Urbanization and Development

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STEG Macro Development Virtual Course, May 7, 2021

Outline

1. Determinants of the city size distribution
   - Desmet and Rossi-Hansberg (*AER* 2013)
   - Role of efficiency, amenities and frictions
   - Application to U.S. and China
2. Space and development
   - Desmet and Henderson (*Handbook* 2015)
   - Henderson, Squires, Storeygard and Weil (*QJE* 2018)
   - Gollin, Jedwab and Vollrath (*JOEG* 2016)
   - Conte, Desmet, Nagy and Rossi-Hansberg (2020)

1. Desmet and Rossi-Hansberg (AER, 2013)

Introduction

- Why do people live in particular cities?
  - High productivity
  - Attractive amenities
  - Low frictions
- In equilibrium larger cities must either be more productive, have better amenities or face smaller frictions, compared to smaller cities
- Use a simple urban theory to estimate these components for the U.S.
- Counterfactual exercises that explain the relative importance of these characteristics for welfare and the city size distribution
  - Similar to growth (or business cycle) accounting

Introduction

- Regional policy often interested in smoothing differences across space
- Eliminating differences in any of these characteristics leads to
  - Relatively modest changes in welfare
  - Large population reallocations
  - Important changes to the fate of individual cities
- Are the relatively small welfare effects specific to the U.S.?
  - Compare to China
- Simple methodology to compare urban systems across countries

The Model

- Standard model of a system of I cities
- Each city is characterized by
  - A level of productivity
  - A level of amenities
  - A level of excessive frictions reflecting the efficiency of providing commuting infrastructure
- N_t identical agents choose where to live and work
- Add externalities in productivity and amenities

Technology

- Goods are produced in I mono-centric circular cities with sizes N_{it}
- Production in city i depends on productivity A_{it}

$$Y_{it} = A_{it} K_{it}^{\theta} H_{it}^{1-\theta}$$

- The standard first order conditions of this problem are

$$\begin{aligned} w_{it} &= (1-\theta)\frac{Y_{it}}{H_{it}} = (1-\theta)\frac{y_{it}}{h_{it}} \\ r_t &= \theta\frac{Y_{it}}{K_{it}} = \theta\frac{y_{it}}{k_{it}} \end{aligned}$$

- Capital is freely mobile so there is a common interest rate r

Preferences

- Utility of an agent in city i is

$$\sum_{t=0}^{\infty} \beta^t \left[\log c_{it} + \psi \log\left(1 - h_{it}\right) + \gamma_i\right]$$

where γ_i denotes the city's amenities

- The problem of an agent with capital k_0 is therefore

$$\max_{\{i_t, c_{it}, h_{it}, k_{it}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t \left[\log c_{it} + \psi \log\left(1 - h_{it}\right) + \gamma_i\right]$$

subject to

$$\begin{aligned} c_{it} + x_{it} &= r_t k_{it} + w_{it} h_{it}\left(1 - \tau_{it}\right) - R_{it} - T_{it} \\ k_{it+1} &= \left(1 - \delta\right) k_{it} + x_{it} \end{aligned}$$

Preferences

- In steady state $k_{it+1} = k_{it}$ and $x_{it} = \delta k_{it}$
- Assume k_{it} is such that $r_t = \delta$
- Budget constraint simplifies to

$$c_{it} = w_{it} h_{it} \left(1 - \tau_{it}\right) - R_{it} - T_{it}$$

- The first order conditions of this problem imply that

$$\left(1 - \tau_{it}\right) = \frac{\psi}{(1-\theta)} \frac{c_{it}}{1 - h_{it}} \frac{h_{it}}{y_{it}}$$

  where τ_{it} is referred to as the labor wedge in Chari et al. (2007)
- Agents can move freely across cities, so utility $u_{it} = \bar{u}_t$

Commuting Costs and Land Rents

- Cities are mono-centric
  - Production happens at city center
  - People's residence is characterized by distance to center, d
- Commuting is costly in terms of goods, $T(d) = \kappa d$
- Each agent lives on one unit of land and pays rent $R(d)$
  - Normalize the price of agricultural land to zero, so $R(\bar{d}) = 0$
- Since all agents in a city are identical

$$R_{it}(d) + T(d) = T(\bar{d}_{it}) = \kappa \bar{d}_{it}$$

- City radius $\bar{d} = \left(\frac{N_{it}}{\pi}\right)^{\frac{1}{2}}$ and total miles traveled $TC_{it} = \frac{2}{3}\pi^{-\frac{1}{2}} N_{it}^{\frac{3}{2}}$

Government Budget Constraint and Frictions

- Cost of providing transport infrastructure depends on total commuting costs and wages

$$G\left(h_{it}w_{it}, \kappa TC_{it}\right) = g_{it}h_{it}w_{it}\kappa TC_{it} = g_{it}h_{it}w_{it}\kappa\frac{2}{3}\pi^{-\frac{1}{2}}N_{it}^{\frac{3}{2}}$$

  where g_{it} is the inefficiency (or the frictions) of government

- The government budget constraint is then given by

$$\tau_{it}h_{it}N_{it}w_{it} = g_{it}h_{it}w_{it}\kappa\frac{2}{3}\pi^{-\frac{1}{2}}N_{it}^{\frac{3}{2}}$$

- The greater the inefficiency g_{it}, the greater the tax or labor wedge

$$\tau_{it} = g_{it}\kappa\frac{2}{3}\left(\frac{N_{it}}{\pi}\right)^{\frac{1}{2}}$$

Characterization of Equilibrium

- Labor market equilibrium satisfies $\sum_{i=1}^{I} N_{it} = N_t$ and all agents receive the same utility level $\bar{u}$
- Given $(A_{it}, \gamma_{it}, g_{it})$ we can calculate N_{it} for all i
- In equilibrium
  - More productive cities are larger: $\frac{dN_{it}}{dA_{it}} > 0$
  - Cities with larger amenities are larger: $\frac{dN_{it}}{d\gamma_{it}} > 0$
  - Higher "excess frictions" make cities smaller: $\frac{dN_{it}}{dg_{it}} < 0$
- Explore this using data on U.S. cities and paying attention to the general equilibrium effects

Data

- Data for all MSAs in the U.S. between 2005-2008
- Production: GDP by MSA
- Consumption: No readily available data on consumption at MSA level
  - Use retail earnings and adjust using national averages
  - For housing consumption use gross rents
- Capital: use U.S. sectoral capital stocks and allocate it to MSAs according to their shares in sectoral earnings
- Hours worked: Current Population Survey

Identifying City Characteristics

- Need to calculate the triplet $(A_{it}, \gamma_{it}, g_{it})$ from the data
- Obtain productivity A_{it} from

$$A_{it} = \frac{y_{it}}{k_{it}^{\theta} h_{it}^{1-\theta}}$$

- Calculate labor wedge τ_{it} from

$$(1 - \tau_{it}) = \frac{\psi}{(1-\theta)} \frac{c_{it}}{1 - h_{it}} \frac{h_{it}}{y_{it}}$$

- Government's budget constraint to obtain excessive frictions g_{it}

$$\ln \tau_{it} = \alpha + \frac{1}{2} \ln N_{it} + \ln g_{it}$$

- Model to obtain the amenity levels γ_{it} as to match size distribution

How Reasonable is This Identification Strategy?

- **Amenities**
  - Data on 23 amenities at MSA level: climate variables, quality of life variables from different city rankings, geographic variables
  - Correlate observed data with model-generated data
  - 22 out of the 23 correlations have the expected sign
- **Efficiency**
  - Correlation between efficiency measure and wages: 0.80

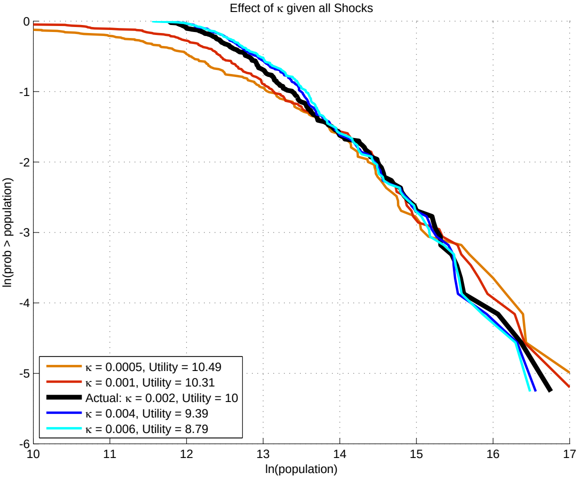
Parameters

- $\psi = 1.4841$ and $\theta = 0.3358$ (McGrattan and Prescott, 2009)
- $r = \delta = 0.02$
- According to the budget constraint

$$\alpha = \ln\left(\frac{2}{3}\right) + \ln\kappa - \frac{1}{2}\ln\pi$$

which allows us to estimate $\kappa = 0.002$

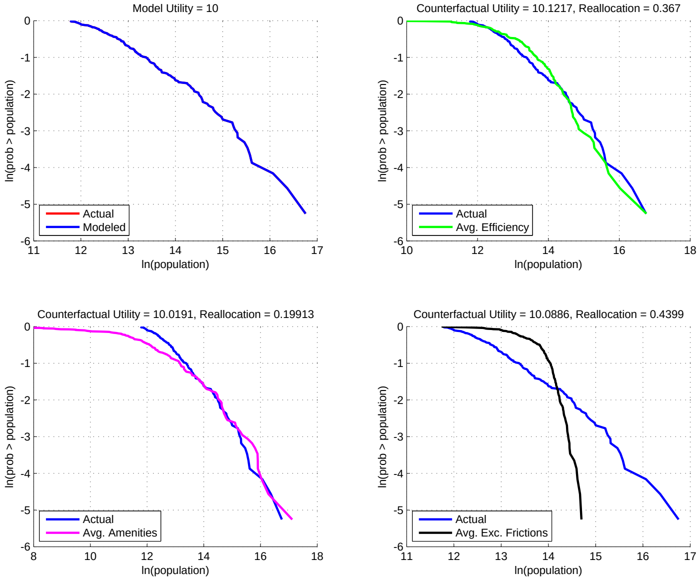
The Effect of Kappa



The Effect of Kappa

- Increasing commuting costs leads to decreased dispersion
  - Large cities become less attractive (higher congestion) and shrink
  - Small cities become more attractive (lower congestion) and grow
  - If commuting costs double, utility drops by 6.1%
- Decreasing commuting costs leads to increased dispersion
  - The disadvantage of being large is less important
  - If commuting costs halve, utility rises by 3.1%

Counterfactuals Without One Shock



Welfare Effects

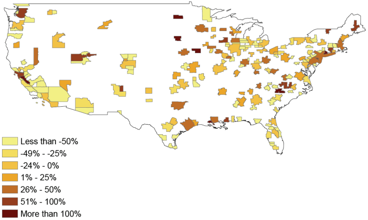
- Eliminate one shock (productivity, amenities, excessive frictions) by setting its value to the population-weighted average
- Eliminating any of the shocks increases utility because it leads to less dispersion and commuting costs are convex
- Modest effects on welfare (less than 1.5%).
  - People can reallocate across cities
  - In terms of consumption equivalence, the drop is larger (up to 15%)
    - Utility depends on more factors
    - Any negative productivity effect, for example, is mitigated through people working less and through the importance of amenities in utility

Effects on Individual Cities

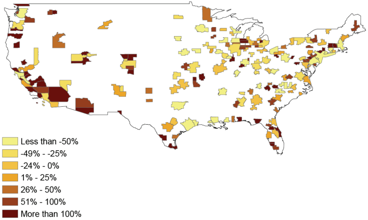
- Effect on the population of individual cities is large
- In the case of excessive frictions, strong relation to size
  - New York and Los Angeles -90%, Santa Cruz +145%
  - Some of the large cities are successful not just because of amenities or efficiency, but because of lower frictions
- In the case of efficiency, also strong relation to size
  - New York -77%, Los Angeles -29% and Chicago -46%
- In the case of amenities, weaker relation to size
  - East Coast gains (New York +44%, Philadelphia +34%)
  - West Coast loses (Los Angeles -8%, San Diego -42%)
  - Some smaller cities gain (Fargo +183%) but not all (Santa Fe -82%)

Geographic Distribution

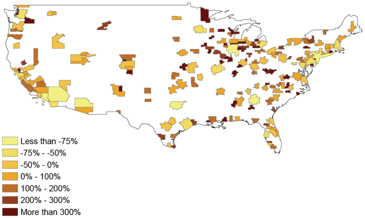
Without Differences in Amenities:



Without Differences in Efficiency:



Without Differences in Excessive Frictions:



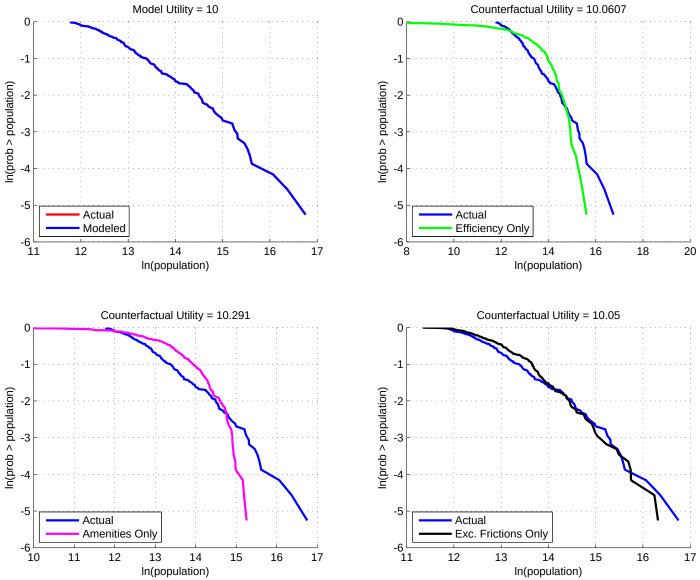
Geographic Distribution

- In the absence of amenity differences:
  - West Coast and Florida loses
- In the absence of efficiency differences:
  - North East and Central regions would lose
- In the absence of differences in excessive frictions:
  - "Rust Belt" would gain
  - Rochester +37%, Syracuse +120%, Toledo +108%, Allentown-Bethlehem +14%

Reallocation

- In the case of equalizing efficiency or amenities, the overall shape of the distribution does not change much
- But cities may be changing their ranking in the distribution, so that the implied population reallocation may be large
- Measure reallocation by adding the number of new workers in expanding cities as proportion of total population
  - Same efficiency: 37% reallocation and welfare gains of 1.2%
  - Same amenities: 20% reallocation and welfare gains of 0.2%
  - Same excessive frictions: 44% reallocation and welfare gains of 0.8%
- Hence, very large reallocations, but relatively modest welfare gains
  - Reallocation in the U.S. economy amounts to around 2.1% over 5 years

Counterfactuals With Only One Shock



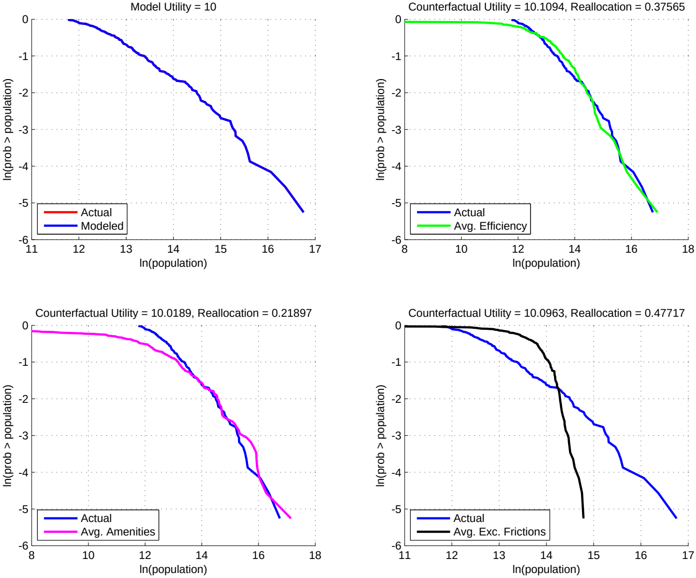
Adding Production Externalities

- Until now efficiency affects agglomeration, but agglomeration does not affect efficiency
- Introduce production externalities

$$A_{it} = \tilde{A}_{it} N_{it}^{\omega}$$

  where $\tilde{A}_{it}$ is an exogenous characteristic and ω governs the elasticity of productivity with respect to size
- Based on literature, $\omega = 0.02$
- Use data on N_{it} and A_{it} to compute the exogenous productivities $\tilde{A}_{it}$.

Counterfactuals with Production Externalities



City Selection Effect

- When eliminating one of the shocks, some small cities become a lot smaller and exit (extensive margin)
- These are cities that lose their only comparative advantage
  - With externalities, this loss gets compounded, leading to exit
- Again, welfare effects are small, and population reallocation is large

Adding Externalities in Amenities

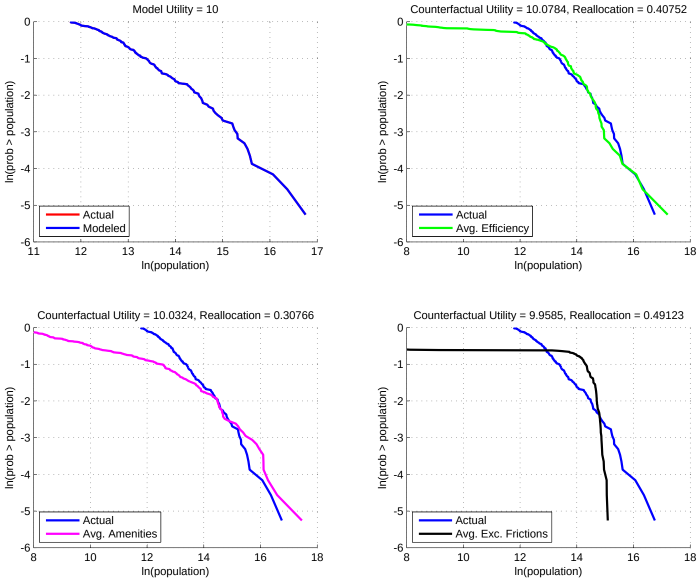
- Introduce amenities externalities:

$$\gamma_{it} = \tilde{\gamma}_{it} N_{it}^{\zeta}$$

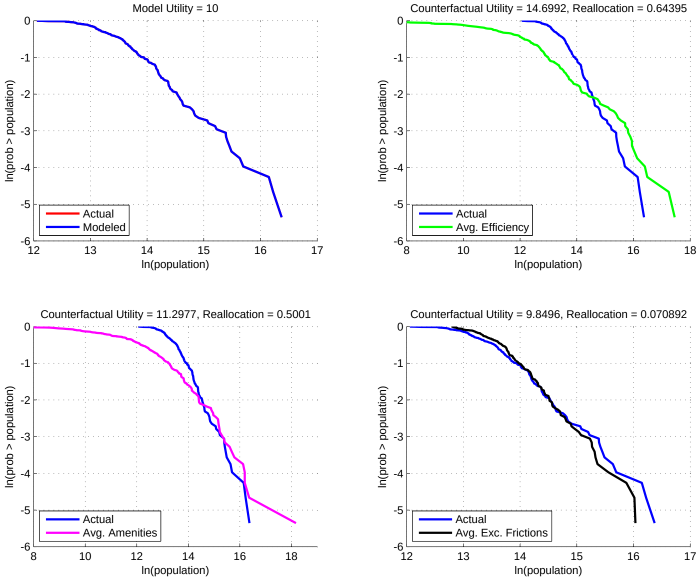
  - As in the case of production externalities we let $\zeta = 0.02$

- Reallocation and welfare changes very similar
- Equalizing city characteristics may decrease utility as cities are not able to take as much advantage of externalities
- City selection effect is stronger (extensive margin)

Counterfactuals Without One Shock and Both Externalities



Comparing with China



Comparing with China

- As in U.S. benchmark exercise, eliminate one shock (efficiency, amenities, excessive frictions)
- Welfare effects are an order of magnitude larger than in the U.S.
  - Equalize efficiency across space: welfare +47% (in U.S. +1.2%).
  - Equalize amenities across space: welfare +13% (in U.S. +0.2%)
  - To maintain utility, it would be enough to give all Chinese cities the efficiency of the lowest 27th percentile location
- Total reallocation of population similar to that of the U.S.
  - Equalizing efficiency: Beijing and Shanghai -97%.
  - Equalizing amenities: Beijing -10%, Shanghai -2%.
  - Equalizing excessive frictions: Shenzhen (one of the SEZs) -71%.

Comparing with China

- Equalizing efficiency or amenities in U.S.: *less* disperse distribution
  - Larger cities become smaller & smaller cities become larger
- Equalizing efficiency in China: *more* disperse distribution
  - Larger cities become larger & smaller cities become smaller
  - Not inconsistent with Shanghai and Beijing losing most of their population if efficiency were equalized
  - Others — those with high amenities but dismal productivity — become the new mega-cities

Comparing with China

- Same holds when equalizing amenities: larger cities become larger
  - Some of the large cities in China have low amenities
  - One potential reason are migratory restrictions that make us estimate low amenities for large cities
    - Shenzhen would grow to a population of 78 million, and Guangzhou would increase its population by 72%
    - Conversely, cities that are actively trying to attract more people should show up as having high amenities (e.g., Chongqing and Chengdu)
  - Other reasons might include air pollution and "time to build"
- The greater welfare effect from smoothing city characteristics in China has to do with the greater dispersion of those characteristics
  - These are bound to become smaller as China becomes more developed

Targeting Lagging Cities or Medium-Sized Cities?

China used to have the policy of *controlling the big cities, moderating development of medium-sized cities, encouraging growth of small cities*

Urban Policies	**Welfare Differences**		
	Efficiency	Amenities	Frictions
Improve in Worse Cities by 20%	4.9%	11.4%	0.2%
Improve in Smallest Cities by 20%	2.0%	4.5%	0.1%
Improve in Medium-Large Cities by 20%	5.2%	8.9%	0.1%

Policy Conclusions

1. Reducing spatial differences across cities does not necessarily imply larger cities becoming smaller
2. In a mature economy, like the U.S., the welfare effects of smoothing out spatial differences are small
3. As developing countries continue to grow, spatial differences will converge to those observed in more mature economies
   - Huge welfare effect in China, insignificant effect in Mexico
   - Greater underlying spatial differences and mobility restrictions in China
4. Favoring small cities is unwarranted
   - Favoring medium-sized cities or backward cities is more effective.
5. Analyzing policy interventions for just one city, without taking into account its effects on other cities, is misleading

2. Other Papers

Desmet and Henderson (*Handbook* 2015)

- What do we know about the spatial distribution of population and development?
- Development, industrialization and urbanization: one approach
  - Income elasticity for food less than one
  - Development leads to industrialization
  - Implies urbanization to the extent that industry is more urbanized
- Development, industrialization and urbanization: another approach
  - Elasticity between food and non-food less than one
  - Industrialization result of higher productivity growth in agriculture
  - Agricultural revolution preceded industrial revolution

Desmet and Henderson (*Handbook* 2015)

- Last decades in U.S.:
  - Spatial dispersion of manufacturing
  - Spatial concentration of services
- Explanation:
  - Land intensity of manufacturing vs services
  - Life cycle of industries (Desmet and Rossi-Hansberg, JET 2009)
- Similar patterns noted in other countries, e.g., Korea

Gollin, Jedwab and Vollrath (*JOEG* 2016)

- Observation: urbanization in Africa and Middle East is occurring at lower levels of industrialization
- Driving force seems to be higher income from natural resources
- Leads to "consumption cities" instead of "production cities"
- Rationalizes "urbanization without industrialization"
- Role of trade is key

Henderson, Squires, Storeygard and Weil (*QJE* 2018)

- Explores determinants of global distribution of economic activity
- Two groups of determinants:
  - Those important for agriculture
  - Those important for trade
- Puzzling finding:
  - Agriculture explains much more of the variation in developed countries than in developing countries
- Possible explanation:
  - Early developers: structural transformation occurred when transport costs were still high, so cities located in agricultural regions
  - Late developers: not the case
  - These initial spatial patterns have persisted

Conte, Desmet, Nagy and Rossi-Hansberg (2020)

- Geography of development
  - Desmet, Nagy & Rossi-Hansberg (*JPE* 2018)
  - Each location is unique in terms of its (i) amenities, (ii) productivity and (iii) geography
  - Each location has firms that produce, innovate and trade
- Extend in two ways
  - Multiple sectors
  - Effect of temperature on production and vice versa
- Discretize the world into 64,800 $1^\circ \times 1^\circ$ cells
- Calibrate and simulate
- Assess effect of global warming

Effect of Climate Change on Population 2200

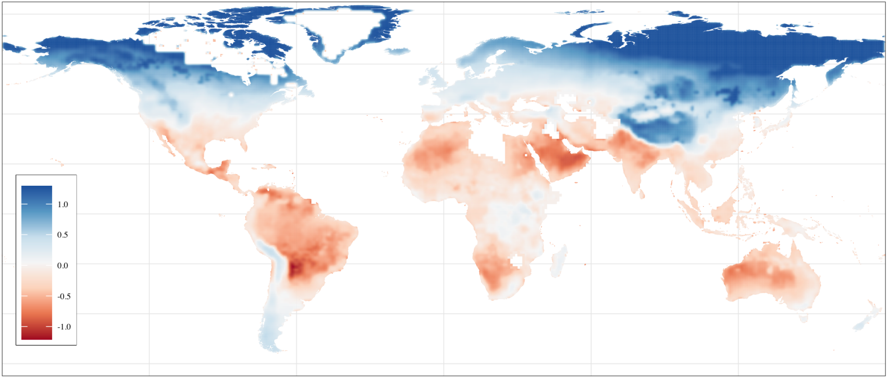
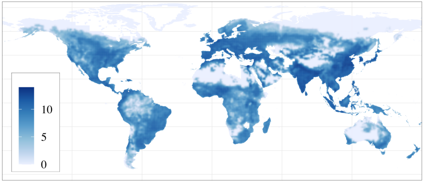


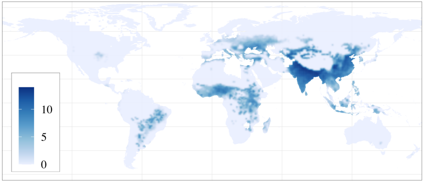
Figure displays $\log(\bar{L}_{200}(r))$ under climate change minus $\log(\bar{L}_{200}(r))$ under no climate change

Climate Change and Agricultural Output

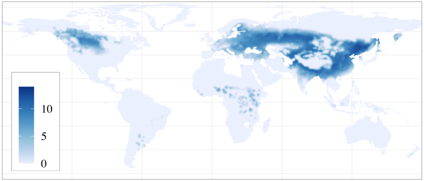
(a) Ag. output 2000



(b) Ag. output 2200: no climate Δ



(c) Ag. output 2200: climate Δ



(d) Ag. output 2200: climate - no climate Δ