China's Green Cities

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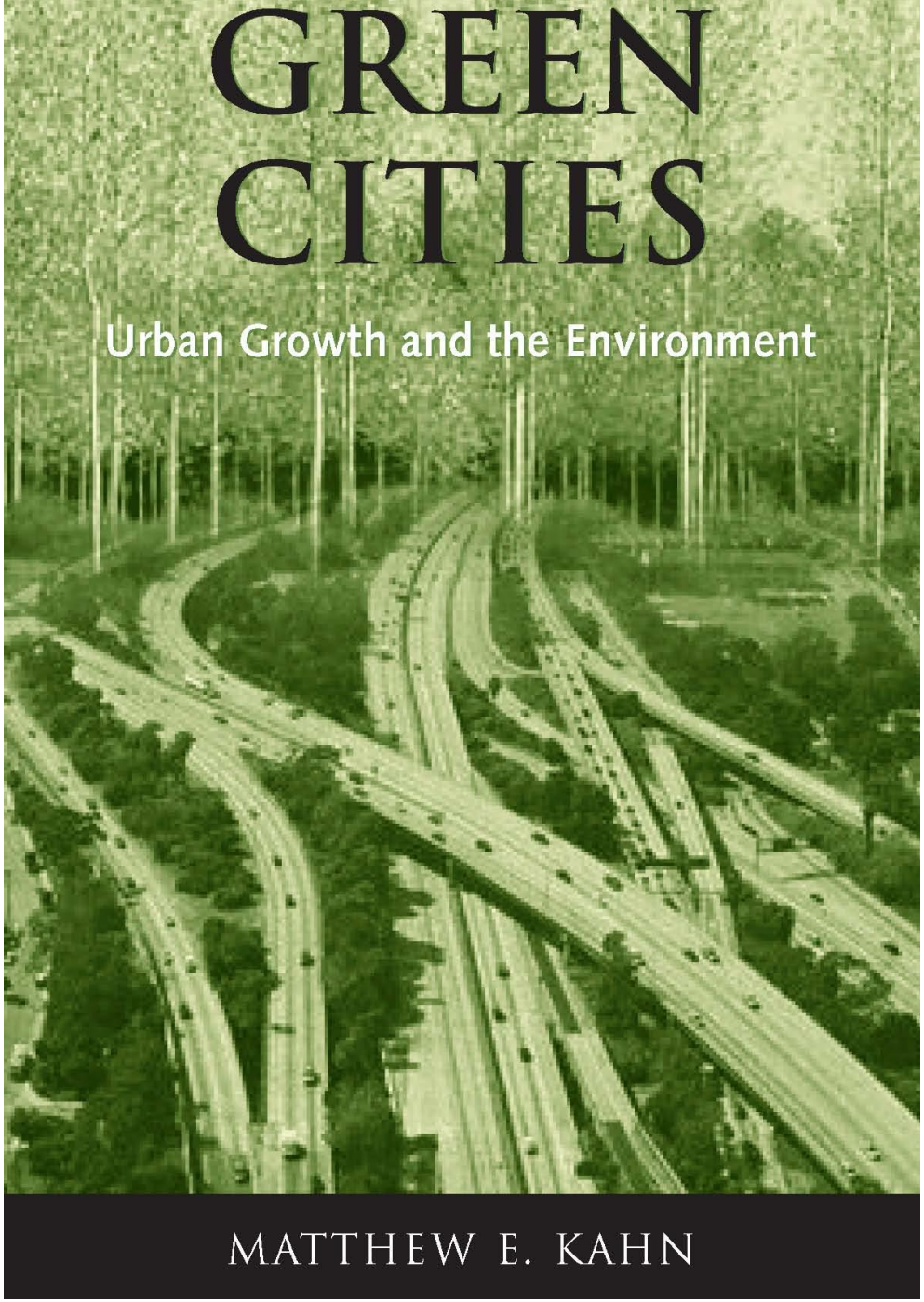
Introduction

- Much of my work focuses on;
- 1. Factors determining urban pollution levels
- 2. Measuring how much urbanites value living in “green cities”
- My empirical work started in the U.S and now has branched out into China.

The “Supply” of Urban Pollution

- Pollution as an emergent byproduct of three factors within a city;
- 1. scale, 2. composition, 3. technique
- Two Examples:
- Total Urban Vehicle Emissions =
- Population*pr(own a car)*Miles*Emissions per Mile
- Total Industrial Emissions = $\sum$ Emissions Per $ of output*output produce


GREEN
CITIES
Urban Growth and the Environment
MATTHEW E. KAHN

What is a “Green City”?

- 1. Local environmental criteria such as air quality and water quality
- 2. Global criteria such as greenhouse gas emissions
- Index Weights Issues similar to HDI issues
- 3. A weakness of my 2006 Brookings book is that it is “too U.S” focused.

Consumer City as the New "Golden Goose"

- Cities are capitalism's growth engine
- Human capital is the key to sustainable economic growth
- Where do the footloose urban skilled want to live and work? Glaeser's work on "Consumer City"
- Environment an important part of "quality of life" (QOL)
- The skilled will vote with their feet and migrate away if urban QOL is low

Transition to China's Cities

- Some Themes in my U.S based empirical work are relevant for thinking about China's future:
- 1. educational attainment correlates with support for environmental regulation (Kahn 2002)
- 2. Deindustrialization ➔ Green Cities (Kahn 1999, 2003)
- 3. Old capital is dirty capital (Kahn 1995, Kahn and Schwartz 2008, Kahn and Davis 2010)

More Themes

- 4. demand for non-market local public goods rises with income (Costa and Kahn 2003, 2004)
- 5. Public transit is not used when people live and work in the suburbs (Glaeser and Kahn 2004)

My Past China Research Projects

- 1. Land and Residential Property Markets in a Booming Economy: New Evidence from Beijing (joint with Siqi Zheng) *Journal of Urban Economics, 63(2)*, 2008, *Pages 743-757*
- *2.* Towards a System of Open Cities in China: Home Prices, FDI Flows and Air Quality in 35 Major Cities (joint with Siqi Zheng and Hongyu Liu) *Regional Science and Urban Economics*, 2010

Ranking Carbon Footprints

- 3. The Greenness of China: Household CARBON DIOXIDE EMISSIONS AND URBAN DEVELOPMENT (Siqi Zheng, Rui Wang, Ed Glaeser and Kahn, 2010 Journal of Economic Geography)

Project #1 Zheng and Kahn 2008

- We use unique GIS geocoded real estate transaction data and land auction data to examine:
- 1. urban monocentric features of Beijing
- 2. capitalization of local public goods including; pollution, crime, universities, access to public transit

Beijing's Environmental Amenities

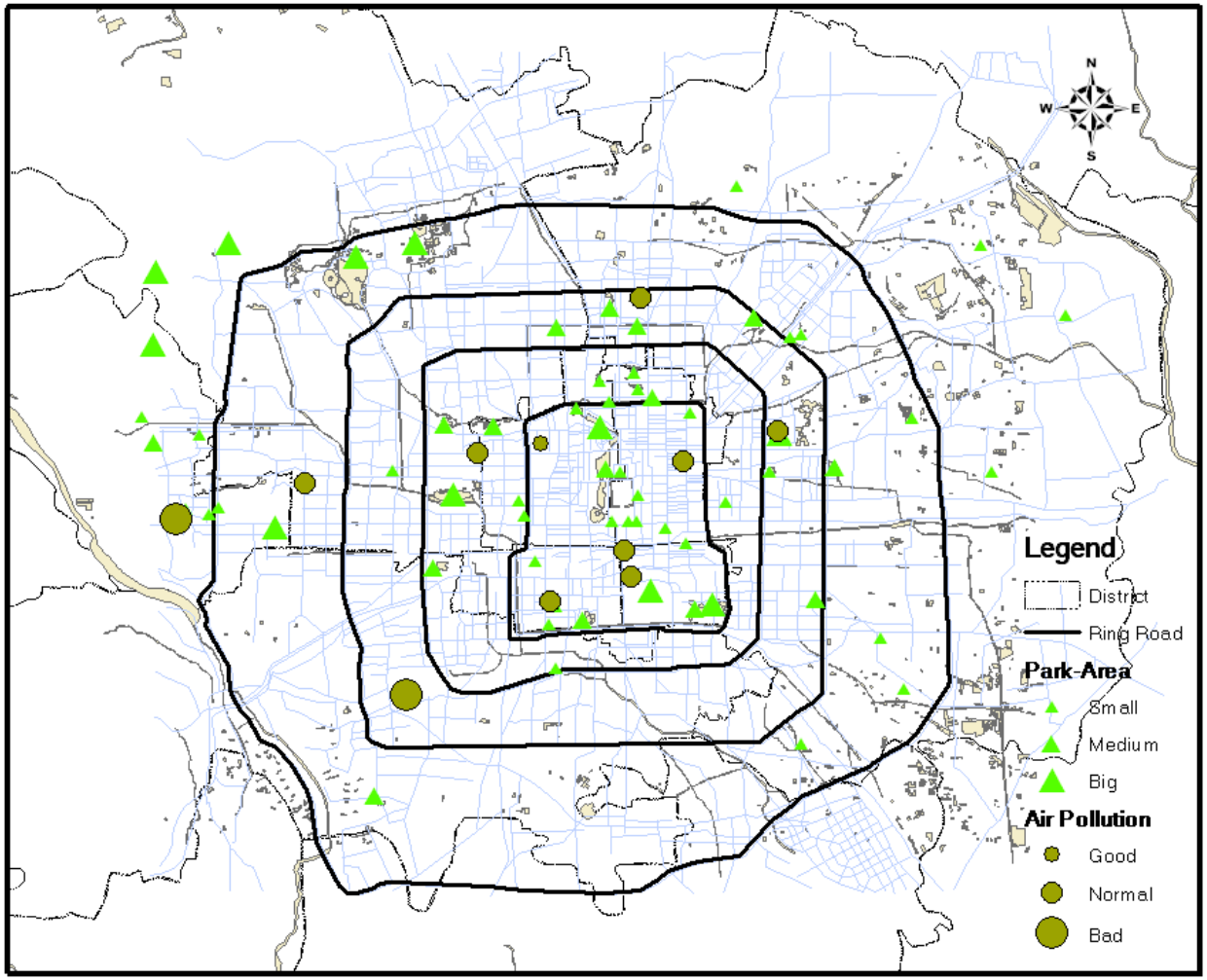


Table Five. Hedonic Capitalization Estimates of Local Public Goods

Within Beijing

Dependent variable: Log(P_PRICE)

	(1)	(2)	(3)	(4)	(5)	(6)
Constant	8.491*** (110.15)	8.805*** (127.39)	9.843*** (19.95)	10.046*** (30.13)	10.252*** (43.60)	8.945*** (19.12)
D_CENTER (in kilometers)	-0.019*** (-7.67)	-0.011*** (-4.81)	-0.008*** (-4.01)	-0.007*** (-3.55)	-0.007*** (-3.82)	-0.007*** (-3.98)
UNIT_SIZE (in square meters)	0.003*** (4.46)	0.003*** (4.78)	0.002*** (3.74)	0.002*** (2.67)	0.002** (2.65)	0.002** (2.52)
$UNIT\_SIZE^2$	-2.09E-6*** (-1.03)	-1.24E-6*** (-0.72)	2.53E-7 (0.10)	4.40E-7*** (0.18)	1.60E-7 (0.06)	8.93E-7 (0.38)
PRO_SIZE (in 000 units)	-0.164*** (-4.32)	-0.132*** (-4.07)	-0.131*** (-3.36)	-0.110*** (-3.64)	-0.115*** (-3.56)	-0.100*** (-3.63)
PRO_SIZE^2	0.025** (2.15)	0.022** (2.27)	0.022*** (4.40)	0.018*** (4.16)	0.020*** (4.76)	0.017*** (3.75)
SOE	-0.091** (-3.64)	-0.077** (-3.64)	-0.100*** (-3.46)	-0.098*** (-3.21)	-0.100** (-2.87)	-0.087** (-2.88)
Log(D_SUBA) (in kilometers)		-0.161*** (-14.25)	-0.113** (-3.25)	-0.089** (-2.70)	-0.082** (-2.54)	-0.108*** (-3.80)
Log(D_SUBB) (in kilometers)		-0.038*** (-3.43)	-0.014 (-0.90)	-0.014 (-0.67)	0.021 (0.84)	0.023 (1.11)
Log(D_BUS) (in kilometers)		-0.079*** (-5.21)	-0.074** (-2.43)	-0.074* (-2.13)	-0.051* (-1.94)	-0.035 (-1.01)
Log(D_PARK) (in kilometers)			-0.104*** (-3.46)	-0.086** (-2.51)	-0.041 (-1.57)	-0.057* (-2.06)
AIRBAD (ug/m^3)			-0.0041** (-2.44)	-0.0049*** (-4.40)	-0.006*** (-6.93)	-0.005*** (-5.85)
Log(D_SCHOOL) (in kilometers)				-0.065** (-2.56)	-0.066** (-2.87)	-0.054** (-2.45)
CRIME				-0.024 (-0.64)	-0.055 (-1.19)	-0.051 (-1.55)
Log (D_UNIV)					-0.104*** (-3.68)	
UNIV_3KM						0.106*** (3.60)
UNIV_SCORE						0.002*** (3.28)
Quarter dummies	yes	yes	Yes	yes	yes	yes
R^2	0.356	0.533	0.569	0.578	0.597	0.601
N. of Obs.	900	900	900	900	900	900

Open Research Questions

- 1. pollution exposure across income groups
- 2. Does the monitoring system (with roughly 20 monitors) truly capture the exposure?
- 3. As Beijing's vehicle fleet grows, which indicators of pollution such as carbon monoxide grow worse?
- 4. Evidence from infant mortality statistics of increased deaths? Or economic growth offsets?

Across Chinese City Comparisons

- Zheng, Kahn and Liu (2010)
- Using excellent real estate price data, we explain cross-sectional variation in real estate prices across 35 major Chinese Cities at multiple points in time
- Test for the presence of a EKC curve and the "turning point"
- Test for the role of city specific FDI on air pollution

Understanding Cross-City Ambient Pollution Differentials in China

	Trend regressions		Log(*PM*)		Log(*SO2*)	
	Log(*PM*)	Log(*SO2*)				
	(1)	(2)	(3)	(4)	(5)	(6)
Log (*POP*)	0.148	0.258	0.18	0.199	0.406	0.423
	[1.54]	[1.75]*	[3.89]***	[2.29]**	[3.00]***	[2.98]***
INC			0.125	0.372	0.399	0.607
			[1.41]	[3.21]***	[2.16]**	[2.25]**
INC^2			-0.004	-0.012	-0.013	-0.019
			[-1.48]	[-3.01]***	[-2.09]**	[-2.22]**
Manuf			0.945	1.779	-0.061	0.64
			[1.37]	[2.82]***	[-0.04]	[0.49]
Log(*CFDIPC*)			-0.113	-0.414	-0.394	-0.647
			[-1.77]*	[-4.00]***	[-3.39]***	[-2.14]**
Log(*RAIN*)			-0.227	-0.041	-0.072	0.084
			[-3.98]***	[-0.37]	[-0.54]	[0.32]
YEAR2004	-0.052	0.008				
	[-2.54]**	[0.18]				
YEAR2005	-0.122	0.032				
	[-6.49]***	[0.49]				
YEAR2006	-0.099	0.006				
	[-4.02]***	[0.08]				
Constant	-2.966	-4.444	-1.95	-3.143	-4.697	-5.702
	[-5.34]***	[-5.12]	[-4.00]***	[-4.05]***	[-3.86]***	[-3.14]***
Observations	120	120	120	120	120	120
R-squared	0.13	0.09	0.596	0.162	0.424	0.344
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Estimation	OLS	OLS	OLS	IV	OLS	IV

Foreign Direct Investment as "Friend or Foe" of Green Cities?

- The "old" pollution havens logic would posit that FDI is a foe as rich countries outsource dirty industries to the LDC.
- More optimistic hypothesis is that FDI causes cleaner technology to be adopted and is correlated with technology transfer.

Key Empirical Findings from this Research

- Evidence of Compensating differentials (for ambient pollution, and proximity to rail transit stations) apparent in cross-section and this premium appears to be growing over time
- Cities that receive more FDI inflows enjoy **improved** air quality --- contradicts the pollution haven claims
- Evidence that several of China's cities have passed the "Turning Point" for the Environmental Kuznets Curve

Politicians and Green Cities

- In 2011, do China's urban politicians have the right incentives to pursue "green cities"?
- Politicians and competition to maximize land tax revenue provides strong incentives to provide valued public goods?

Ranking Cities with Respect to their Household Carbon Footprint

- Where would Al Gore want a standardized household to live?
- To minimize carbon emissions, compact city with cool summers and temperature winters and clean electric utilities

Methodological Details

- Equation (1)
- Carbon Dioxide Emissions = γ_1*Transportation + γ_2 *Electricity + γ_3*Heating
- Emissions factor γ_2 varies by a city's region

Methodological Details II

- Using household level geocoded data
- For household consumption of 1. transportation, 2. electricity, 3. heating we estimate OLS regressions of the form:

$$Energy_{ij} = c_j + b_{1j} * Income_i + b_{2j} * Demographics_i + U_{ij}$$

- Take the OLS estimates and predict energy consumption for each city for a “standardized household”, plug these estimates into equation (1)

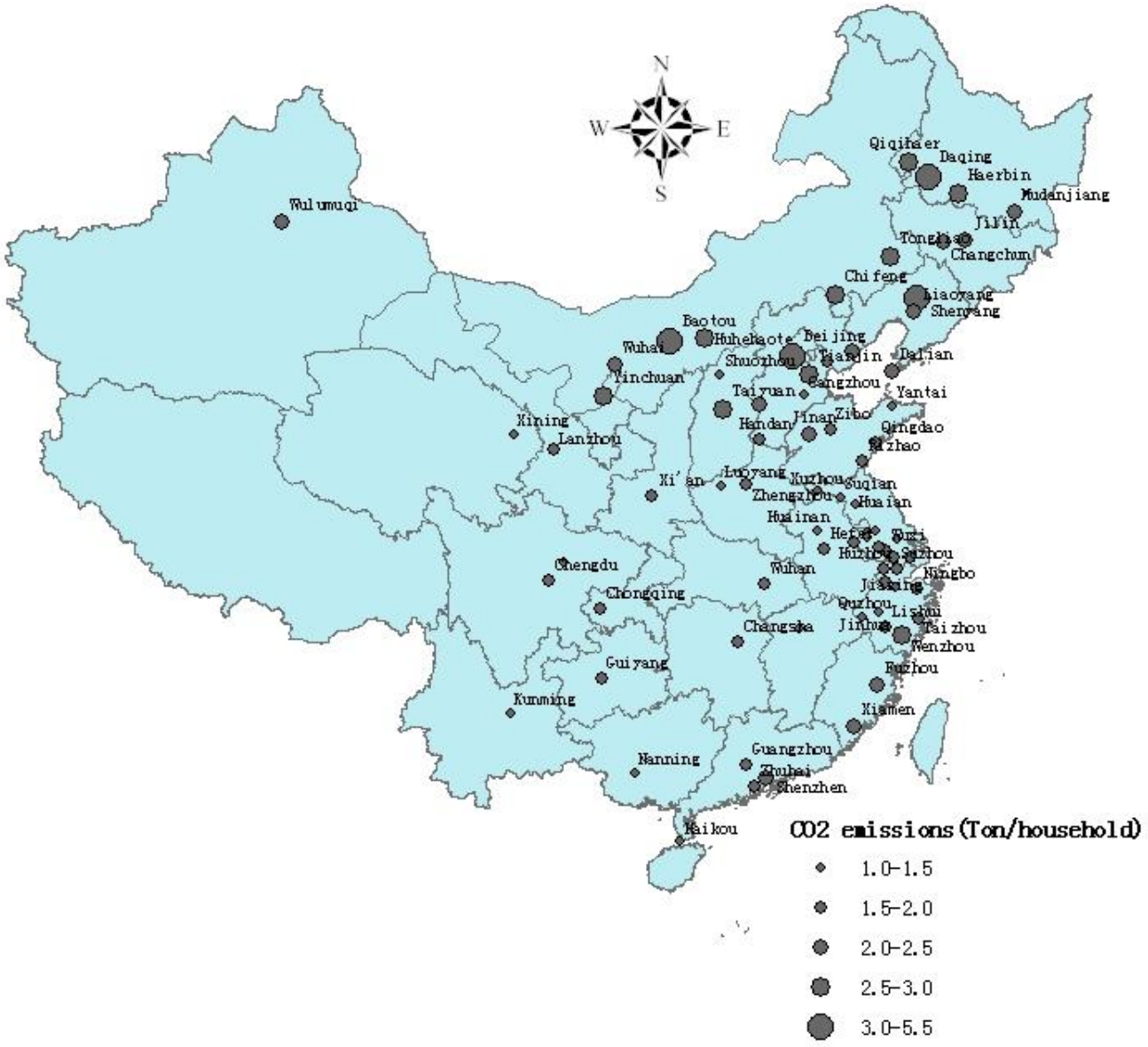
Details

- Zheng, Wang, Glaeser, and Kahn use the 2006 Chinese Urban Household Survey Micro data
- Detailed information on household consumption of electricity, transportation, home heating
- We estimate separate regressions by city, by energy category to predict consumption for a standardized household
- We plug in the predictions to an aggregation formula to rank cities

Example of Transport in Beijing

- estimate a logit model:
- Ln (Prob(Owning a car)/(1- Prob(Owning a car))) = -15.57 + 1.43**Log(Income)* + 0.005**Household Size* - 0.025**Age*
- *Estimate a gasoline consumption model: log(Car Fuel Use)*= -10.41+1.46**Log(Income)* + 0.12**Household Size* - 0.02**Age*
- Car fuel consumption = .179 *86.67 = 15.5 Liters

Figure 4: Carbon Dioxide Emissions Per Household in 74 Chinese Cities



Implications

- These rankings are useful for understanding the unintended environmental consequences of government policies that favor growth of specific cities and regions
- Environmental costs of cold Northern China's growth
- Caveat: Emissions factors are not a law of physics; the case of the natural gas pipeline

A Preview of a New Beijing Project

- Over the last 8 years in Beijing, there have been several improvements in local public goods;
- 1. New subway lines
- 2. Construction of the Olympic Village for the 2008 games
- For each of these spatial “treatments”, we are investigating how SOE developers and private sector real estate developers respond

Conclusion

- I am optimistic about China's cities' pollution progress
- "Battle" between Scale, Composition and Technique
- Coal fired power plants and "co-benefits"
- Manufacturing in China
- The induced innovation hypothesis
- "Green City" benefits of energy intensity reductions