of unmarried males in weakly skewed regions only. It could be the case that at relatively balanced sex ratios, the incentive to compete by conspicuous consumption may be attenuated relative to the incentive at higher ratios.

We investigate this case in Table 6 which parcels the sample in quartiles of the sex ratio distribution. It is apparent that robust and precise estimates only appear for the most skewed sex ratio regions. In these regions sex ratios are highly skewed, ranging from 107 to 132 males per female, so it is unsurprising that this would be the subset of prefectures where pressure for consumption signaling is greatest.

Our sample is not large enough to split the data by both sex ratio and income quartiles at once and still precisely estimate the model. At the same time, the results above provide suggestive evidence that it is the relatively poorest males in the regions with the most imbalanced sex ratios that heavily use car purchases as conspicuous consumption to signal to potential marriage partners.

B. Externalities Associated with Conspicuous Consumption

A number of studies have established negative impacts of consumption signaling. This includes diversion of expenditures away from commodities thought to have positive externalities such as education, with particularly detrimental consequences for lower income households (Banerjee and Duflo 2007; Brown et al. 2011; Case et al. 2013; Charles et al. 2009; Kaus 2013; Moav and Neeman 2010, 2012). Other authors have argued that collective action may make conspicuous consumption an unproductive necessity. In other words, to the extent that everyone within a reference group undertakes some expenditure specifically to signal status, the ultimate result can be that individuals engage in a rat race with no net change in local distribution of status (Hopkins and Kornienko 2004).[10] We explore

10. In such a world, there exists a pareto-improvement in which one could reallocate everyone's expenditure away from positional commodities in favor of others which may be desirable on other grounds, but doing so unilaterally is not individually rational, as failing to signal alone would net a relative fall in status.

TABLE 7
Externalities Associated with Luxury Purchases

Dependent Variable	1	2	3	4	5
Fuel efficiency	−0.047***	−0.038***	−0.030***	−0.030***	−0.032**
	(0.014)	(0.012)	(0.010)	(0.010)	(0.013)
Vehicle weight	2.44***	1.67**	1.54**	1.55**	1.76***
	(0.67)	(0.60)	(0.60)	(0.61)	(0.54)
Borrower characteristics	N	Y	Y	Y	Y
Prefecture characteristics	N	N	Y	Y	Y
Province fixed effects	N	N	N	Y	Y
Housing price controls	N	N	N	N	Y

Notes: Pooled sample spanning 2009–2011. Expenditures are deflated to real 2010 RMB prices using the CPI. Sample excludes individuals earning in excess of 250,000 RMB per year. Borrower characteristics include age, age squared, earnings, and dummies for education level. FGLS estimates of the triple interaction coefficient from Table 6 for the fourth quartile of sex ratio. Samples range from 5,703 to 5,973 observations except for column (5) which has 2,337 observations. Standard errors are clustered at the province level in specifications (1)–(3) and reported in parenthesis, while columns (4) and (5) report Huber–White robust standard errors in parenthesis.

Source: Panels A and B: Authors' calculations using vehicle loan data detailed in Section IV; MPG information obtained from the Ministry of Industry and Information Technology of China (2014). Panel C: Most variables are obtained from China Economic Information Network (CEInet) Statistics Database. Sex ratios are derived from the provincial statistical yearbooks (2011) and mean house prices are obtained from www.elivecity.cn.

*$p < .1$; **$p < .05$; ***$p < .01$.

a further potential impact of this behavior—that the expenditure changes may directly generate negative externalities.

Automobiles are a commonly studied commodity which is thought to generate negative externalities due to their impact on air pollution, congestion, and use of natural resources. Some of these can be quantified and measured in a standardized form. For our sample, we compile data on average mileage (in MPG) and weight (in lbs) of all vehicles in our data. MPG should be informative of the impact cars have on both resource use and on pollution, as well as the vehicle's lifetime usage cost. Weight can generate negative externalities, both through its impact on average MPG and through its impact on the severity of car crashes (Anderson and Auffhammer 2014).

To get a sense for how large the impact of these externalities could be, we focus on prefectures in the highest quartile of skewed sex ratio and estimate the FGLS regression as in Table 6.[11] As can be seen from Table 7, cars purchased by unmarried males in the most skewed regions exhibit both lower fuel economy and higher weight. The MPG effect is rather sizeable, with a one unit increase in the sex ratio among the most skewed sex ratio regions being associated with a reduction in fuel efficiency in the range of 0.30–0.47 MPG. This suggests that consumption signaling in this setting may indeed be exacerbating this class of existing negative externalities associated with automobiles. Interestingly, the impact of vehicle weight is not economically meaningful in size with these vehicles being only a few pounds heavier per unit change in the sex ratio.[12] As can be seen in Panel B of Table 1, the standard deviation of weight is pretty low as well, suggesting that cars purchased in China are relatively homogenous in size.

V. CONCLUSION

Using a novel dataset on borrowers in China, we have shown that the increasingly skewed sex ratios in many parts of the country are creating incentives for unmarried men to significantly alter their automobile consumption habits in ways that appear competitive in nature. The effects that we observe are strongest in the quartile of regions with the most unbalanced sex ratios, suggesting that positional spending may yet worsen if the sex ratio continues to deteriorate.

We further demonstrate that the largest expenditure reallocations occur among the poorest quartile of borrowers in our sample. This evidence supports the hypothesis that the range of

11. Estimates obtained from regressions utilizing the full sample are roughly one-fourth to one-half of those for this group in magnitude and are generally less precisely estimated.

12. This suggests that it is possible to signal status through vehicle quality without requiring larger cars to do so.

commodities used to jockey for social status varies across individuals in different portions of the income distribution (or among those facing different peer groups). Beyond the direct social inefficiency that status competition represents, we demonstrate that this behavior also leads to consumption of vehicles with lower vehicle fuel efficiency. Thus, to the extent that China's one child policy has generated incentives which further skewed sex ratios, it may also have exacerbated social status competition. In many areas of the country, unmarried men now appear to compete in a zero-sum game of consumption signaling, one which is capable of generating large negative externalities. Given that there is little reason to suspect that growth in the rate of car ownership in China will slow, conspicuous consumption may become even more important and generate greater aggregate distortions as time passes.

APPENDIX

TABLE A1
Excluding Cities with Ownership Restrictions

	Dependent Variable: Automobile Sales Price				
	1	**2**	**3**	**4**	**5**
Male	36,863.57**	19,449.57	19,755.79	21,077.00	26,956.20**
	(15,905.76)	(15,815.61)	(15,904.49)	(15,675.42)	(12,839.15)
Unmarried	35,602.73**	37,400.47**	34,887.62**	33,604.08**	34,271.76**
	(14,375.00)	(15,525.67)	(14,767.52)	(14,115.36)	(14,243.03)
Sex ratio	1,021.11***	795.33***	822.79***	579.98**	319.05*
	(139.86)	(154.33)	(199.81)	(242.01)	(171.96)
Unmarried × Sex ratio	−440.57***	−479.42***	−454.68***	−442.06***	−445.03***
	(136.90)	(143.60)	(137.31)	(131.49)	(131.59)
Unmarried × Male	−41,921.58**	−40,664.60**	−37,062.16*	−36,903.49*	−37,800.37**
	(17,755.54)	(19,185.87)	(20,038.23)	(19,975.29)	(17,537.81)
Sex ratio × Male	−325.75**	−256.32*	−259.14*	−270.43*	−316.61***
	(144.68)	(143.84)	(144.78)	(142.46)	(113.28)
Sex ratio × Male × Unmarried	398.55**	489.82**	452.68**	449.11**	450.79***
	(171.29)	(179.28)	(188.39)	(188.93)	(157.97)
Borrower characteristics	N	Y	Y	Y	Y
Prefecture characteristics	N	N	Y	Y	Y
Province fixed effects	N	N	N	Y	Y
Housing price controls	N	N	N	N	Y
Mean of dependent variable	1,30,946	1,30,946	1,30,987	1,30,987	1,29,052
Number of observations	23,339	23,339	22,726	22,726	14,135
R^2	0.017	0.135	0.137	0.143	0.149

Notes: FGLS estimates. Sources, sample, and controls as described in Table 4. Standard errors are clustered at the province level in specifications (1)–(3) and reported in parenthesis, while columns (4) and (5) report Huber–White robust standard errors in parenthesis.

*$p < .1$; **$p < .05$; ***$p < .01$.

TABLE A2
Robustness Checks Using Age-Adjusted Sex Ratios

	Dependent Variable: Automobile Sales Price					
	OLS			**FGLS**		
	(1) Prefecture Overall Sex Ratio	**(2) Prefecture 20–49 Years Old**	**(3) Province 20–49 Years Old**	**(4) Prefecture Overall Sex Ratio**	**(5) Prefecture 20–49 Years Old**	**(6) Province 20–49 Years Old**
Male	23,510.13	12205.14	47436.80**	17,966.41	5603.04	46833.12*
	(16,586.20)	(9258.73)	(21707.19)	(14,971.25)	(12751.46)	(27504.62)
Unmarried	37,044.48***	21952.10*	50196.76*	31,942.09**	13150.80	38524.07
	(14,334.04)	(12892.77)	(25494.79)	(13,927.77)	(15338.92)	(25921.52)
Sex ratio	881.22***	554.84***	636.72**	811.81***	431.43**	623.57*
	(196.07)	(150.06)	(284.67)	(186.80)	(159.49)	(333.95)
Unmarried × Sex ratio	−479.39***	−371.67***	−650.53***	−428.42***	−276.51*	−526.14**
	(132.71)	(118.23)	(243.71)		(137.28)	(243.30)
Unmarried × Male	−36,111.73*	−20412.08	−46037.49	−37,304.11*	−18003.06	−43900.51
	(19,243.25)	(14790.56)	(30926.71)	(18,947.05)	(16791.96)	(27191.82)

TABLE A2
Continued

	Dependent Variable: Automobile Sales Price					
	OLS			FGLS		
	(1) Prefecture Overall Sex Ratio	(2) Prefecture 20–49 Years Old	(3) Province 20–49 Years Old	(4) Prefecture Overall Sex Ratio	(5) Prefecture 20–49 Years Old	(6) Province 20–49 Years Old
Sex ratio × Male	−294.39*	−210.69**	−557.01***	−242.67*	−149.08	−552.94**
	(150.44)	(84.75)	(208.30)	(136.29)	(116.64)	(266.17)
Sex ratio × Male × Unmarried	443.55**	322.67**	576.62*	454.43**	294.61*	550.53**
	(180.79)	(137.80)	(299.79)	(178.63)	(155.06)	(262.05)
Borrower characteristics	Y	Y	Y	Y	Y	Y
Prefecture characteristics	Y	Y	Y	Y	Y	Y
Province fixed effects	N	N	N	N	N	N
Housing price controls	N	N	N	N	N	N
Mean of dependent variable	1,30,771	1,30,771	1,30,771	1,30,771	1,30,771	1,30,771
Number of observations	23,520	23,520	23,520	23,520	23,520	23,520
R^2	0.131	0.132	0.107	0.108	0.089	0.089

Notes: Sources and sample as described in Table 2. Borrower characteristics include age, age squared, earnings, and dummies for education level. Prefecture characteristics include income per capita, population, paved road area, buses, and taxis per capita. Standard errors are clustered at the province level and reported in parenthesis. Columns (1) and (4) are copied from column (3) of Table 3 and Table 4 for comparison.

*$p < .1$; **$p < .05$; ***$p < .01$.

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