



Effects of Rail Transit Proximity on Commuter's Co2 Emission in Suburban Area of Shanghai

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1. Introduction

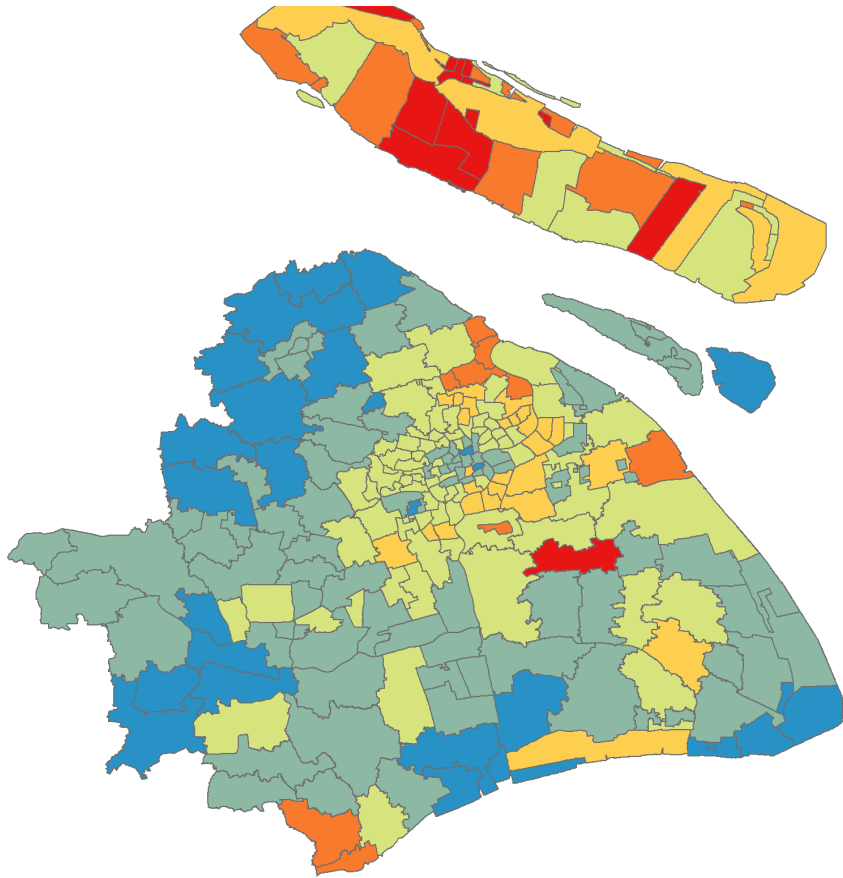
Urban Expansion Motorization and Environment



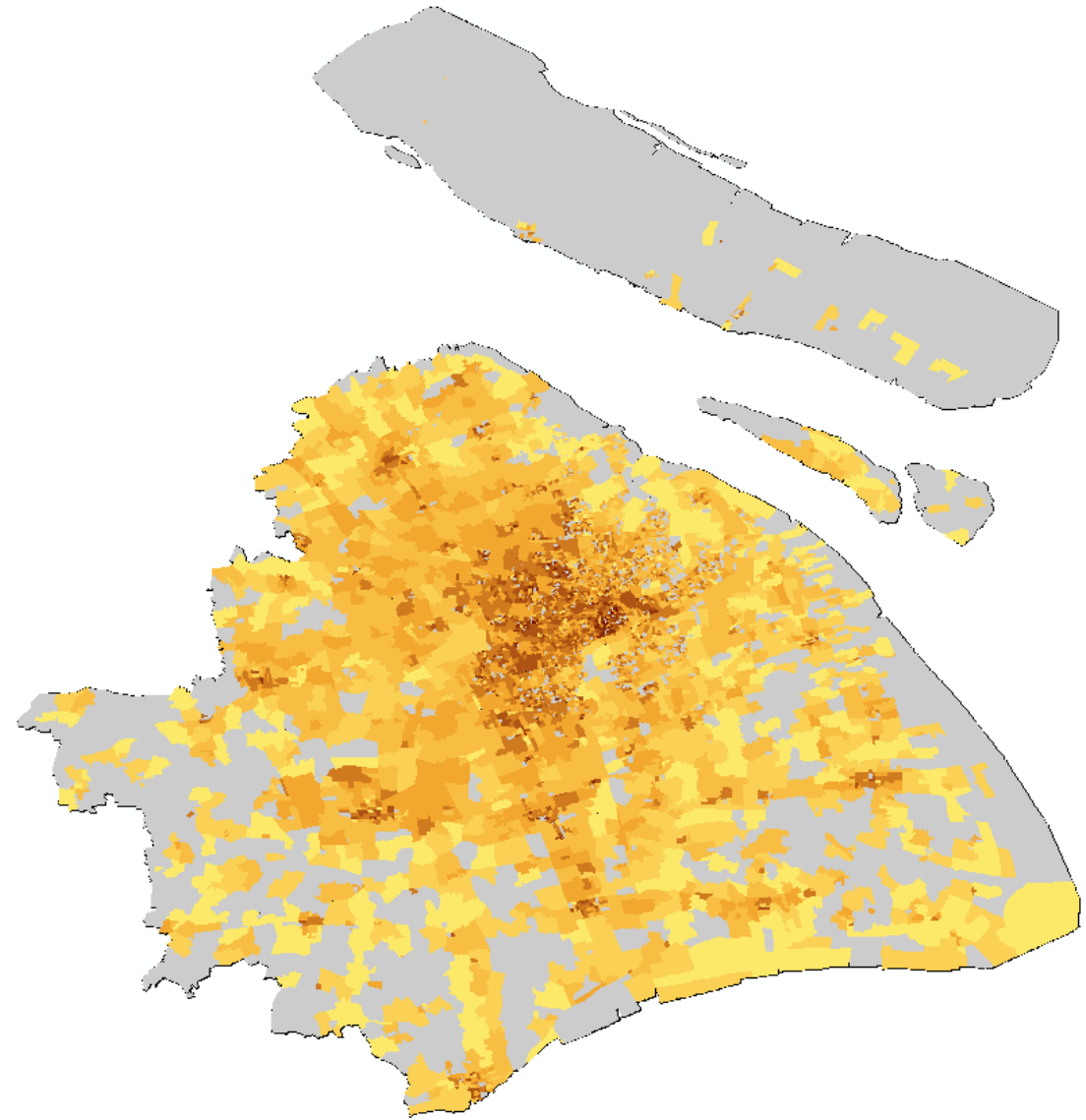
1989: 13 Million



2013: 24 Million

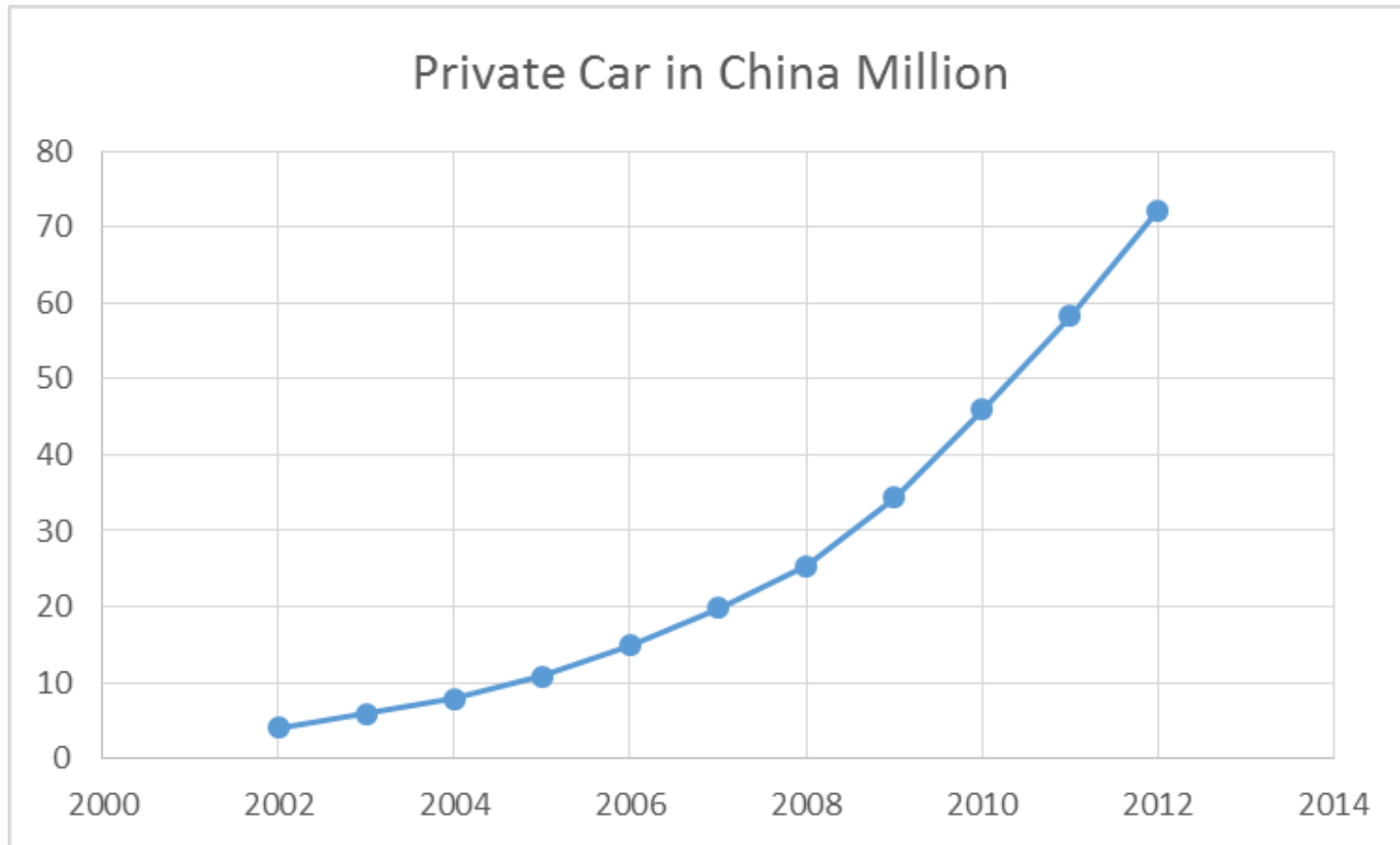


Average Commuting Travel Distance



Job Distribution

Motorization, In Mega City 80% pollution from Vehicle



2. Policy Response

**Sustainable Development must be the Key National Strategy in China
in middle 90's**

Meanwhile Car Industry Promotion Strategy

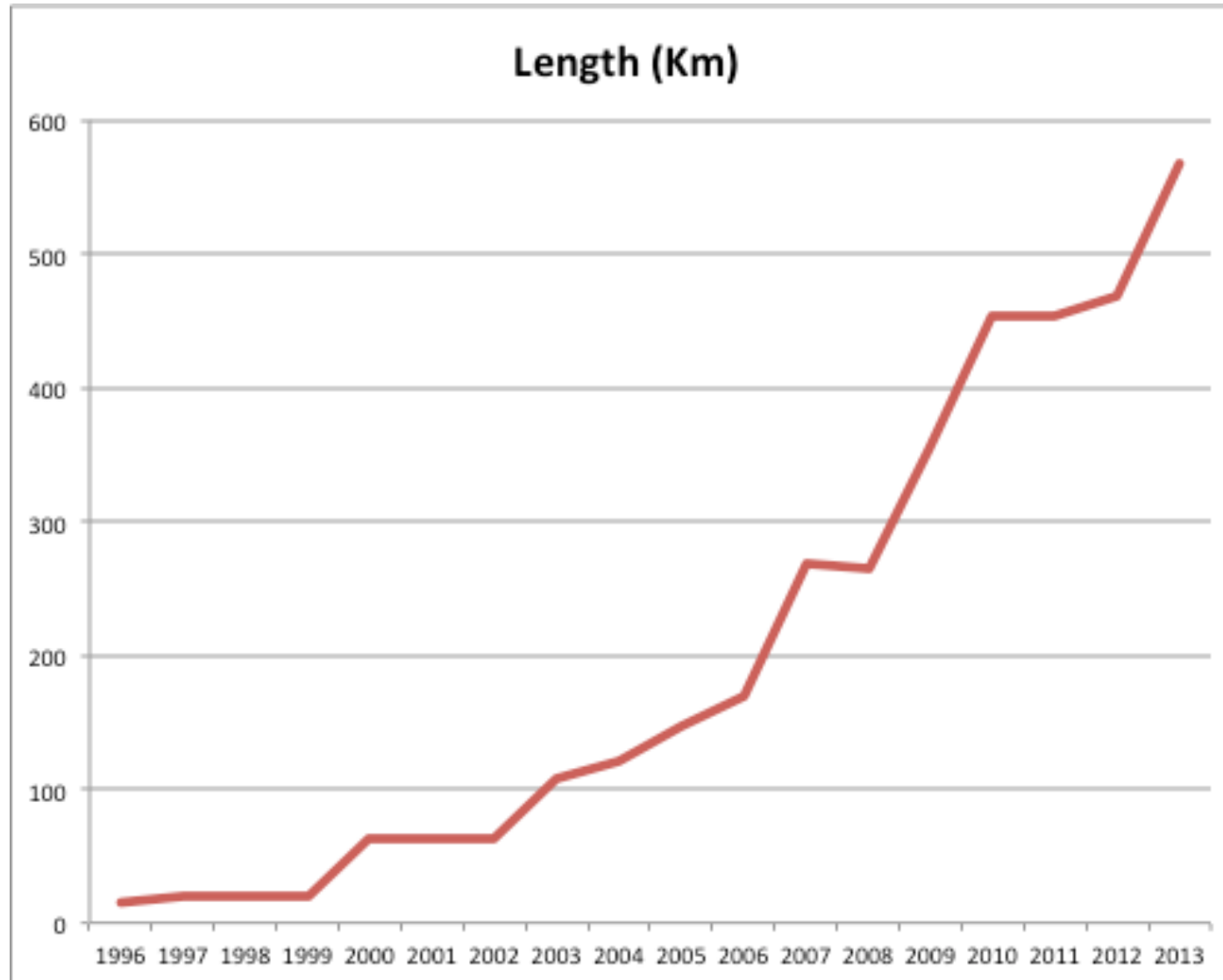
Environment Friendly and Resource Saving Society – in Middle 00's

**2010 Shanghai World Expo– Living Show Case of Public Transport, Especially
Metro, one million people more in the already congested area --Pull**

Congestion and Pollution-- Push

- **Public Transport Priority Policy Issued by State Council 2012-12**
- **Car ownership Control : Shanghai, Beijing, Guangzhou, Hangzhou**
- **Parking Fee Increasing**
- **Public Transport Transfer Discount**
- **Walking and Bike Transport Planning Guideline , Ministry of Housing and Construction**
- **Large Scale Metro Network Construction**

Metro Network Size in Shanghai



Research Intention:

Comparing Commuting Co2 Emission in Areas with Good/Poor Metro or PB Service and the influence of

- **Demographic**
- **Public Transport Service Level**
- **Density**
- **Car Ownership**
- **Income**

3. Emission Estimation and Literature

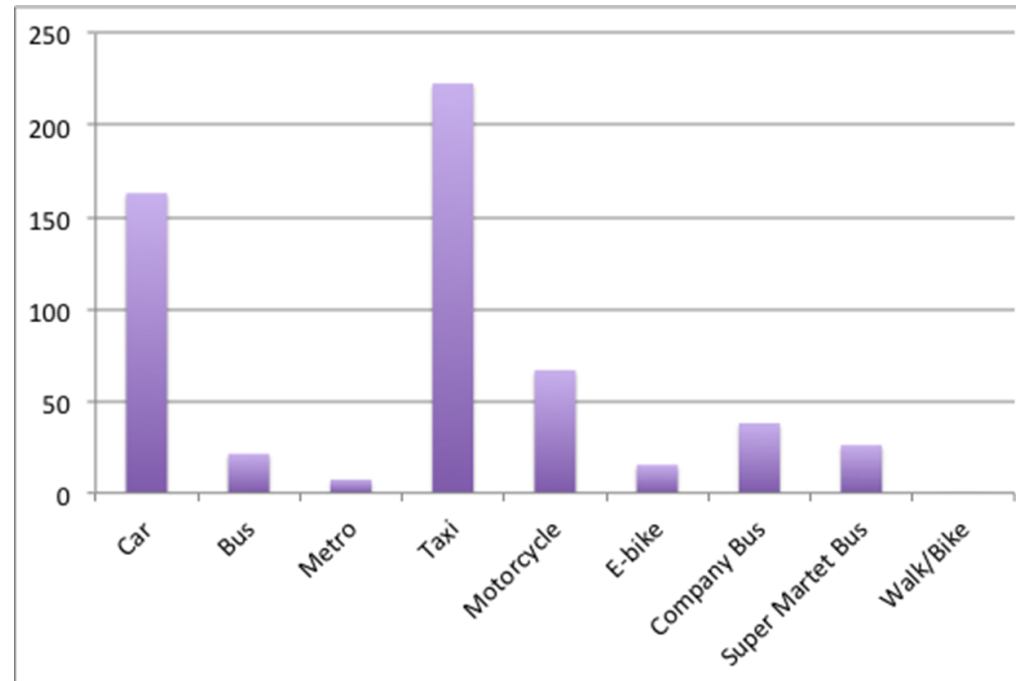
Co2 Emission M_i by Travel Mode i

$$M_i = D_i \times E_i$$

D_i Travel distance -km

E_i Emission factor-g/pkm

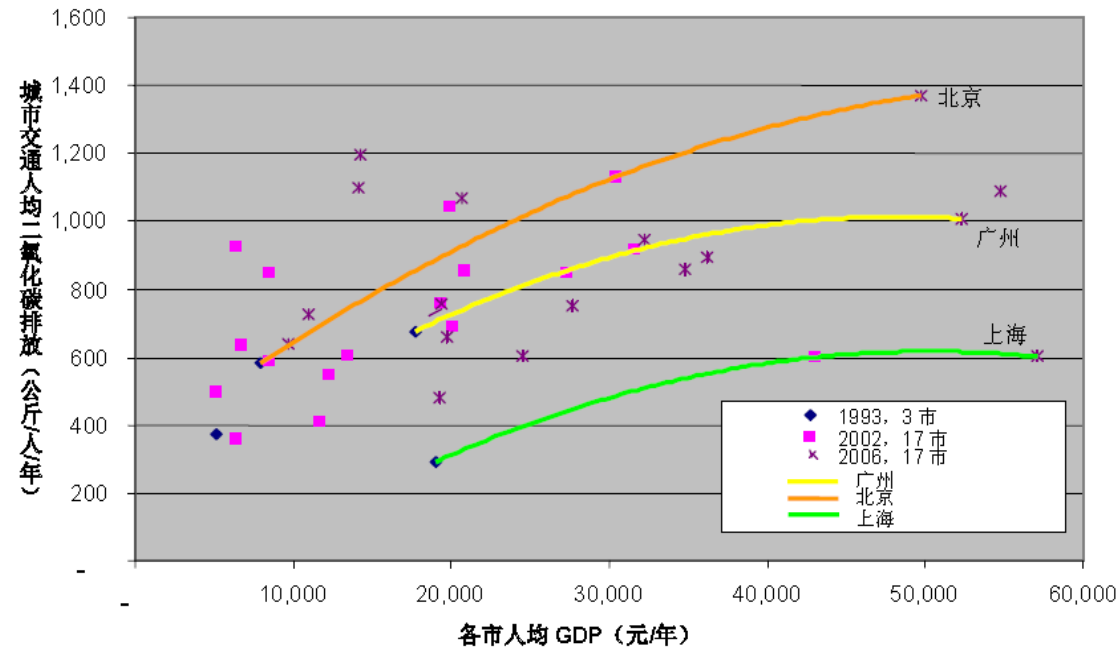
Calculation Based on Shanghai Travel Survey in 2009 and other Sources



Economic Demographic

More Car, More Emission , Jean-Pierre Nicolas et al. 2009; Christian Brand et al. 2010; Petter Naess,2010;Christian Brand et al. 2013

High Income, High Emission, but big Variation



Travel Mode

Because of Car Ownership Control and Slow Modes, Co2 Emission in Shanghai is less than in Beijing, Zhu Lisong(2008)

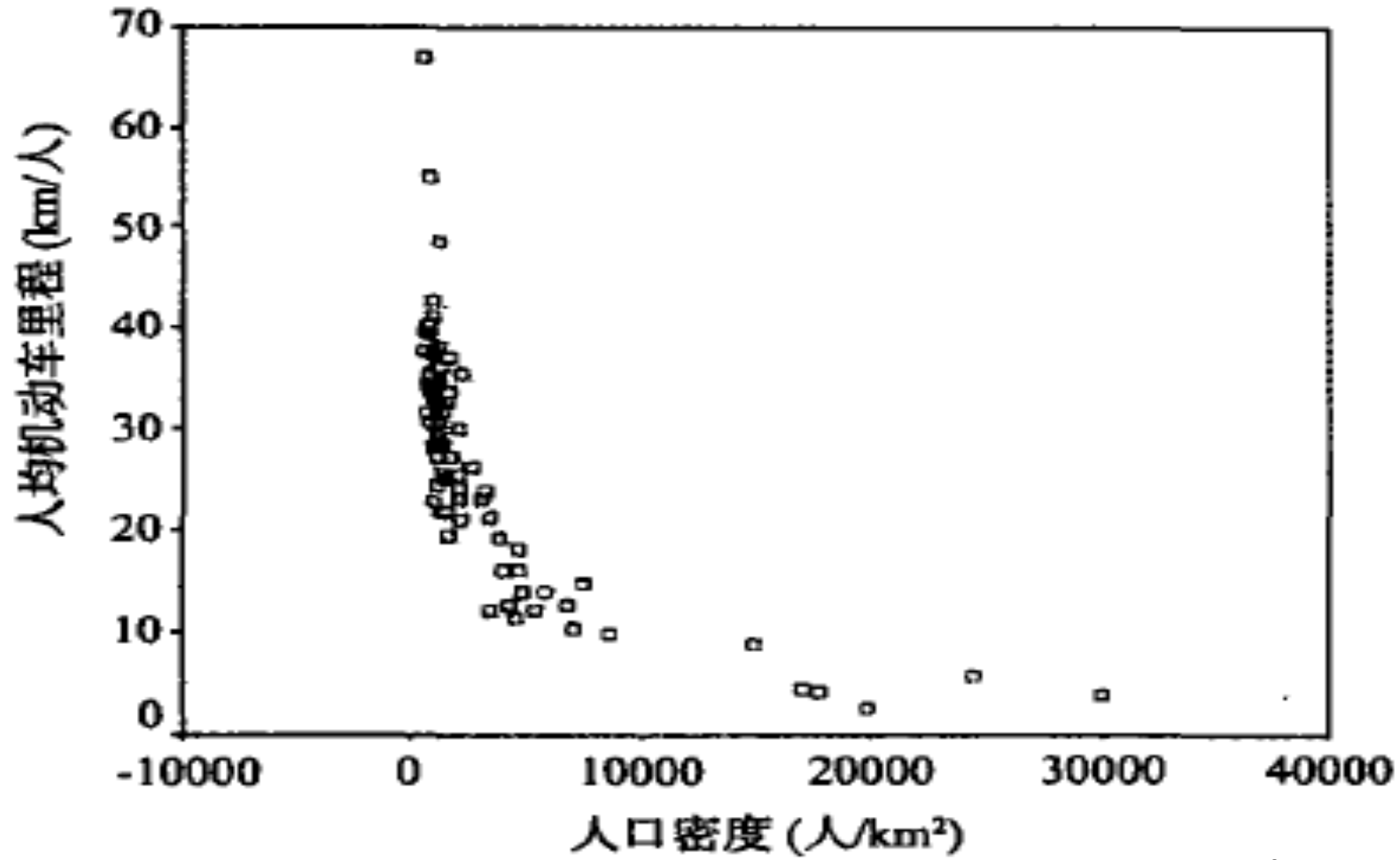
Public Transport Service

Try to attract Car Passenger, but Quite High Share of Public Transport Passenger Shifted from Slow Modes

Built Environment

Density and VMT

VMT



Pop Density

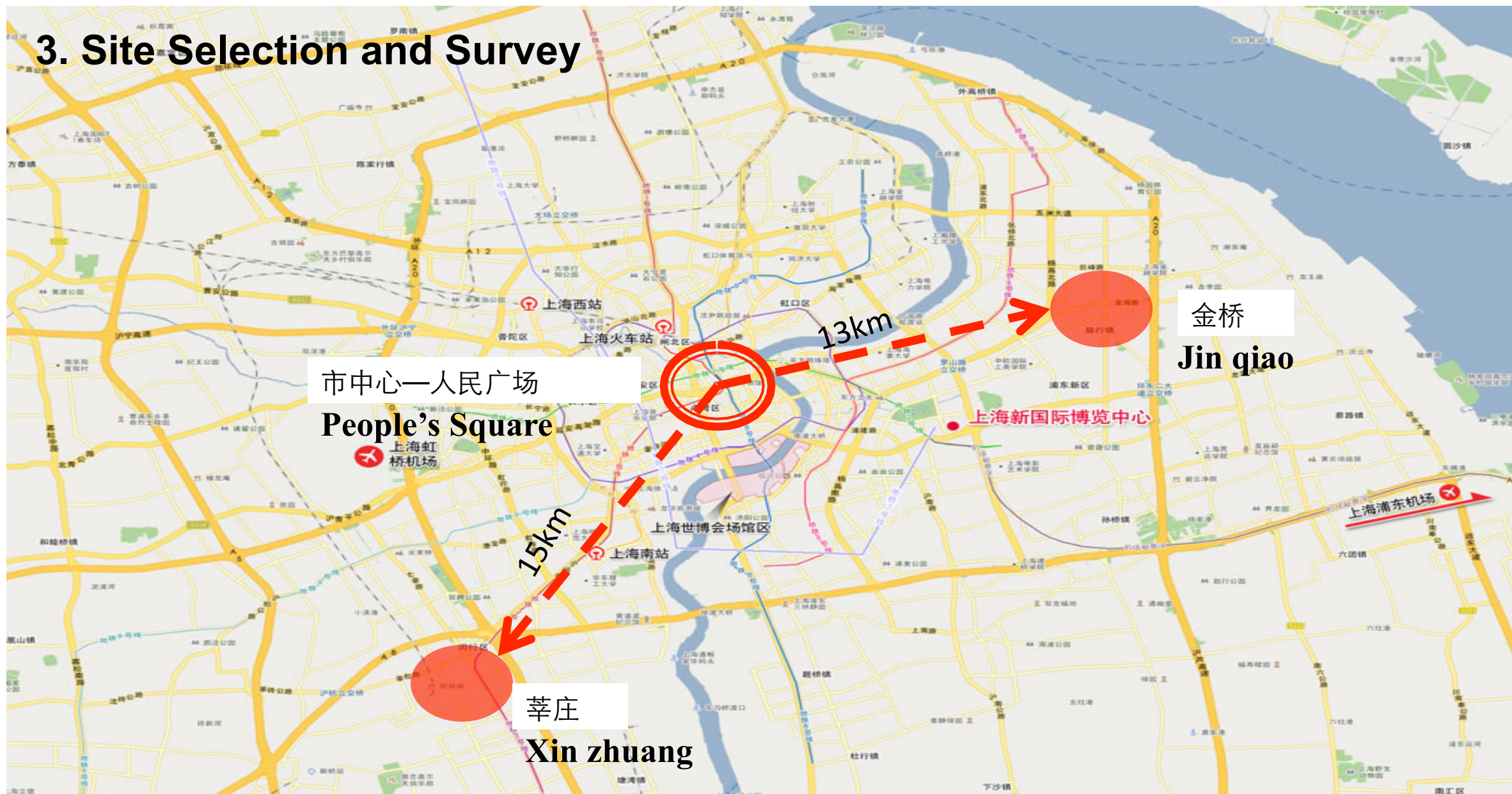
Some Studies Show Density only has Little Impact on Co2 Emission

Only 4.8% Difference in VMT Comparing High Density and Low Density Household, Brownstone

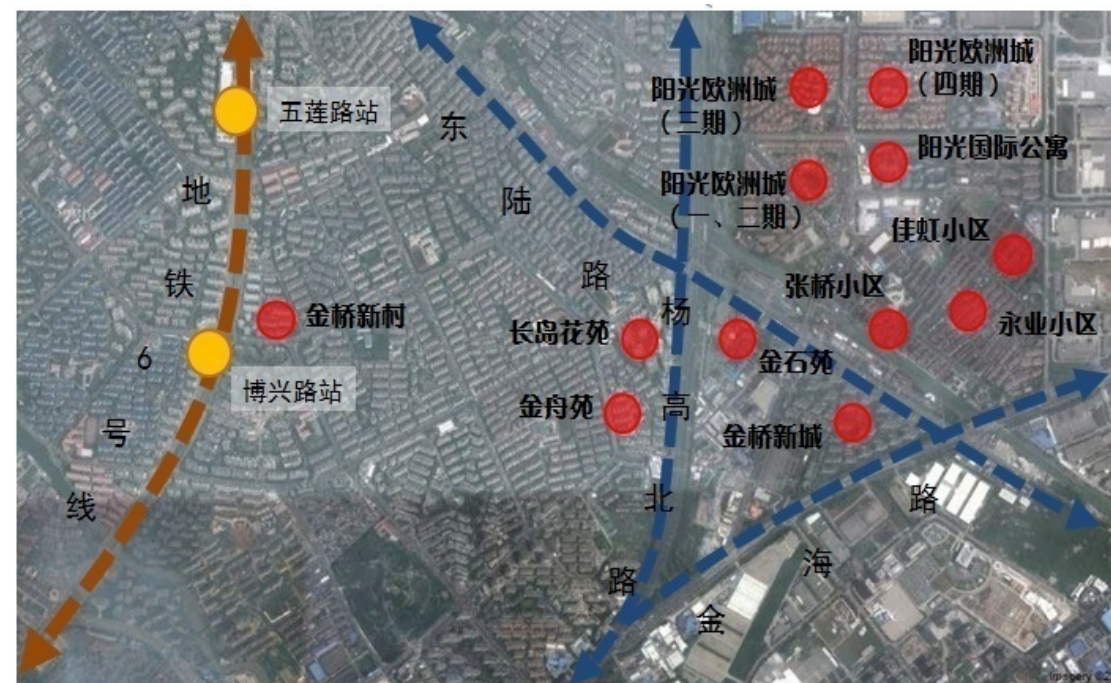
Land Use Mix

Reduce Car Use, Reduce VMT (Cervero, Frank&Pivo, Kockelman, Pan, Shen & Zhang)

3. Site Selection and Survey

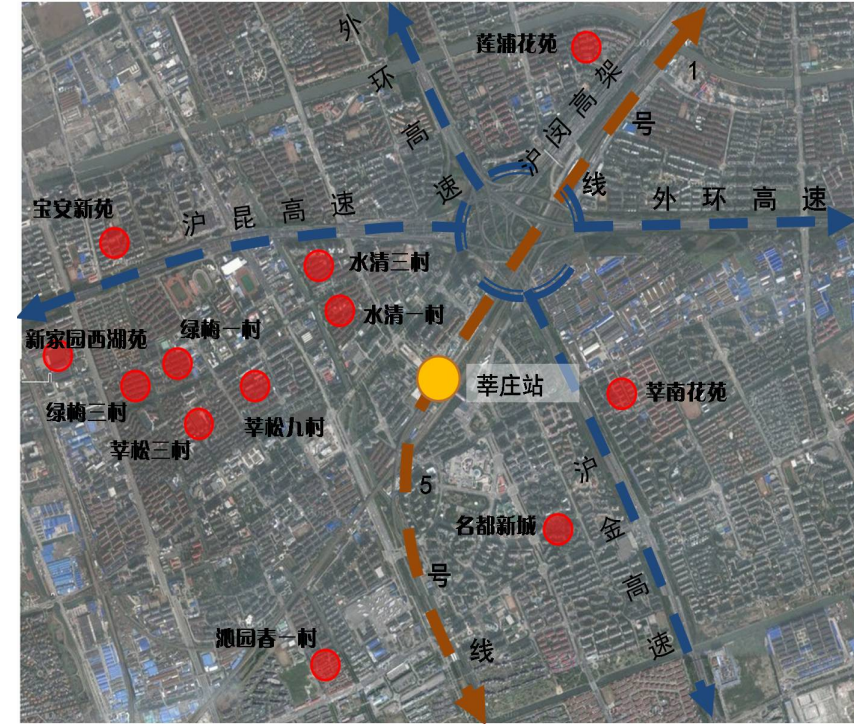


600 Households , 992 people with job, 983 valid, 2011-4



Jinqiao Site, Metro Line 6, Opened 2007

300 Households , 419 people with Job, 410 valid 2010-12



Xinzhuang, Metro Line 1, Opened 1996

- **Travel Distance : Based on shortest Distance Between Road Intersections**
- **For Bus + Metro Combination , Baidu Map, Manually and Shortest Time Route**



1

85路 → 地铁4号线

▲

约1小时40分钟 / 26.3公里

起

长岛路东陆路

发送到手机

★

🖨️

🚶

步行至 [长岛路东陆路站](#)

50米

🚌

乘坐 [85路](#), 在 [浦东大道钱仓路站](#) 下车

16站

🚶

步行至 [浦东大道站](#)

110米

🚇

乘坐 [地铁4号线\(宜山路\)方向](#)(或 [地铁4号线\(宜山路\)方向](#)), 在 [金沙江路站](#) 下车

10站

🚶

步行至 [金沙江路/杨柳青路\(...\)](#)

1000米

终

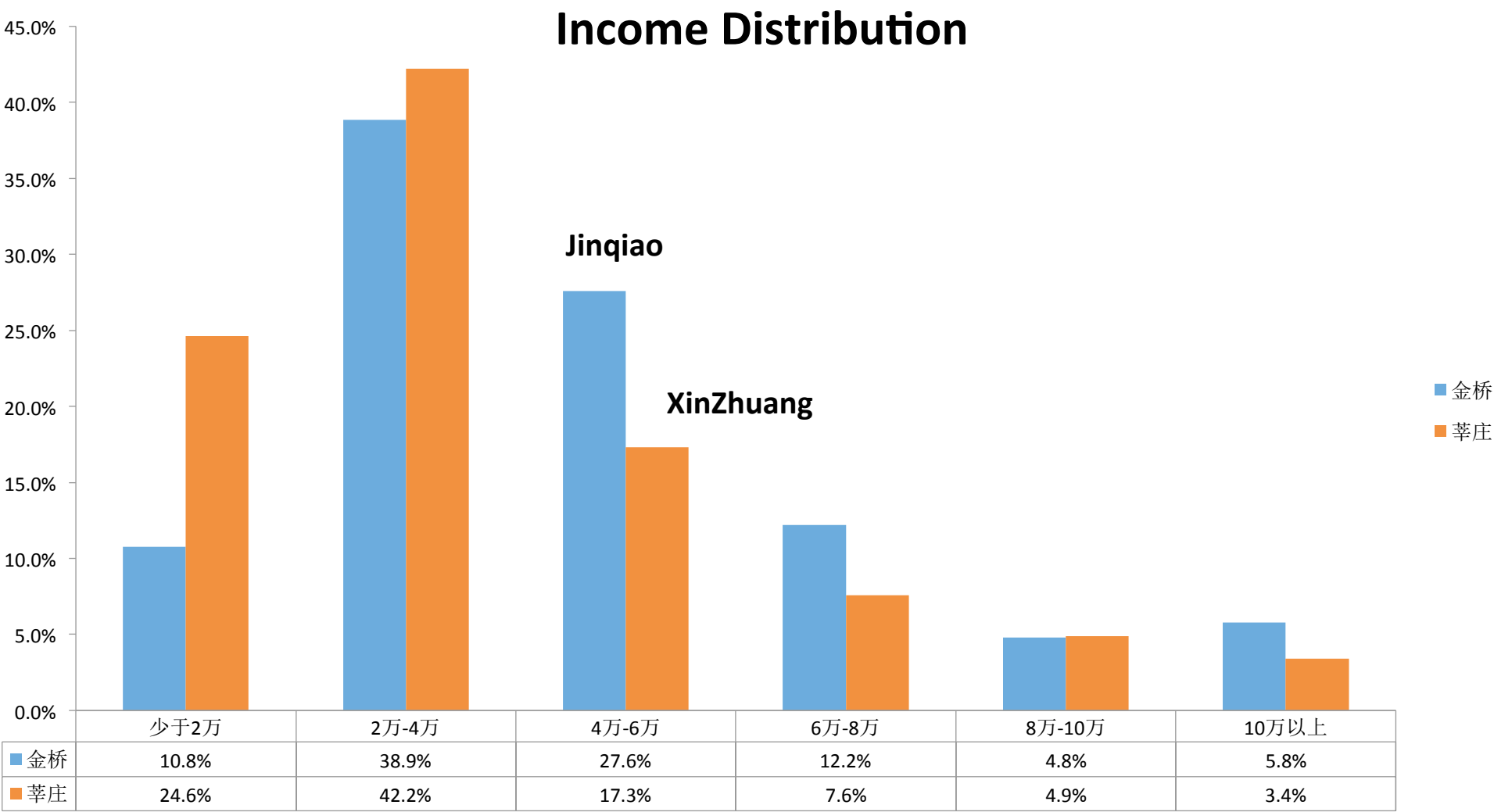
金沙江路/杨柳青路(...)

Co2 Emission Calculated Based on Distance Travelled in Each Segment

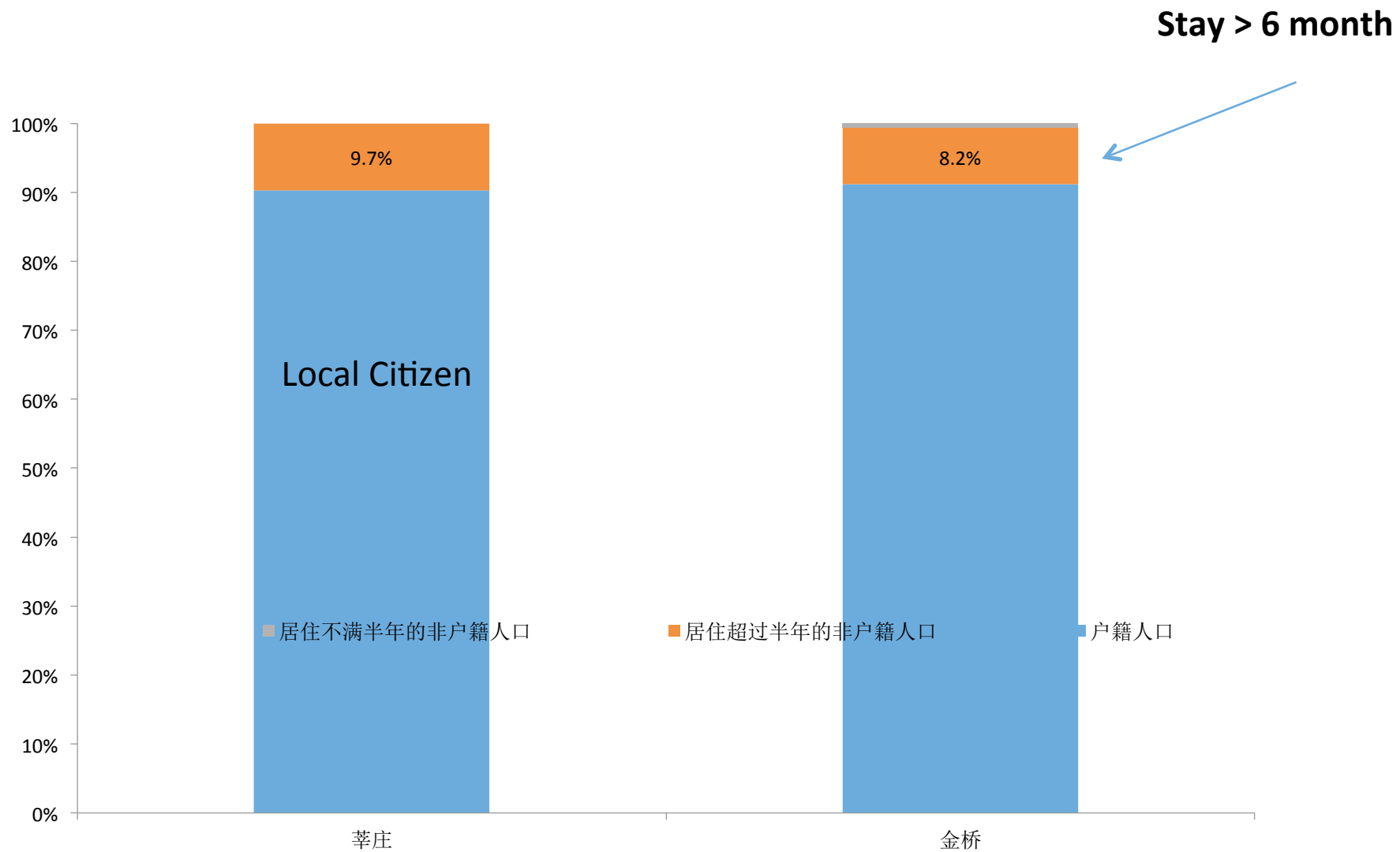
Variables Measured

Category	Variable	Category	Index
Social-Demo	Gender	Metro Service	1. Very good: metro station within 500meter
	Age		2. Good metro service, metro station within 500-2000m
	Occupation		3. Poor Metro Service, Staion over 2000km
	Family Structure	Bus Service	No. of bus Stops in 300 meter
	Citizenship		No. of bus lines to city center in 300 meter
	Income		No. of other bus lines in 300 meter
	Job Location		No. of bus stop surround the neighborhood
	Moving in Time		No. of bus line to city center surround the neighborhood
	Appartment Owneship		No. of other bus line surroud the neighborhood
	Appartment Area		No. bus line linking to metro station
	Car		
	Motocycle		
	E-bike		
	Bike		
	Car Purchasing Intention		
Travel	Travel Time	Density: Low , Middle and High	
	Mode		
	O &D		

4. Social Demographic

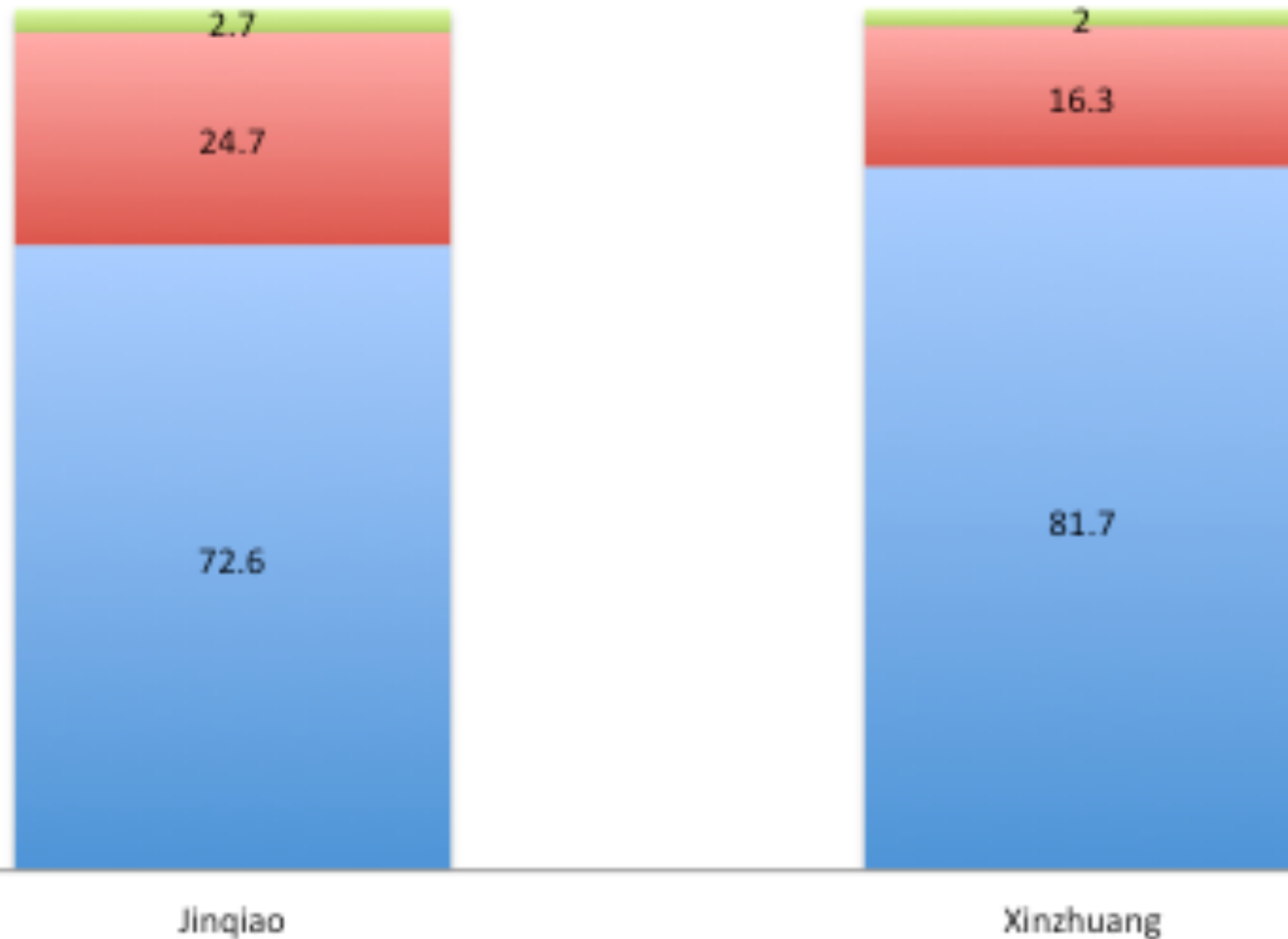


Hukou



Car Ownership

■ No car ■ One car ■ Two car



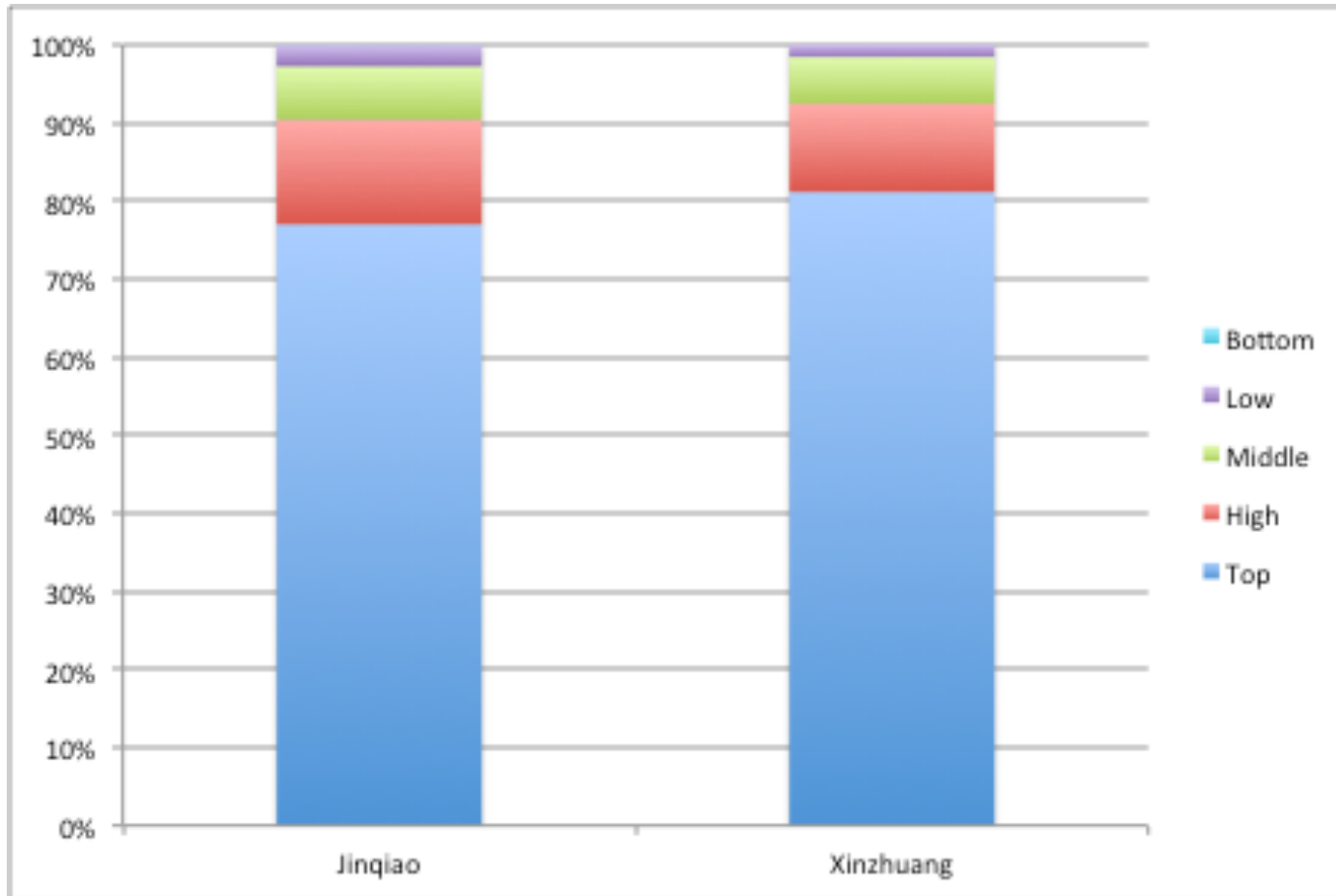
JQ:

80% Family with Car

XZ:

54% Family with Car

Co2 Emission Contribution by Group

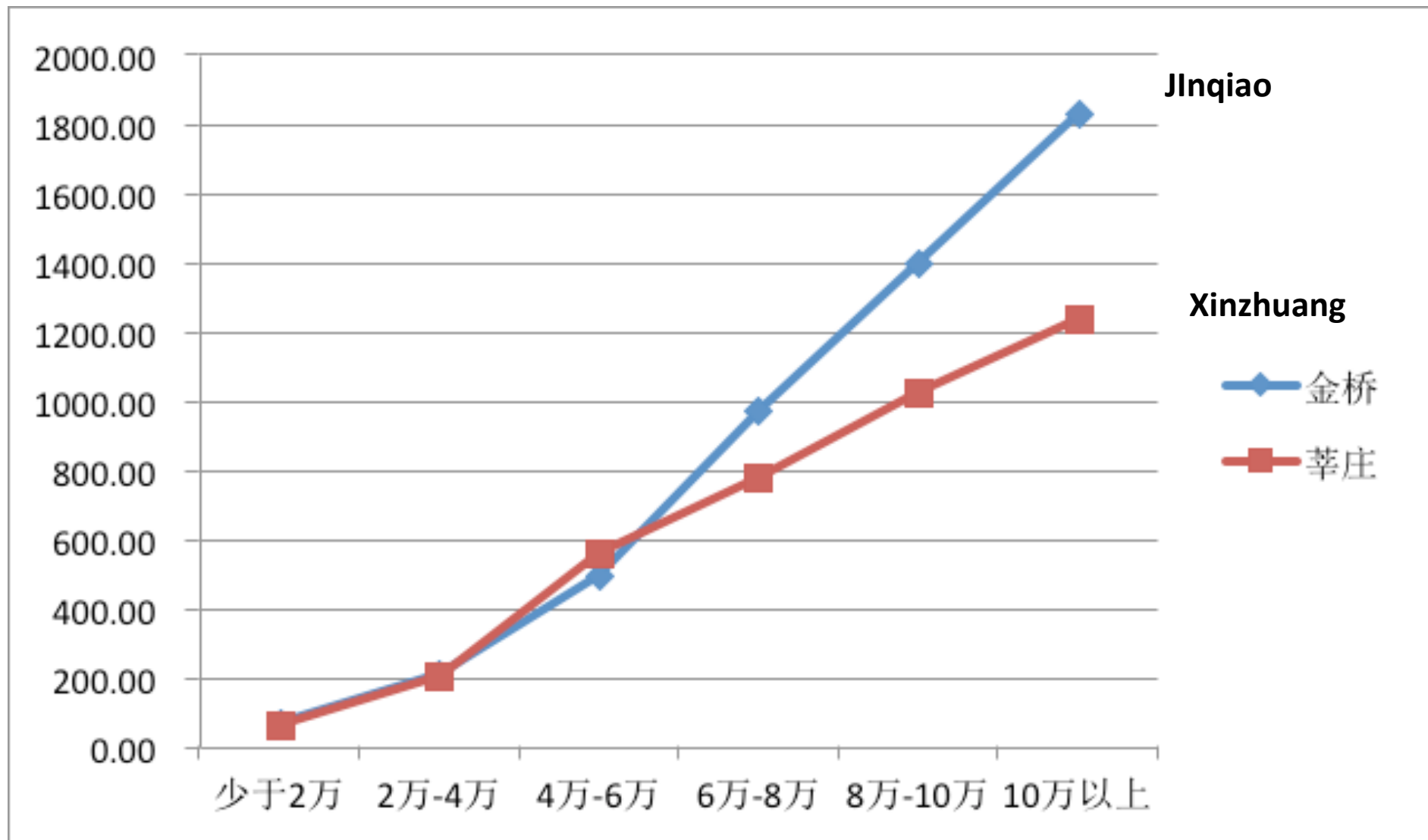


20% Top Contribution

Jinqiao : 77%

Xinzhuan: 81%

20-80

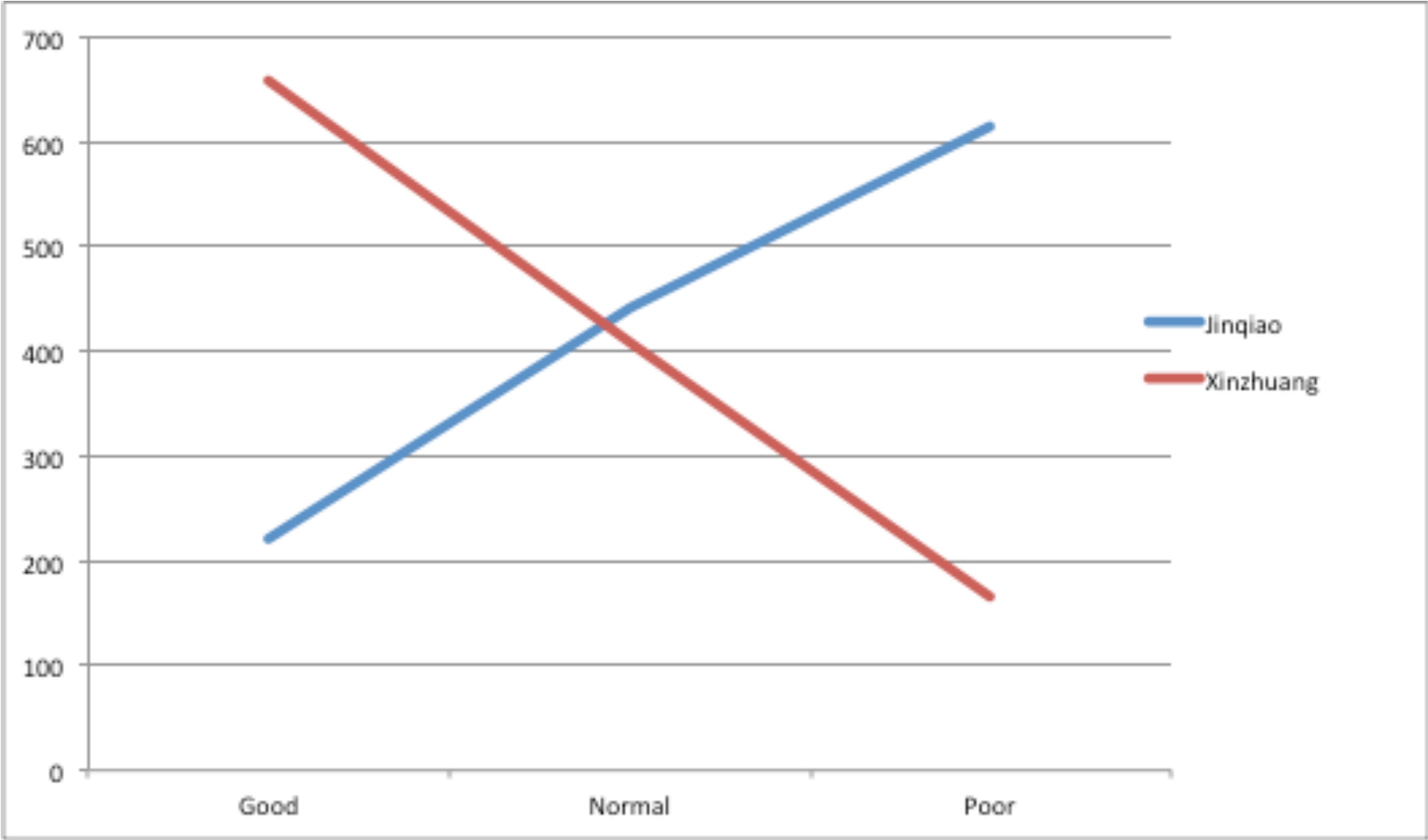


Working age, Gender, Car , Income

		Jinqiao			Xinzhuang		
		Unstandardize	Standardized	Sig.	Unstandardize	Standardized	Sig.
		d Coefficients	Coefficients		d Coefficients	Coefficients	
		B	Beta		B	Beta	
Gender	Male	129.591	0.065	0.019**	142.53	0.095	0.028**
Age	<24	19.261	0.005	0.886	142.271	0.043	0.373
	24-54	157.533	0.062	0.054*	187.467	0.099	0.044**
Hukou	Local 1	123.806	0.037	0.205	430.137	0.182	0.000**
Occupation	Manager	156.85	0.06	0.699	306.789	0.144	0.336
	Worker	31.955	0.013	0.937	78.009	0.042	0.805
	Public Institution	-195.072	-0.054	0.633	115.841	0.027	0.743
	Office Worker	5.594	0.003	0.989	107.519	0.072	0.729
	Professional	627.757	0.064	0.185	254.516	0.109	0.427
	Private Business	-43.773	0-.008	0.917	150.878	0.045	0.655
Income		185.307	0.24	0.000**	148.073	0.25	0.000**
Family Size		0.306	0	0.99	-26.111	-0.036	0.417
Moving time		18.079	0.016	0.596	-51.688	-0.068	0.154
Car		658.422	0.365	0.000**	564.471	0.391	0.000**
Bike		-6.199	-0.005	0.86	-29.544	-0.029	0.513
Appt.Area		58.858	0.059	0.072*	-31.905	-0.037	0.424

5. Public Transport Service Level

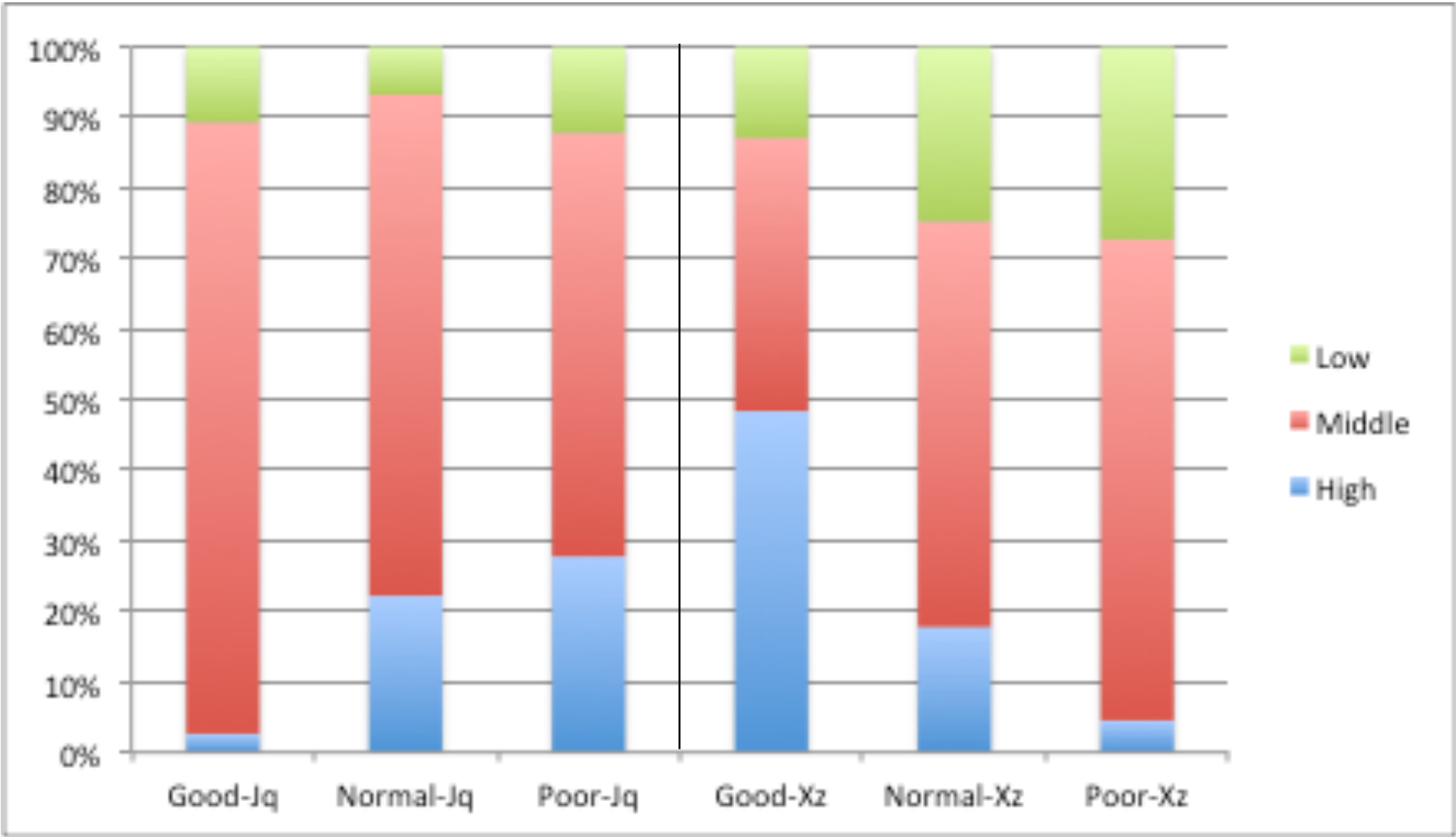
Co2 Emission by Metro Service Level



Income and Metro Service Level

JQ: High Incomer far away from Metro

XZ: High Incomer close to Metro



JQ– Public Transport Service, three model to avoid collinearity

	Model 1		Model 2		Model3	
Variable	B	Sig.	B	Sig.	B	Sig.
Income	0.295	0.000**	0.289	0.000**	0.265	0.000**
Car	0.378	0.000**	0.368	0.000**	0.355	0.000**
Metro ST<2km	-0.056	0.073*				
Busline to metro>4	0.034	0.293				
Bus stop in 300 m			-0.052	0.051*		
Busline to center in 300 m			0.077	0.024**		
other busline in 300m			-0.033	0.33		
Bus stop in SRD					-0.162	0.000**
Busline to center in SRD					0.202	0.001**
Other buline in SRD					-0.038	0.342

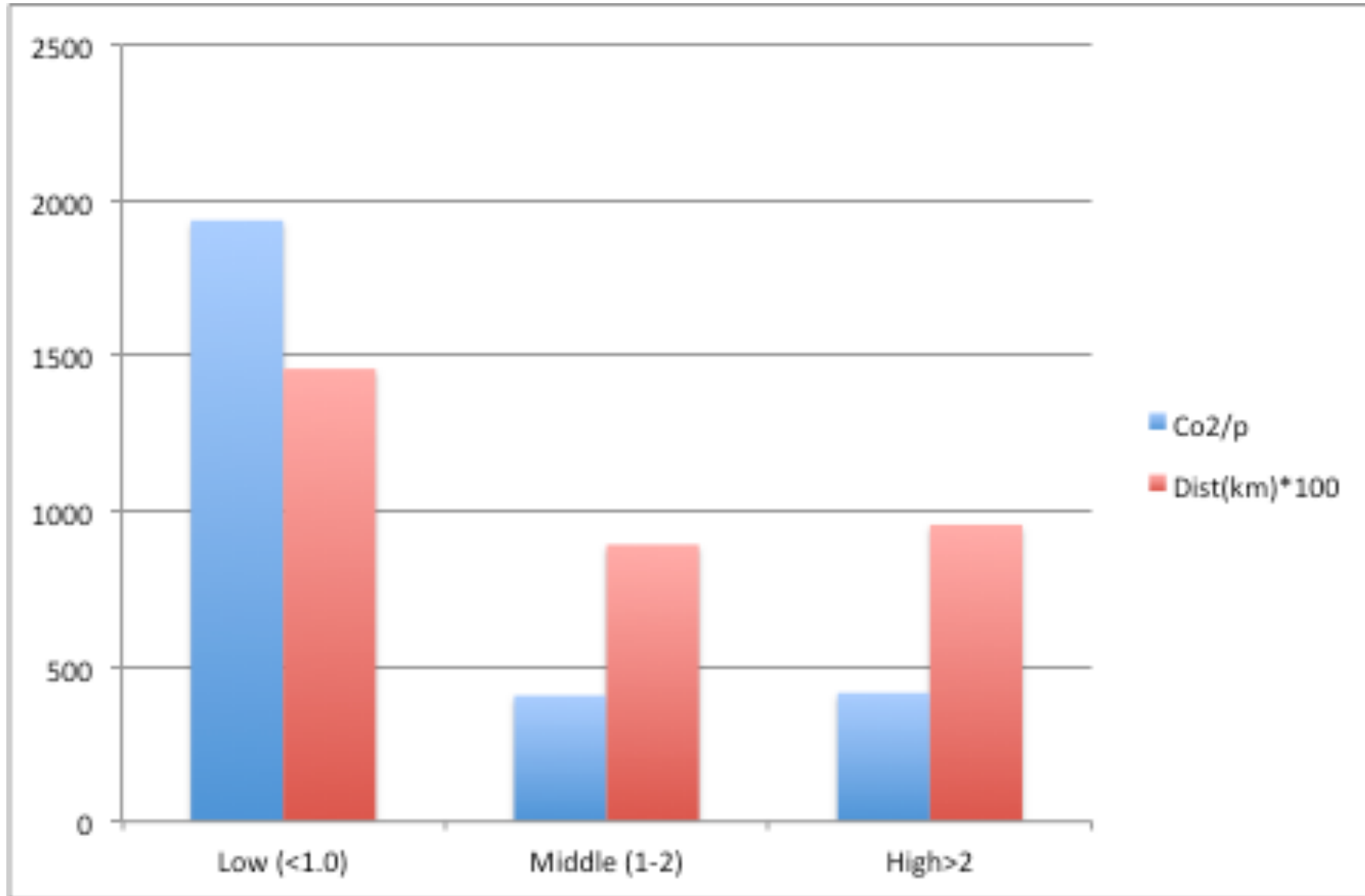
XZ– Only car and income

	Model 1		Model 2		Model3	
Variable	B	Sig.	B	Sig.	B	Sig.
Income	0.294	0.000**	0.3	0.000**	0.294	0.000**
Car	0.388	0.000**	0.388	0.000**	0.385	0.000**
Metro ST<2km	-0.003	0.952				
Busline to metro>4	0.029	0.563				
Bus stop in 300 m			0.02	0.683		
Busline to center in 300 m			-0.014	0.757		
other busline in 300m			0.004	0.929		
Bus stop in SRD					-0.014	0.817
Busline to center in SRD					0.055	0.216
Other buline in SRD					0.038	0.494

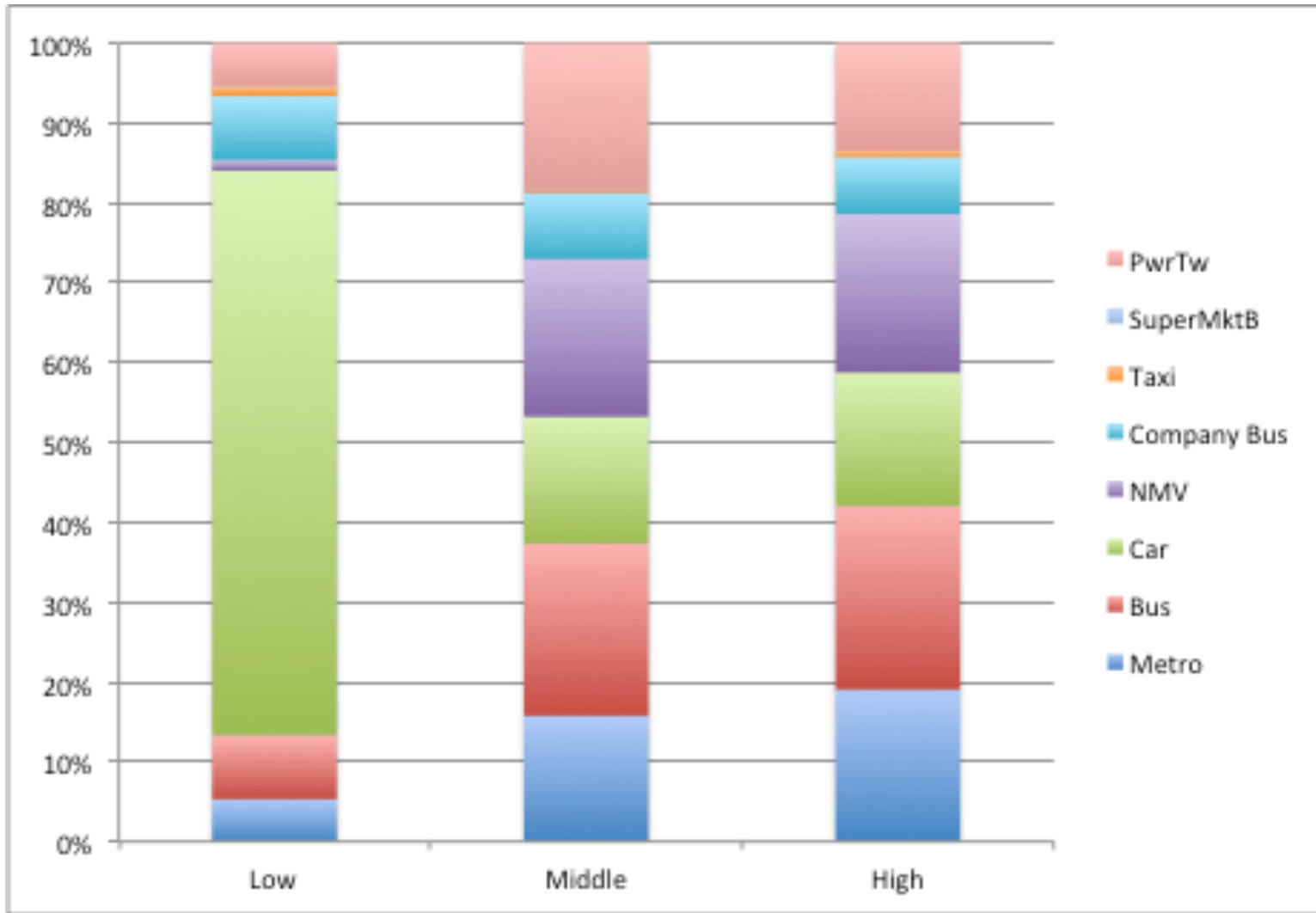
6. Density

Area	NBH	Building Coverage %	Far
Jinqiao	Changdao	15.00%	3.35
	Jinzhou	26.20%	1.24
	Jinqiao V	26.40%	1.32
	Jinqiao C	19.10%	1.4
	Jinshi	29.10%	1.6
	Sunlight I	24.90%	0.83
	Sunlight II	29.00%	0.87
	Sunlight III	29.00%	0.87
	Sunlight IV	17.90%	1.21
	Sunlight Intl	28.40%	1.55
	Yongye	28.10%	1.51
	Jiahong	27.90%	1.5

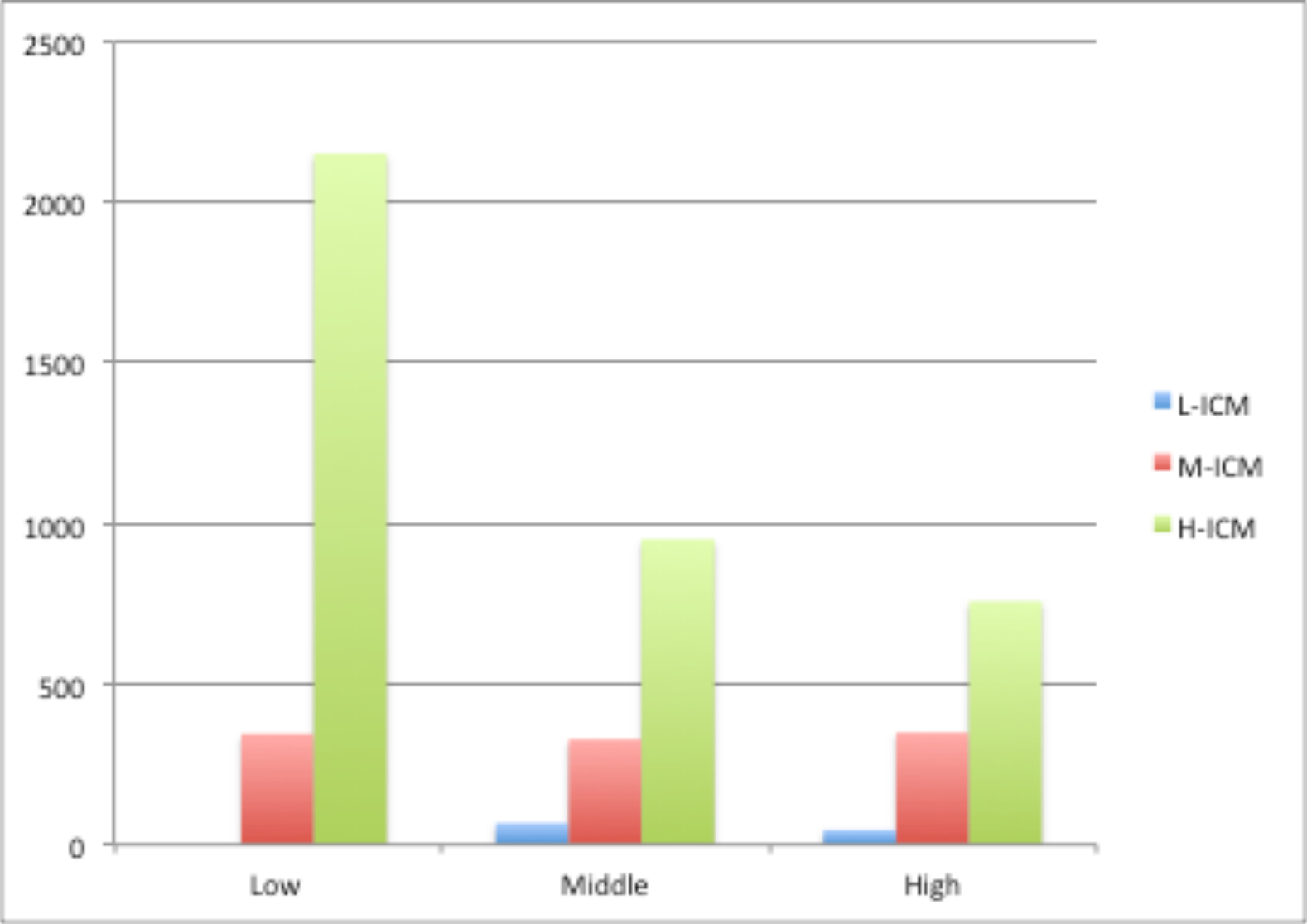
Density and Co2 Emission and Travel Distance



Density and Modal Split



Co2 by Density and Income



Low Density High Emission

Co2 Emission with Demo., Public Transport Service, FAR

	B	Beta	Sig.
In JQ?	34.722	0.012	0.654
DIST	51.349	0.464	0.000**
Male	123.777	0.064	0.003**
Working Age	89.084	0.035	0.096*
ICM	98.423	0.135	0.000**
Car	790.5	0.382	0.000**
Moving After Metro	30.246	0.014	0.499
MTR-ST<2km	4.341	0.002	0.929
Bustp in 300M	-35.668	-0.038	0.146
Far	-78.986	-0.052	0.033*

7. Conclusion

- **With Income Increasing, more Co2 Emission from Commuting in Suburban Area where the Travel Distance is Longer.**
- **The Impact of Large Scale Metro Construction and More Bus Service only on Co2 Emission Reduction may Varied in those Areas.**
- **Policy Package should be Explored, due to “20-80” , Policy should be more Focused on the Top 20%**
- **Car Ownership Control is an most Effective Measure Under Current Situation in Shanghai.**
- **Low Density Urban Construction must be Limited, Encourage Infill Development**

Thank You