City Size, Commuting Cost and Household Savings Rate: Evidence from China

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Abstract: *Economics literature has long overlooked an important economic phenomenon: Residents in large cities tend to save a smaller percentage of their disposable income than their peers in small and medium-sized cities. As an explanation for this phenomenon, this paper puts forth the hypothesis that: Residents in large cities purchase more services to increase their leisure time, which is reduced by longer commuting time than in small and medium-sized cities, thus lowering their household savings rate. We conducted an empirical study using panel data of China's prefecture-level cities and urban household survey data, and employed an instrumental variable to address the endogeneity problem. The result confirmed the accuracy of the above hypothesis. In identifying the economic phenomenon and putting forth the hypothesis, this paper (i) creates a theoretical link between city size and household savings rate, which helps unravel the determinants of the urban household savings rate; (2) provides important implications for China's policy-making on domestic consumption, urban populations, and industrial development. Priority should be given to developing large and medium-sized cities given the positive effects on domestic consumption and service sector development, and migrant labor shall not be barred from entering large and medium-sized cities to provide services to local residents.*

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1. Introduction

Two important questions in economics research are: What factors determine the household savings rate? What are the implications of these factors for economic growth? Studies on China's economy made from different perspectives have attempted to explore the factors underlying China's high household savings rate. Based on data on Chinese cities, we found that China's household savings rate is smaller in large cities than it is in small and medium-sized cities. Using aggregated city-level data from the *China Statistical Yearbook for Regional Economy*, we calculated household savings rates in large cities and

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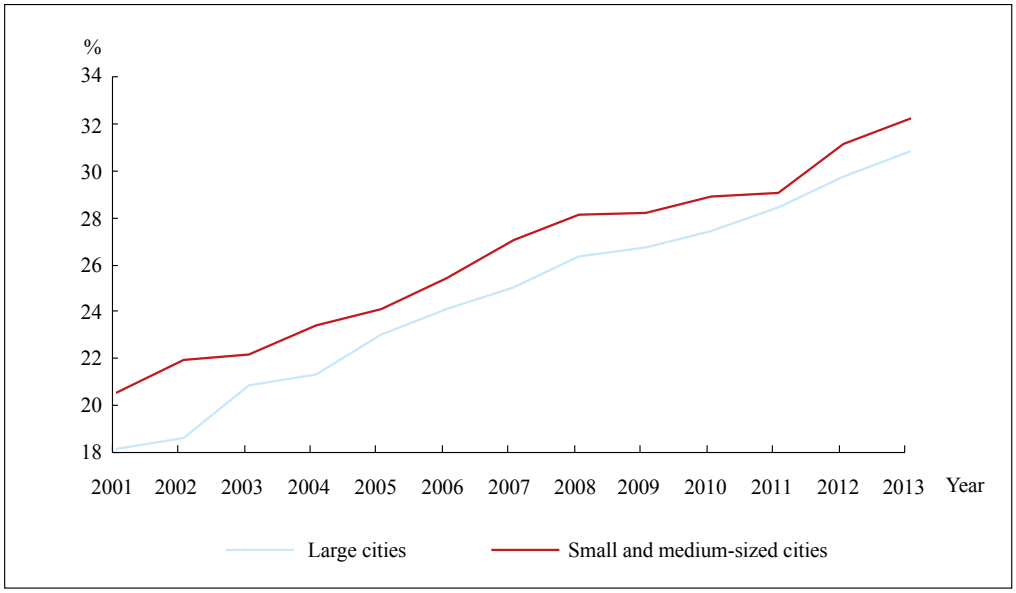

Figure 1: Household Savings Rate in Cities of Different Sizes
Source: Calculated with indicators from the *China Statistical Yearbook for Regional Economy, 2002-2014*.

small and medium-sized cities for the period 2001-2013, and report the results in Figure 1[1]. As can be seen from the chart, household savings rates in cities of all sizes increased during this period, but was always smaller in large cities than in small and medium-sized cities.

Then, we re-calculated the household savings rates in cities of different sizes and urban districts using Urban Household Survey (UHS) data from the National Bureau of Statistics (NBS), and report the results in Figure 2[2]. As can be seen from the chart, the larger the city, the smaller the household savings rate. Also, the household savings rate is significantly higher in non-urban districts than in urban districts. Figures 1-2 reveal an important phenomenon in China's economy, which also exists in other countries. Mendershausen (1940) found that in the 1930s, households in large American cities saved a much lower percentage of their disposable income in comparison to their peers in small and medium-sized cities. He discovered that, on average, the US household savings rate was about 11% in megacities (population above 1.5 million), 17% in large cities (population between 100,000 and 1.5 million), 21% in medium-sized cities (population between 25,000 and 100,000), and roughly 24% in small cities (population between 2,500 and 25,000). Akhtar (1987) also found that in Pakistan the household savings rate was smaller in large cities than in small and medium-sized cities.

As can be seen from the above discussions, there is a negative correlation between the size of the city and the household savings rate in different countries over different periods of time and at various levels of development. Regretfully, this important correlation has been barely noticed in the literature on economics. As we know, households in larger cities earn higher incomes and consume more, but whether their savings rate is higher or lower than that of their peers in smaller cities remains unanswered in the literature.

Most studies explain the determinants of China's household savings rate from such angles as

[1] Household savings rate is calculated by subtracting consumption spending from household disposable income and then dividing by household disposable income; 36 large cities are sampled, including municipalities, provincial capitals, and cities under separate planning.

[2] Household savings rate is calculated in the same manner as Figure 1. We have excluded samples with household savings rates below -2 and greater than 1 to avoid the impact of outliers.

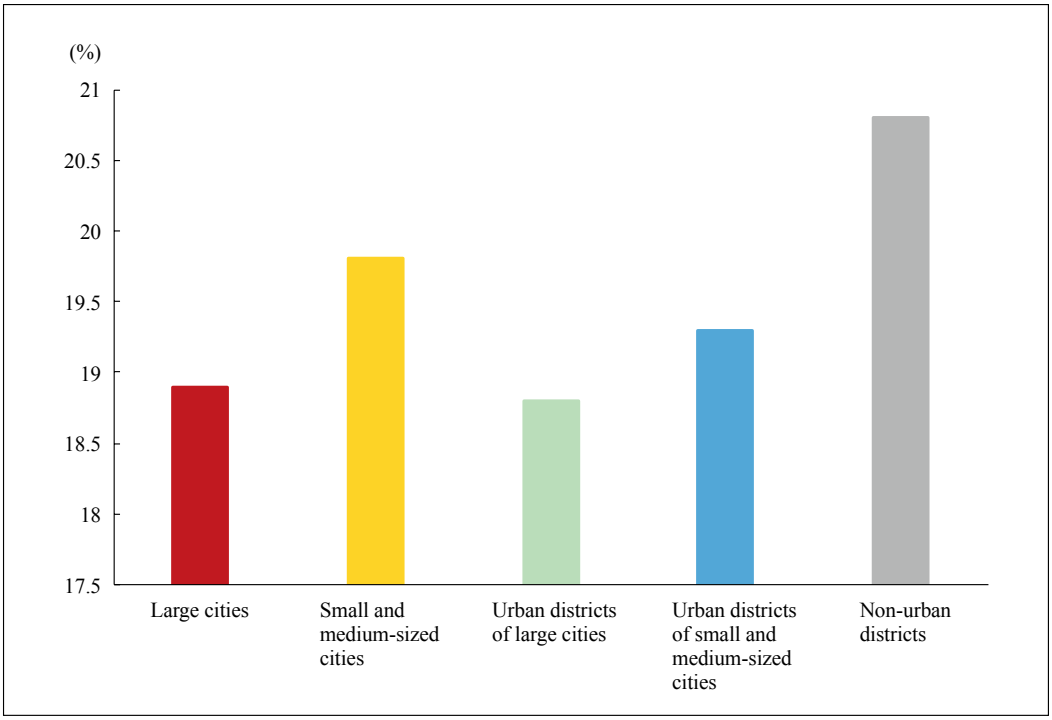

Figure 2: Household Savings Rate in Cities of Different Sizes

Source: Calculated with household samples from 2005 to 2009 in the seven provinces in which the NBS conducted the urban household survey.

demographics and uncertainties. None explain why the urban household savings rate correlates with city size. Studies on agglomeration and urban development consistently discovered that household income and consumption levels are higher in large cities than in small and medium-sized cities, but, based on the existing theories, none could forecast whether the household savings rate would be higher or lower in large cities. This paper fills this void with the following hypothesis to explain why the household savings rate is smaller in large cities: Residents in large cities spend so much more time commuting and less time on leisure that under the same time constraint, they tend to purchase more services to avoid having to do housework in exchange for more leisure time, thus saving a smaller percentage of their incomes. Based on the city panel data and the urban household survey (UHS) from the NBS, this paper conducted an empirical test with the following findings: (i) City size is negatively correlated with the household savings rate. (ii) City size is positively correlated with the level of household spending on services. (iii) Higher commuting cost in large cities drives up household service consumption and lowers the household savings rate.

The rest of this paper is structured as follows: Section 2 Literature Review; Section 3 Theoretical Hypothesis; Section 4 Test of the hypothesis based on the panel data of China's prefecture-level cities; Section 5 tests the hypothesis with urban household survey data. Section 6 reveals the underlying mechanism behind the hypothesis. Section 7 presents the conclusions and policy implications.

2. Literature Review

The correlation between city size and urban household savings rate exists but factors influencing it have yet to be investigated. Mendershausen (1940) discovered that the household

savings rate in the US during the 1930s was smaller in large cities than in small and medium-sized cities. He offered the explanation that residents of small and medium-sized cities were more "thrifty" probably because, despite the higher incomes, in large cities the cost of living was much higher than in small and medium-sized cities. While enjoying more diverse consumer goods, residents of large cities also spend more on consumption for technical reasons, which are not elaborated in his study.

Most existing studies in the field of urban economics that establish a correlation between city size and urban household savings rate are on city size, economic agglomeration, and consumption level. Since Glaeser *et al*. (2001), studies have come to realize that the agglomeration effect of expanding cities will influence both firm behavior and household consumption.After Glaeser *et al*. (2001), numerous scholars started to investigate how the size of a city influences the local consumer market. Waldfogel (2003, 2008), George and Waldfogel (2003), Chen and Rosenthal (2008), and Lee *et al*. (2010) investigated how city size influences broadcasting, newspaper and restaurants, and found a significant increase in the quantity and diversity of local consumption in these sectors as a result of city expansion. Schiff (2015), in his study on restaurants in the US, uncovered that larger cities have a greater variety of restaurants than smaller cities. Berry and Waldfogel (2010) discovered that as cities grow in size there is an increase in the diversity of commodities as well as in the diversity of their quality. Glaeser and Glottlieb (2006) discovered that residents of large cities visit public entertainment venues such as galleries, museums and concert halls, and dine at restaurants more often than residents of smaller cities. Coutune (2016), using US transportation and restaurant data, found that an increase in catering service diversity may increase welfare for local residents by satisfying consumer preferences and reducing the cost of transportation, and that satisfying consumer preference plays a bigger role in increasing welfare for local residents than reducing the cost of transportation does. Murphy (2018) found that in large US cities, residents buy more services to substitute for domestic work. From an agglomeration-induced efficiency point of view, he concluded that in more densely populated large cities where land is costlier, residents will save time and money by buying local services to avoid having to pay for additional space, which housework requires.

Most of the studies on China focus on attempting to uncover the underlying reasons for China's high household savings rate. Yang (2012) and Chen *et al*. (2014) provide a literature review, but most of those studies are from the perspectives of demographic structure and future uncertainties. Based on the "lifecycle hypothesis", studies from a demographic structure perspective identify demographic change, gender ratio imbalance, and increasing life expectancy as key factors that drive China's household savings rate (Modigliani and Cao, 2004; Wei and Zhang, 2011; Liu *et al*., 2012; Yang and Zhang, 2013; Zhou, 2014; Banerjee *et al*., 2014). Studies from an uncertainty point of view consider that Chinese households are motivated to make precautionary savings to provide a buffer against uncertainties with respect to the skyrocketing house price, children's education, healthcare, pension, and other unforeseeable risks (Meng, 2003; Wan *et al*, 2003; Huang and Wu, 2006; He *et al*., 2008; Yi *et al*., 2008; Yang and Chen, 2009; Zhou, 2010; Chamon and Prasad, 2010; Bai *et al*., 2012; Chamon *et al*., 2013; Lei and Zhang, 2013; Chen and Yang, 2013; Zhao *et al*., 2013; He and Shi, 2014; Yi and Yang, 2015; Fan and Liu, 2015; Li and Huang, 2015). In addition, some studies have examined how factors like habits, culture, special experience, and the household registration system influence the household savings rate (Chen, 2005; Hang, 2009; Sun and Huang, 2010; Chen *et al*., 2010; Cheng and Zhang, 2011; Chen and Chen, 2016). Some studies have examined Chinese households' service consumption. Studies on Chinese households' service consumption can be traced back to Becker and Michael's (1973) extension of the household production function, based on which, many empirical studies started to discuss the determinants of household service consumption. Most studies on China's household service consumption have focused on the effects of household income, family structure, and household head attributes on household service consumption (Ma *et al*., 2006; Min *et al*., 2004; Song, 2008). Yang *et al*.'s (2014) study of the relationship between city size and household service consumption is one of the very few studies to

investigate how city-level factors influence household service consumption.

As the above literature review shows, (i) only a few English-language studies have taken note of the correlation between city size and household savings rate; (ii) despite abundant research on China's household savings rate, no study has linked city size with China's urban household savings rate; (iii) while some studies on urban economics have investigated how city size influences the consumer market, none have paid any attention to whether city size also influences the household savings rate. This paper is intended to address this gap in the research, and offer evidence from China.

3. Theoretical Hypothesis

As cities grow larger, commuting time, which varies considerably among cities, becomes a key factor in household decision-making. According to the *Research Report on Road Transportation Development in Large Chinese Cities* released by the Road Transportation Safety Research Center of the Ministry of Public Security, in 2015, Shanghai, with an average commuting time of some 57.6 minutes,,ranked first among the 36 cities, while Lhasa, with a commuting time of 26.8 minutes, ranked last. Compared with small and medium-sized cities, large cities are more vulnerable to traffic congestion. AutoNavi released the rush-hour congestion delay index for some Chinese cities in 2017. Out of 100 cities, the top 15 cities listed in this index, with the longest congestion delay, were large cities. Beijing ranked second. Among the 36 large cities, 31 ranked in the top 50. Figure 3, based on AutoNavi's rush-hour congestion delay index for the top 100 cities, presents a scatter diagram of this index's relationship with the permanent urban population in cities, which has apparently a positive correlation.[3] Regression of

Figure 3: Scatter Diagram of City Size and Rush-hour Congestion Delay Index

Source: The rush-hour congestion delay index is from the *Report on Transportation Analysis for Major Chinese Cities in 2017* released by AutoNavi, and the urban permanent population data is from the *China City Statistical Yearbook* for 2015.

city size with respect to the congestion index shows that a 1% increase in urban population is associated with a roughly 0.08 increase in the rush-hour congestion index.

In this section, we put forth this paper's theoretical hypothesis. Unlike Murphy's (2018) hypothesis that each family allocates one unit of time to a regular job and domestic work, this paper assumes that any employee has to divide his or her 24 hours of time each day into four parts: time for a regular job, time for commuting, time for domestic work such as doing laundry, cooking and taking care of the elderly and children, and time for leisure and rest. Based on the above assumption, we may infer that with other conditions constant, longer commuting time means that residents of large cities have less spare time for leisure. Therefore, residents of large cities tend to buy more services as a substitute for personally doing domestic work and increase their leisure time. Urban households may purchase a wide range of services - particularly catering service – as a substitute for personally doing domestic work and increase their leisure time. In Figure 4, we report urban households' per capita dining expenses in large cities and in small and medium-sized cities. As shown in the chart, per capita spending on dining out is much higher in large cities than in small and medium-sized cities. If samples only from urban districts are taken into account, per capita spending on dining out is significantly higher in large cities than in small and medium-sized cities. This suggests that an increase in city size will motivate China's urban dwellers to buy more services as a substitute for personally doing domestic work. Based on the above analysis, we put forth the following hypothesis: *Compared with residents of small and medium-sized cities, residents of large cities have to spend more time commuting and purchase more services as a substitute for personally doing domestic work to increase their leisure time; more time spent commuting and more leisure time will not increase their income level, but the higher cost of commuting and the purchase of more services will increase household spending, thus driving down the household savings rate in large cities, with other conditions constant.* In this section, we will test the above hypothesis

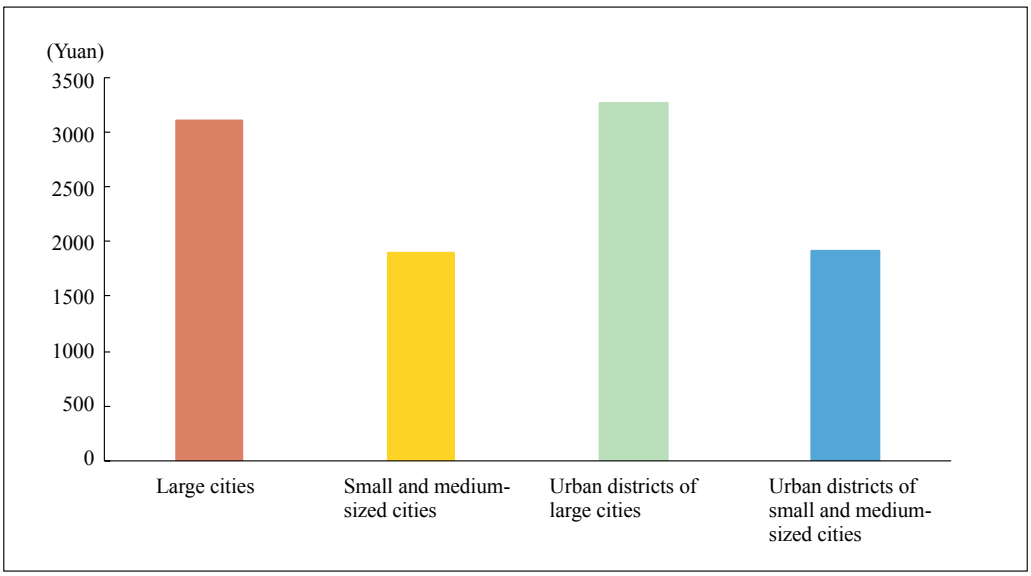

Figure 4: Per Capita Spending on Dining Out in Cities of Different Sizes (yuan)
Data source: Calculated with household samples from seven provinces in the NBS UHS data of 2005-2009.

[3] Since the latest City Statistical Yearbook has yet to publish total population data for the top100 cities in 2017, we replace the missing data with total population in 2015.

and the underlying mechanism with the panel data of China's prefecture-level cities and the NBS urban household survey data, respectively.

4. Empirical Test Based on the Panel Data of Prefecture-Level Cities

4.1 Model Specification and Data Source

Based on panel data of China's prefecture-level cities for the period 2002-2012, we create the following benchmark model to examine the relationship between city size and household savings rate:

$$S_{it}=\alpha_0+\alpha_1 citysize_{it}+\beta Y_{it}+\sigma_t+\delta_i+\varepsilon_{it} \quad (1)$$

Where, dependent variable S is the household savings rate, and Y is other control variables. Referencing common methods for savings rate measurement in the literature, we employ equation (2) to measure urban household savings rate:

$$S1=\frac{\text{Disposable income-Consumption spending}}{\text{Disposable income}} \quad (2)$$

City size is the independent variable. In the benchmark regression, we first employ the total population of urban districts as a proxy for city size, and the built-up area of cities as another proxy in conducting the robustness test. Since our empirical study employs the panel data of prefecture-level cities, we have controlled for the fixed effects of year and city in the regression model.

Referencing the literature on the determinants of household savings rate, the model's control variables include: per capita disposable income, the growth rate of per capita disposable income, the share of employed population,[4] house price,[5] and CPI. These variables are from the China Statistical Yearbook for Regional Economy and the China City Statistical Yearbook. Table 1 shows variable

Table 1: Variable Definitions for Panel Data of Prefecture-level Cities

Variable	Definition
S1	Household savings rate (equation 2)
lnurpop	Total population in urban districts (logarithm)
lnbuild	Urban built-up area (km^2, logarithm)
lninc	Disposable income level of urban households (yuan, logarithm)
growth	Growth rate of urban household disposable income (%)
lnhprice	House price (yuan, logarithm)
workrate	Ratio of employed population
cpi	Consumer price index for urban households
rail_1933	Access to railway in 1933

[4] Since there is no dependency ratio data with a consistent statistical approach in the statistical indicators for prefecture-level cities, we measure demographic structure by the ratio between employed population and permanent population, which is a common practice in many studies (Modigliani and Cao, 2004, et al.). In addition, we have also employed provincial-level dependency ratio for a robustness test, and the conclusion remains unchanged.

[5] Calculated by dividing the commercial housing sales value by sales area in the *China Statistical Yearbook for Regional Economy*.

Table 2: City Size and Household Savings Rate: Benchmark Regression with Prefecture-level Cities' Data

	1	2	3	4	5	6
lnurpop	-0.0214***	-0.0194**	-0.0210**	-0.0210**	-0.0204**	-0.0206**
	(-2.60)	(-2.29)	(-2.51)	(-2.47)	(-2.44)	(-2.47)
lninc		0.0872***	0.0734***	0.0734***	0.0776***	0.0795***
		(6.11)	(4.74)	(4.65)	(4.80)	(4.88)
growth			0.0557***	0.0577***	0.0561***	0.0565***
			(3.26)	(3.02)	(2.93)	(2.94)
lnhprice				0.0092	0.0090	0.0087
				(1.60)	(1.19)	(1.50)
workrate					0.0729**	0.0667**
					(2.28)	(2.08)
cpi						-0.0675
						(-1.58)
year FE	YES	YES	YES	YES	YES	YES
city FE	YES	YES	YES	YES	YES	YES
N	2993	2993	2927	2860	2859	2859
R^2	0.70	0.71	0.71	0.71	0.71	0.71

Note: Numbers in parentheses are t values; *, ** and *** respectively denote significance at 10%, 5% and 1% levels. The same below.

definitions.

4.2 OLS Model Regression

Table 2 reports OLS model regression results based on data of prefecture-level cities. Model 1 only controls for city size and the fixed effects of city and year, which shows a significant negative correlation between city size and household savings rate; such control variables as disposable income level, the growth of disposable income level, house price, the percentage of employed population and CPI are individually included into Models 2-6. After the inclusion, there is still a significant negative correlation between city size and household savings rate: A twofold increase in city size will lead to a 2.1% decrease in the household savings rate.

4.3 2SLS Model Regression

OLS regression results in Table 2 suggest a significant negative correlation between city size and household savings rate. However, endogeneity may exist in the OLS model of city size. For instance, large cities may have infrastructures or cultural contexts unlike those in small and medium-sized cities, which may influence the household savings rate. Such endogeneity reflected in the model is missing variables. Hence, we use an instrumental variable to overcome endogeneity. Referencing Ciccone and Hall (1996) and Zhang and Liu (2008), this paper uses a city's access to the railway in 1933 as an instrumental variable for current city size.[6] We use this instrumental variable for the following reasons:

First, given the railway's effects on the attraction of population and economic activity, cities with access to the railway in 1933 should have grown larger in the present day; second, the construction and the site selection of railway before the founding of the People's Republic of China in 1949 were primarily subject to the level of technology and socio-economic development at that time, and after decades of social and economic transformations, access to railway no longer exerts a direct socio-economic impact on cities today, and therefore meets exogeneity requirements.

With the above instrumental variable, Table 3 reports 2SLS model regression results. First, as can be seen from the first-order regression, among all regression models, whether a city had access to the railway in 1933 has a significantly positive effect on its current city size, and this result is consistent with theoretical expectations. In addition, all F values of the first-order regression are greater than 10, i.e. free from the weak instrumental variable problem.

Second, as can be learned from the regression results in Tables 2 and 3, city size still has a significantly negative effect on the household savings rate, and there is little change in the regression coefficients and the coefficients in the OLS model. That is to say, there is a limited endogeneity problem of city size in the OLS equation of the household saving rate. As expected in our theoretical hypothesis, this result suggests that city size has a significantly negative causal relationship with the urban household

Table 3: City Size and Household Savings Rate: 2SLS Regression for Prefecture-level Cities

	1	2	3	4	5	6
lnurpop	-0.0115***	-0.0225***	-0.0219***	-0.0217***	-0.0217***	-0.0218***
	(-2.92)	(-4.18)	(-4.06)	(-3.30)	(-3.35)	(-3.36)
lninc		0.0595***	0.0570***	0.0638***	0.0640***	0.0669***
		(5.23)	(4.94)	(6.54)	(5.70)	(5.90)
growth			0.0486**	0.0472**	0.0471**	0.0467**
			(2.42)	(2.13)	(2.10)	(2.06)
lnhprice				-0.0048	-0.0047	-0.0053
				(-0.70)	(-0.65)	(-0.74)
workrate					-0.0009	-0.0033
					(-0.04)	(-0.17)
cpi						-0.141*
						(-1.88)
year FE	YES	YES	YES	YES	YES	YES
prov FE	YES	YES	YES	YES	YES	YES
First-order regression results						
rail_1933	0.6700***	0.5220***	0.5230***	0.4400***	0.4500***	0.4480***
	(19.37)	(16.14)	(16.16)	(14.03)	(14.25)	(14.25)
F value	375.01	260.52	261.0	196.88	203.01	202.94
N	1981	1981	1957	1915	1915	1915

[6] Railway data is from the *China Transportation History* written by Bai Shouyi in 1937.

saving rate. In addition, we use the urban built-up area as another proxy for city size, and reached consistent conclusions. With the instrumental variable, a twofold increase in the urban built-up area will lead to a 2.5% decrease in the household saving rate.

5. Empirical Test Based on Urban Household Survey Data

5.1 Model Specification, Data Sources, and Variable Definition and Measurement

This section further employs urban household data to test this paper's theoretical hypothesis with the following motivations: First, differences may exist in savings rate at the macro and micro levels due to inconsistent statistical scopes and calculation methods, and some research conclusions based on the macro level may not hold at the micro-level (Chamon and Prasad, 2010); second, city-level aggregated data cannot reflect savings rate differences among households in the same city; lastly, given the lack of macro data indicators, we cannot test the underlying mechanism behind the theoretical hypothesis with the panel data of cities. Hence, we create the following model:

$$S_{it}=\alpha_0+\alpha_1 citysize_{it}+\beta Y_{it}+\sigma_t+\delta_i+\varepsilon_{it} \quad (3)$$

Where, the dependent variable S is the household savings rate, and Y is the control variables. Referencing the literature on China's household saving rate, the model's control variables include household disposable income, family size, the percentage of workers in a family, whether a household has any elderly person and underage child, whether a household has a son, pension and medical insurance coverage, and the household head's personal attributes, including gender, ethnicity, household registration, age, age square, length of education, and type of job. In addition, we simultaneously control for the fixed effects of year and city, and cluster the standard errors in the regression at the city level.

We still use the total population (*lnurpop*) of the urban districts to measure city size; aside from equation (2) for measuring household savings rate as the explained variable, we create two other household savings rate indicators S2 and S3 for robustness tests. Since most urban residents in China dwell in their own houses, we convert the rents of self-owned housing and included the same into the disposable income (equation 4) referencing Chen and Yang (2013). In calculating S3, we substitute the original consumption spending with basic consumption spending referencing Shen and Xie (2012), and basic consumption spending only includes the most basic daily expenses, excluding non-current daily consumption expenses (equation 5).[7]

$$S2 = \frac{\text{Disposable income + Virtual rent - (Consumption spending + virtual house rent)}}{\text{Disposable income + Virtual house rent}}$$

$$= \frac{\text{Disposable income - Consumption spending}}{\text{Disposable income + Virtual house rent}} \quad (4)$$

$$S3 = \frac{\text{Disposable income - Basic consumption spending}}{\text{Disposable income}} \quad (5)$$

The micro-level data employed in this section is the observations of 69,434 urban households in seven provinces in the NBS urban household survey (UHS) of 2005-2009. See Table 4 for the definitions of all variables in the subsequent empirical studies.

[7] Basic consumption spending = Consumption spending - Spending on durable goods - Spending on the means of transportation - Spending on the means of communication - Spending on education, entertainment and culture - Spending on decoration - Miscellaneous expenses

Table 4: Definitions of Household-level Variables

Variable	Variable definition
S1	Household savings rate 1 (equation 2)
S2	Household savings rate 2 (equation 4)
S3	Household savings rate 3 (equation 5)
lninc	Household disposable income (logarithm)
num	Family size
workrate	Working persons as a share of total household members
an	Pension insurance coverage
medc	Medical insurance coverage
age	Age of household head
ages	Square of household head age
female	Gender of household head
minor	Ethnicity of household head
regist	Type of household head's household registration
edu	Length of household head's education
job	Occupation of household head (virtual variable)
lnhprice	House price (logarithm) (yuan)
old	Whether a household has any elderly person
child	Whether a household has any underage child
boy	Whether a household has a son
comcost	Commuting cost
Serrate1	Service consumption as a share of disposable income 1
Serrate2	Service consumption as a share of disposable income 2

5.2 OLS Model Regression

Table 5 first reports OLS model regression results. Model 1 only controls for the city size, year and city fixed effects, and the result still shows a significantly negative correlation between city size and household savings rate, i.e. a twofold increase in city size will lead to a 3.1% decrease in the household savings rate. As Models 2-5 gradually include other control variables, the negative correlation between city size and household savings rate remains significant. Take Model 5 for instance, a twofold increase in city size will lead to a roughly 3.8% decrease in the household savings rate.

5.3 Treatment of Endogeneity Problem

The potential endogeneity problem also faces the OLS model for household savings rate. For instance, households preferring daily conveniences tend to live in large cities. To address this problem, we have limited samples to households headed by locals. We have included the question "When did you come to live in the city/town" in UHS data. We define household heads who have lived in the city for more than five years and obtained local urban household registration as locals, and used such subsamples

Table 5: City Size and Household Savings Rate: Benchmark Regression with Household-level Data

	1	2	3	4	5
lnurpop	-0.0313**	-0.0244*	-0.0278**	-0.0291**	-0.0379***
	(-2.40)	(-1.78)	(-2.11)	(-2.42)	(-2.81)
lninc		0.1690***	0.1750***	0.1660***	0.1760***
		(27.42)	(28.32)	(26.76)	(26.32)
Household head attribute	NO	NO	YES	YES	YES
Household attribute	NO	NO	NO	YES	YES
Insurance and house price	NO	NO	NO	NO	YES
year FE	YES	YES	YES	YES	YES
city FE	YES	YES	YES	YES	YES
N	62,462	62,462	62,462	61,962	59,310
R^2	0.02	0.12	0.13	0.14	0.15

Table 6: Treatment of Endogeneity

	1	2	3	4	5
lnurpop	-0.0231	-0.0281**	-0.0285**	-0.0289**	-0.0377***
	(-1.64)	(-2.46)	(-2.15)	(-2.43)	(-2.74)
lninc		0.1720***	0.1770***	0.1690***	0.1780***
		(26.95)	(27.64)	(25.72)	(25.08)
Household head's attributes	NO	NO	YES	YES	YES
Household attributes	NO	NO	NO	YES	YES
Insurance and house price	NO	NO	NO	NO	YES
year FE	YES	YES	YES	YES	YES
city FE	YES	YES	YES	YES	YES
N	59,632	59,632	59,632	59,160	56,637
R^2	0.02	0.12	0.13	0.14	0.15

for conducting the above-mentioned regression, with results shown in Table 6.

As can be seen from Models 2-5, the significant negative correlation between city size and household saving rate remains after the exclusion of the immigration factor, and there is little change in the regression coefficient, which indicates a limited impact of the self-selection endogeneity problem. With the self-selection problem of households taken into account, city size still has a significantly negative effect on the household saving rate. In addition, we have also employed the instrumental

variable of whether a city had access to the railway in 1933 for a 2SLS regression, but still find a significantly negative correlation between them.

5.4 Robustness Test

We have conducted a host of robustness tests on the above results. For instance, we have employed S2 and S3 as explained variables, urban built-up area, and the dummy variable of whether a city is a large city to measure city size, removed household samples with negative savings rate, and removed household samples from municipalities, provincial capitals, and cities under separate planning. After these interventions, the conclusions remain robust.

6. Mechanism Test: Commuting Cost and Service Consumption

In this section, we continue to use urban household data to test the underlying mechanism behind this paper's hypothesis: Whether residents of large cities spend more on commuting and services that drive down their savings rate. Before conducting the empirical analysis, we first determine the measurement of commuting time or commuting cost and service consumption.

6.1 Measurement of Commuting Cost

In the UHS data, there is no indicator that directly measures commuting time for urban households. Hence, we employ household spending on commuting as a proxy variable for commuting cost.[8] Urban households commute mainly by public or private means of transportation. Hence, the commuting cost for urban households is measured by the sum spent on municipal public transportation and private vehicle fuel consumption.[9] The following equation measures the household per-worker commuting cost (comcost):

$$\text{Commuting cost} = \frac{\text{Spending on municipal public transport} + \text{Spending on private vehicle fuel consumption}}{\text{Total employed persons}} \quad (6)$$

In the following empirical analysis, we employ the logarithm of the above household per-worker commuting cost as the proxy variable for the household commuting cost.

6.2 Definition and Measurement of Service Consumption

Now, we create an indicator of service consumption. In the UHS data, service consumption refers to cultural and consumer services purchased by households, which includes all non-commodity consumption. In this paper's hypothesis, service consumption refers to services that can be performed by households themselves such as cooking, doing laundry and caring for children, and excludes services that households cannot perform such as healthcare, culture and entertainment. Based on this paper's hypothesis, we create a new approach to service consumption 1:

Service consumption 1 = Food processing cost + Expenses for dining out × 50% + Clothing cost + Household service fee + Taxi fee + Nursery fee + Home tutoring fee + School boarding fee + Decoration expenses × 40% + Residential service fee (7)

Given the heterogeneity of households and cities, however, we find it hard to create a very precise

[8] At a given price of the means of public transportation, more commuting expenses means longer commuting distance and time; when the cost of the private means of transportation (fuel price) is given, more spending on fuel consumption means longer commuting distance and time. Hence, commuting expenses can be used as a proxy variable for commuting time. In addition, we will conduct a robustness test with the variable of average commuting time in prefecture-level cities in 2010 obtained from another survey.

[9] Spending on municipal public transportation is defined as the ticket fees for family members travelling by municipal public transportation such as bus, subway and light rail. Vehicle fuel expenses include gasoline, diesel, lubricant, battery and battery recharging fees for private vehicles.

scope of services that households may purchase to increase their leisure time. To ensure the reliability of this paper's conclusions, we create a more stringent service consumption 2 for a robustness test:

Service consumption 2 = Expenses for dining out × 50% + Domestic service expenses + Nursery and home tutoring fees + School boarding fee (8)

In "Service consumption 2", we have only retained dining out, domestic service and caring for children since these services are the most basic and can be performed by any household. The purchase of these services thus best reflects the purpose of increasing leisure time as stressed in this paper.

In the following empirical analysis, we measure the level of urban household service consumption by the above-mentioned service consumption as a share of household disposable income (Serrate).

6.3 Mechanism Test: Commuting Cost and Service Consumption

We first examine the effect of city size on household per-worker commuting cost, and create the following model:

$$Comcost_{it} = \alpha_0 + \alpha_1 citysize_{it} + \beta Y_{it} + \sigma_t + \delta_i + \varepsilon_{it} \quad (9)$$

Where, the dependent variable is household per-worker commuting cost, and Y is other control variables, which are defined in Table 5. In addition, we have controlled for the fixed effect of year and city. Table 7 reports the OLS model's regression results, and Model 1 only controls for city size. Obviously, there is a significantly positive correlation between city size and household commuting cost. Then, Models 2-5 gradually include household-level control variables and the fixed effects of city and year, and find that the larger the size of the city, the longer the commuting time will be.

In this section, we test the effects of commuting costs on household service consumption. We use service consumption as a share of household disposable income measured by equations (7) and (8) as the explained variable. Table 8 reports the results of the regression of household per-worker commuting cost with respect to the share of service consumption. In the first three models, the explained variable is service consumption of the first statistical scope, from which it can be seen that the regression

Table 7: Mechanism Test: City Size and Household Commuting Cost

	1	2	3	4	5
lnurpop	0.4230***	0.3020***	0.3090***	0.2560***	0.1590*
	(48.33)	(37.37)	(38.77)	(28.73)	(1.67)
lninc		0.9940***	1.1370***	1.0820***	0.8930***
		(87.02)	(94.31)	(82.56)	(64.22)
Household head attribute	NO	NO	YES	YES	YES
Household attribute	NO	NO	NO	YES	YES
Insurance and house price	NO	NO	NO	NO	YES
year FE	NO	NO	NO	NO	YES
city FE	NO	NO	NO	NO	YES
N	54428	54428	54428	52210	52210
R^2	0.04	0.21	0.24	0.25	0.35

Table 8: Mechanism Test: Commuting Cost and the Share of Service Consumption (OLS model)

	Serrate1			Serrate2		
	1	2	3	1	2	3
comcost	0.0064***	0.0039***	0.0042***	0.0048***	0.0030***	0.0030***
	(46.10)	(24.10)	(23.53)	(47.34)	(25.66)	(23.75)
lninc		0.0016***	0.0006		-0.0010**	-0.0021***
		(2.93)	(1.00)		(-2.54)	(-5.05)
Control variable	NO	YES	YES	NO	YES	YES
year FE	NO	NO	YES	NO	NO	YES
city FE	NO	NO	YES	NO	NO	YES
N	60262	57600	57600	60273	57609	57609
R^2	0.04	0.07	0.09	0.04	0.10	0.13

coefficient of the commuting cost is positive no matter whether controlling only fot the commuting cost or including household-level control variables and the fixed effects of city and year. In the latter three models, the explained variable is service consumption of the second statistical scope, from which we can still see a significant positive correlation between commuting cost and household purchase of services. This result is identical to the mechanism revealed by the hypothesis.[10] Moreover, we have also tested whether the rising commuting costs will affect another consumption expense of local residents. After conducting a regression of various household consumption expenses as a share of household disposable income with respect to region-level average commuting cost, the result suggests that commuting cost exerts no significant impact on most consumption expenses. That is to say, commuting cost influences the household savings rate mainly through service consumption.

6.4 Robustness Test: Working Hours and Overtime Work

This paper's hypothesis assumes the same working hours for employees across regions without the possibility of raising income by working overtime. Yet, in reality, there can be differences in working hours across different cities. For instance, we can observe the widespread overtime hours for start-ups in large cities. Hence, there may be a correlation between commuting cost and working hours and overtime hours, and whether employees have to work overtime will affect household decisions to purchase services. Therefore, the endogeneity of missing variables may arise if working hours are not controlled for. To address this problem, we conducted a regression of subsamples where household heads and/or their spouse's work at state-owned entities for the following reasons: First, in most cases, only private and individual businesses will require employees to work overtime, and working hours at state-owned entities are roughly consistent across cities of different sizes. Hence, this subsample regression is equivalent to controlling for working hours or the question of overtime work. Table 9 reports the results of the OLS regression based on the subsamples, which shows a significant positive correlation between household per-worker commuting cost and household service consumption. By comparing the regression results of Table 8 and Table 9, it can be found that limiting the regression samples to households with

[10] We conducted a regression with regional average commuting cost as an independent variable, and the conclusions were the same.

Table 9: Commuting Cost and the Share of Service Consumption: Subsample Regression

	Household head works at a state-owned entity		Both household head and spouse work at a state-owned entity	
	serrate1	serrate2	serrate1	serrate2
comcost	0.0041***	0.0030***	0.0038***	0.0030***
	(13.87)	(14.62)	(8.79)	(10.75)
Control variable	YES	YES	YES	YES
year FE	YES	YES	YES	YES
city FE	YES	YES	YES	YES
prov FE	YES	YES	YES	YES
N	22583	22583	10133	10133
R^2	0.08	0.11	0.08	0.11

family members working at state-owned entities does not significantly change the size of the regression coefficient. Hence, the difference in working hours or the practice of working overtime will not change this paper's hypothesis and research conclusions.

7. Conclusions and Policy Implications

This paper identifies an important yet long-overlooked economic phenomenon: Residents of large cities tend to save a smaller percentage of their disposable income compared with their peers in small and medium-sized cities. Then, a hypothesis is offered from a commuting cost perspective to explain this phenomenon: Longer commuting time has shortened leisure time for residents of large cities, prompting them to purchase more services to substitute for personally doing housework such as doing laundry, cooking, and caring for children. Money spent on domestic services will drive down their savings rate. Then, we conducted an empirical study with data from China, and used an instrumental variable to address the endogeneity problem. Empirical results suggest that: (i) City size has a negative impact on the household savings rate. Research with prefecture-level cities' data reveals that a twofold increase in city size will lead to a roughly 2.2% decrease in the household savings rate. Research with microscopic urban household data discovers that a twofold increase in city size will lead to a roughly 3.8% decrease in the household savings rate. (ii) Research with urban household data reveals that residents of large cities spend more time and money commuting, which significantly increases household service consumption and reduces the household savings rate.

This paper offers the following contributions: First, this paper's hypothesis creates an intrinsic correlation between city size and household savings rate, and explains the underlying mechanisms. Second, this paper's hypothesis and empirical results uncover the determinants of the differences in the household savings rate between households in large cities and those in small and medium-sized cities. Future studies may further explore differences in savings rate in cities of different sizes from new perspectives. Third, this paper provides a new perspective for unraveling the determinants of China's urban household savings rate. This paper's conclusions also provide important implications for China's policy-making on domestic consumption, urban populations, and industrial development. Since larger cities will boost household service consumption, policymakers should encourage the development of

large and medium-sized cities and further relax various restrictions on the migration of rural workers to cities, with a view to satisfying the household demand for service consumption in large and medium-sized cities, spur domestic consumption, deepen service specialization, and promote the development of the urban service sector.

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