Getting Urbanization Right in Bangladesh

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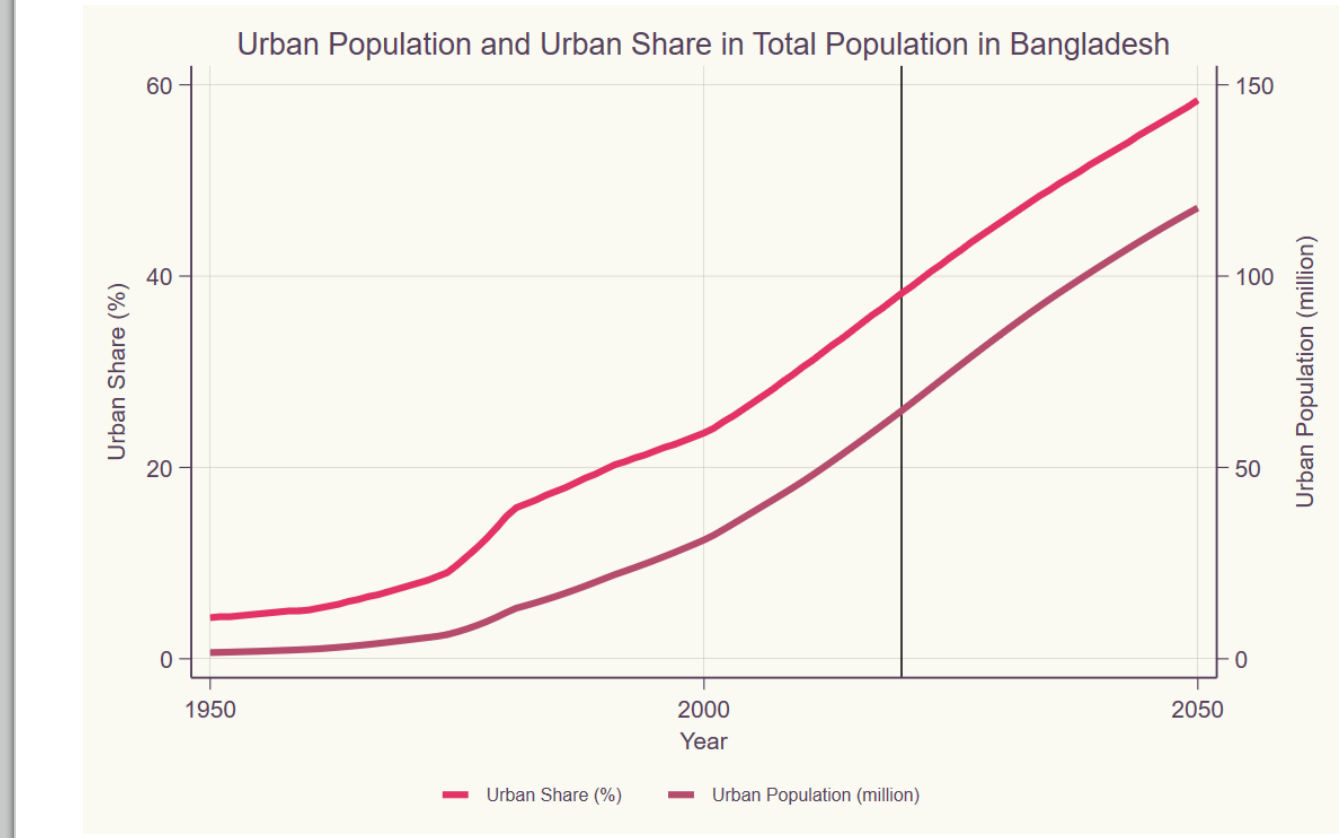
Rapid Urbanization is expected in Bangladesh

- Urbanization rate to rise from 38% in 2020 to 60% by 2050
- Total urban population will double by 2050
- Lots of attention on Dhaka city but can it absorb another 50 million people?



This Talk

- Addresses the following questions:
  - How did urbanization pattern evolve in the past focusing on differences between mega-city of Dhaka and other cities;
  - How do recent developments of improved connectivity may affect urbanization pattern;
  - How cities will cope with migration due to climate induced sea-level rise, flooding and natural disasters.

Patterns of Urbanization

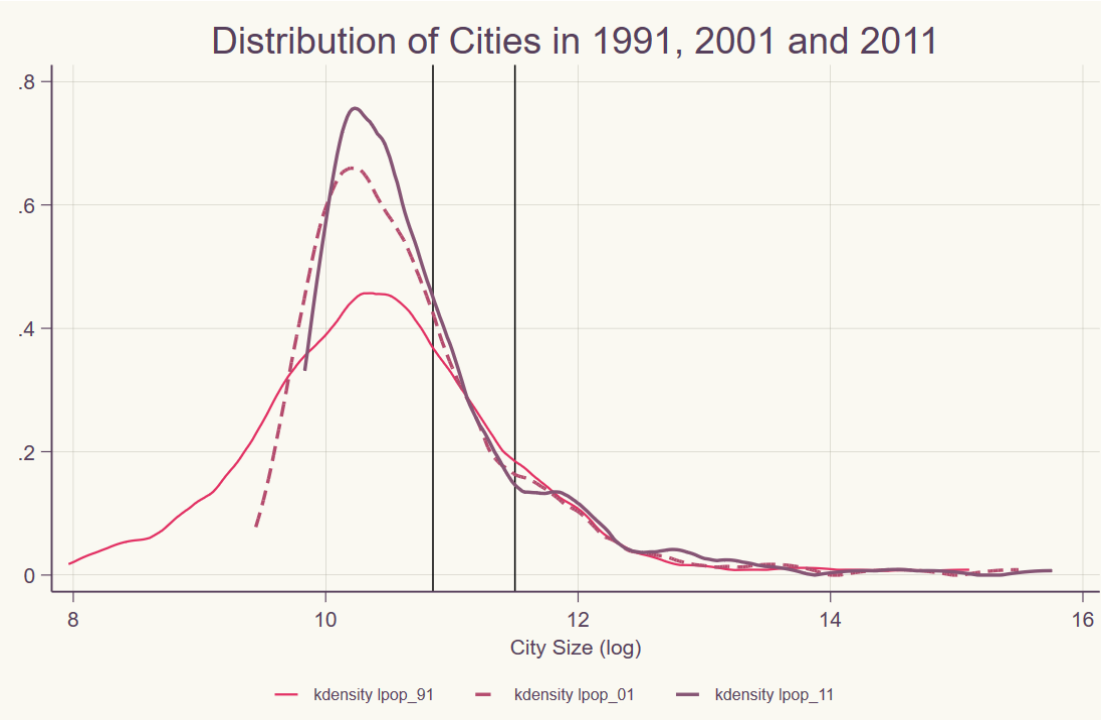
Pattern of Urbanization

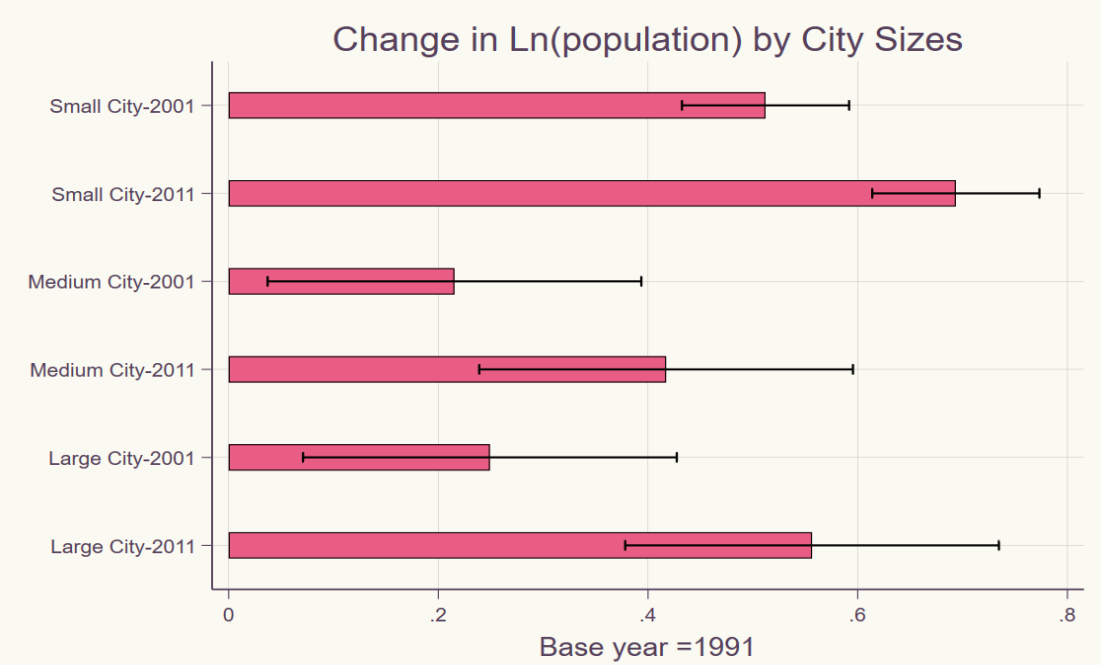
- We rely on three sources of data
  - Censuses (1991, 2001, 2011)
  - Global Human Settlement Layer (GHSL) on built-up areas (1975, 1990, 2000, 2014)
  - Harmonized Nightlights data (1992-2020)

Population in Cities and Towns overtime

- Cities and Towns are identified from censuses labeled as city or municipality
- We do not know how land areas of cities changed overtime
- No. of cities: 20 cities, 240 towns/smaller cities and 2 Cantonments (around Dhaka) in 2011
- Total number increased from 133 in 1991 to 194 in 2001 and 262 in 2011

- Little change in the distribution of cities across size class
- Robust growth of population of smaller cities (<50k) during the 1990s, slower growth in medium sized cities (between 50-100k) in 2000's
- Do not know whether growth is horizontal (addition of more areas) or vertical (higher density)

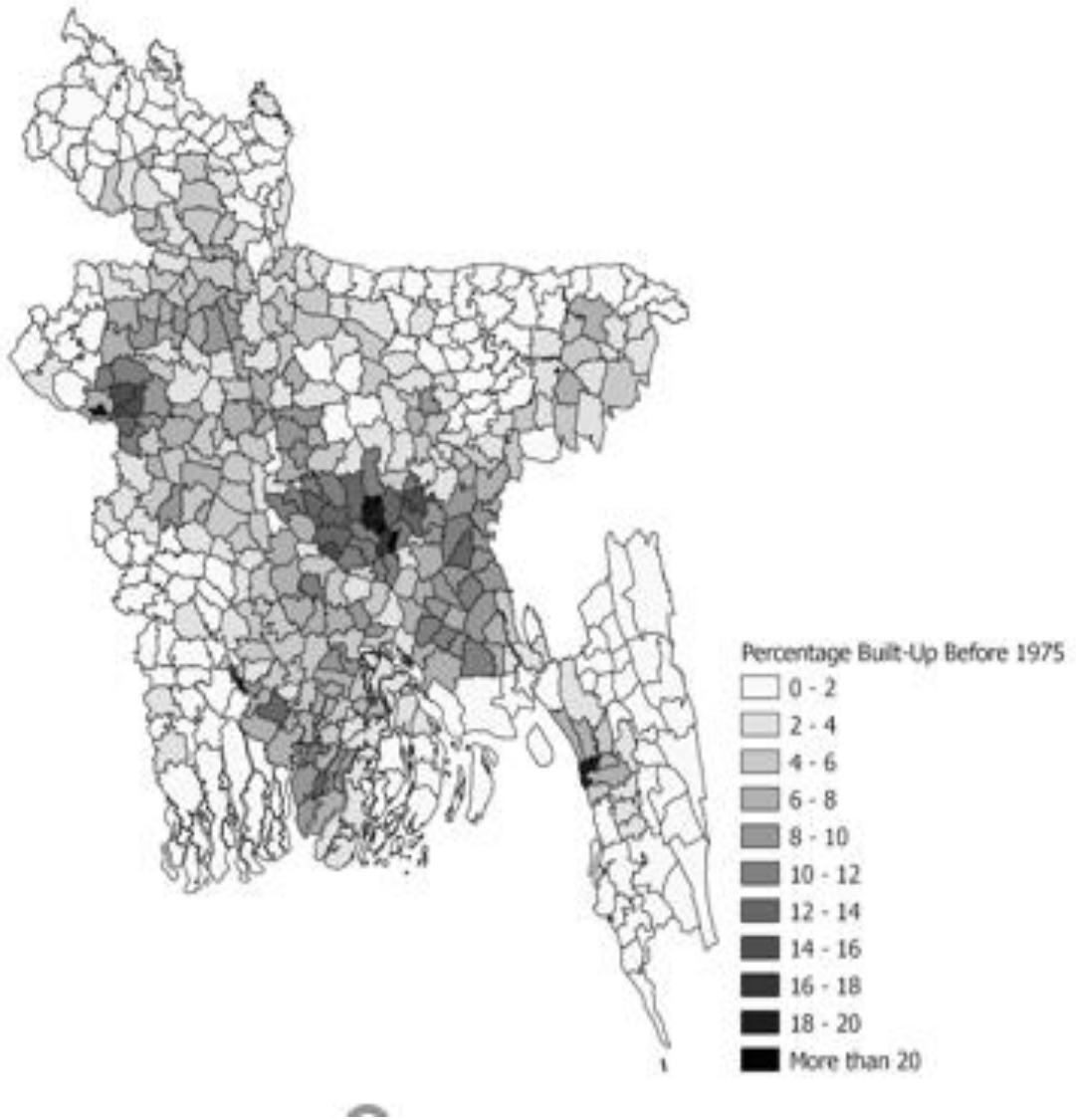


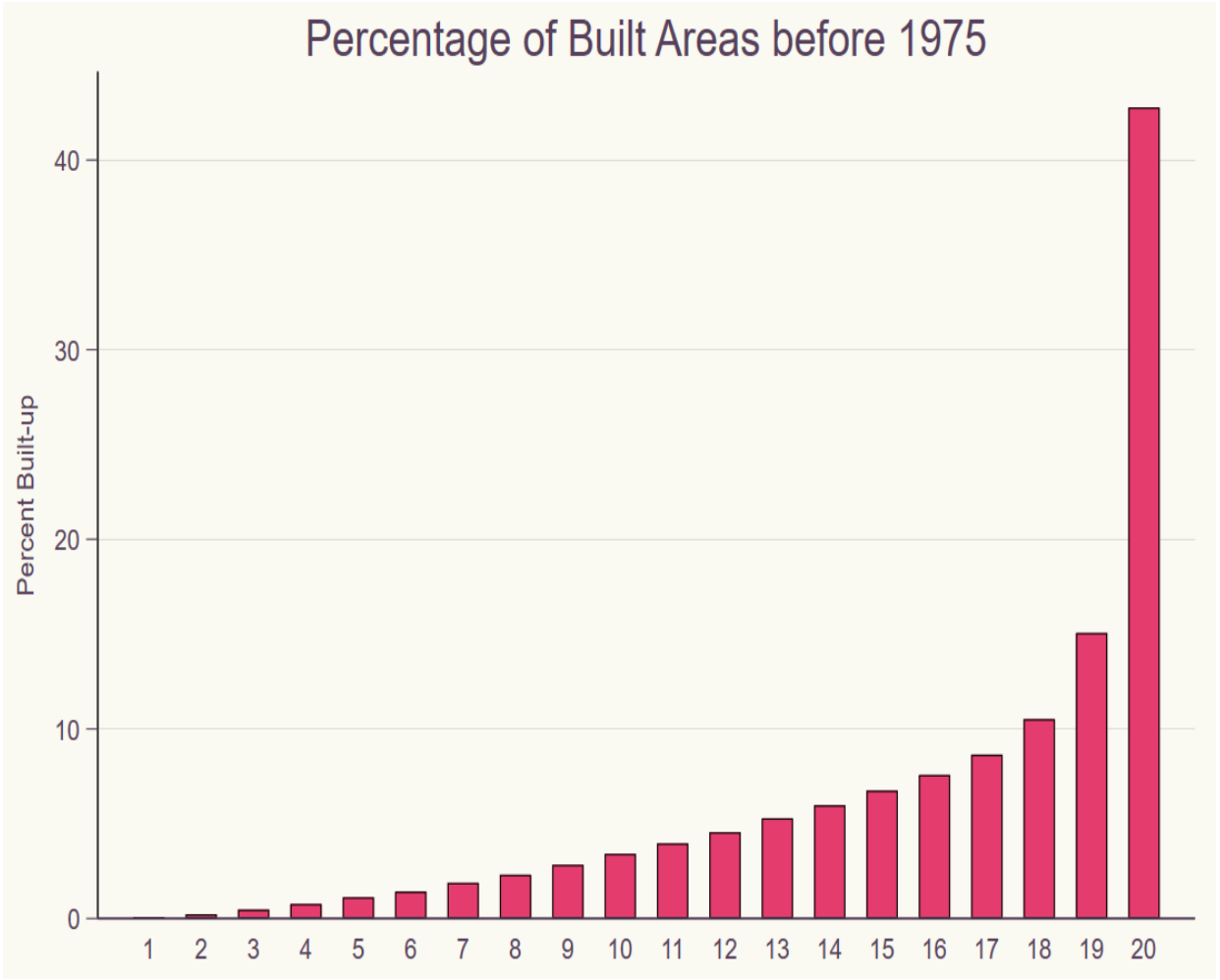


Urbanization at a finer scale

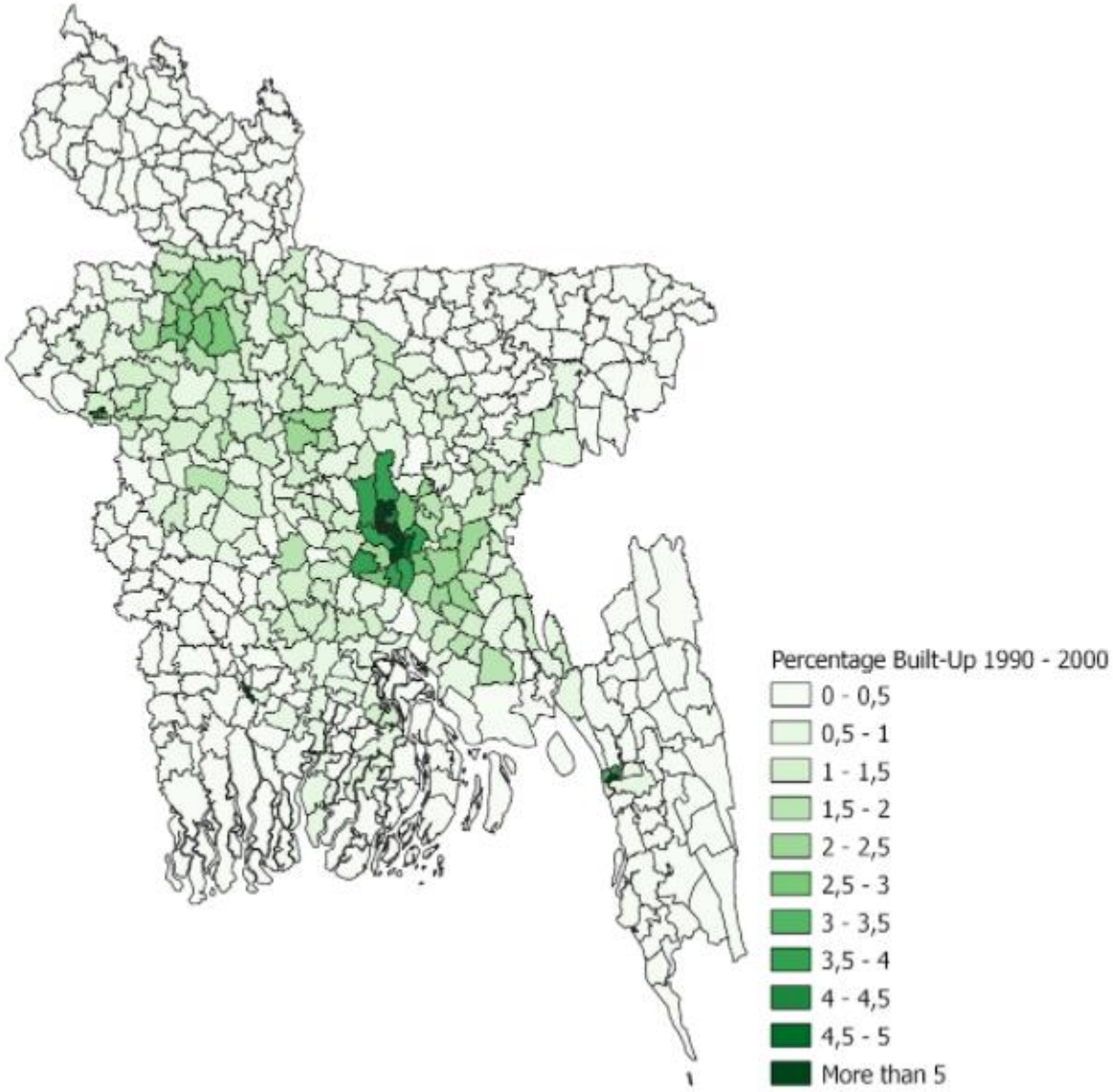
- Use Global Human Settlement Layer : Built-up data at 30mX30m resolution. Data available for 1975, 1990, 2000 and 2014
- Construct upazila level panel using 1991 upazila boundary shapefile
- Define urban spectrum in terms of built-up density in 1975: divide upazilas in 20 quantiles in terms of proportion of pixels built-up by 1975

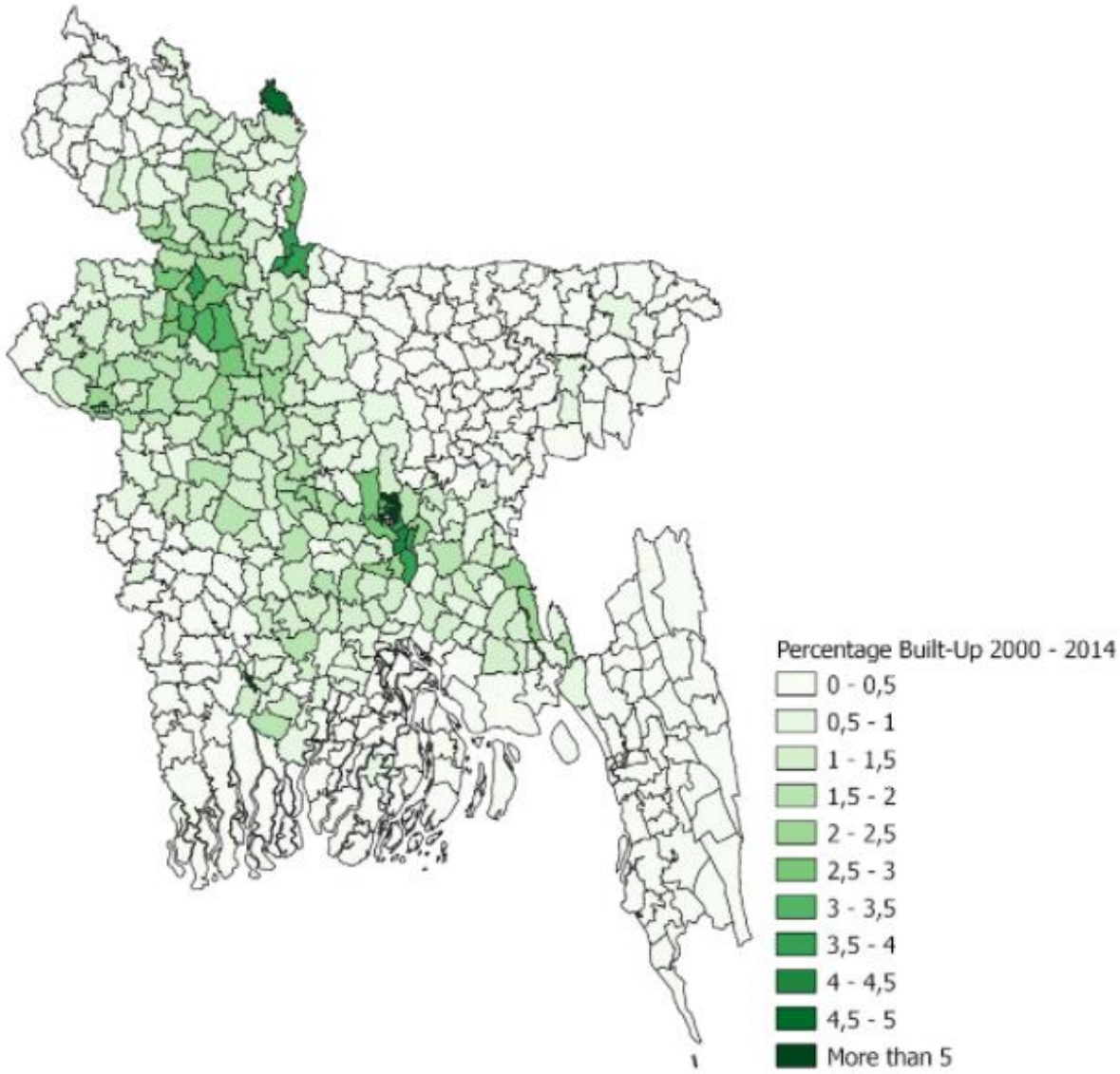
Built-up density in 1975



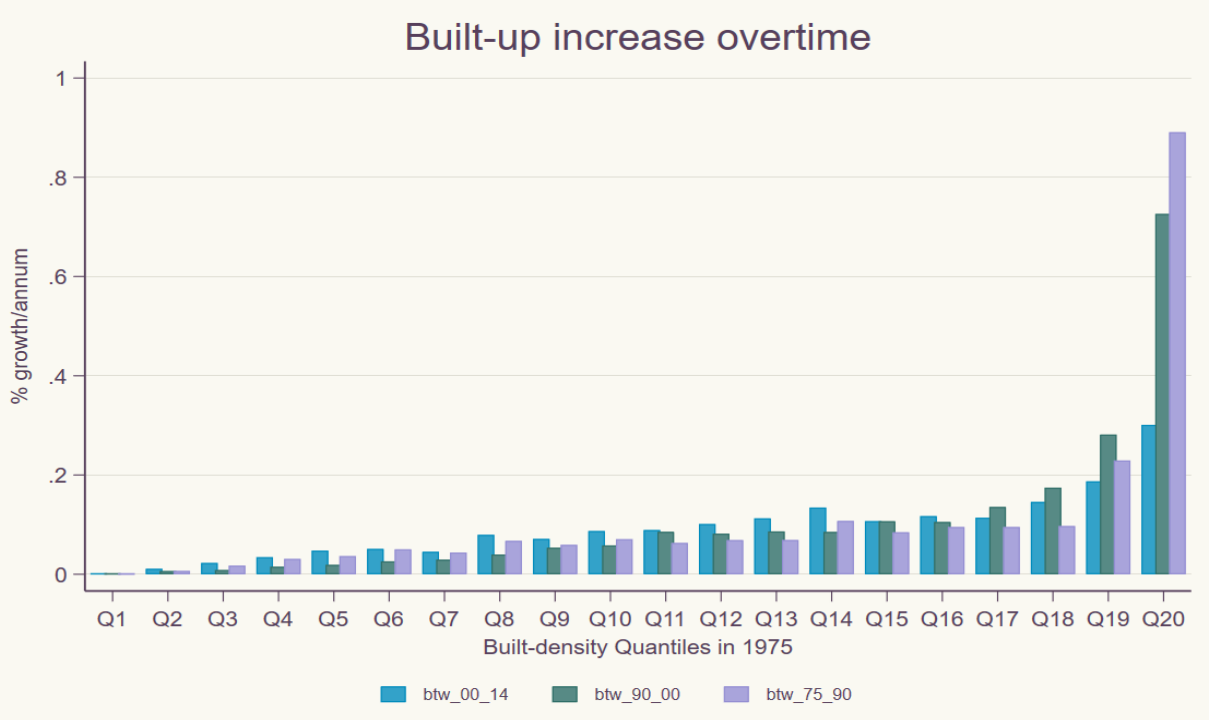


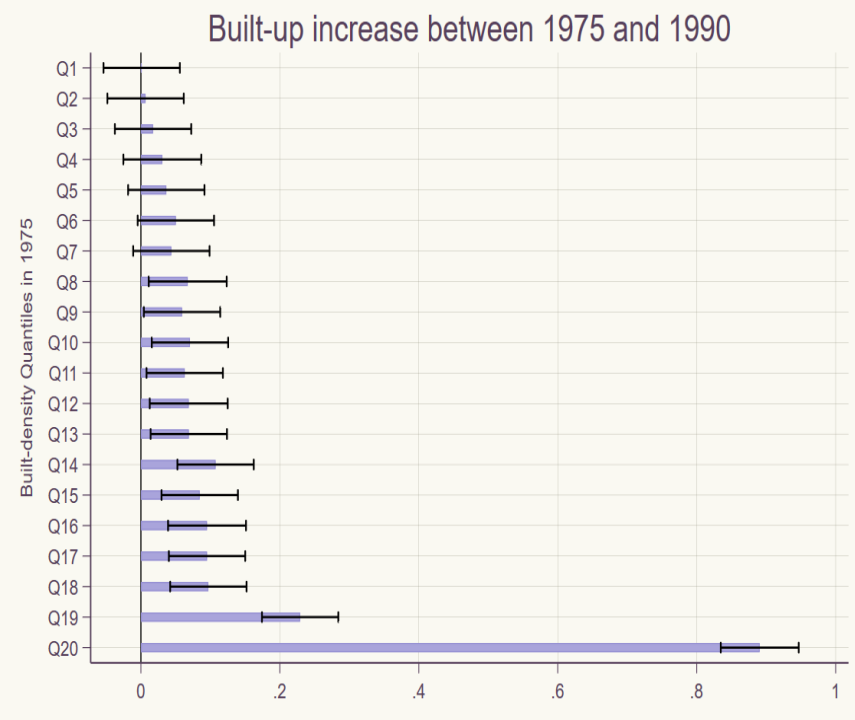
Growth in Built-up areas in a SE-NW gradient and dominated by Dhaka city

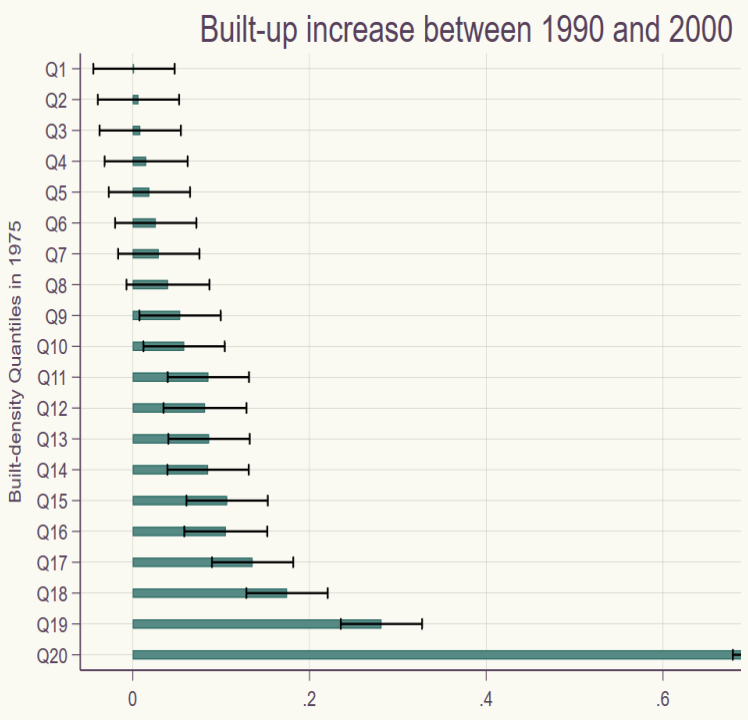


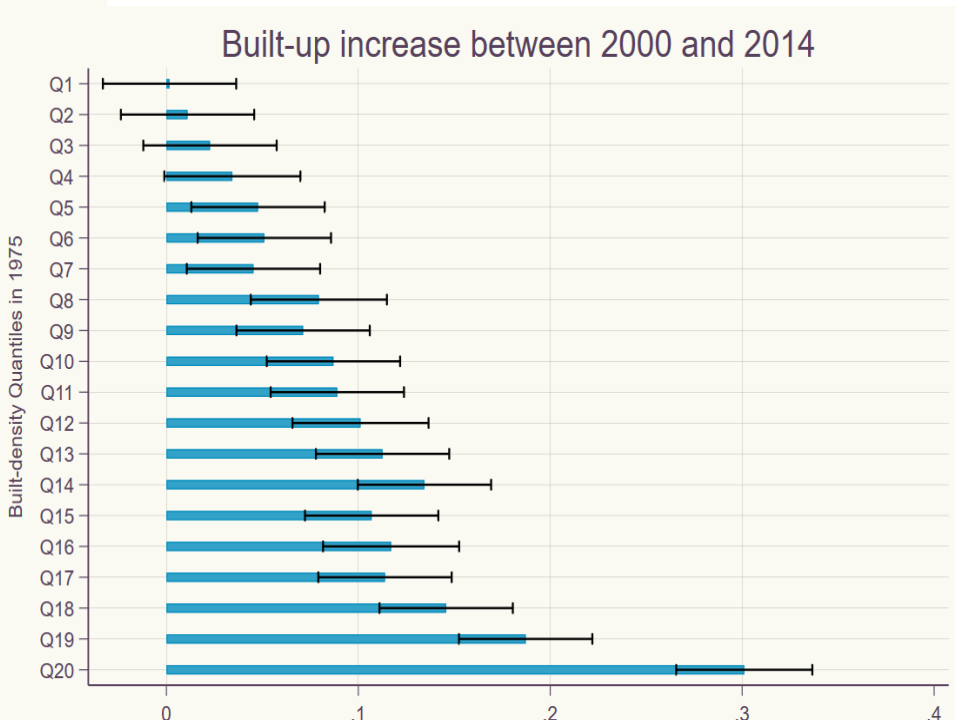


- *Breaking Wave of Built-Up*: Built-up increased in waves, mostly concentrated in most densely built areas (Dhaka city) in 1975-2000
- Growth slowed down in 2000-2014 period but differences between Dhaka city and other areas narrowed considerably
- Dhaka gained in height



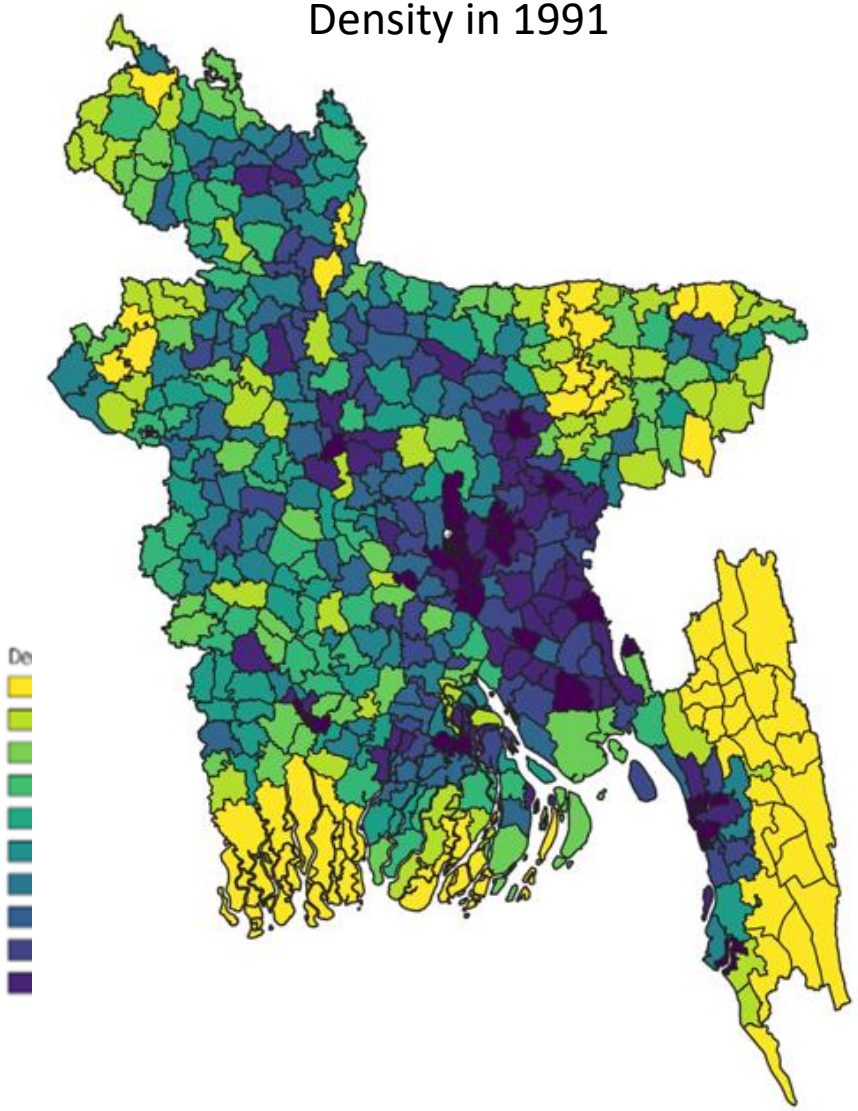




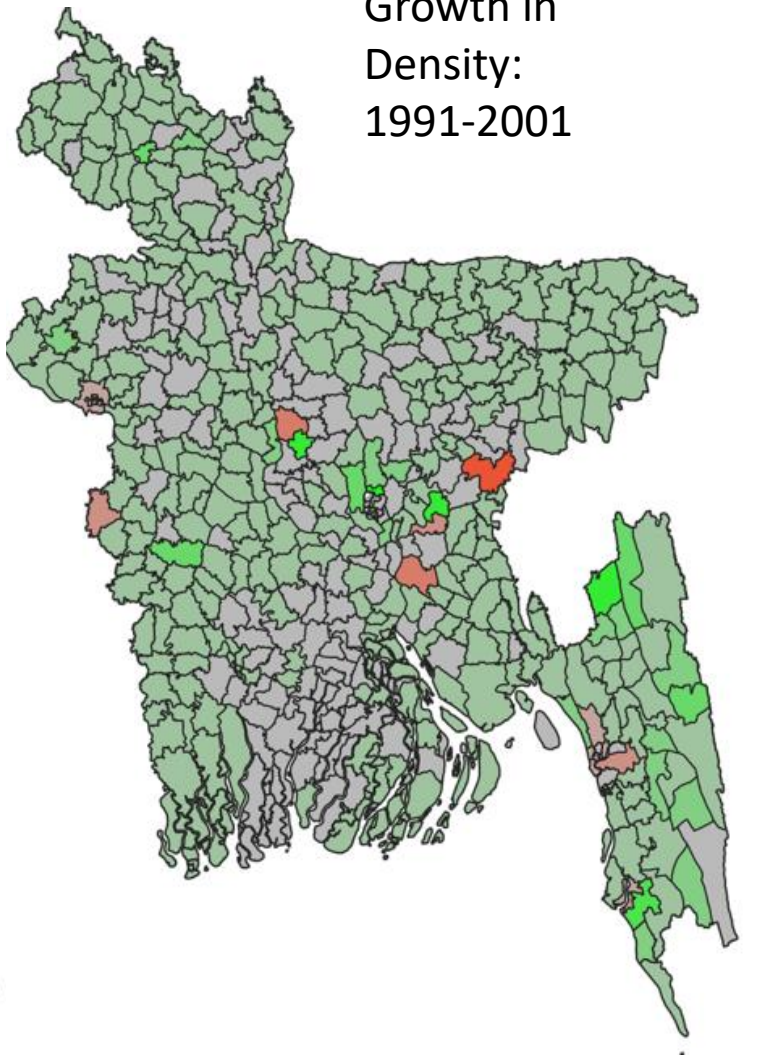


Population Density and its growth: Upazila level evidence

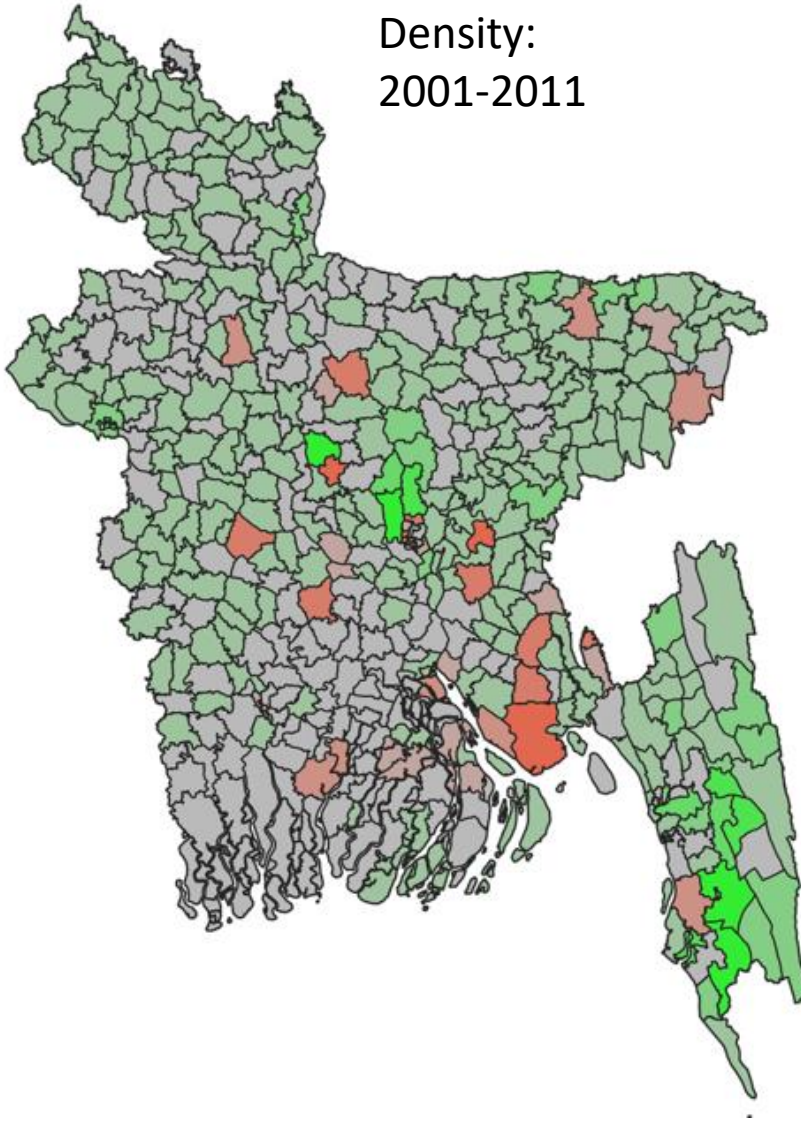
Density in 1991



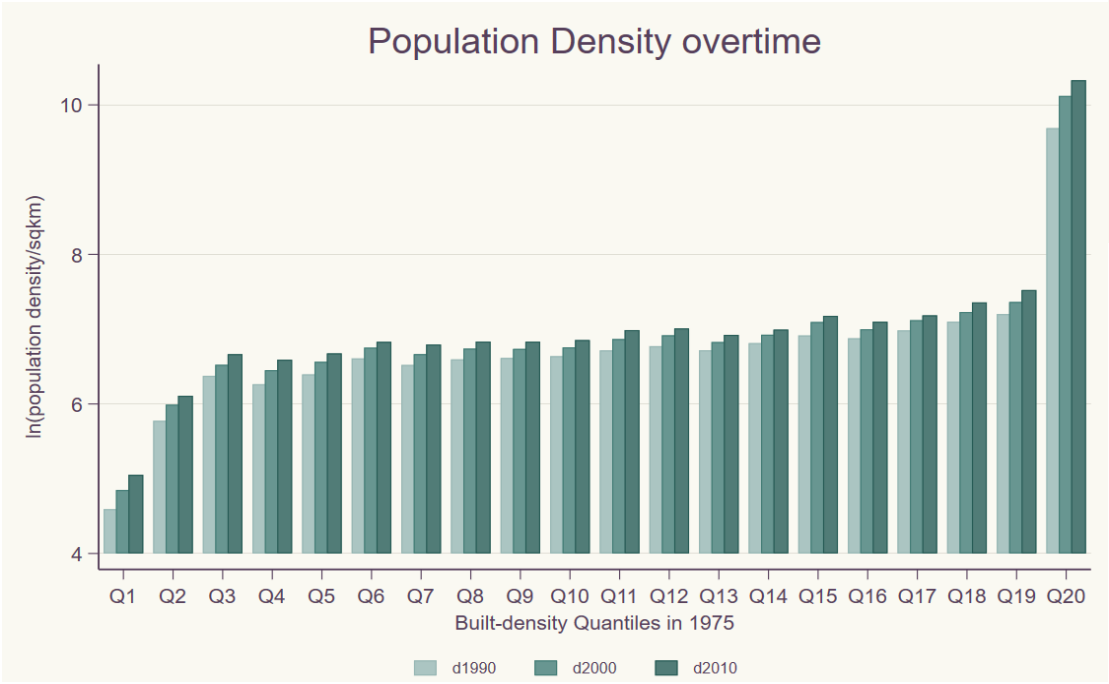
Growth in Density: 1991-2001

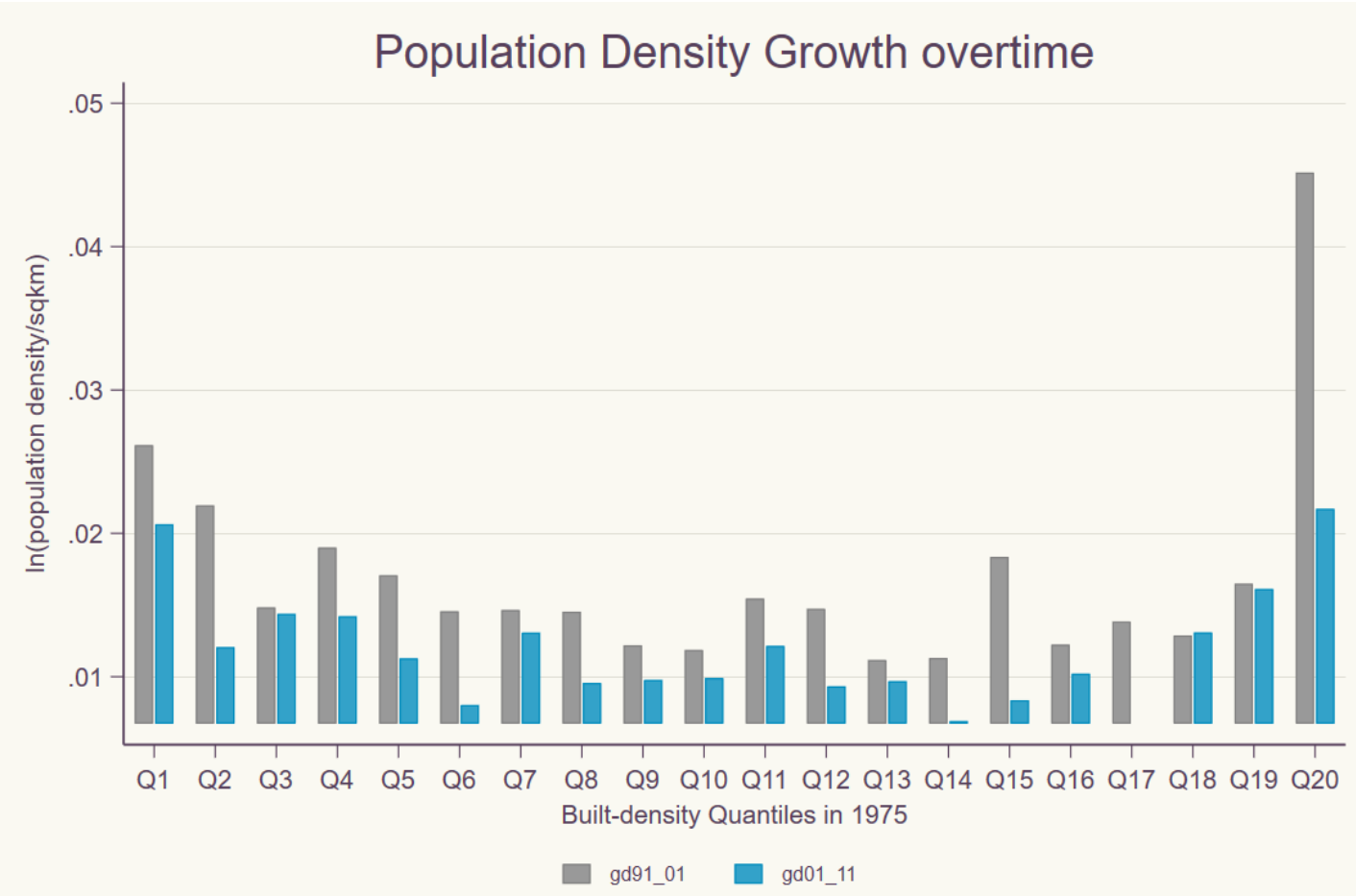


Growth in Density: 2001-2011



- Population density at upazila level shows pattern similar to built-up density: difference between top quantile and pen-ultimate quantile is very large (Dhaka city effect)





U-Shaped growth of population density

- Growth is much smaller in the middle part of the distribution ("missing middle" in town/city growth!)

Main Findings on pattern of urbanization

Central role of Dhaka city

Overall slowing down during 2010's relative to earlier decades

Breaking wave of urbanization: Some spreading of growth and convergence between Dhaka and other cities

U-Shape of density growth: Smaller cities are unable to attract people: slowest of growth in density

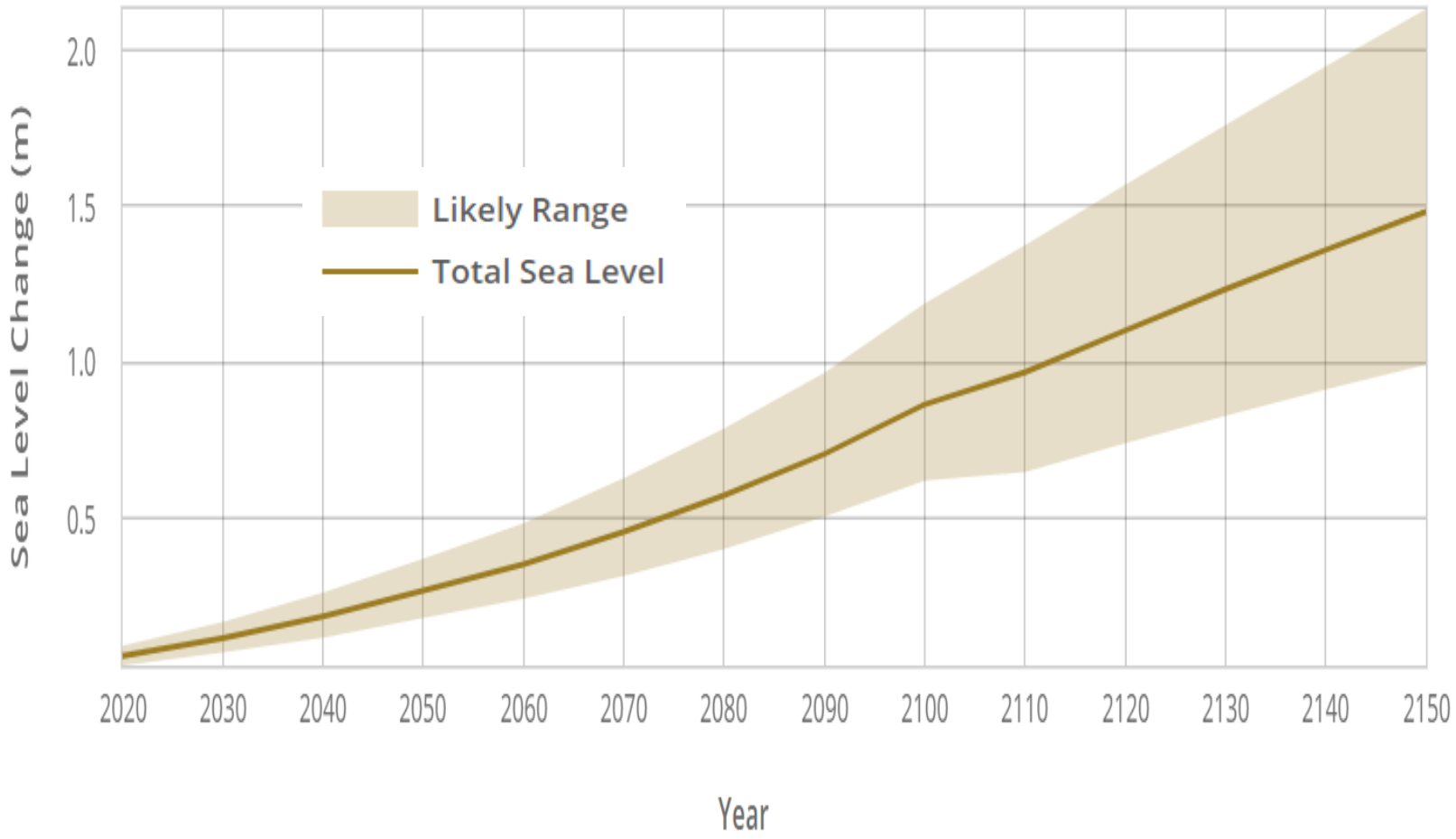
Future of Urbanization in Bangladesh

- Slowing of urban density growth in Dhaka city and evidence of some spreading of urbanization in the next tier
- Dhaka city has been the focus of recent World Bank studies: looked at embankment construction, transport investment, zoning reform and economic reforms to Dhaka's growth
- Little is known about growth in cities/towns outside Dhaka: connectivity is an important policy lever
- Climate induced migration is another emerging issue for urbanization

Climate Change and Urbanization

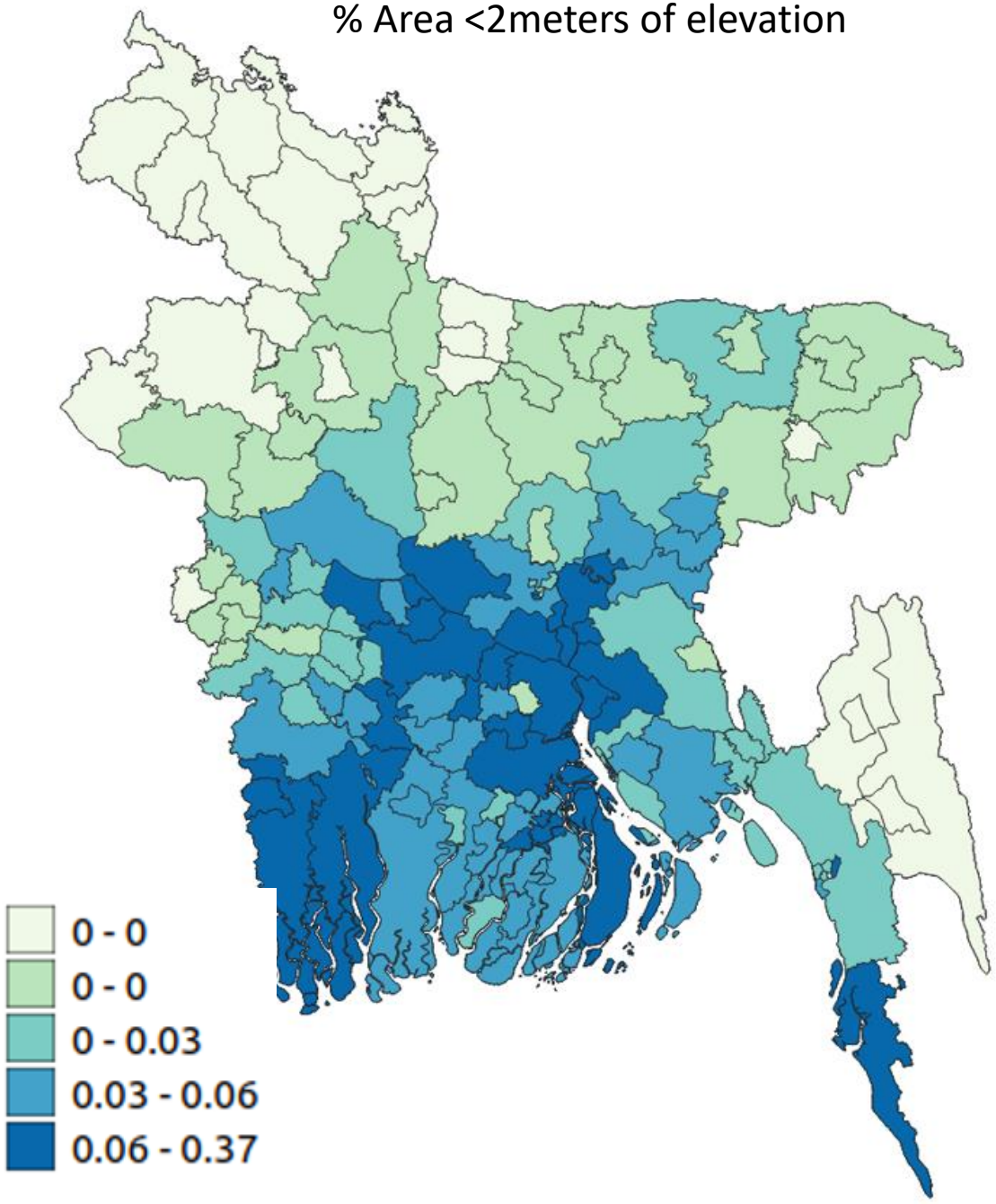
Climate Change and Rising sea level in Bangladesh

Hiron Point, Bangladesh: SSP5-8.5 Scenario

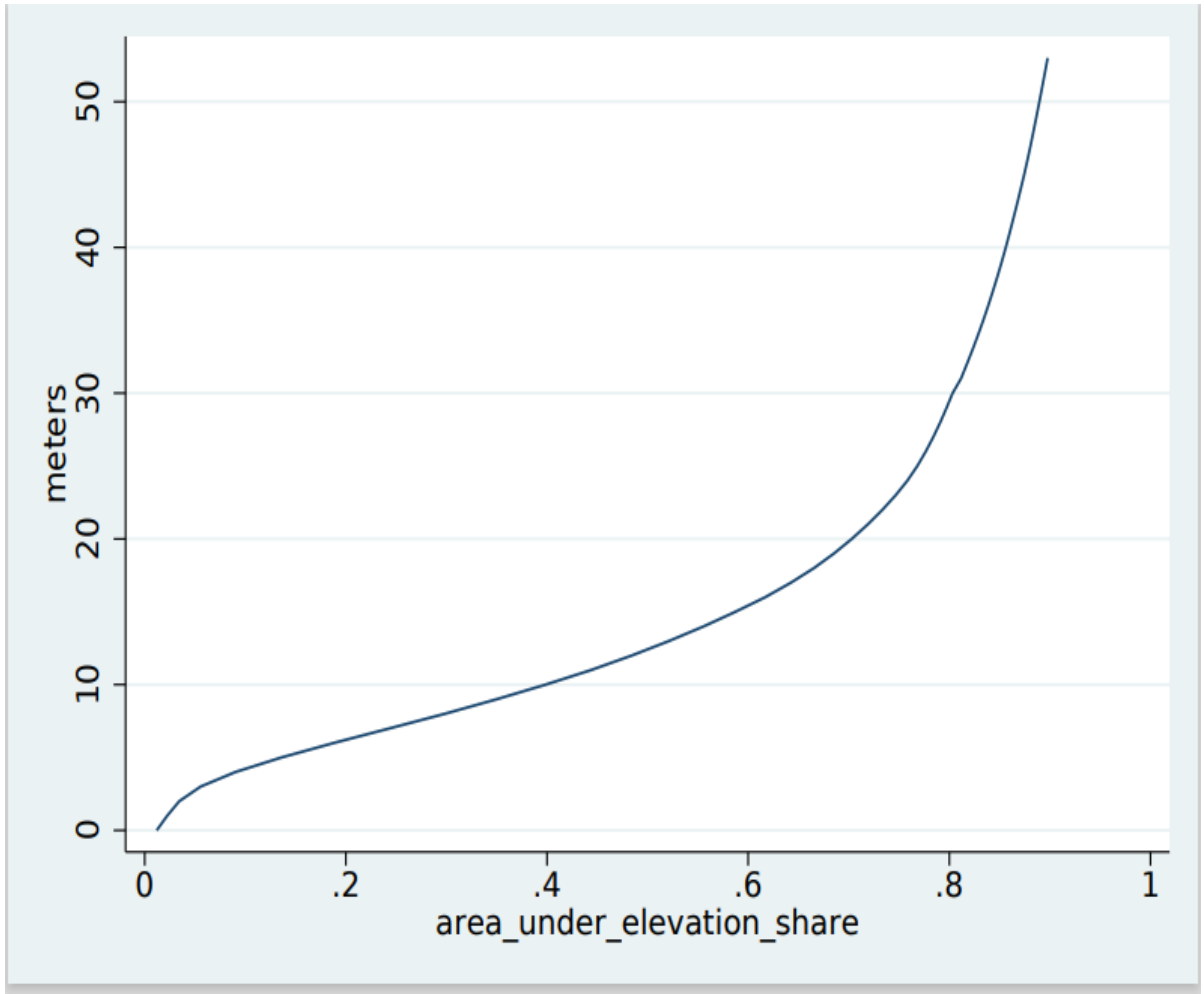


IPCC AR6 Sea Level Projection Tool
Sea Level Projection Tool – NASA Sea Level Change Portal

% Area <2meters of elevation



Elevation: 80% below 30 meters



Empirical Analysis and Policy Simulations

Step 1: Developing a quantitative spatial general equilibrium model

Step 2: Estimation of basic parameters of quantitative spatial general equilibrium model

Step 3: Counterfactual policy simulations

Improved connectivity due to transport investments (Padma Bridge)

Migration induced by Sea-level rise

Quantitative Spatial General Equilibrium Model

- Based on Redding and Rossi-Hansberg (ARE, 2017) and Redding (JIE, 2016)
- Key elements are:
  - Each location is endowed with productivity (subject to agglomeration economy) and amenity (subject to congestion) and residential land
  - Transport network connects different locations, and determines iceberg trade costs among them
  - Consumers' preference for differentiated products determines demand
  - Production is subject to increasing returns, firms use labor as only input and there is monopolistic competition
  - Workers with heterogenous preference for migration move freely across locations
  - Equilibrium determines trade and migration flows across locations, along with population density, wages, rents, prices.

Connectivity and Urbanization

Transport model and dynamic cost routing

- We build a transportation network tool that allows us to
  - Compute travel times under counterfactual transportation networks of arbitrary complexity.
  - Account for events such as ferry and bridge crossings on a route.
- Baseline transportation network from OSM
  - + Routing engine with run-time cost attribution
  - + counterfactual transportation networks
  - = Query counterfactual travel times with arbitrary resolution
- Examples
  - What is the fastest route from *a* to *b* if a ferry crossing takes 6 hours? What if a ferry crossing takes 7 hours?

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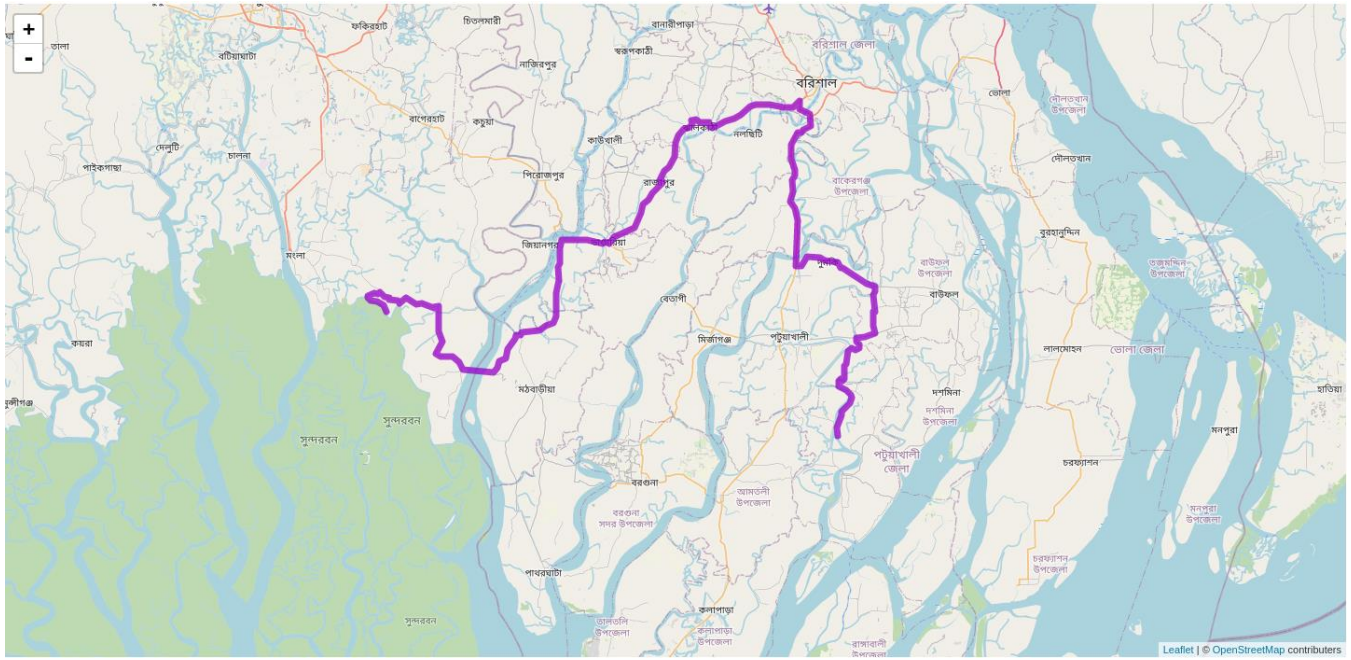
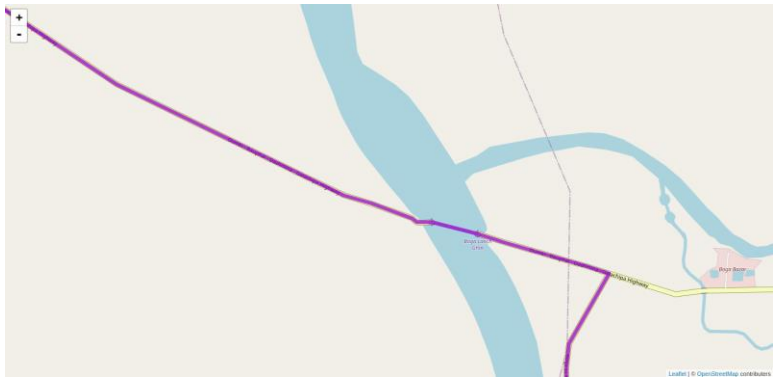
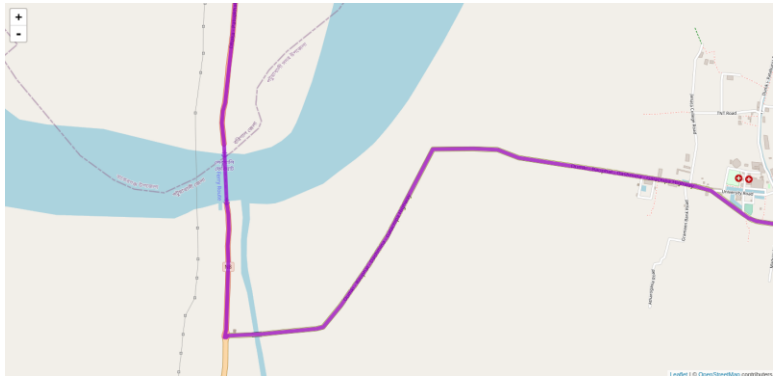
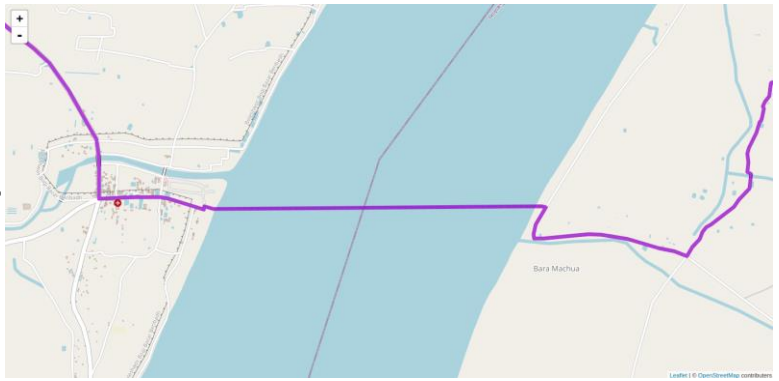
Dynamic cost routing

A destination that is 68 km as the crow-flies may take 30+ hours (3 separate ferries, assuming 6-hour duration)



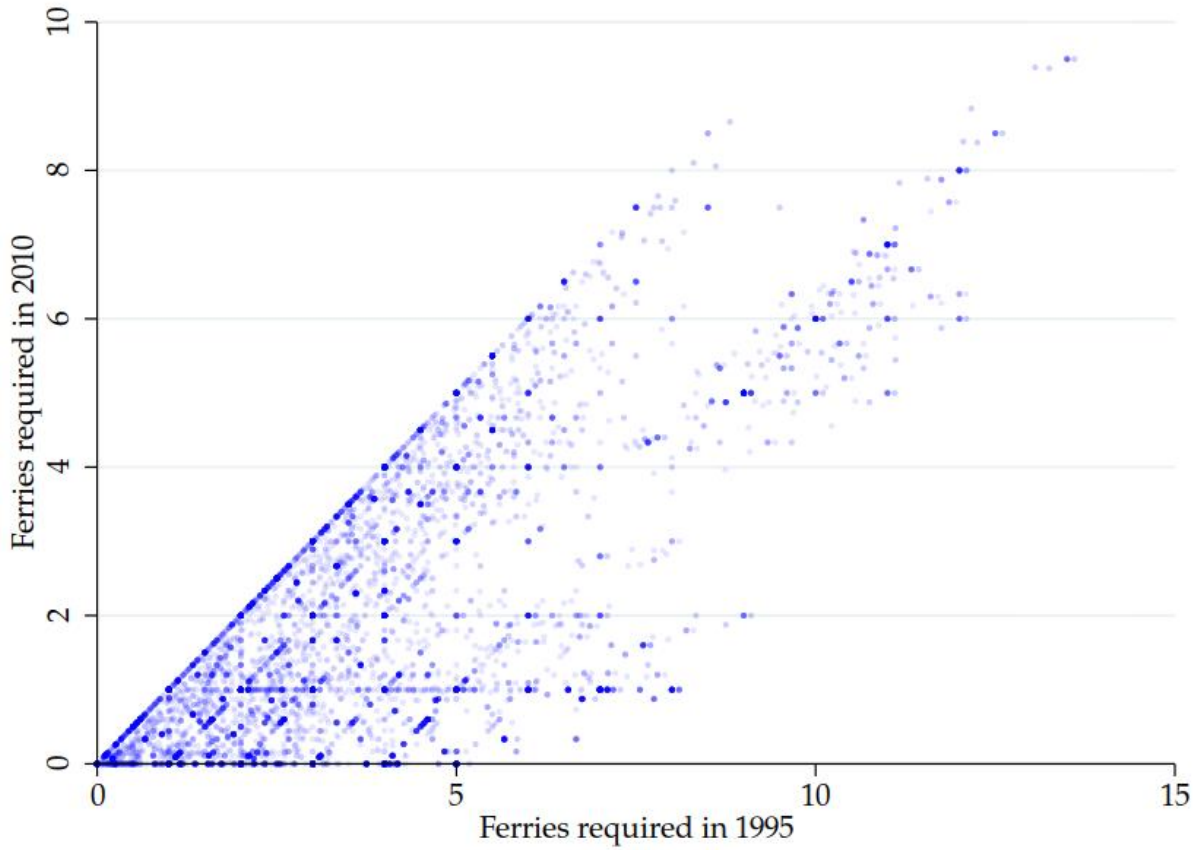


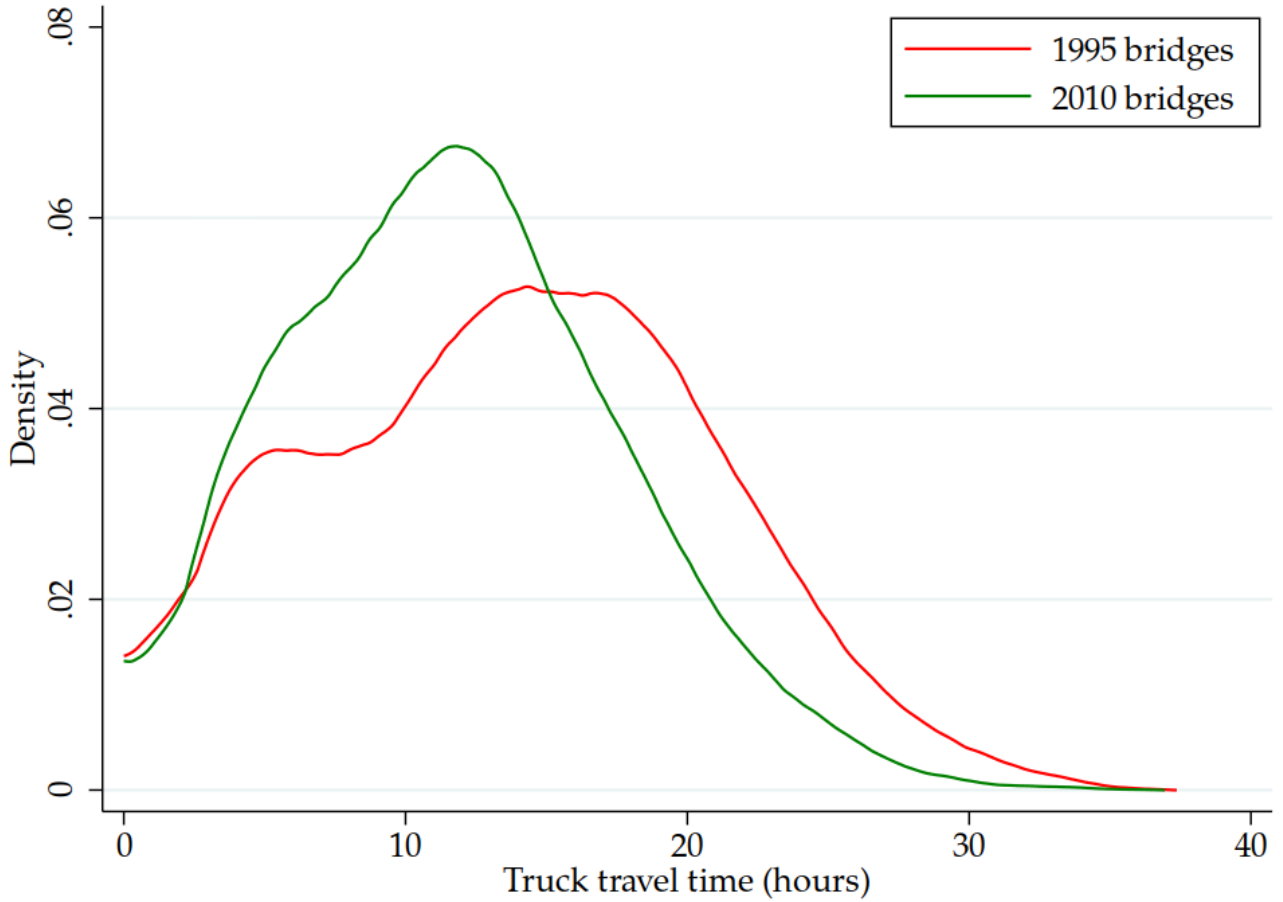




- Repeat routing over 125K pairs between sample points in BGD.
- Tally ferry and bridge crossings under alternative networks.

Estimation exploits Δ bridge connectivity

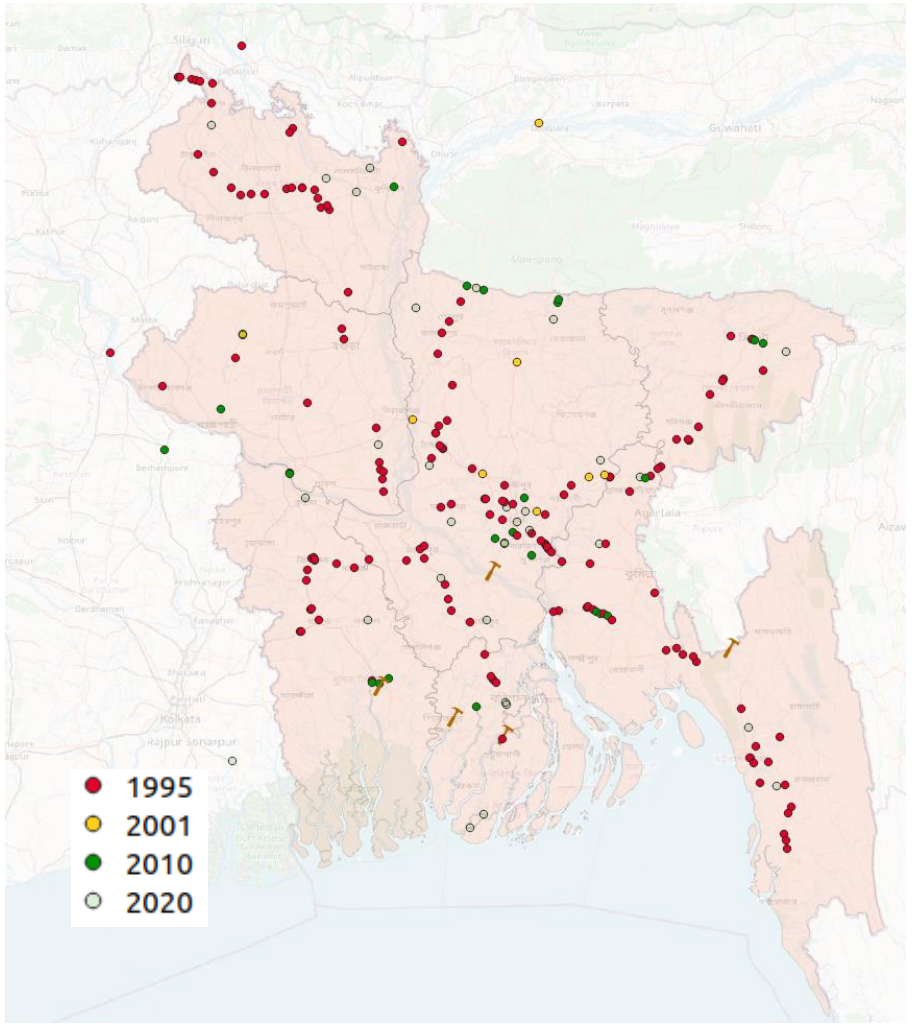




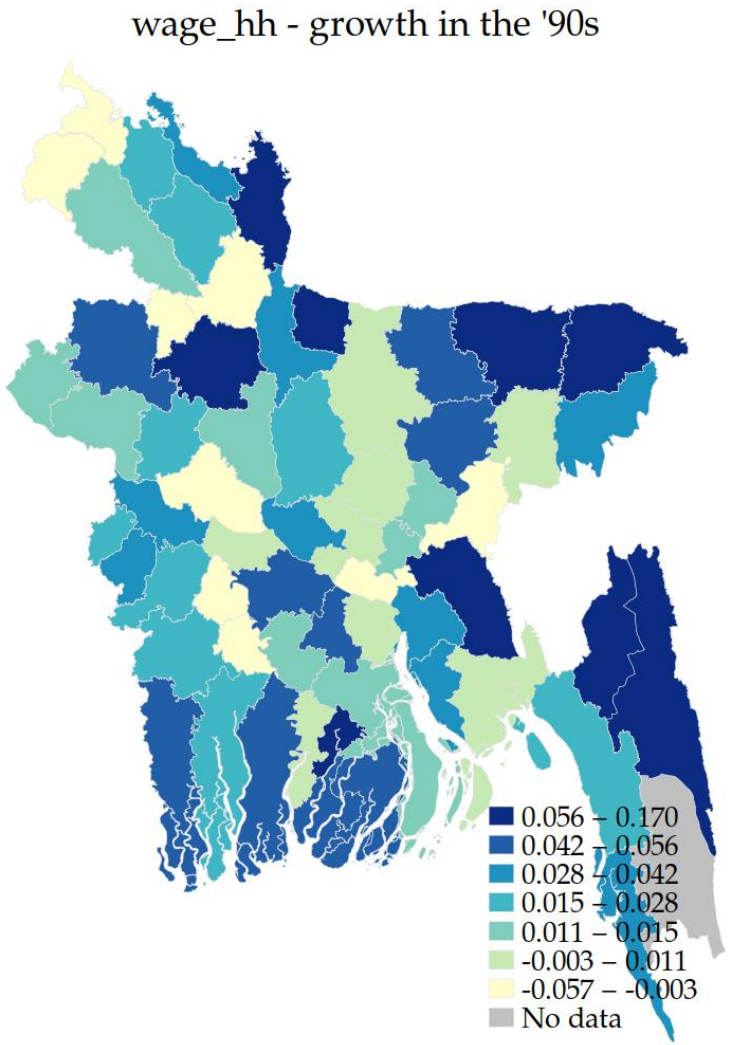
Change in the avg. number of ferry crossings required between spatial units, 1995 to 2010 (*spatial units are a subset of urban upazila and the remainder, non-urban district hinterland*)

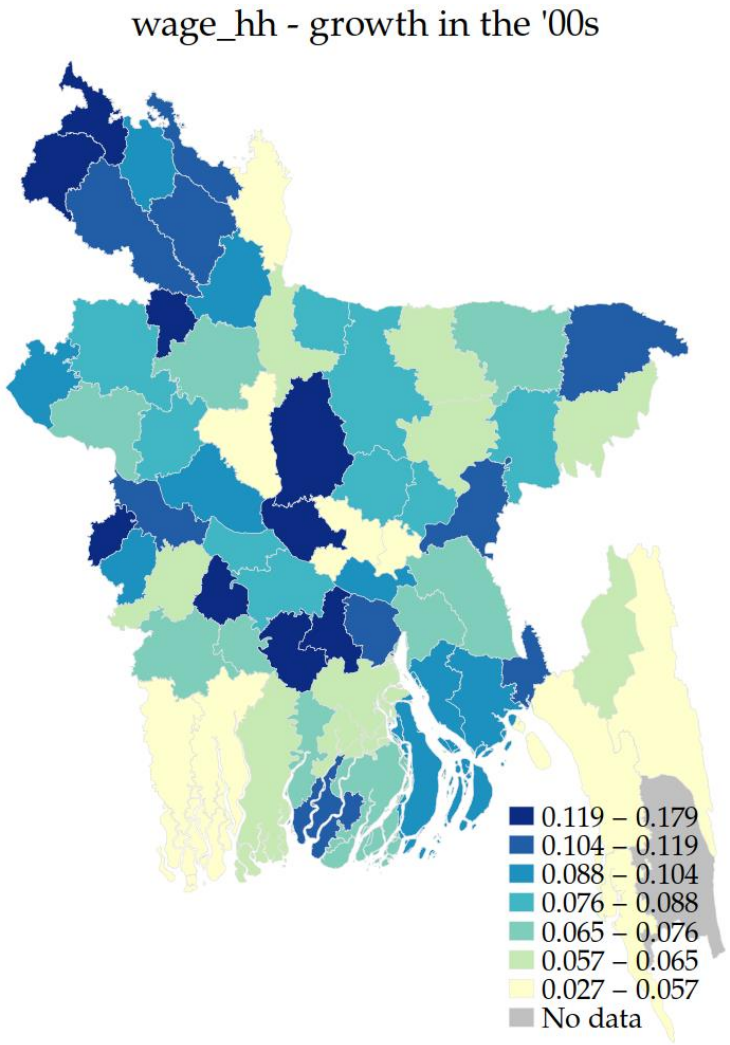
Change in travel time due to bridges, (assuming a 6 hr time reduction due to Jamuna)

Estimation exploits Δ bridge connectivity



Bridges available by date

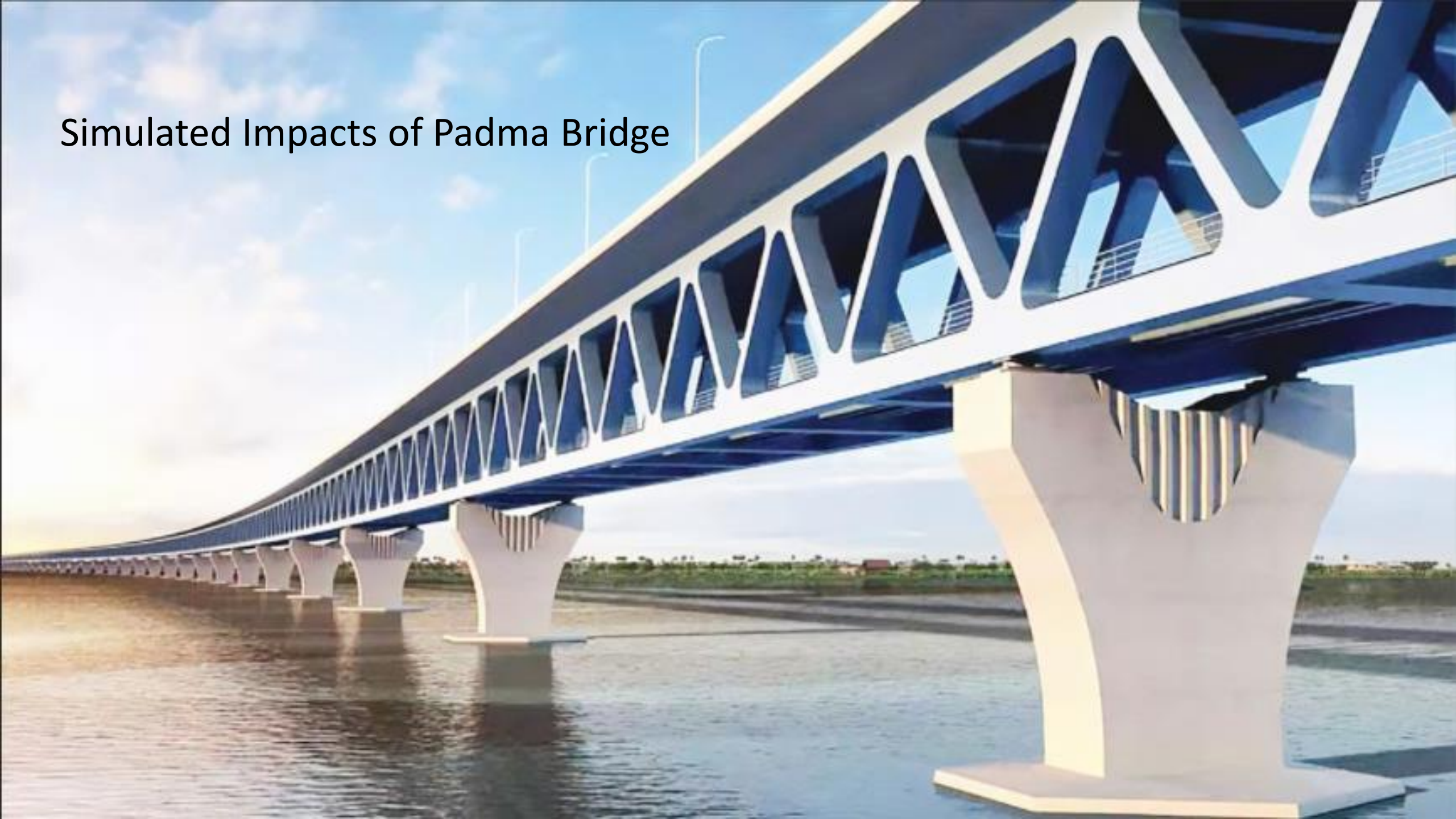




Estimation of quantitative spatial economic model

- Spatial unit: a mix of urban upazilas (61 units) and districts, exc. urban (63 units) Inputs
  - Distribution of wages, population, in 1995, 2001, 2010. Distribution of land.
  - Transportation network in 1995, 2001, 2010 (change in bridges vs. ferry crossings).
- Identification: assume change in wages and population distribution occur only due to
  - change in aggregate GDP, which is absorbed.
  - Change in connectivity / transport cost between spatial units.
- Estimation by GMM equates distribution of structural unobservable productivity, amenities (*a*,*b* in QSE model) using changes in bridge/ferry connectivity as instruments.
- Estimate two key model parameters in a local context:
- - sensitivity of economic activity to transport cost (q in QSE model)
- - incremental cost of a ferry crossing (FC) over a bridge connection.
- Find $\hat{\theta} = 8.6$ and $\widehat{FC} = 26.7$ hours (relative to an avg. 9.6 hrs across Bangladesh)

Simulated Impacts of Padma Bridge

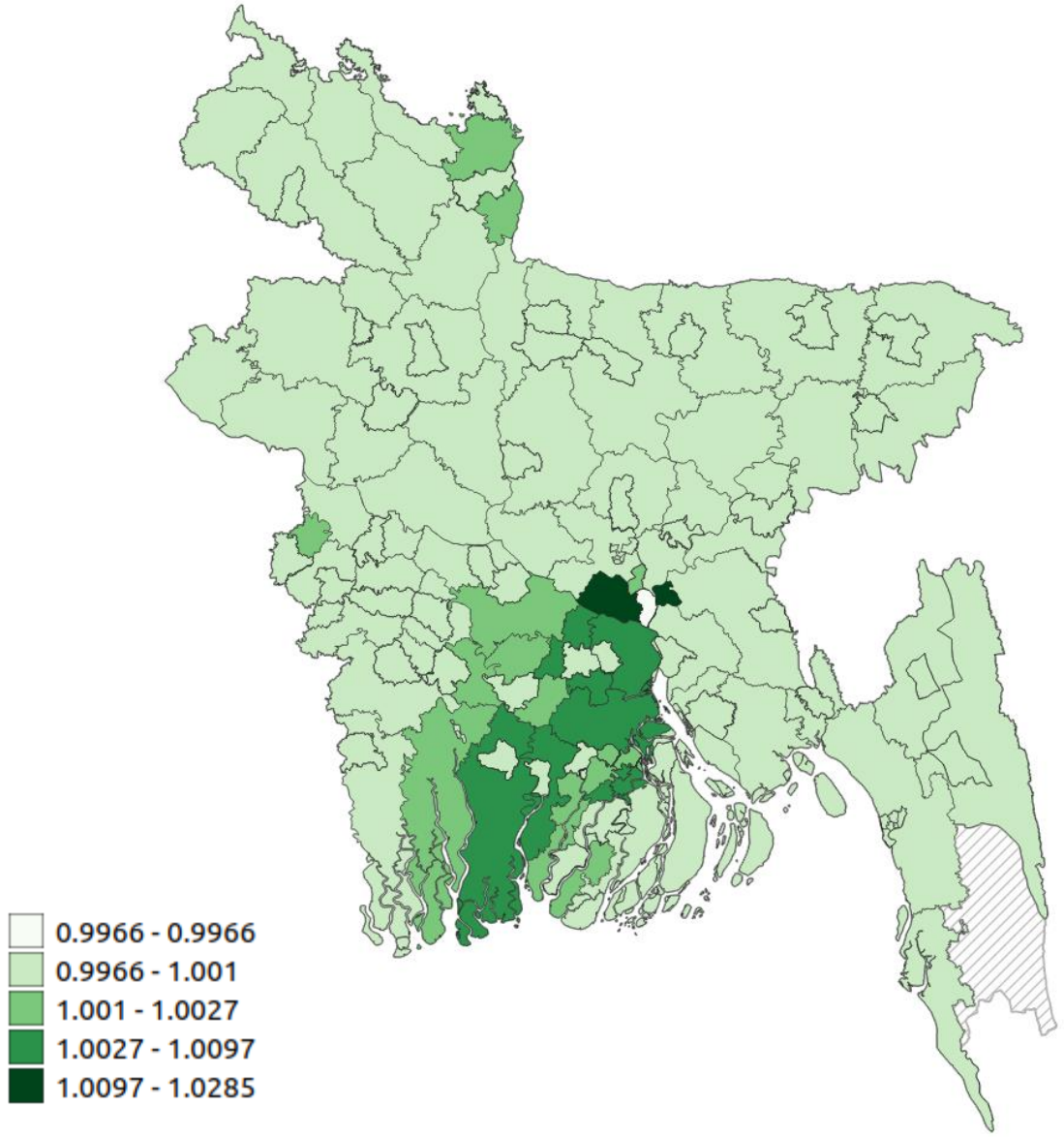


Counterfactual: Padma bridge

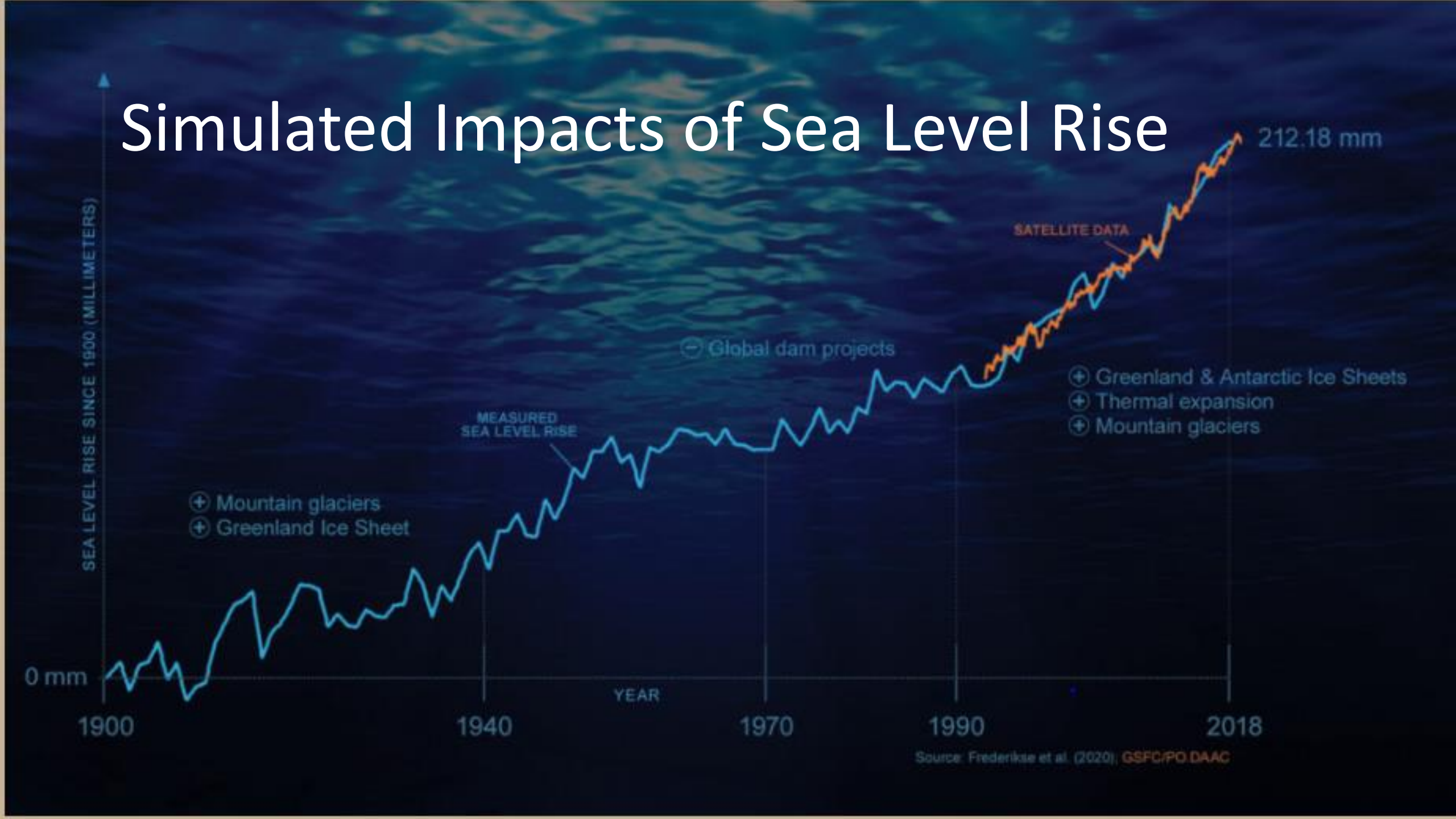
Recompute wages under the 2010 economy, under the counterfactual that Padma bridge is available.

Highest benefits to rural districts gaining market access:

- Barisal, Faridpur/Padma, which connect to Dhaka
- Rural Munshiganj, connecting south of Padma

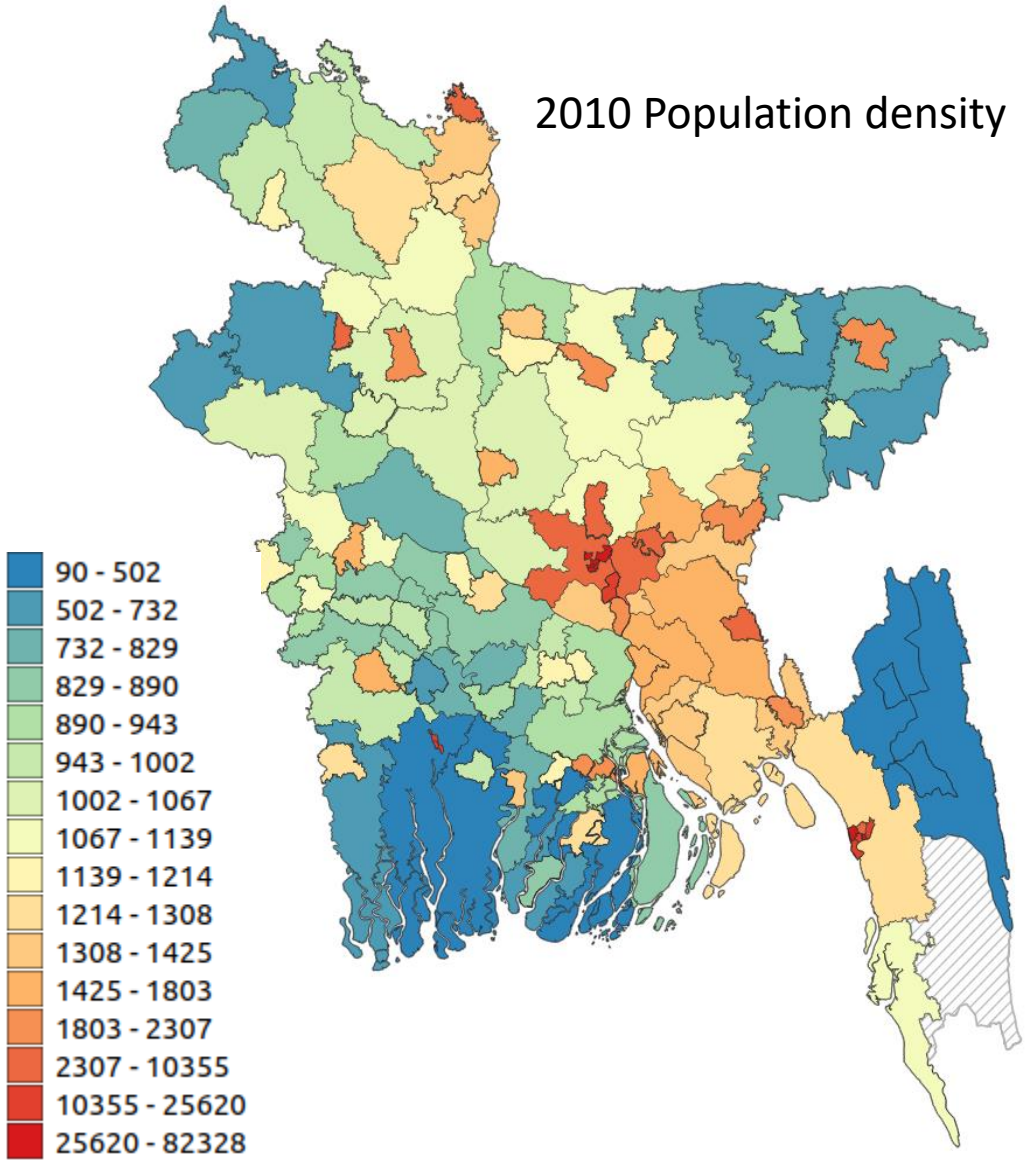


Simulated Impacts of Sea Level Rise

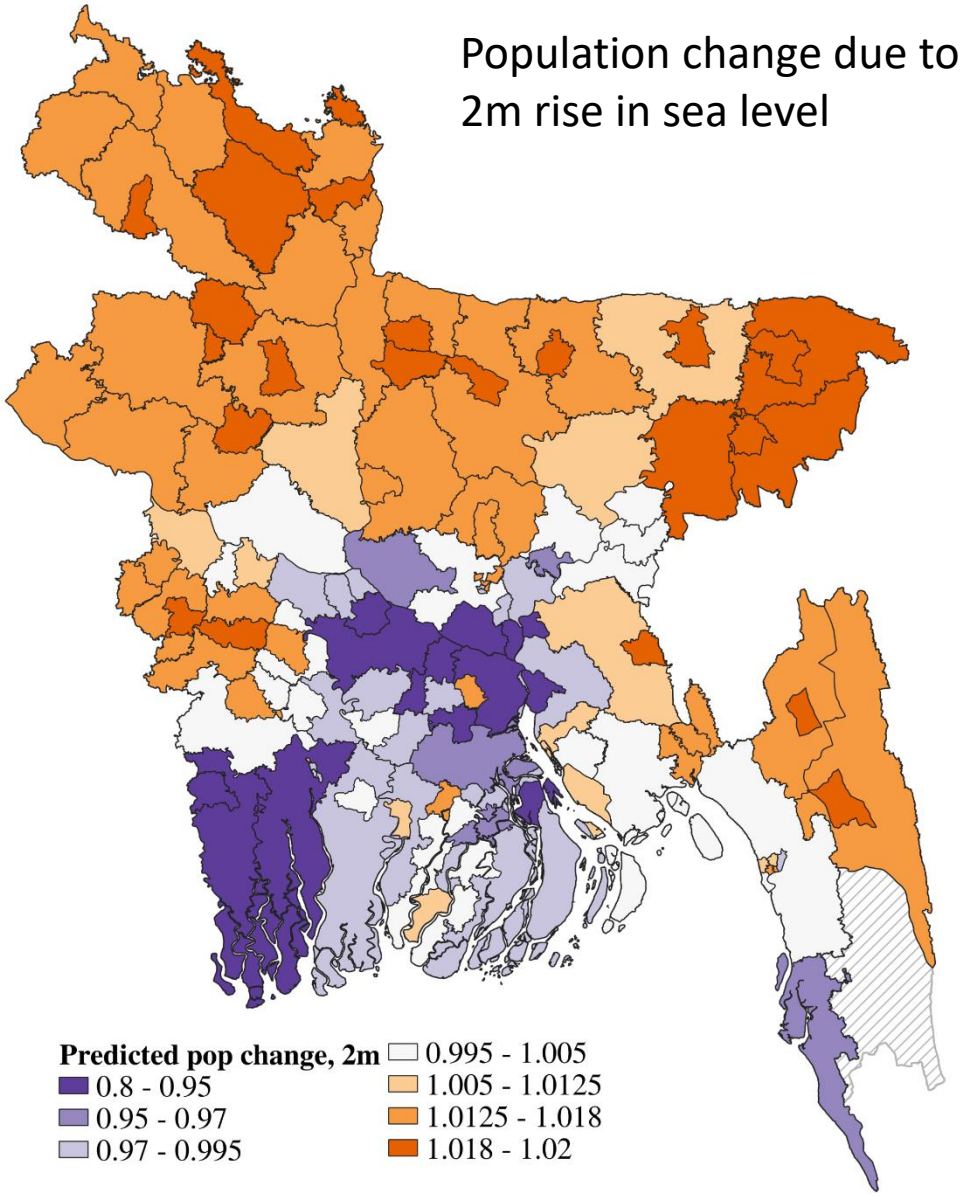


Counterfactual: Sea level rise

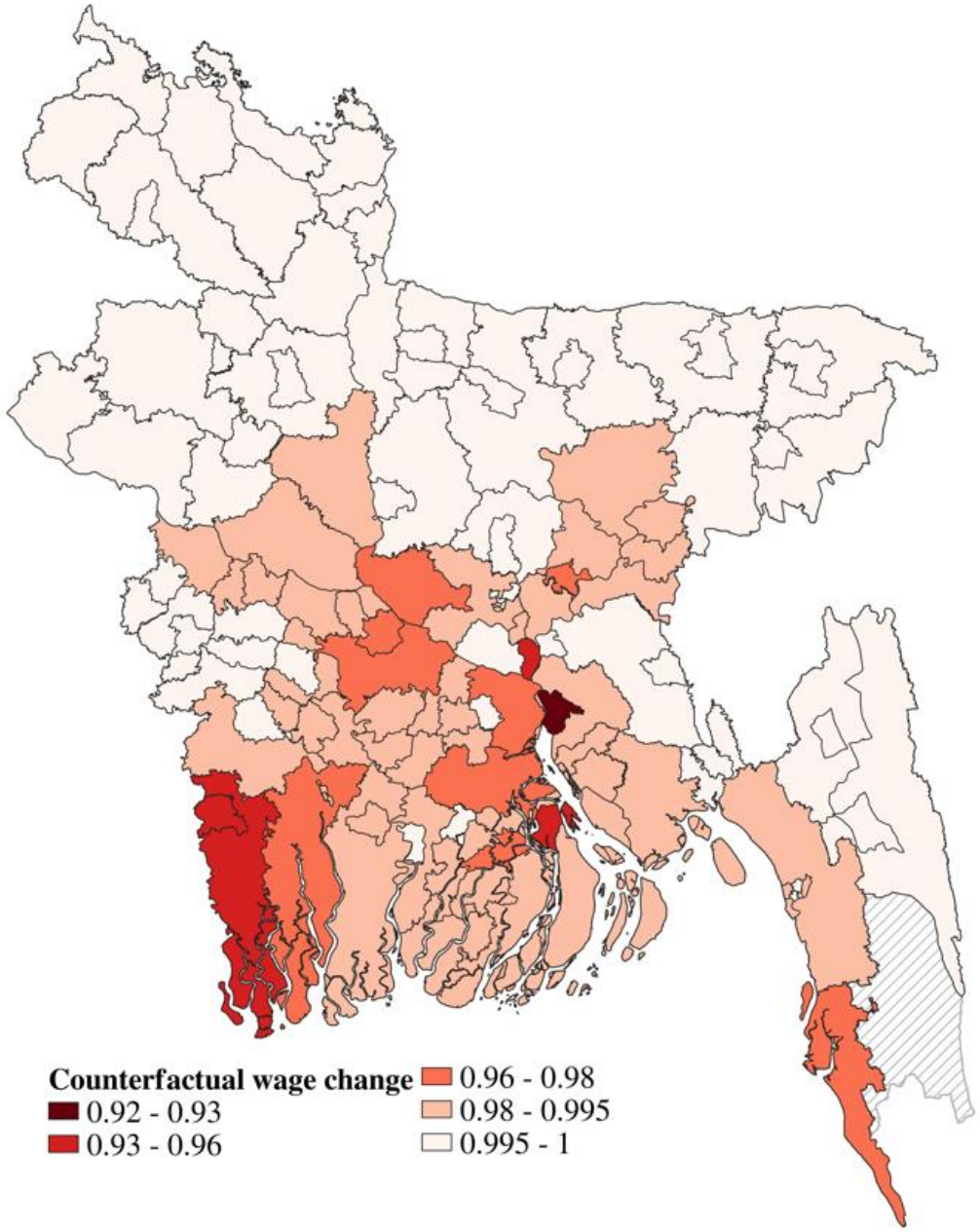
2010 Population density



Population change due to 2m rise in sea level



Counterfactual: Sea level rise and Padma Bridge together



Key Findings

- Density growth in Dhaka slowed down, whereas it slightly picked up in the next tiers of cities/towns, but the third tiers fared worst even relative to rural areas
- Improvement of transport connectivity will benefit the connected districts most
- A boost to population in areas with higher elevation will come from climate induced migration. Sea level rise will affect Dhaka and Chittagong adversely

Policy Options for Urbanization

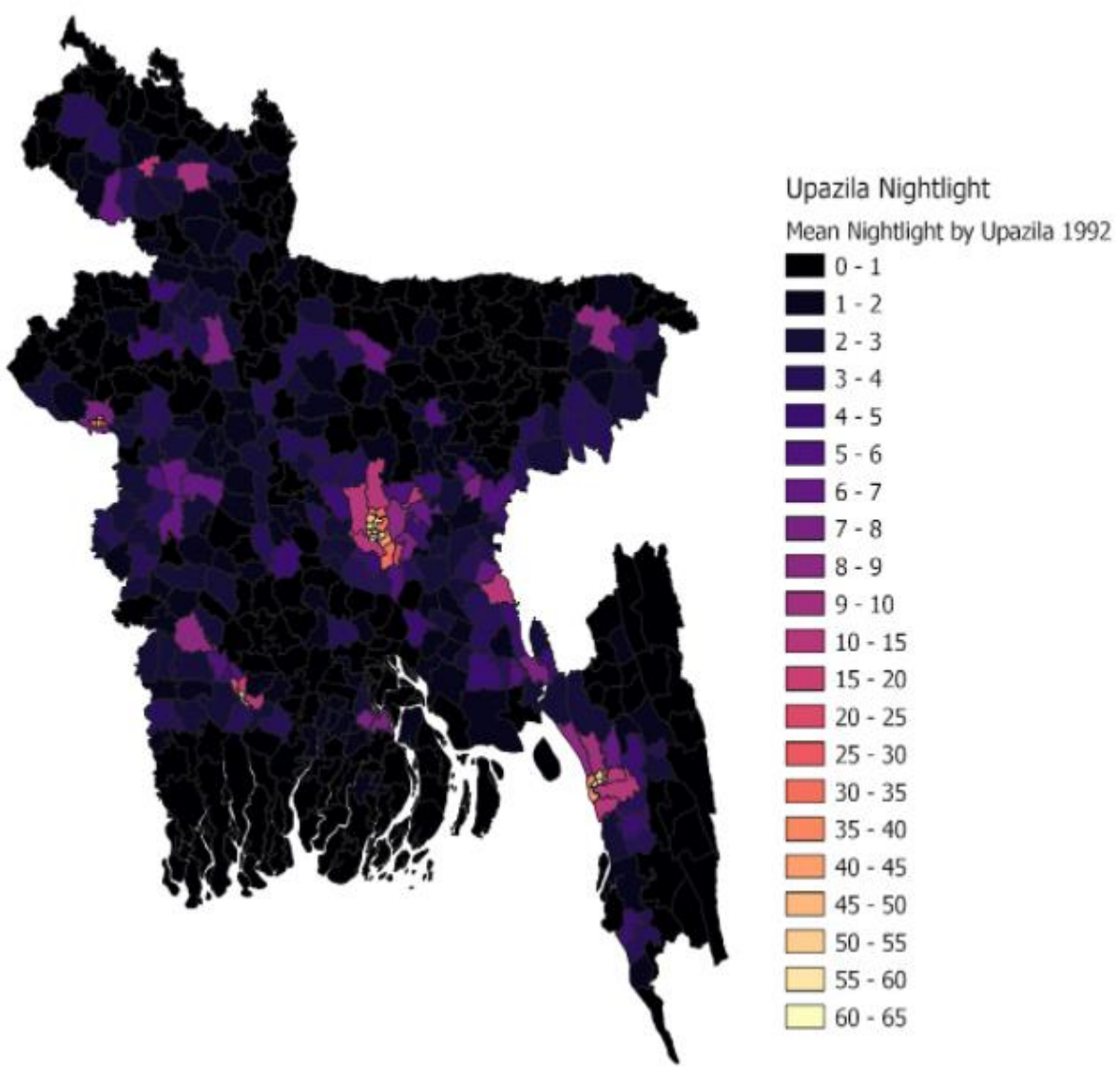
- Consider the options of supporting cities/towns in areas with higher elevation vs. constructing infrastructure to combat sea level rise in the South
- Two types of policies:
  - Place based policies try to bring economic activities to less developed areas through investment in infrastructure and complementary services: largest experiment has been the Tennessee Valley Authority (TVA) in USA with mixed results
  - Connectivity and reduction in costs of trading and business is the other option that is found to be more successful

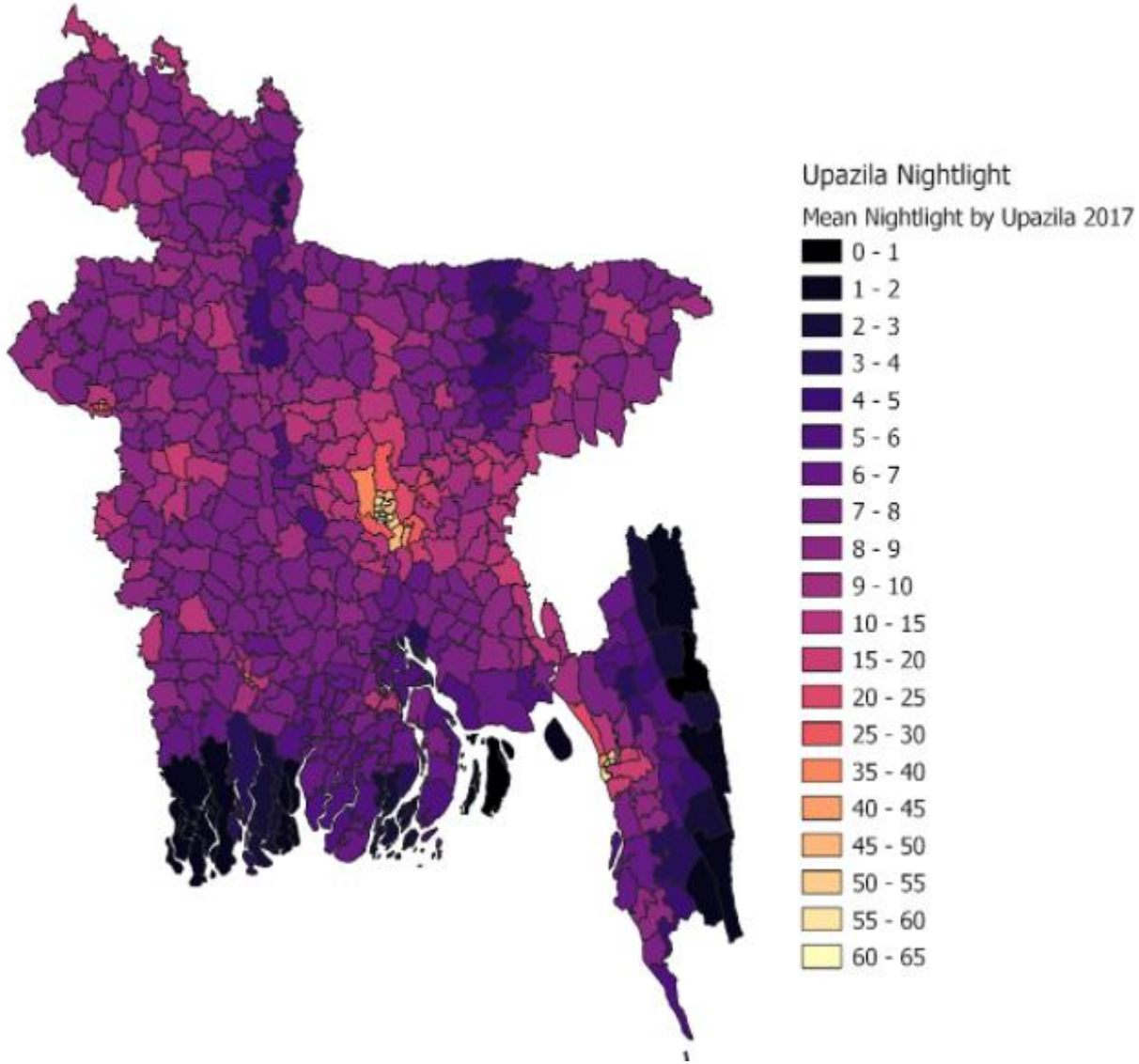
How would urbanization evolve?

- Activities that predominate in cities evolve over time: Artisan products => Tradeable Manufacturing (e. g. garments) => high value and specialized manufacturing and Tradeable Services (IT)
- Transition process is associated with higher productivity
- Transition in Dhaka would mean that some of existing low value manufacturing may move to next tier of cities
- This will require provision of services, housing and other amenities in those cities
- Activities will concentrate in few cities instead of spreading out all over

Extra Slides

Night Light Luminosity in 1992 and 2017





- Utilized harmonized night light luminosity data
- Cross-sectional patterns are similar to that of built-up and population density
- But overtime changes are not consistent: nightlights imply negative or no growth in topmost quantile