Institut für Raumordnung und Entwicklungsplanung
Universität Stuttgart

# Comparative risk assessment

Megacities transitions: towards justice with resilience
May 11th, 2016

Prof. Dr. Joern Birkmann and Dr. Torsten Welle



## Content



- 2 risk assessment approaches
  - Indicator based approach – city scale
  - Household based approach – household level
- Composition of the indicator system and the household survey analysis
- Results and first conclusions

## 3 Composition: Vulnerability Index

ireus | Institut für Raumordnung und Entwicklungsplanung

### Susceptibility

**Demography**

A) Population density (SSP)
B) Percentage of people older than 65y (SSP)

**Health and Nutrition**

C) Life expectancy (IFs)
D) Percentage of obese population (malnutrition) (IFs)
E) Infant mortality rate (per 1000 live births) (IFs)

**Poverty and Income**

F) Dependency ratio (SSP)
G) Unemployment rate (no data)
H) Poverty rate (IFs)

**Economic capacity and income distribution**

I) GDP per capity in US$ (PPP) (SSP)
J) Gini Index (maybe using IFs)

**Housing and Neighborhood conditions**

K) Overcrowded apartments and slum population (no data)

### Coping Capacity

**Government and Authorities**

A) Corruption Perception Index (IFs)
B) Crime Index (IFs)
C) Urban planning (green space per person m2/person) (no data)

**Medical Services**

D) Number of Physicians per 100,000 People (no data)
E) Number of hospitals beds per 100,000 people (no data)

**Economic Coverage**

F) GDP of the metropolitan area as % of national value (SSP)

**Disaster preparedness**

G) Number of fire fighter/100,000 people probably nothing (no data)

### Adaptive Capacity

**Education and Research**

A) Percent of population with higher education (students completing secondary education) (SSP)
B) Literacy rate (IFs)

**Environmental Status / Ecosystem Protection**

C) Air quality (PM10) ug/m3 (IFs)
D) Waste generated by person (kg/person/year) (no data)

**Gender Equity**

E) Share of female representatives in the National Parliament (maybe IFs)
F) Share of women in wage employment in the nonagricultural sector (IFs)

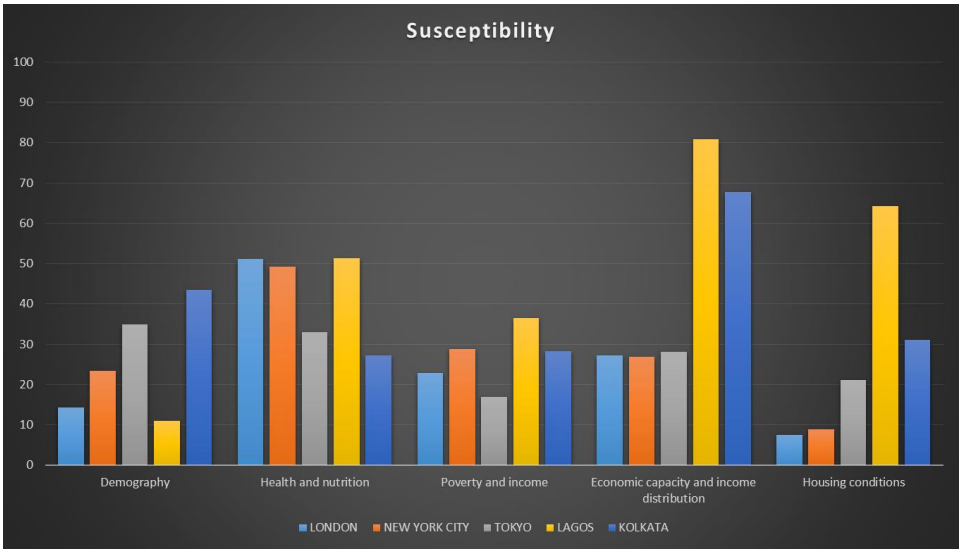
**Adaptation strategies/Awareness**

G) GHG emissons per cap of 50 largest cities ratio of case study cities) (no data)
H) Transportsystem (public transport network km/km2) – (IFs)



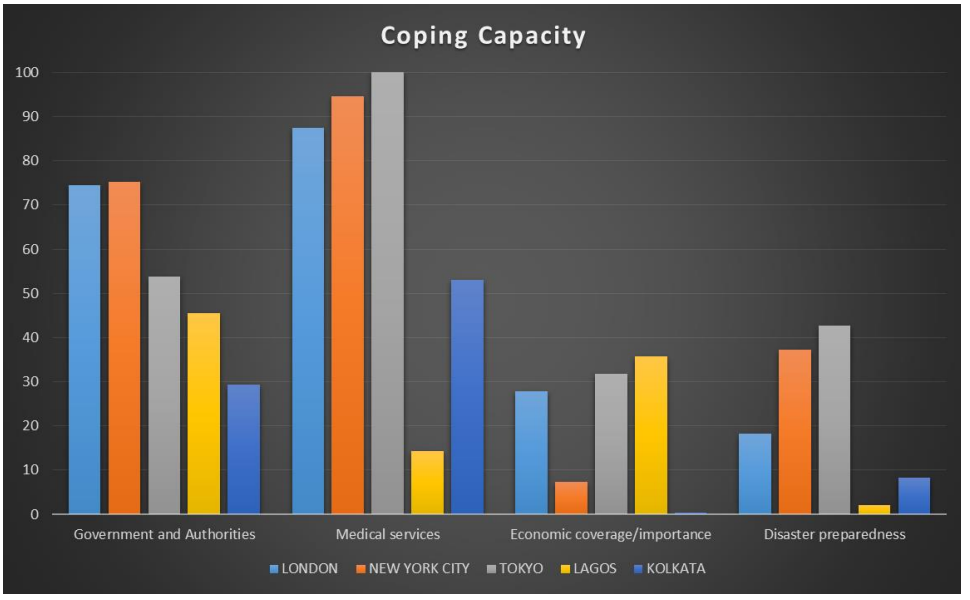
## 4 Susceptibility index

ireus | Institut für Raumordnung und Entwicklungsplanung



## 5 Coping Capacity index

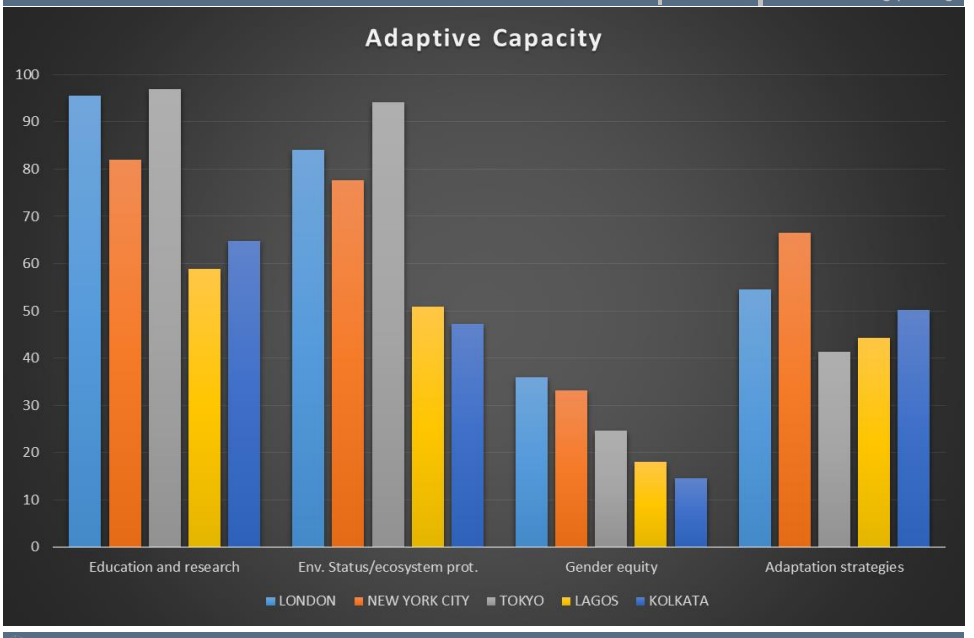
ireus Institut für Raumordnung und Entwicklungsplanung





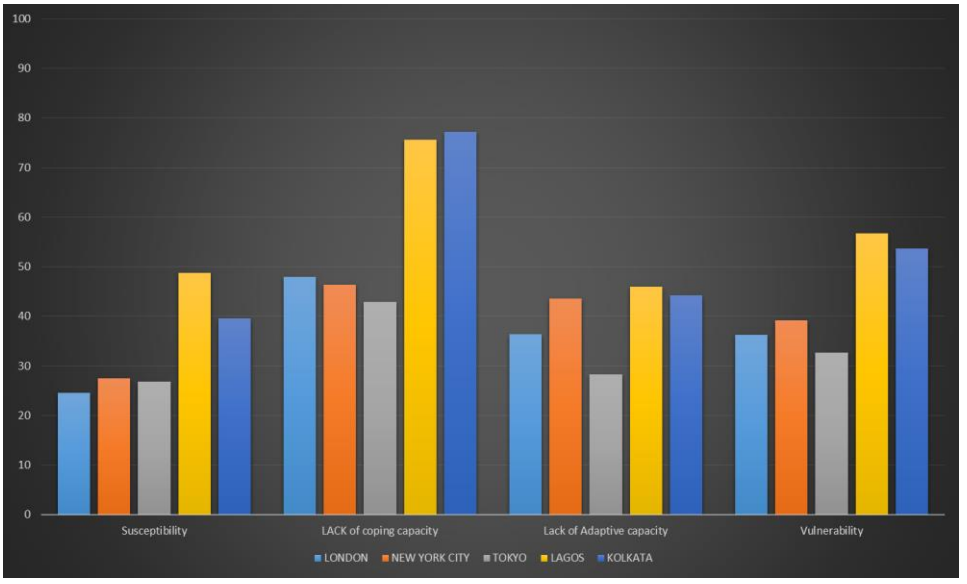

## 6 Adaptive Capacity index

ireus Institut für Raumordnung und Entwicklungsplanung



## 7 Vulnerability index

ireus Institut für Raumordnung und Entwicklungsplanung






## 8 Vulnerability index – city comparison

ireus Institut für Raumordnung und Entwicklungsplanung

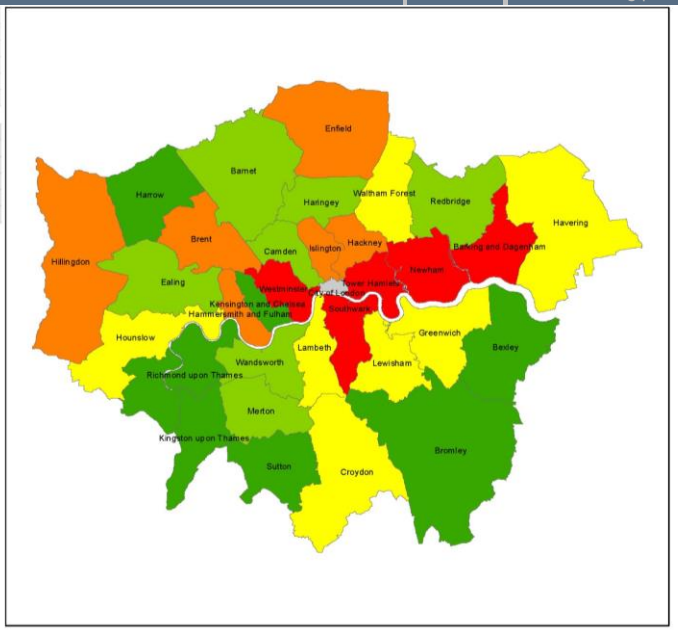
| | lowest vulnerability |
|---|---|
| 1 | Richmond upon Thames |
| 2 | Kingston upon Thames |
| 3 | Harrow |
| 4 | Kensington and Chelsea |
| 5 | Bromley |

| | highest vulnerability |
|---|---|
| 1 | Newham |
| 2 | Barking and Dagenham |
| 3 | Westminster |
| 4 | Tower Hamlets |
| 5 | Southwark |

City of London not included due to data constraints

**Vulnerability London Boroughs**

- 25,68 - 31,79 *very low*
- 31,80 - 34,44 *low*
- 34,45 - 35,75 *medium*
- 35,76 - 38,46 *high*
- 38,47 - 46,93 *very high*
- City of London



## Household Survey



**Method:** factor analysis

- Selection of eleven variables

1. Performance of local authority
2. Performance of medical services
3. Performance of local authority in risk mgtm over past years
4. Help from friends and neighbors
5. Feel prepared
6. Resources to change livelihood
7. Risk reduction practice
8. Financial resources of hh
9. Awareness of risk mgtm in neighborhood
10. Consumption of water and energy within neighborhood
11. Access to early warning

**Rotated Component Matrix[a]**

| | Component | | |
|---|---|---|---|
| | 1 | 2 | 3 |
| q49 | ,856 | | |
| q410 | ,831 | | |
| q67 | ,705 | | |
| q412 | ,599 | ,486 | |
| Feel prepared | | ,773 | |
| q63 | | ,716 | |
| q65 | | ,623 | ,547 |
| q411 | ,558 | ,609 | |
| q64 | | | ,732 |
| q62 | | | ,713 |
| q66 | | | ,562 |

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation conve

| Rotation Sums of Squared Loadings | | |
|---|---|---|
| Total | % of Variance | Cumulative % |
| 2,669 | 24,266 | 24,266 |
| 2,282 | 20,745 | 45,011 |
| 1,903 | 17,299 | 62,310 |

**KMO and Bartlett's Test**

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | ,812 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 3059,963 |
| | df | 55 |
| | Sig. | ,000 |





## Comparison of risk management



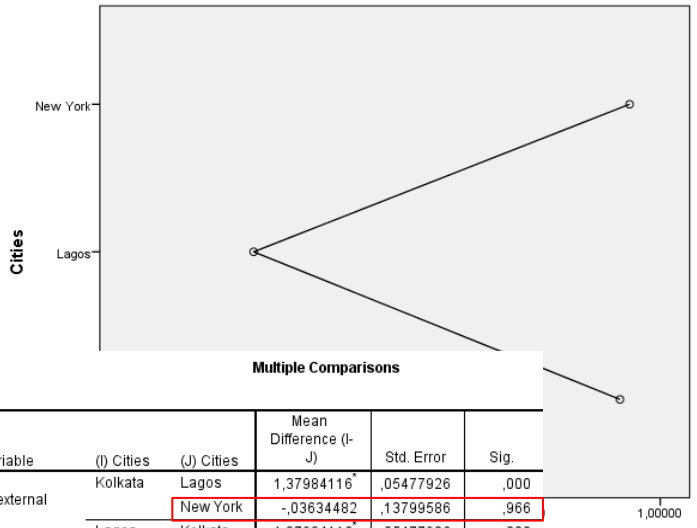
**Method:** analysis of variance (anova and scheffe test)

**Descriptives**

| | | N | Mean | Std. Deviation | Std. Error | 95% Confidence Interval for Mean | | Minimum | Maximum |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound | | |
| authority performance_external risk mgt | Kolkata | 285 | ,8482379 | ,67467004 | ,03996400 | ,7695747 | ,9269011 | -1,19435 | 2,96026 |
| | Lagos | 508 | -,5316033 | ,73672259 | ,03268678 | -,5958215 | -,4673850 | -2,05895 | 2,46586 |
| | New York | 32 | ,8845827 | 1,21666547 | ,21507810 | ,4459281 | 1,3232374 | -1,70915 | 2,57200 |
| | Total | 825 | ,0000000 | 1,00000000 | ,03481553 | -,0683376 | ,0683376 | -2,05895 | 2,96026 |
| HH performance_internal risk mgtm | Kolkata | 285 | ,1224424 | 1,05671296 | ,06259427 | -,0007652 | ,2456499 | -2,13289 | 3,37404 |
| | Lagos | 508 | -,1026743 | ,95730519 | ,04247355 | -,1861202 | -,0192285 | -2,45803 | 3,14624 |
| | New York | 32 | ,5394529 | ,86698473 | ,15326270 | ,2268715 | ,8520342 | -1,10205 | 1,95897 |
| | Total | 825 | ,0000000 | 1,00000000 | ,03481553 | -,0683376 | ,0683376 | -2,45803 | 3,37404 |
| neighborhood performance | Kolkata | 285 | -,3639663 | ,67787858 | ,04015406 | -,4430036 | -,2849290 | -2,21814 | 1,91927 |
| | Lagos | 508 | ,1048424 | 1,04100559 | ,04618715 | ,0141006 | ,1955841 | -2,23352 | 4,10475 |
| | New York | 32 | 1,5772024 | ,82547943 | ,14592552 | 1,2795853 | 1,8748195 | -,62527 | 2,92312 |
| | Total | 825 | ,0000000 | 1,00000000 | ,03481553 | -,0683376 | ,0683376 | -2,23352 | 4,10475 |

## 11 Comparison of risk management

ireus Institut für Raumordnung und Entwicklungsplanung




**Multiple Comparisons**

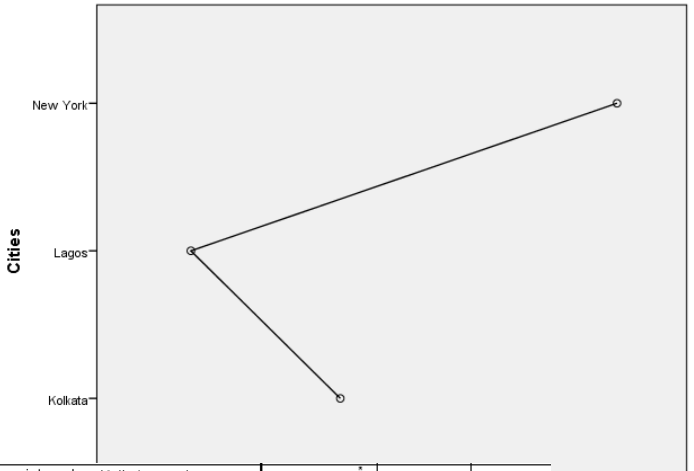
Scheffe

| Dependent Variable | (I) Cities | (J) Cities | Mean Difference (I-J) | Std. Error | Sig. |
|---|---|---|---|---|---|
| authority performance_external risk mgt | Kolkata | Lagos | 1,37984116* | ,05477926 | ,000 |
| | | New York | -,03634482 | ,13799586 | ,966 |
| | Lagos | Kolkata | -1,37984116* | ,05477926 | ,000 |
| | | New York | -1,41618598* | ,13490371 | ,000 |
| | New York | Kolkata | ,03634482 | ,13799586 | ,966 |
| | | Lagos | 1,41618598* | ,13490371 | ,000 |

J. Birkmann & T. Welle

## 12 Comparison of risk management

ireus Institut für Raumordnung und Entwicklungsplanung

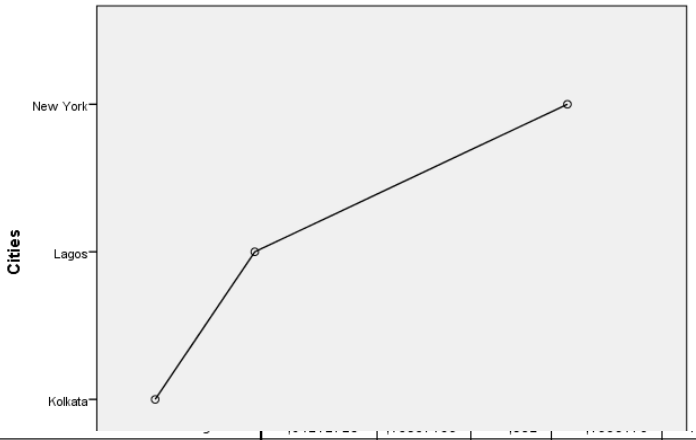



| | | | | | |
|---|---|---|---|---|---|
| HH performance_internal risk mgtm | Kolkata | Lagos | ,22511672* | ,07324204 | ,009 |
| | | New York | -,41701049 | ,18450593 | ,078 |
| | Lagos | Kolkata | -,22511672* | ,07324204 | ,009 |
| | | New York | -,64212720* | ,18037159 | ,002 |
| | New York | Kolkata | ,41701049 | ,18450593 | ,078 |
| | | Lagos | ,64212720* | ,18037159 | ,002 |

J. Birkmann & T. Welle

## 13 Comparison of risk management

ireus Institut für Raumordnung und Entwicklungsplanung




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| neighborhood performance | Kolkata | Lagos | -,46880868* | ,06834769 | ,000 | -,6364118 | -,3012055 |
| | | New York | -1,94116873* | ,17217646 | ,000 | -2,3633822 | -1,5189552 |
| | Lagos | Kolkata | ,46880868* | ,06834769 | ,000 | ,3012055 | ,6364118 |
| | | New York | -1,47236005* | ,16831840 | ,000 | -1,8851128 | -1,0596073 |
| | New York | Kolkata | 1,94116873* | ,17217646 | ,000 | 1,5189552 | 2,3633822 |
| | | Lagos | 1,47236005* | ,16831840 | ,000 | 1,0596073 | 1,8851128 |

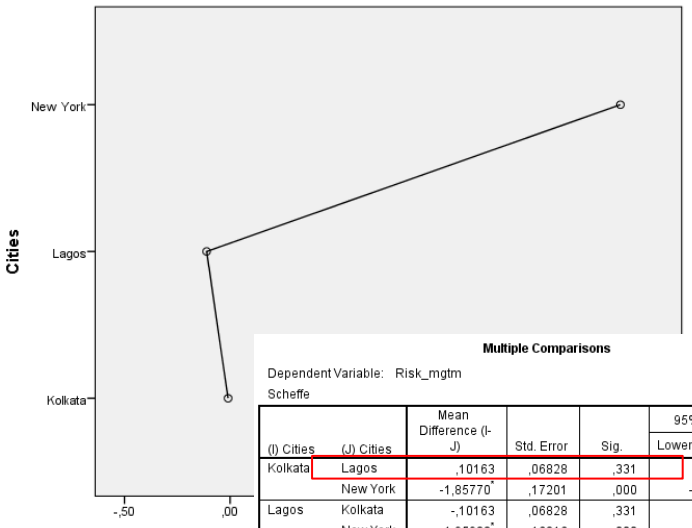
*. The mean difference is significant at the 0.05 level.

T. Welle

## 14 Comparison of risk management

ireus Institut für Raumordnung und Entwicklungsplanung

Aggregated factors to risk management




**Multiple Comparisons**

Dependent Variable: Risk_mgtm

Scheffe

| (I) Cities | (J) Cities | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval Lower Bound | 95% Confidence Interval Upper Bound |
|---|---|---|---|---|---|---|
| Kolkata | Lagos | ,10163 | ,06828 | ,331 | -,0658 | ,2691 |
| | New York | -1,85770* | ,17201 | ,000 | -2,2795 | -1,4359 |
| Lagos | Kolkata | -,10163 | ,06828 | ,331 | -,2691 | ,0658 |
| | New York | -1,95933* | ,16816 | ,000 | -2,3717 | -1,5470 |
| New York | Kolkata | 1,85770* | ,17201 | ,000 | 1,4359 | 2,2795 |
| | Lagos | 1,95933* | ,16816 | ,000 | 1,5470 | 2,3717 |

*. The mean difference is significant at the 0.05 level.

## Conclusion



- Household level risk assessment - particularly low values for Lagos; contrast: neighborhood level risk assessment – Lagos higher compared to Kolkata.
- Quantitative indicators underscore that significant differences exist e.g. in terms of coping capacities for example „governance“ and „disaster preparedness“ as well as regarding adaptive capacities.
- Challenges still exist regarding the cross-validation of the results generated by the different assessments, however, important structures (vulnerability profiles) are evident.





ireus Institut für Raumordnung und Entwicklungsplanung

# THANK YOU FOR YOUR ATTENTION

joern.birkmann@ireus.uni-stuttgart.de
torsten.welle@ireus.uni-stuttgart.de