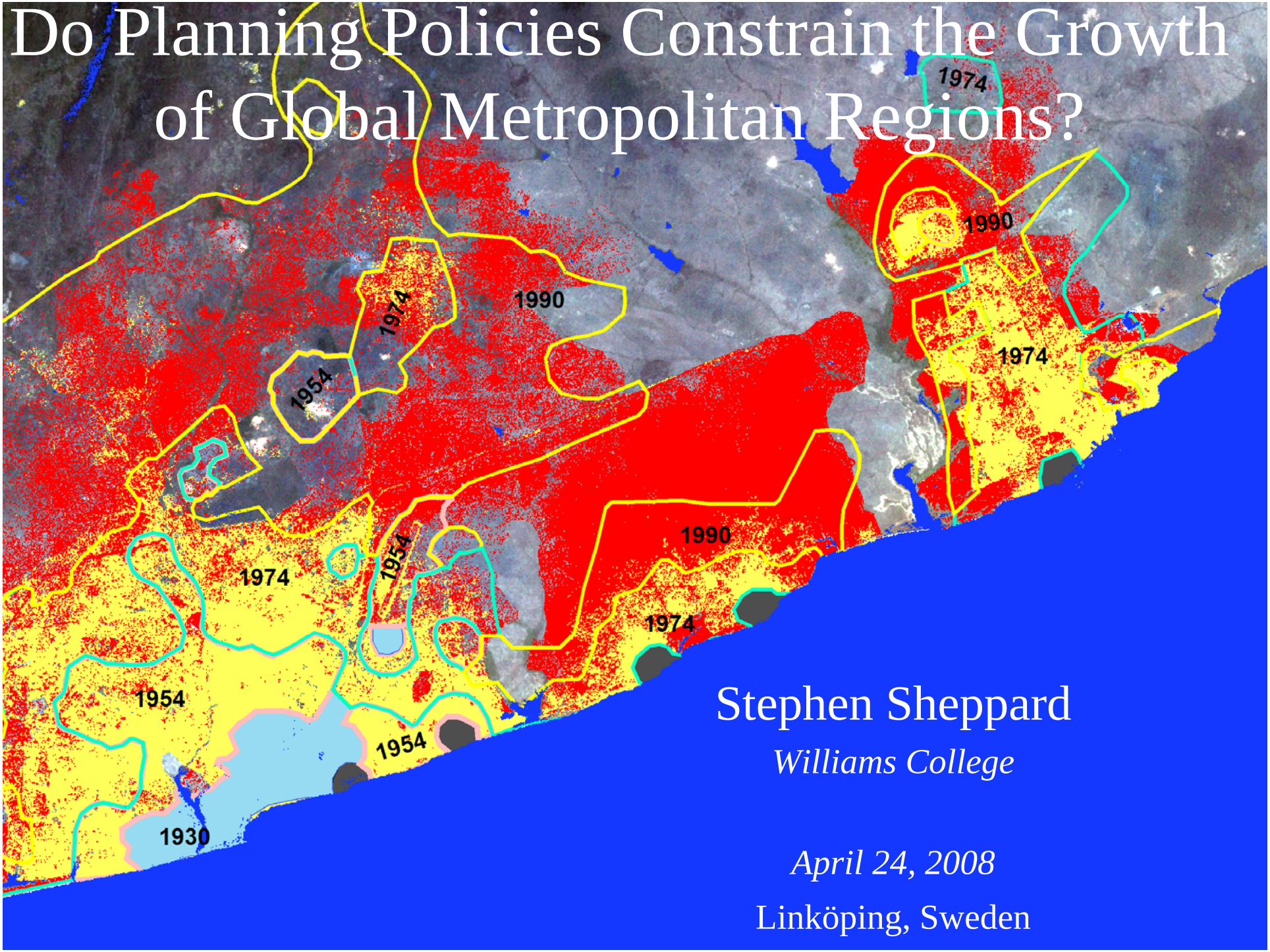
Do Planning Policies Constrain the Growth of Global Metropolitan Regions?



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April 24, 2008

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Metropolitan Expansion

- Metropolitan areas are expanding …
- Growth of urban population
- Increased share of urban in total population:

Global population	6,615,900,000
Share urban	50%
World pop growth rate (2005-2010)	1.1%
World urban pop growth rate (2005-2010)	2.0%
Poorest country urban pop growth rate (2005-2010)	4.0%

- Expansion of urban land use
  - Increased residential and commercial land use
  - Theoretical understanding
- Expansion of urban land cover
  - This is what we can measure

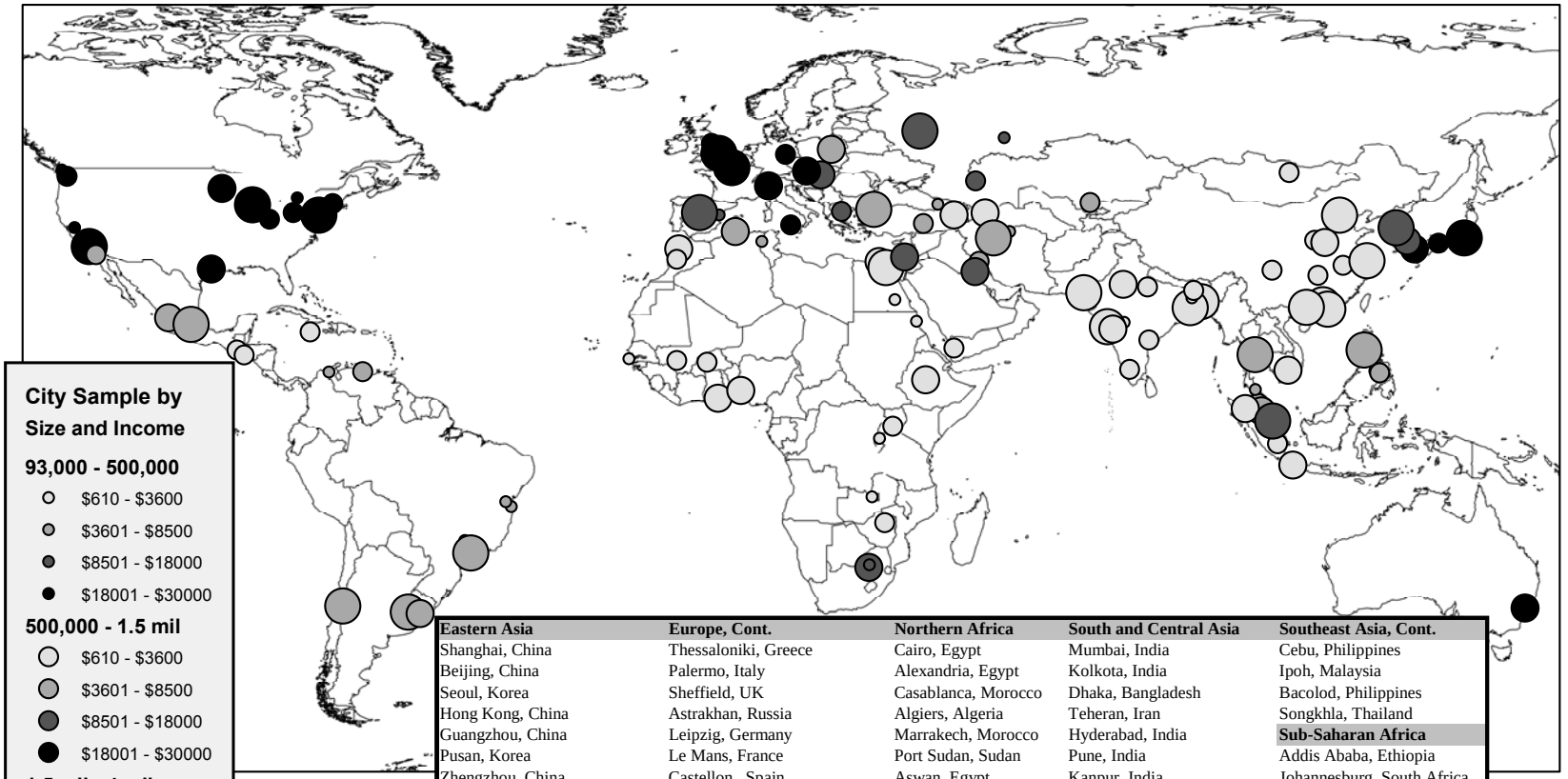
Why the concern?

- Urban expansion important for development?
  - Form of urban system, rather than urbanization *per se*
  - Plan urban expansion to optimize growth
  - Optimal degree of primacy
  - Henderson, 2003
- Other considerations
  - Infrastructure costs and congestion
  - Elasticity of capital expense per person w.r.t. urban population = .144
  - Expected doubling of urban population in next 30 years will increase capital expenses per person by 14%
  - Arimah, 2003
- Are such policies even feasible?
  - Growth controls might not be enforced
  - Developing country cities littered with failed plans
  - Political economy considerations

Effect of planning constraints

- Considerable research exists
  - Mostly in the context developed countries
  - Evidence of constraint
    - Net cost of distortions equivalent to 4% of incomes
    - Cheshire and Sheppard (2002)
- Do these policies constrain growth in global cities?
  - Largely unknown
  - Little systematic data are available
- Data needed
  - Urban land use
  - Planning policies
  - Other relevant urban factors (transport, population, etc.)
  - Global sample

Measuring Urban Expansion – global sample



City Sample by Size and Income

93,000 - 500,000
- $610 - $3600
- $3601 - $8500
- $8501 - $18000
- $18001 - $30000

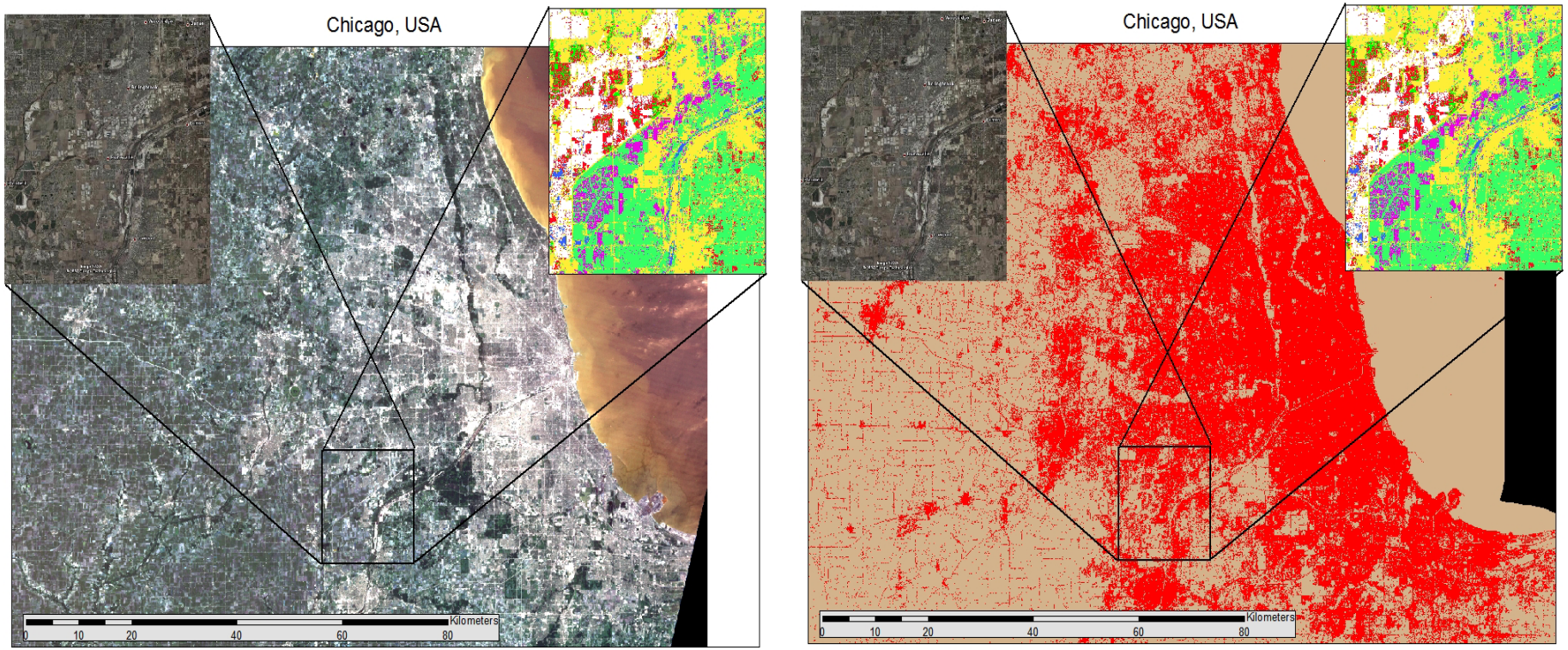
500,000 - 1.5 mil
- $610 - $3600
- $3601 - $8500
- $8501 - $18000
- $18001 - $30000

1.5 mil - 4 mil
- $610 - $3600
- $3601 - $8500
- $8501 - $18000
- $18001 - $30000

Over 4 million
- $610 - $3600
- $3601 - $8500
- $8501 - $18000
- $18001 - $30000

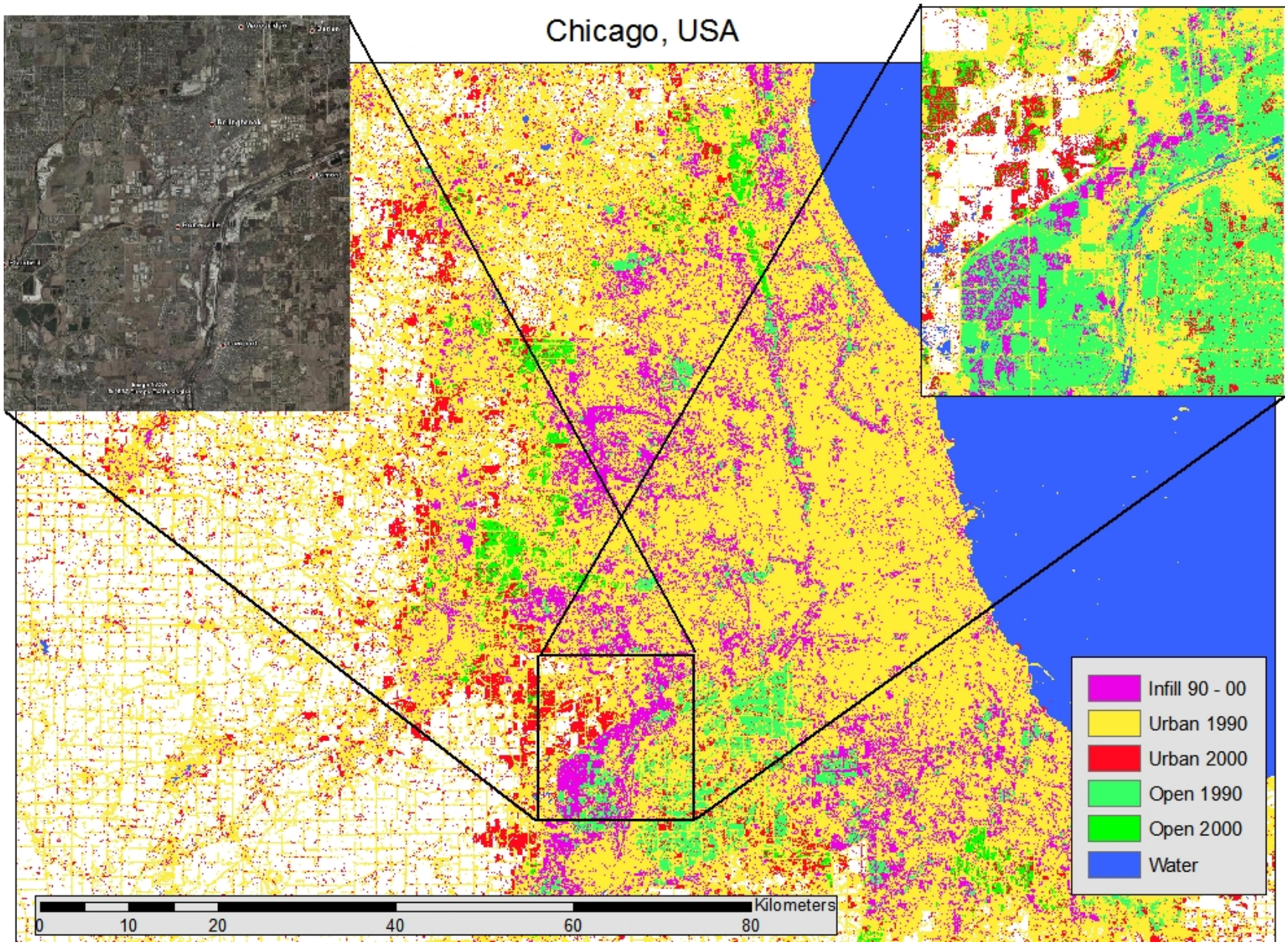
Eastern Asia	Europe, Cont.	Northern Africa	South and Central Asia	Southeast Asia, Cont.
Shanghai, China	Thessaloniki, Greece	Cairo, Egypt	Mumbai, India	Cebu, Philippines
Beijing, China	Palermo, Italy	Alexandria, Egypt	Kolkota, India	Ipoh, Malaysia
Seoul, Korea	Sheffield, UK	Casablanca, Morocco	Dhaka, Bangladesh	Bacolod, Philippines
Hong Kong, China	Astrakhan, Russia	Algiers, Algeria	Teheran, Iran	Songkhla, Thailand
Guangzhou, China	Leipzig, Germany	Marrakech, Morocco	Hyderabad, India	**Sub-Saharan Africa**
Pusan, Korea	Le Mans, France	Port Sudan, Sudan	Pune, India	Addis Ababa, Ethiopia
Zhengzhou, China	Castellon , Spain	Aswan, Egypt	Kanpur, India	Johannesburg, South Africa
Yulin, China	Oktyabrsky, Russia	Tébessa, Algeria	Jaipur, India	Accra, Ghana
Yiyang, China	**Latin America & Caribbean**	**Other Developed**	Coimbatore, India	Harare, Zimbabwe
Leshan, China	Mexico City, Mexico	Tokyo, Japan	Vijayawada, India	Ibadan, Nigeria
Ulan Bator, Mongolia	Sao Paolo, Brazil	Los Angeles, USA	Rajshahi, Bangladesh	Pretoria, South Africa
Changzhi, China	Buenos Aires, Argentina	Chicago, USA	Ahvaz, Iran	Kampala, Uganda
Anqing, China	Santiago, Chile	Philadelphia, USA	Shimkent, Kazakhstan	Bamako, Mali
Ansan, Korea	Guadalajara, Mexico	Houston, USA	Jalna, India	Ouagadougou, Burkina Faso
Chinju, China	Guatemala City, Guatemala	Sydney, Australia	Gorgan, Iran	Ndola, Zambia
Chonan, Korea	Caracas, Venezuela	Minneapolis, USA	Saidpur, Bangladesh	Banjul, Gambia
Europe	San Salvador, El Salvador	Pittsburgh, USA	**Southeast Asia**	Kigali, Rwanda
Paris, France	Montevideo, Uruguay	Cincinnati, USA	Manila, Philippines	**Western Asia**
Moscow, Russia	Tijuana, Mexico	Fukuoka, Japan	Bangkok, Thailand	Istanbul, Turkey
London, UK	Kingston, Jamaica	Tacoma, USA	Ho Chi Minh City, Vietnam	Tel Aviv, Israel
Milan, Italy	Ribeirão Preto, Brazil	Springfield, USA	Singapore, Singapore	Baku, Azerbaijan
Madrid, Spain	Valledupar, Colombia	Modesto, USA	Bandung, Indonesia	Sana'a, Yemen
Warsaw, Poland	Guarujá, Brazil	St. Catharine's, Canada	Medan, Indonesia	Yerevan, Armenia
Vienna, Austria	Ilhéus, Brazil	Victoria, Canada	Palembang, Indonesia	Kuwait City, Kuwait
Budapest, Hungary	Jequié, Brazil	Akashi, Japan	Kuala Lumpur, Malaysia	Malatya, Turkey
				Zugdidi, Georgia

Classification of urban land cover



- 2 Landsat TM/ETM images, approximately 10 years apart
- 28.5 meter resolution, 3 visual brightness, 3 IR
- 3-pass supervised cluster analysis used for both times
- Pixels classified as urban, non-urban or water

Detecting Urban Development Dynamics

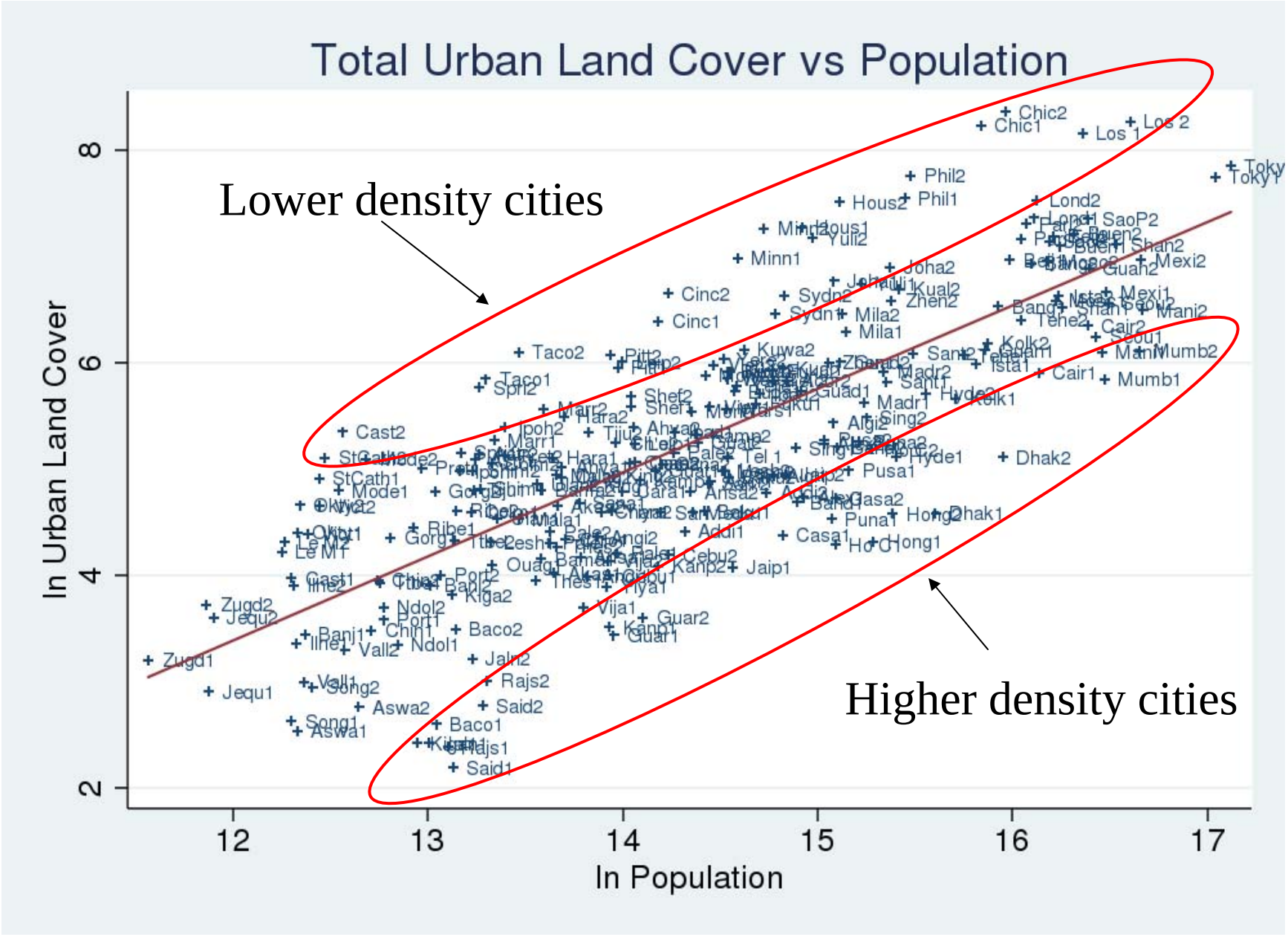


Descriptive statistics

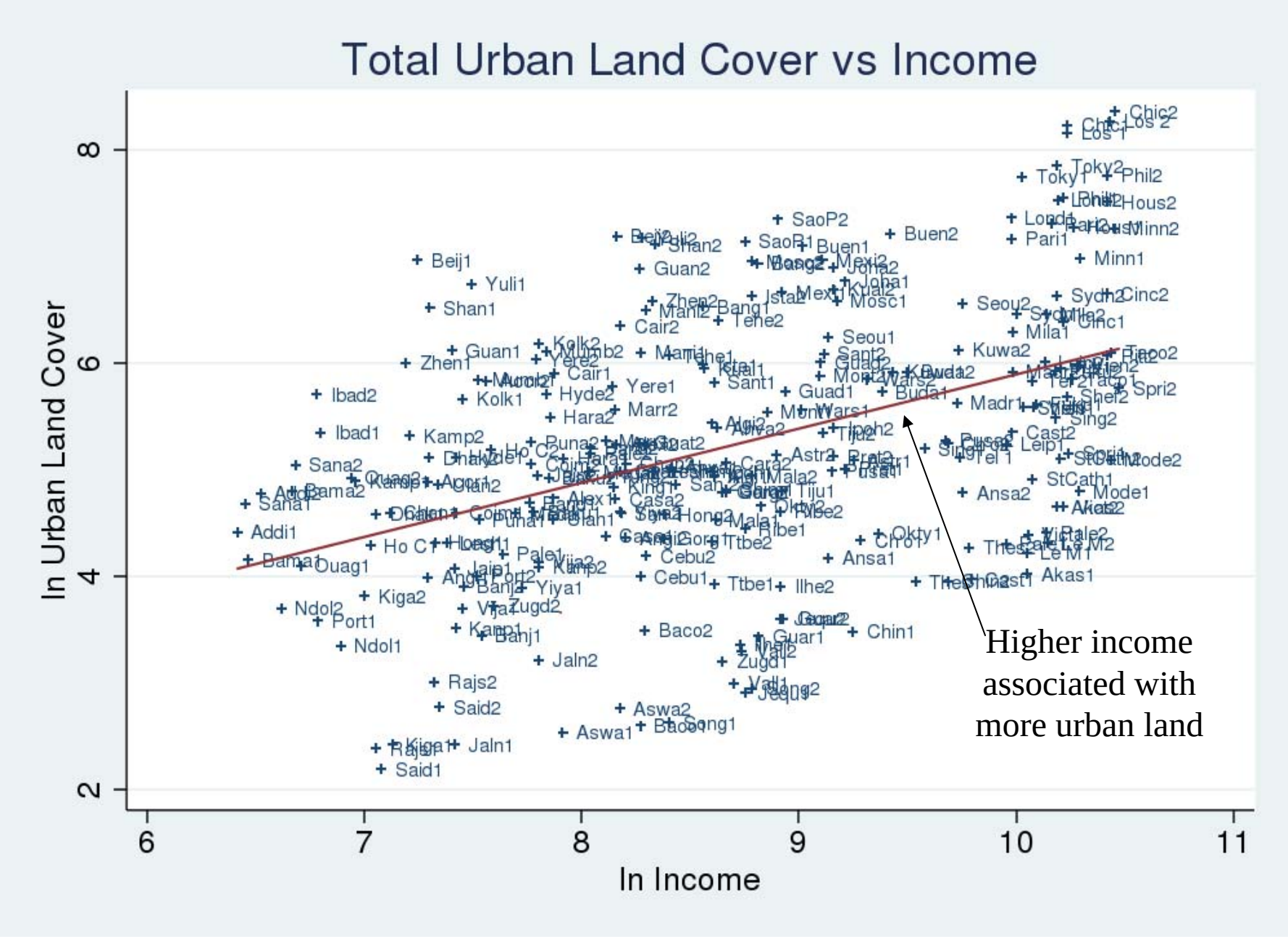
Variable	Obs	Mean	Std. Dev.	Min	Max	CV
Urban Land	240	402.805	635.114	8.917693	4267.998	1.577
Population	240	3,363,025	4459765	93040.91	2.72E+07	1.326
Income	240	9914.078	9916.698	609.881	35354	1.000
Ag Land Value	240	3347.646	12569.780	68.837	150542.9	3.755
Fuel Cost	240	0.620	0.357	0.02	1.56	0.576
Rural Land Conversion	182	13.799	44.485	1	416	3.224
Share Allow	126	0.605	0.358	0	1	0.592
Demolish	154	193.740	1180.937	0	10000	6.095
Subdivide	206	5.684	8.777	0.0833	75	1.544
Planning Staff per 100K	178	4.607	8.052	0	63.72207	1.748

East Asia	240	0.133	0.341
Europe	240	0.133	0.341
Latin America	240	0.133	0.341
North Africa	240	0.067	0.250
South Central Asia	240	0.133	0.341
South East Asia	240	0.100	0.301
SubSaharan Africa	240	0.100	0.301
West Asia	240	0.067	0.250
Other Developed	240	0.133	0.341

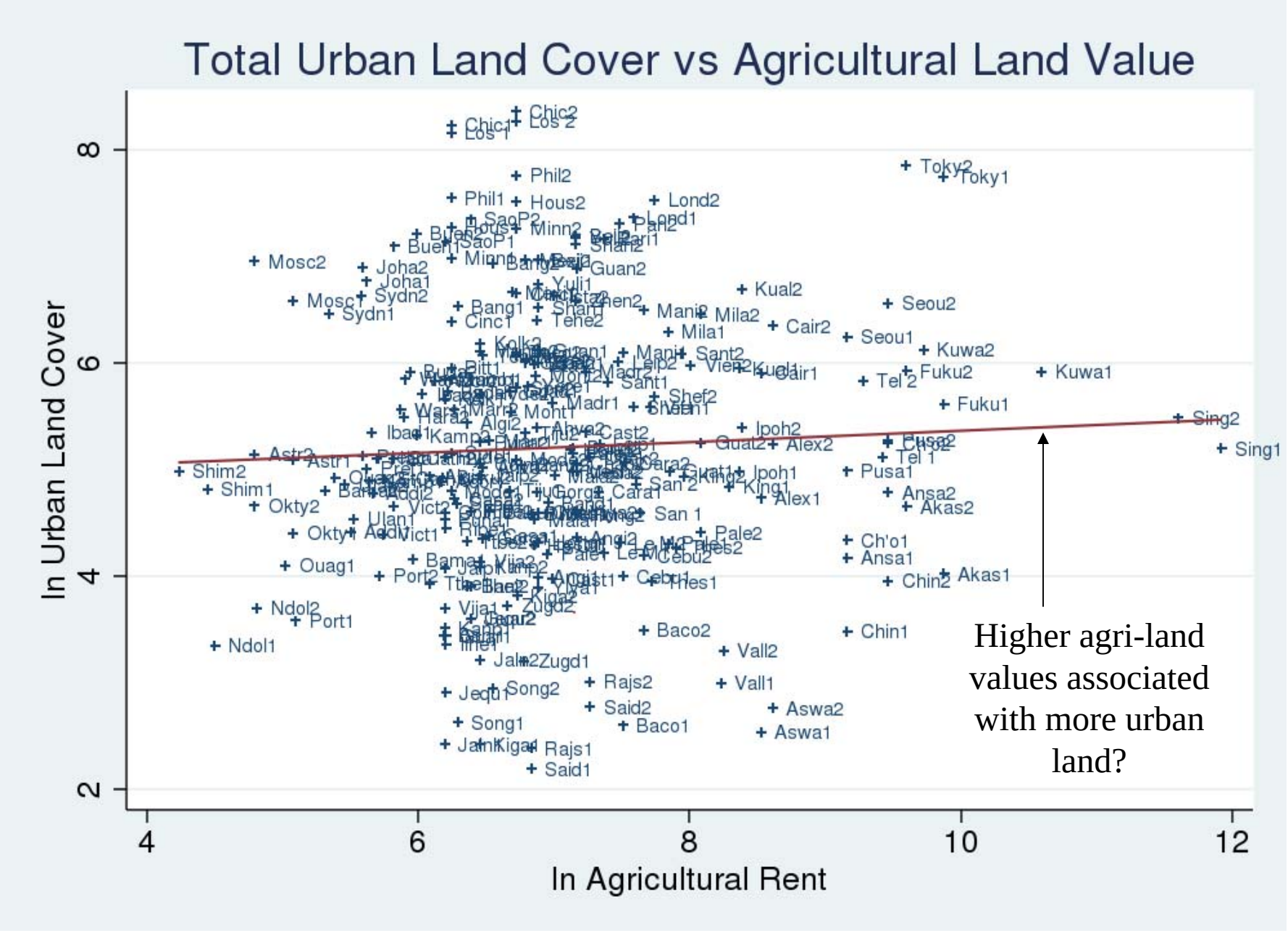
Impact of population growth



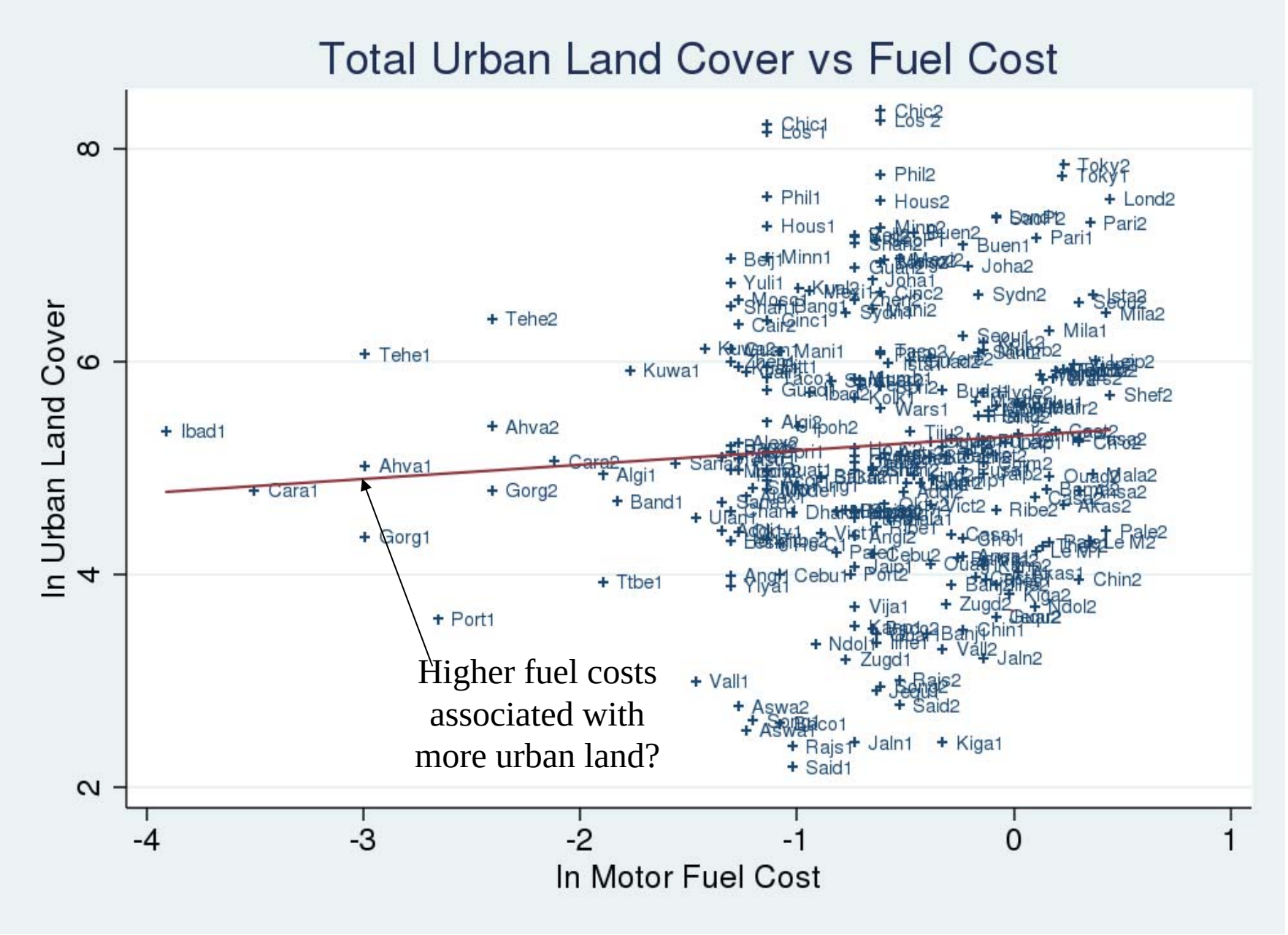
Impact of growing incomes



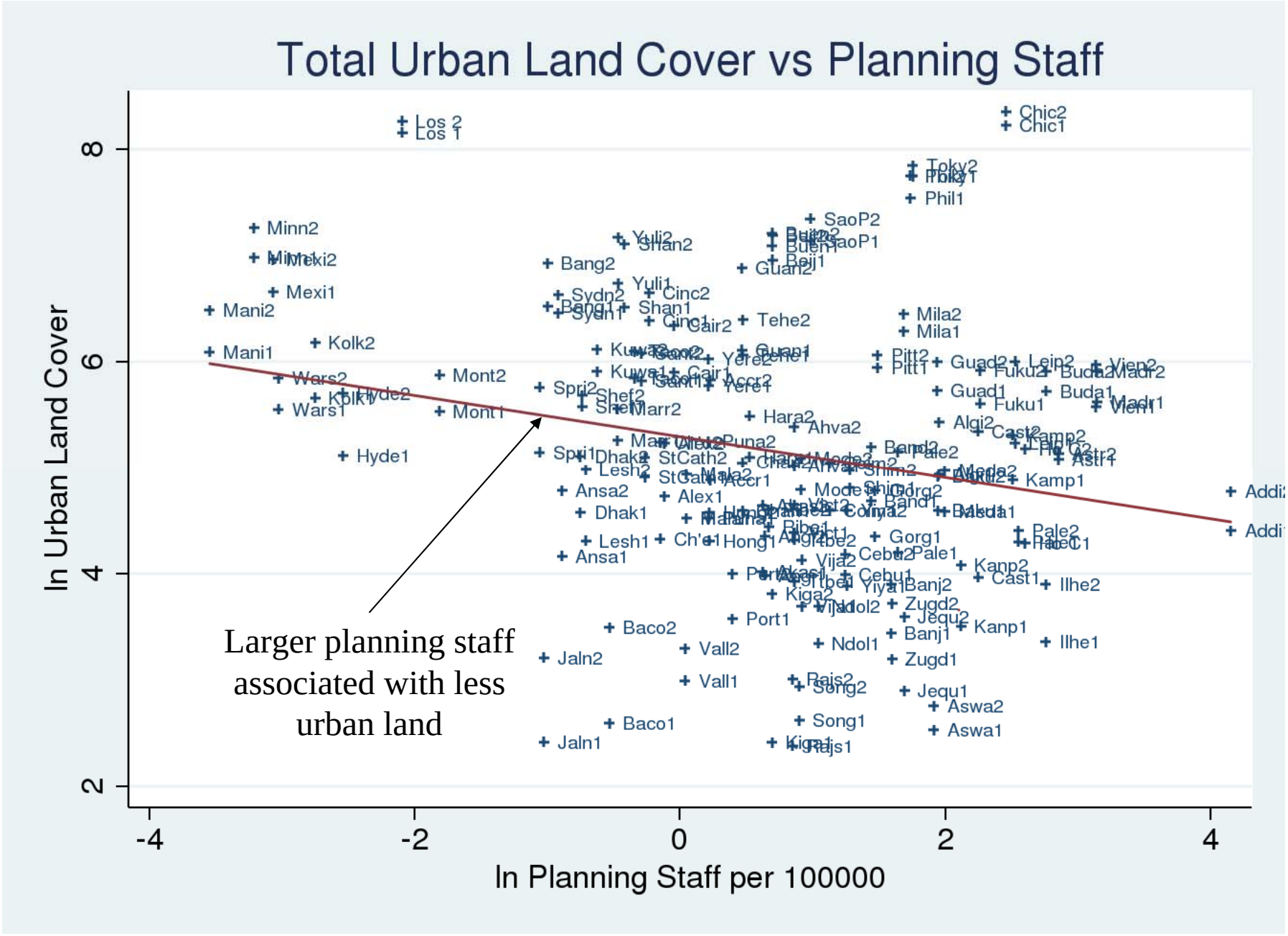
Impact of agricultural land values



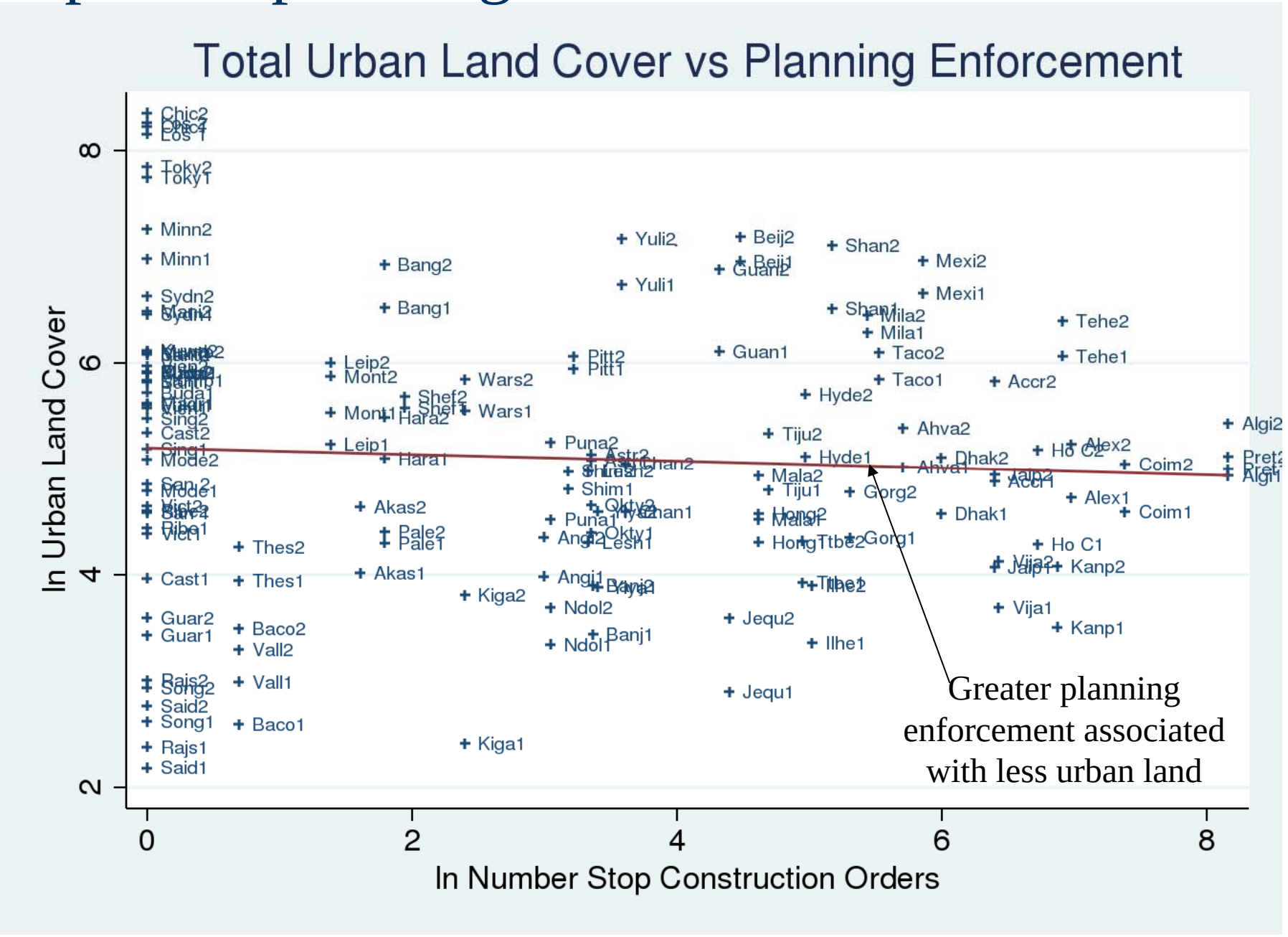
Variations in cost of motor fuel



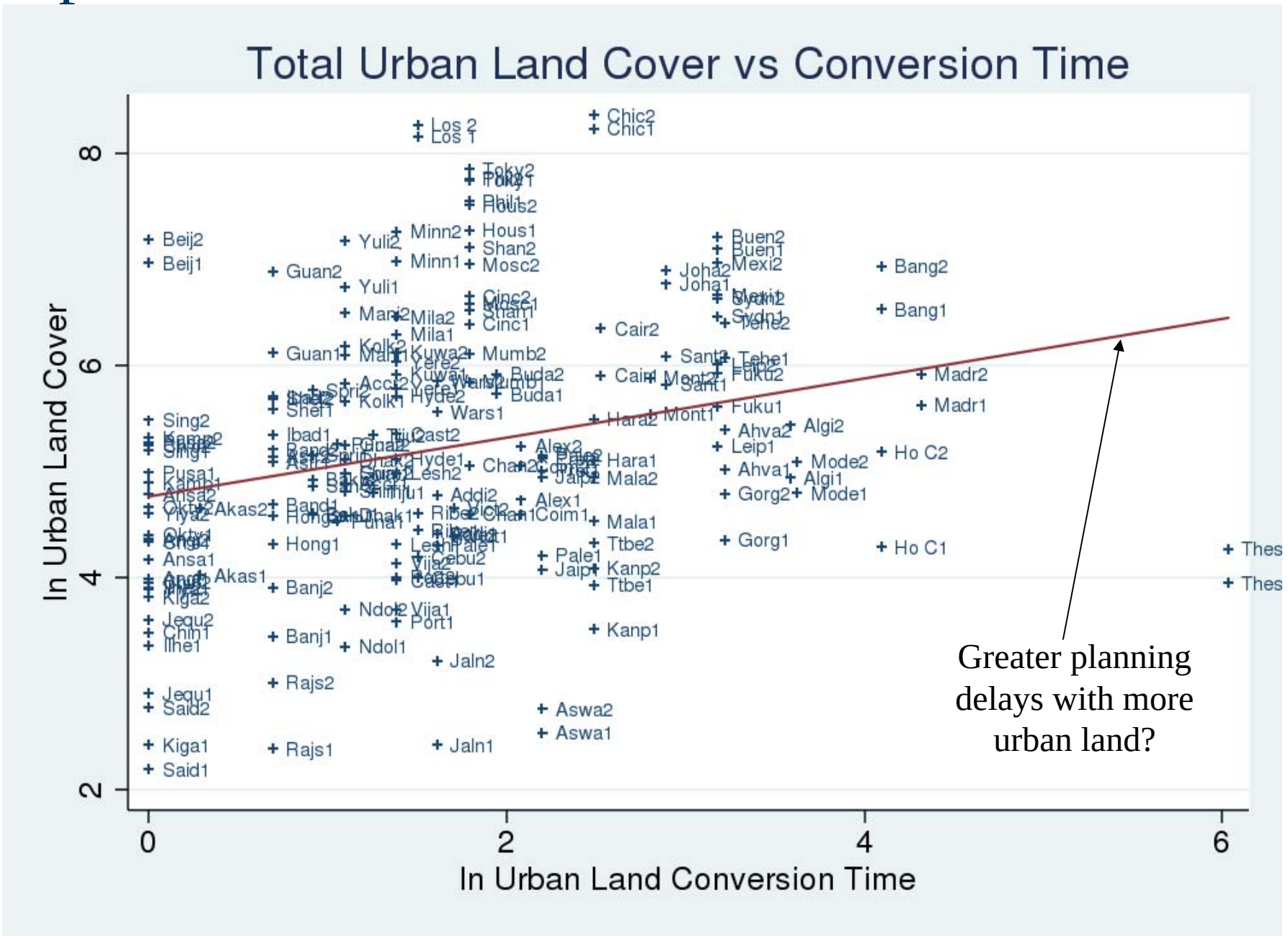
Impact of size of planning department



Impact of planning enforcement



Impact of time to convert rural to urban use



Modeling

- Estimate using cross-section data
  - Ideally we would have time series as well to use panel
  - Lack panel data on planning constraints
- Endogeneity problems!
  - Population, income, planning policies
- Approach
  - Begin with OLS evaluation
    - Region fixed effects
    - Clustered standard errors
  - Employ IV estimation
    - Instruments: location, environmental factors, social and political background
    - Check first stage results and test validity of instruments
- Examine variety of planning policies
  - What are the pathways of policy effectiveness?

OLS Results

	Staff	Demolish	Allow	Subdivide	Both	Rural-Urban
Population	0.8360***	0.8513***	0.8306***	0.8017***	0.8129***	0.8192***
Income	0.6224***	0.7466***	0.6815***	0.5299***	0.6005***	0.6124***
Plan Staff per 100000	-0.0062					
Demolitions		-0.0192				
Share Allowed			-0.0045			
Months Subdivide				-0.0357	-0.0267	
Convert Urban-Rural					-0.0264	-0.0292
Agricultural Land Rent	-0.3064***	-0.2442***	-0.3237***	-0.2462***	-0.2579***	-0.2665***
Fuel Cost	-0.0447	-0.1291*	-0.0851	-0.1549***	-0.1668***	-0.1653***
Region FE?	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-9.9784***	-11.9850***	-10.3171***	-8.9457***	-9.7273***	-9.9142***
	-1.0711	-0.9911	-1.061	-0.7982	-0.9482	-0.8719
Observations	174	154	126	206	176	182
Centered R^2	0.88	0.88	0.88	0.86	0.86	0.87

Insignificant effects – limited policy impact

IV Results

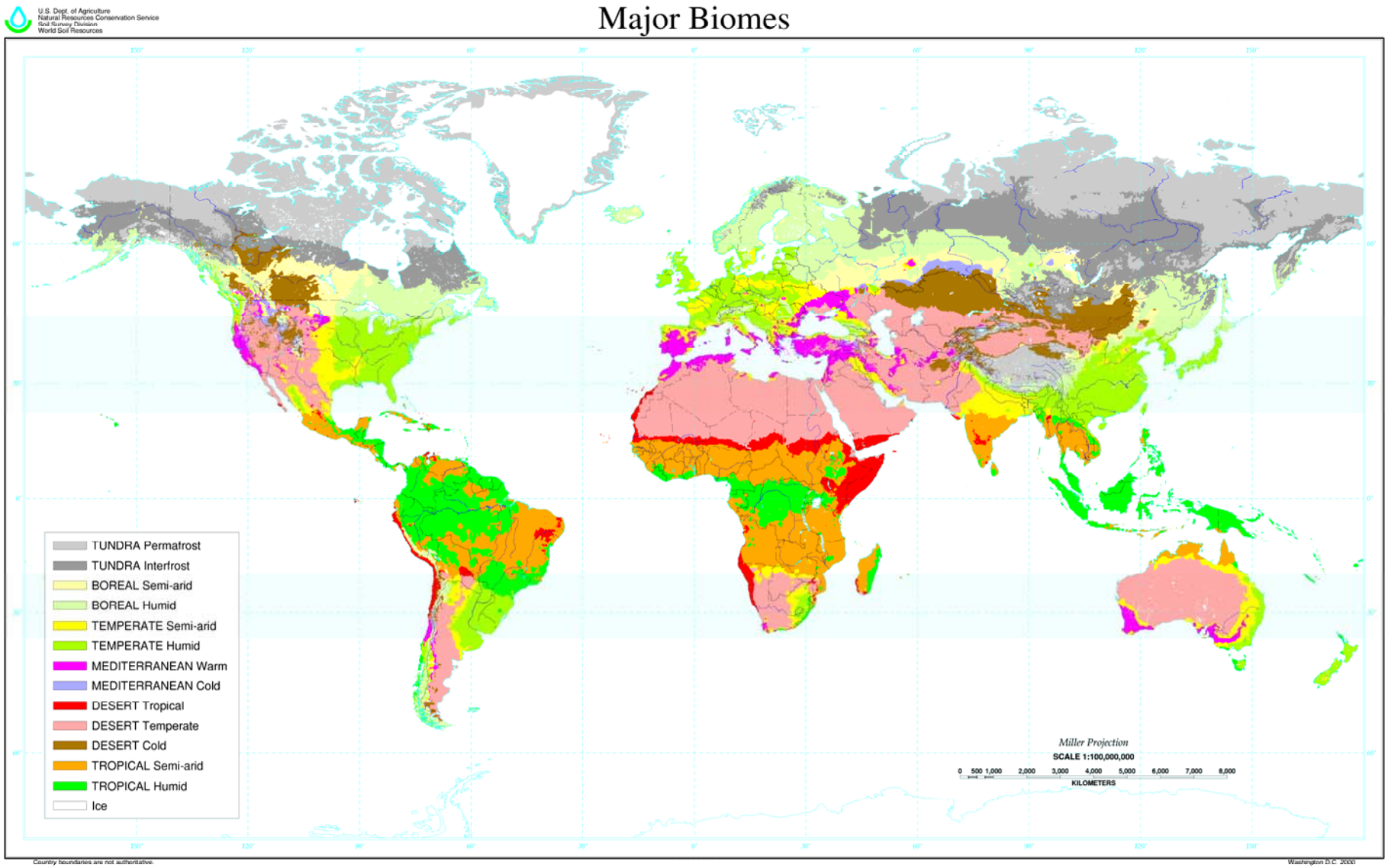
	Staff	Demolish	Allow	Subdivide	Both	Convert Rural
Population	0.8329***	0.7483***	0.8032***	0.6101***	0.8805***	0.8377***
Income	0.2882*	0.6036***	0.6042***	0.5095***	0.5184***	0.5930***
Plan Staff per 100000	0.0749					
Demolitions		-0.0039				
Share Allowed			0.0207			
Months Subdivide				0.0184	0.2256	
Months Convert					-0.2558**	-0.1459**
Agricultural Land Rent	-0.3620***	-0.2081***	-0.3655***	-0.3156***	-0.4146***	-0.3793***
Fuel Cost	-0.222	-0.3614**	-0.0953	-0.224	-0.1583	-0.2852
Constant	-6.1822***	-9.4107***	-8.7843***	-5.5810***	-8.6522***	-8.9956***
Region FE?	Yes	Yes	Yes	Yes	Yes	Yes
Observations	174	154	126	206	176	182
Centered R^2	0.8324	0.8592	0.8756	0.8112	0.7989	0.8431
Anderson LR	18.49	27.338	21.384	18.646	10.519	23.436
P-value	0.1016	0.0069	0.0296	0.0974	0.4844	0.0242
Hansen J	10.293	14.173	4.694	11.508	9.63	9.166
P-value	0.5043	0.2236	0.9106	0.4018	0.4736	0.6066
H0: Endogeneity						13.765
P-value						0.0032
H0: Orthog Instruments						6.733
						0.5657

Impact of planning delays

First stage regressions with instruments

	Population	Income	Convert Land	AgLand Value	Fuel Cost
Ground Water	-0.1926	-0.1125	-0.3082	0.0377	-0.0565
Biometype 4	3.1832***	0.234	1.0206*	0.3144	-0.1958
Biometype 5	1.0952	0.5001	0.7542	2.1986***	0.5514*
Biometype 6	1.9506*	1.3768***	1.7837**	2.7397***	0.6841*
Biometype 7	1.1181	0.8127*	2.3643***	2.6536***	0.3939
Biometype 9	-0.7032	0.7845*	-0.008	2.2037***	1.0417***
Biometype 10	0.5437	0.6195	0.2088	1.9147**	0.4005
Biometype 11	1.2655	1.4605***	1.4549	1.2496	-0.0649
Biometype 12	1.3831	0.272	1.1722	2.3055***	0.7837**
Biometype 13	0.0712	0.6914	-0.5628	2.8039***	0.9754***
Latitude	-0.0003	-0.0067*	-0.0197**	0.019**	-0.0072
Longitude	0.0012	-0.0069***	0.0034	0.0018	-0.0014
Slope	-0.096	0.2974***	-0.246	0.3013*	0.1447
Ethnic	0.0801	-0.2221**	0.6184***	-0.4213**	-0.3181***
Language	-0.026	-0.0432	-0.449**	-0.1729	0.0424
Religion	0.0807	-0.0332	-0.3527***	0.3009*	0.0327
R^2	0.1984	0.4381	0.5002	0.5147	0.3263
F	8.54***	10.12***	7.27***	14.71***	33.26***

Biometypes?


U.S. Dept. of Agriculture
Natural Resources Conservation Service
Soil Survey Division
World Soil Resources
Major Biomes
TUNDRA Permafrost
TUNDRA Interfrost
BOREAL Semi-arid
BOREAL Humid
TEMPERATE Semi-arid
TEMPERATE Humid
MEDITERRANEAN Warm
MEDITERRANEAN Cold
DESERT Tropical
DESERT Temperate
DESERT Cold
TROPICAL Semi-arid
TROPICAL Humid
Ice
Miller Projection
SCALE 1:100,000,000
0 500 1,000 2,000 3,000 4,000 5,000 6,000 7,000 8,000
KILOMETERS
Country boundaries are not authoritative.
Washington D.C. 2000

Relative impact

- Which forces are the “most important”?
  - Using CV gives the percent change from one σ change in variable (relative to mean)
  - Multiply by estimated elasticity to obtain impact on total urban land cover

	One σ %	% Urban Land
Population	132.61%	111.09%
Income	100.03%	59.32%
Ag Land Value	375.48%	-142.42%
Fuel Cost	57.63%	-16.44%
Rural to Urban Delay	322.38%	-47.03%

- A one standard error increase in ‘planning delay’ is associated with a 47% decrease in urban land cover

Conclusions

- Using data from a global sample of cities
  - Variation in population, income, agricultural land values, transport costs all associated with expected changes in urban land cover
  - Urban theory works pretty well
- Planning policies show mixed effectiveness:
  - Size of planning department shows no impact
    - “Planning” produces public goods other than constraint
  - Enforcement actions and restrictiveness show no impacts
    - Enforcement may rise in response to violations, but not sufficient
    - Restrictiveness may reflect public sector bargaining position

Conclusions

- Delay in subdividing land approved for urban use has no impact
  - Approval for urban use indicates expansion
  - Delay may reflect local infrastructure provision
- Delay in approval of change from rural to urban use has an impact
  - Clearest link to restriction of urban expansion
  - Even if eventually approved, increases risk of development
- Land use regulation can be effective constraint even in global context
  - Potential role as part of growth policy
  - Constraint does NOT imply efficiency!

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  - Williams College