Labor Mobility and Geography of Pandemics

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Motivation

- COVID-19 Pandemic is the ultimate economic externality…
  - People spreading it are least likely to be impacted
- Epidemiology (SIR) models are good at capturing this
  - Pandemic is spread through mobility of people – both within and across cities
- Two shortcomings:
  - Mobility of people is endogenous
  - Policy interventions have spillovers and distributional impacts
- Need to merge endogenous labor mobility model with SIR model

Questions

- How mobility impacts spread of outbreak? (and vice versa)
- How different policies impact spread of outbreak, labor mobility and welfare?
- How policy responses in one city spill over to other cities?
- (Why) do we need policy coordination?

Additional points

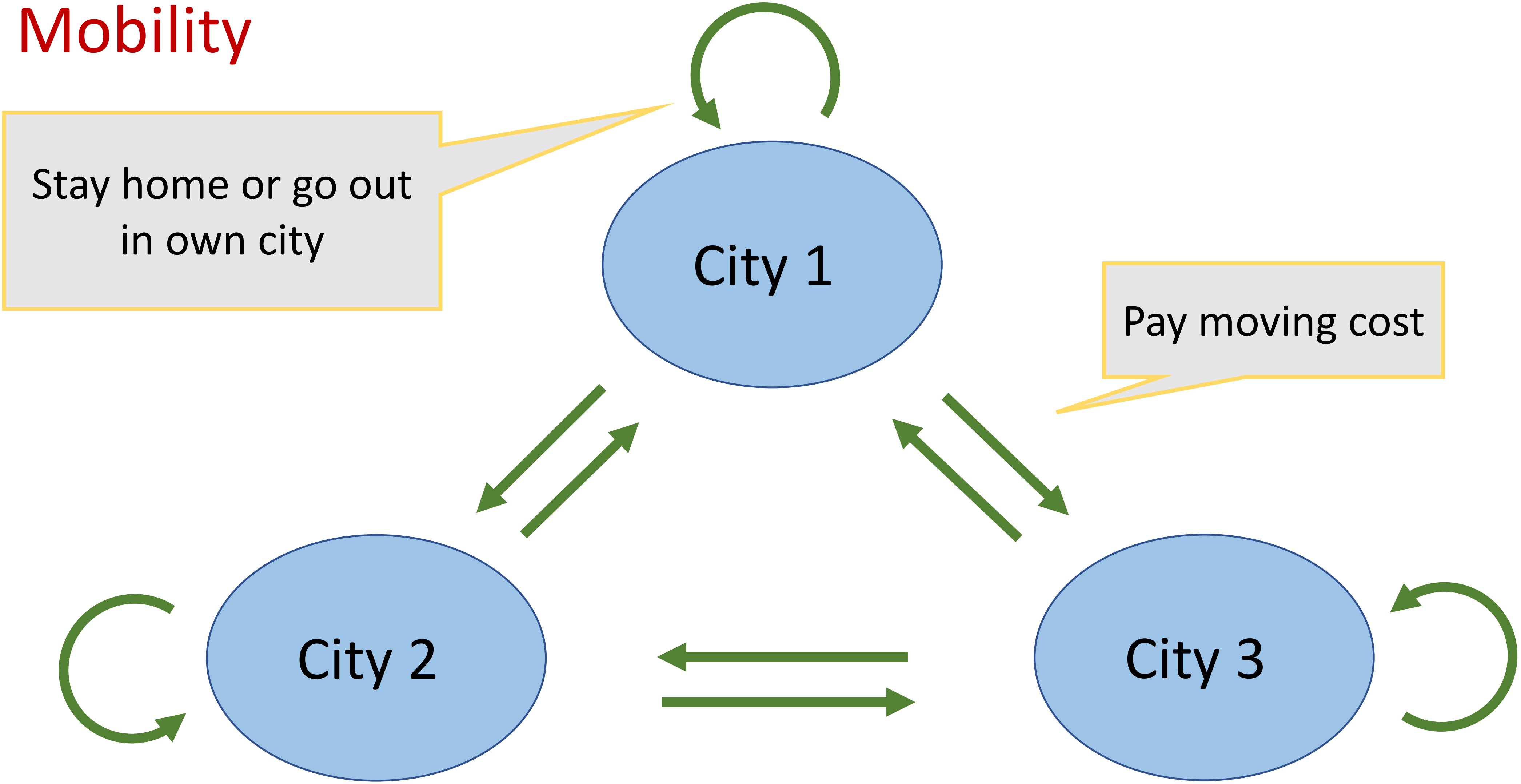
- Different risk levels across individuals
  - Low-risk: Mild or no symptoms, usually young and no pre-existing conditions
  - High-risk: Severe symptoms, possibly fatal, old and pre-existing conditions

- Low-risk people put high-risk individuals in danger → <u>First externality</u>

- Different risk levels across cities (or countries)
  - Heterogeneity of optimal response based on stage of outbreak
  - Spillovers across cities→ <u>Second externality</u>

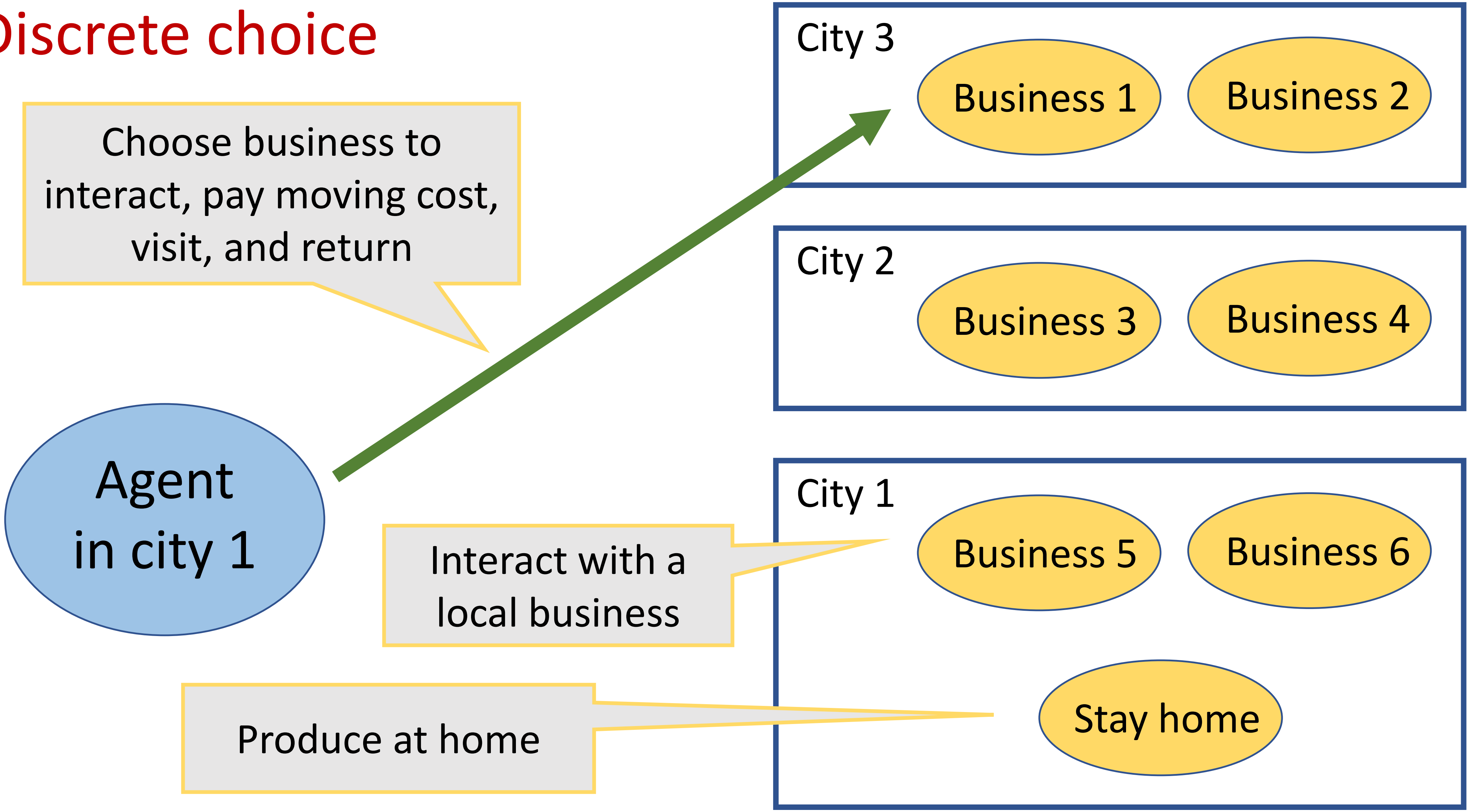
- Bring some concepts from trade and migration literatures
  - Need dynamics and high frequency, cannot use the most standard models

Mobility

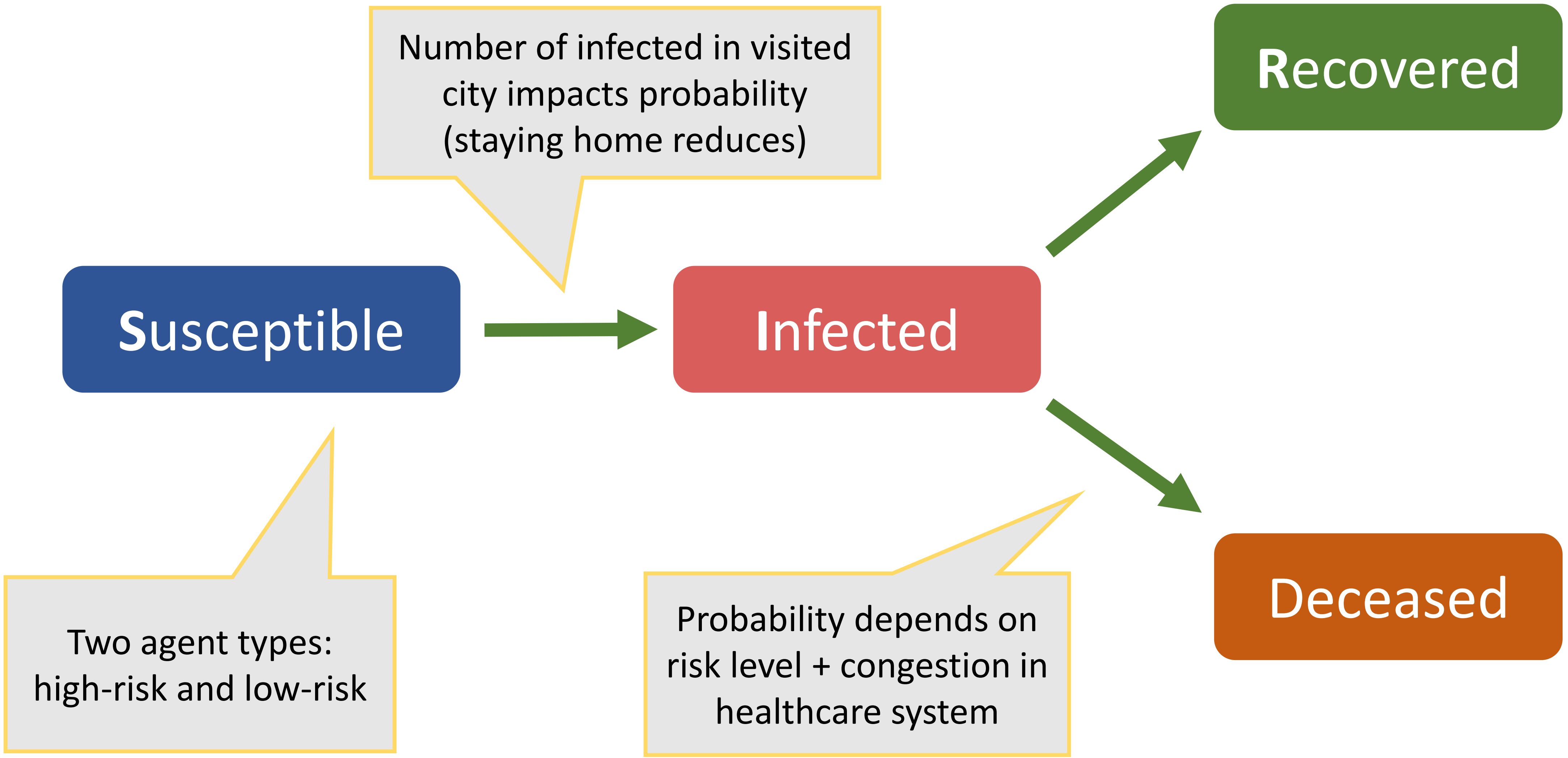


Stay home or go out in own city
City 1
Pay moving cost
City 2
City 3

Discrete choice



Health transition (SIR)



Bellman equation (w/ expectation)

sum over cities
(+ stay home)

Number of businesses

Probability of switching from health status h to h'

$$V_{i,t}^{s,h} = \omega_t^{s,h} + \sum_j m_{ij,t}^{s,h} \left(-\nu \log m_{ij,t}^{s,h} + \nu \log N_{j,t}^{s,h} - C_{ij,t}^{s,h} + \sum_{h'} \pi_{j,t}^{s}(h, h')\, \beta E_t V_{i,t+1}^{s,h'} \right)$$

Instantaneous utility

Moving probability of agent w/ risk factor s, and health status h

Moving cost

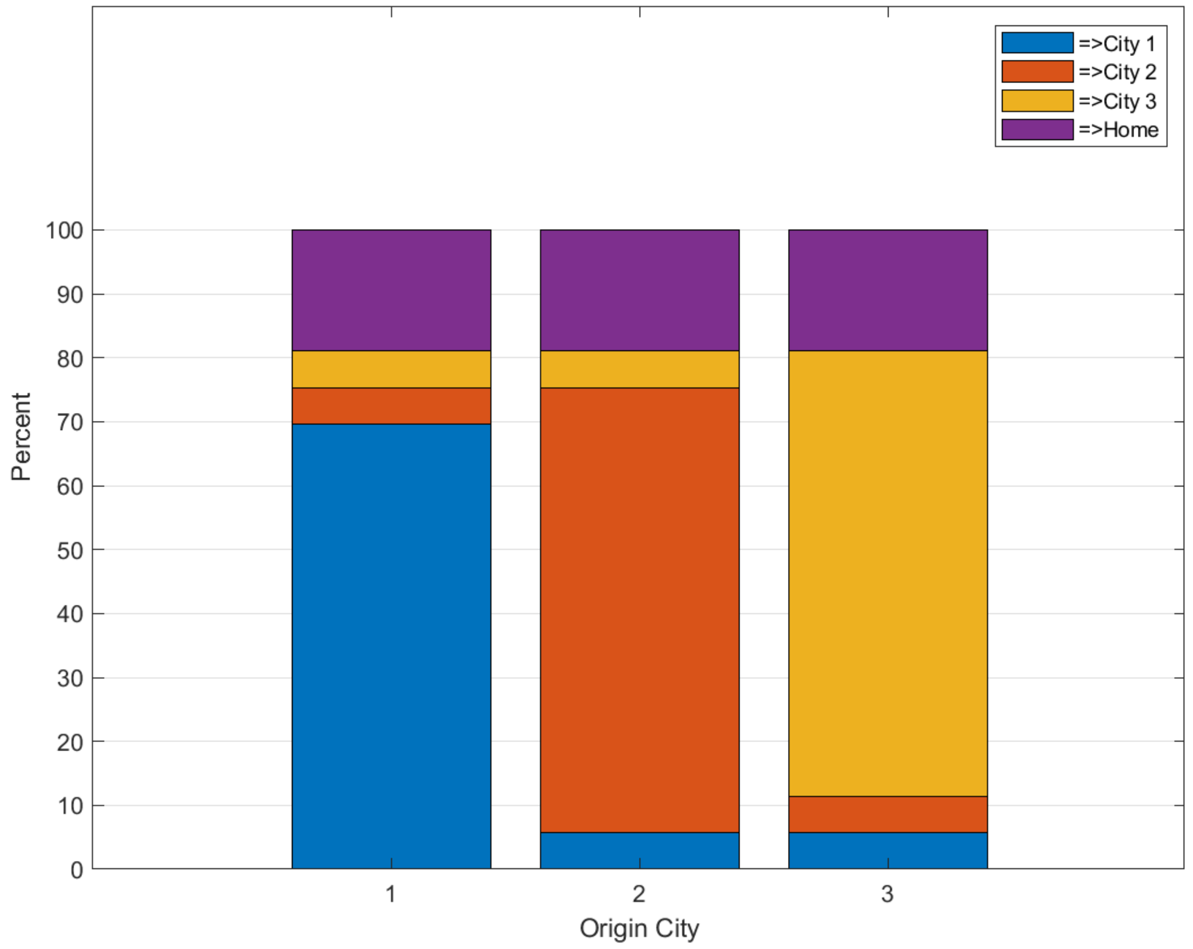
Next period expected value

Simulations

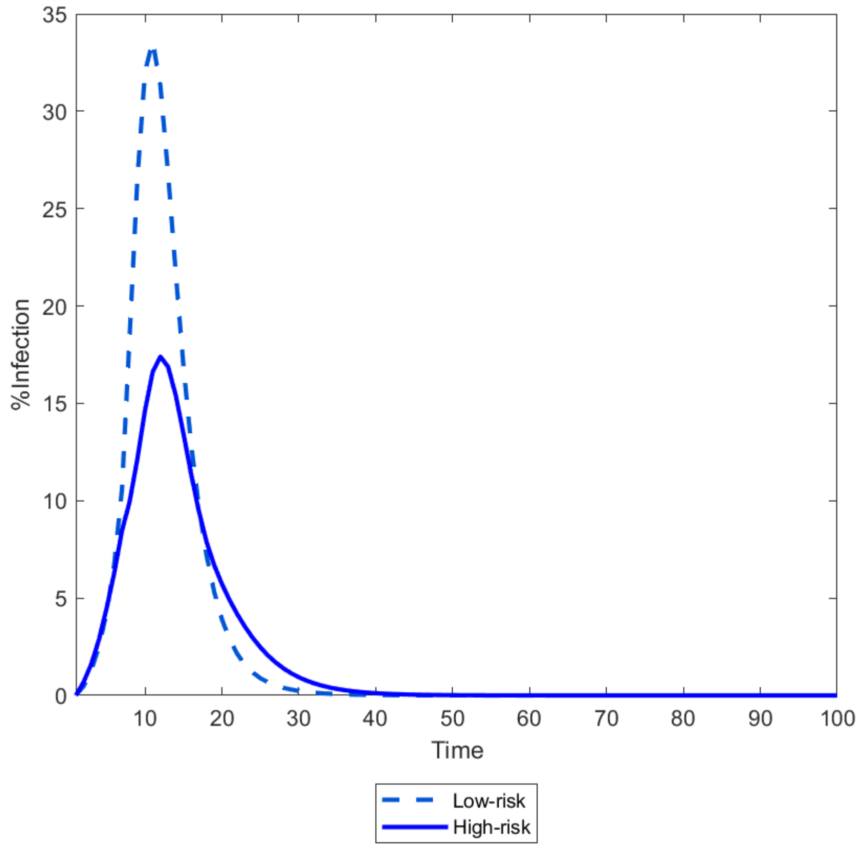
- Time unit = 1 week, discount factor β=0.998
- Three cities:
  - Each city has 4 businesses plus an option to stay home for locals
  - 50% high-risk population, 50% low-risk population
  - City 1 has 5% infected initially, otherwise identical
- Marginal weekly infection rate is 0.9 (but 0.3 while at home)
- Recovery takes approximately 3 weeks
- Death probability
  - for low-risk: 0.5%
  - for high risk: 5%   (+ increasing)

→We consider <u>city-isolation</u> and <u>social distancing</u> scenarios

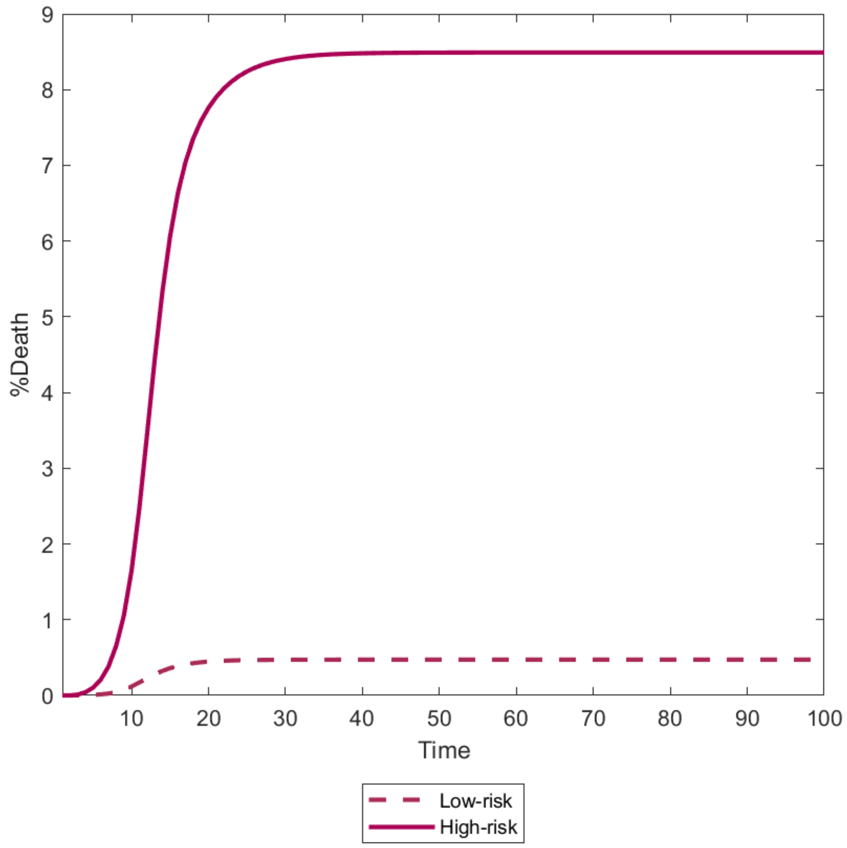
Mobility before COVID-19



Infection & cumulative death dynamics

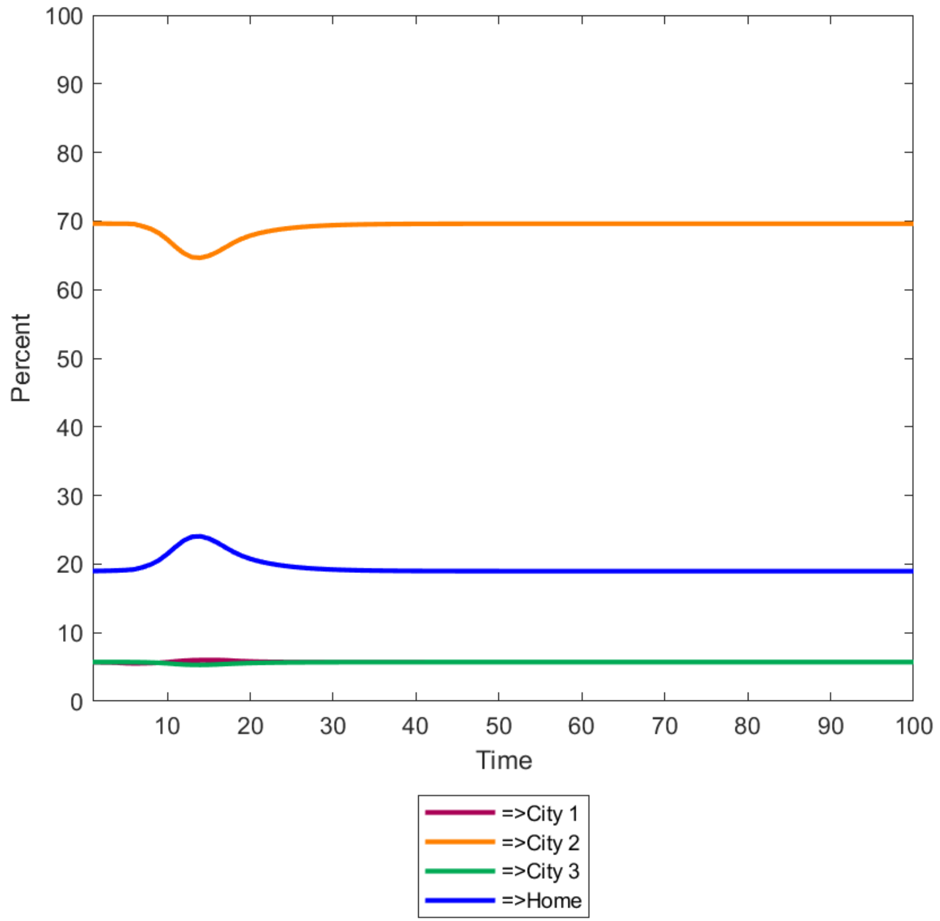


Infection dynamics in city 2

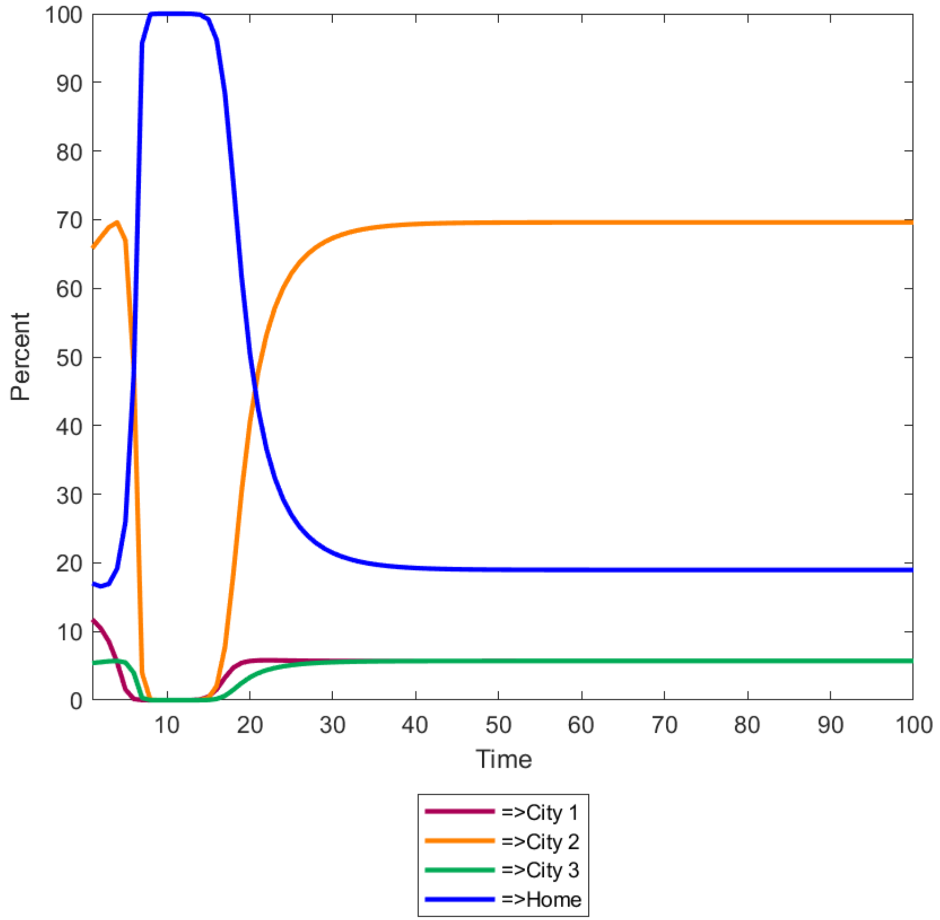


Cumulative deaths in city 2

Mobility dynamics

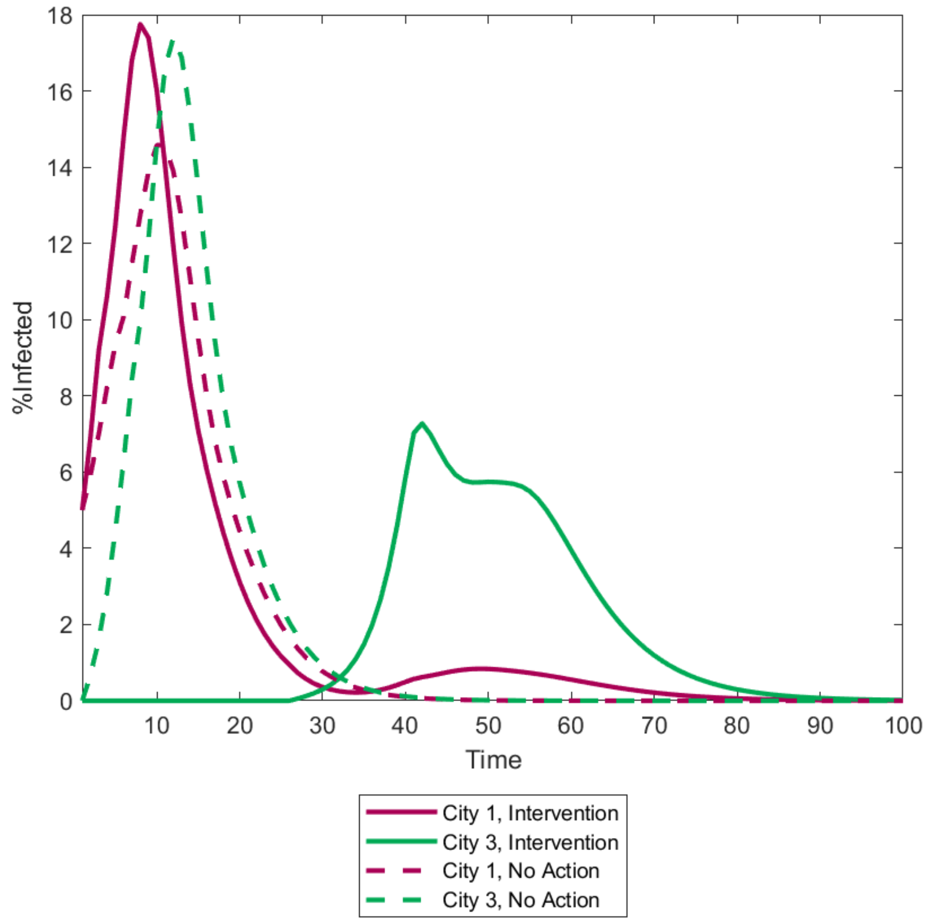


Low-risk, from city 2

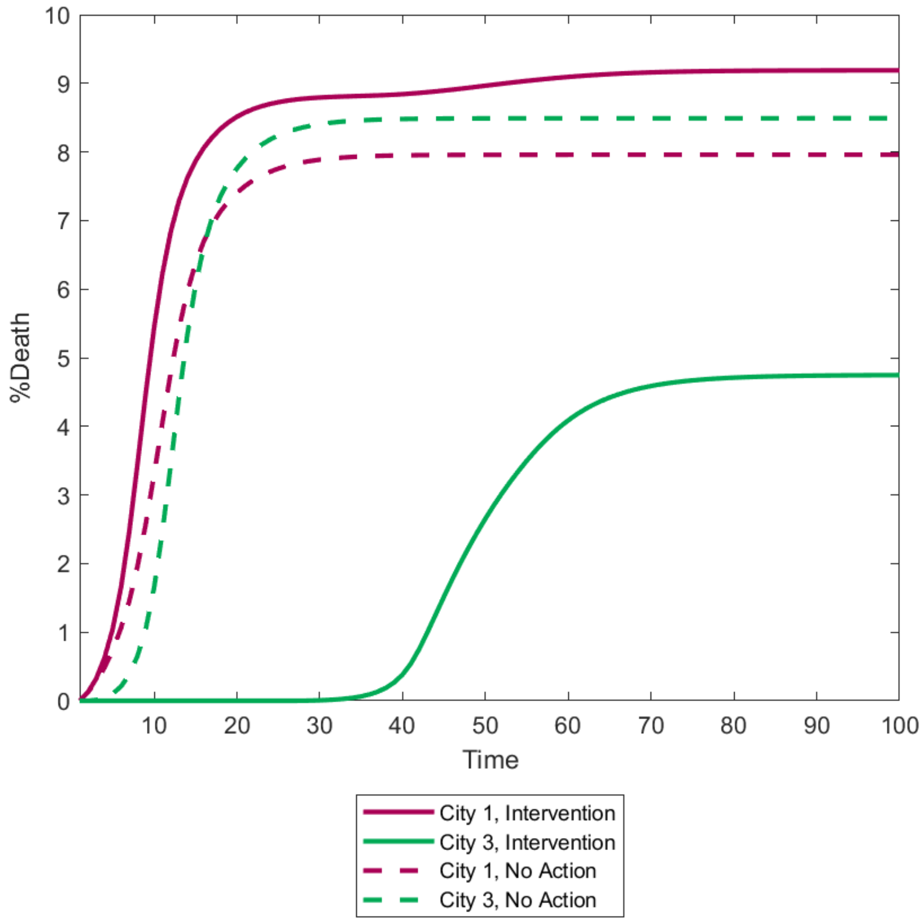


High-risk, from city 2

Policy I - Isolate city 1



Infection dynamics (high risk)



Cumulative deaths (high risk)

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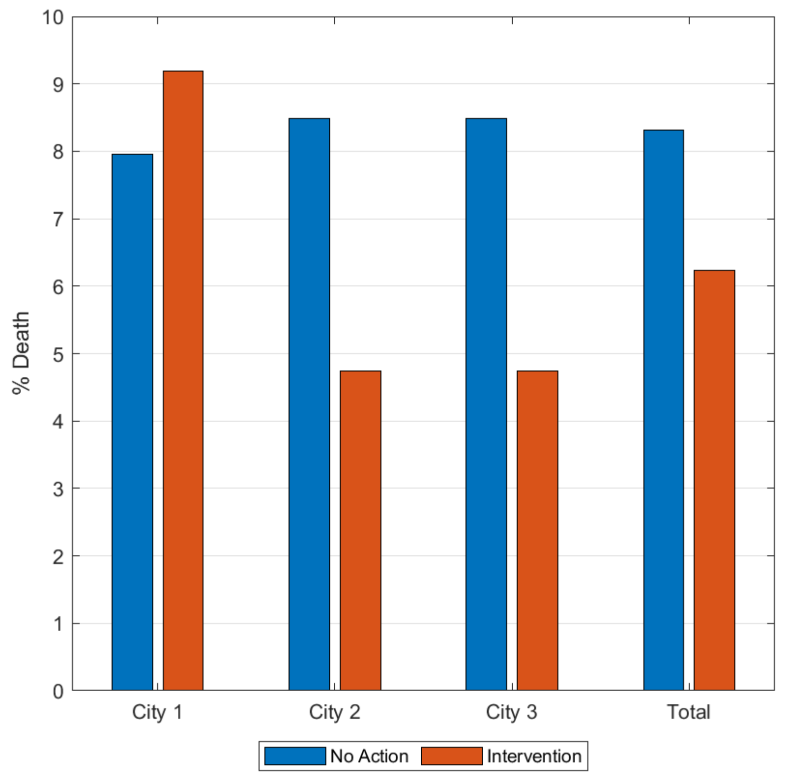
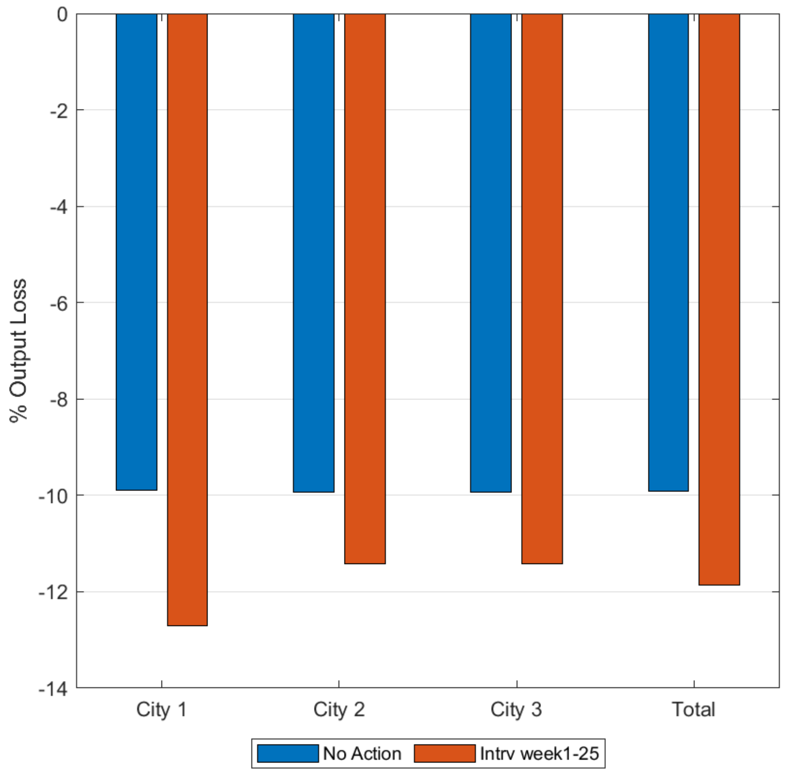
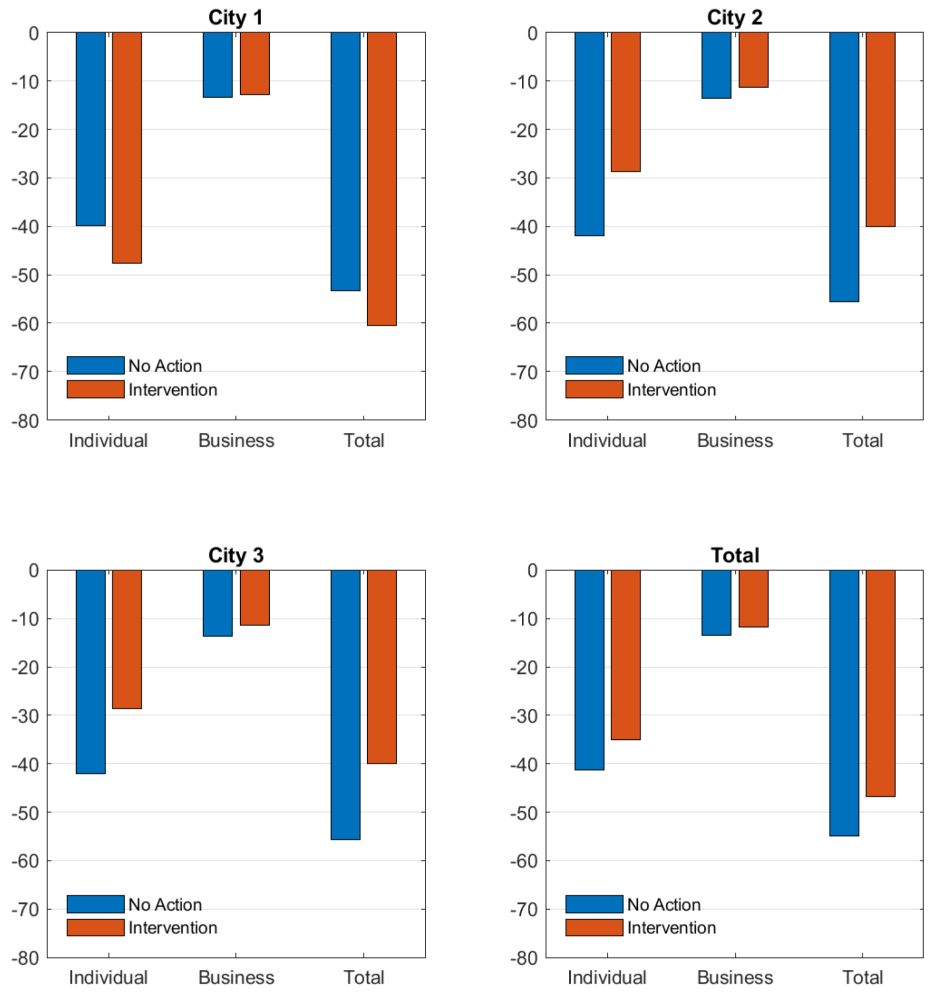


% Death (high-risk)



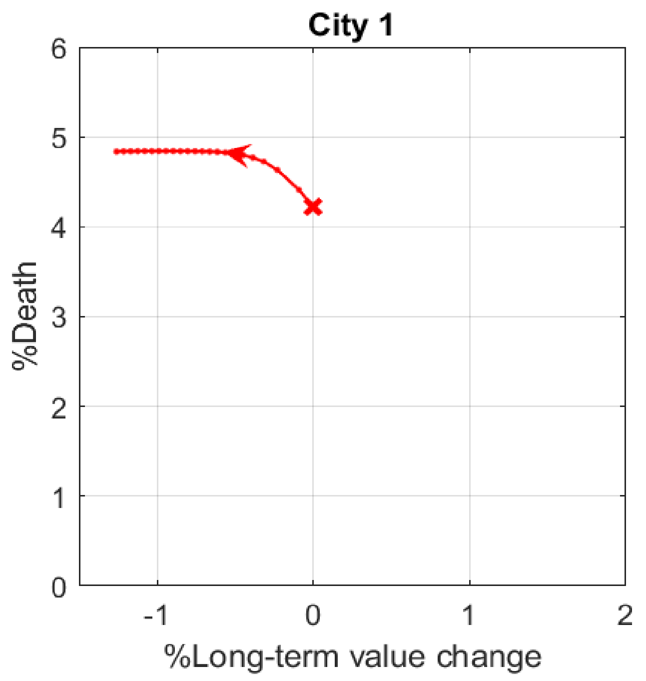
%Annual output loss
(compared with pre-COVID19)

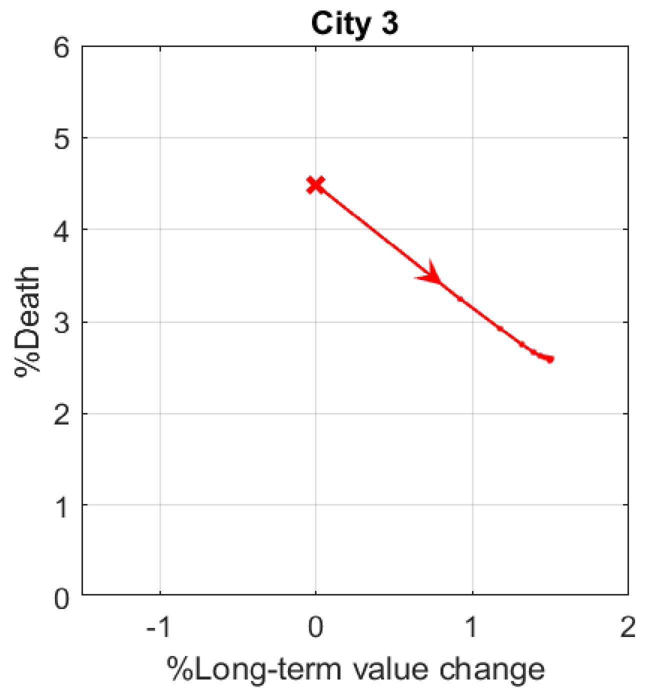
Policy I - Isolate city 1



Values (average discounted present)

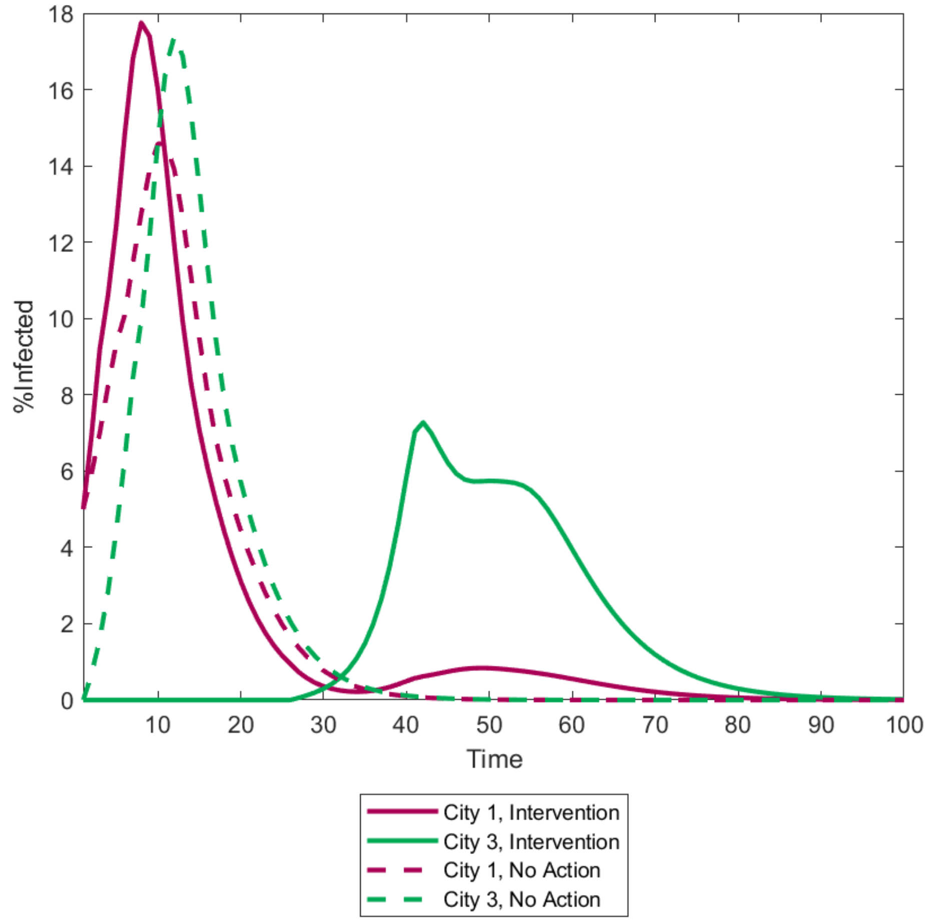
Policy I - Isolate city 1



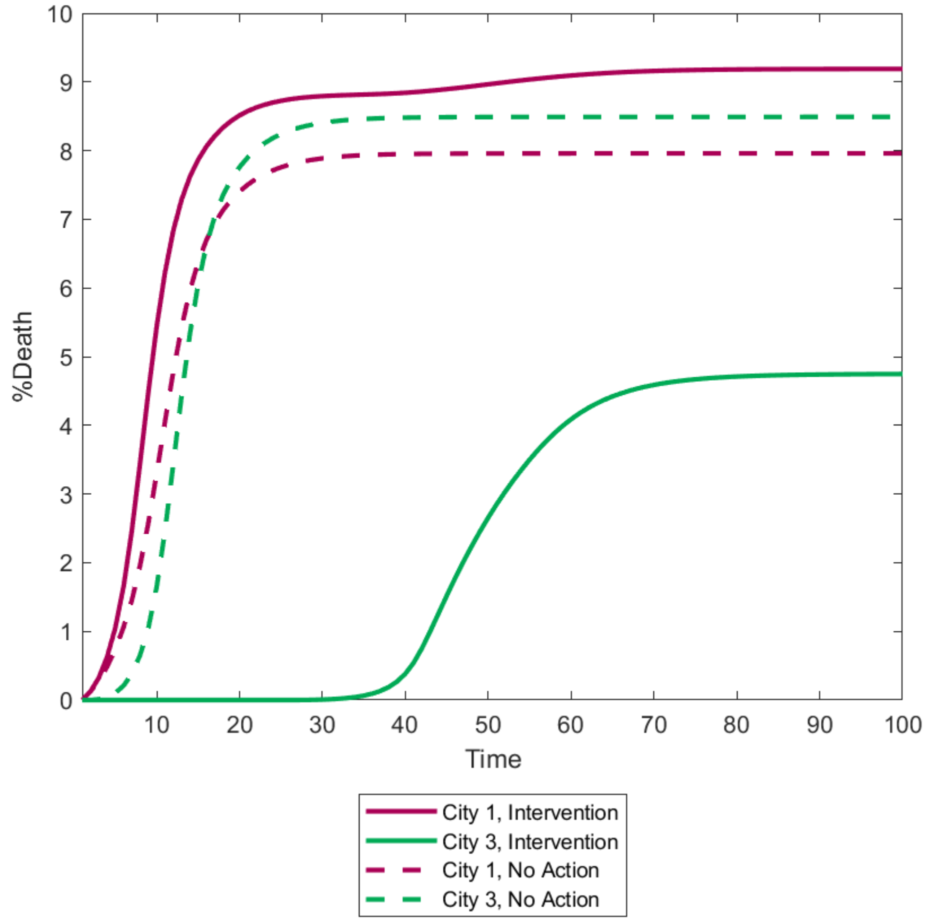


Death vs. average value
(Duration changing from 8 weeks to 50 weeks)

Policy II - Isolate all cities

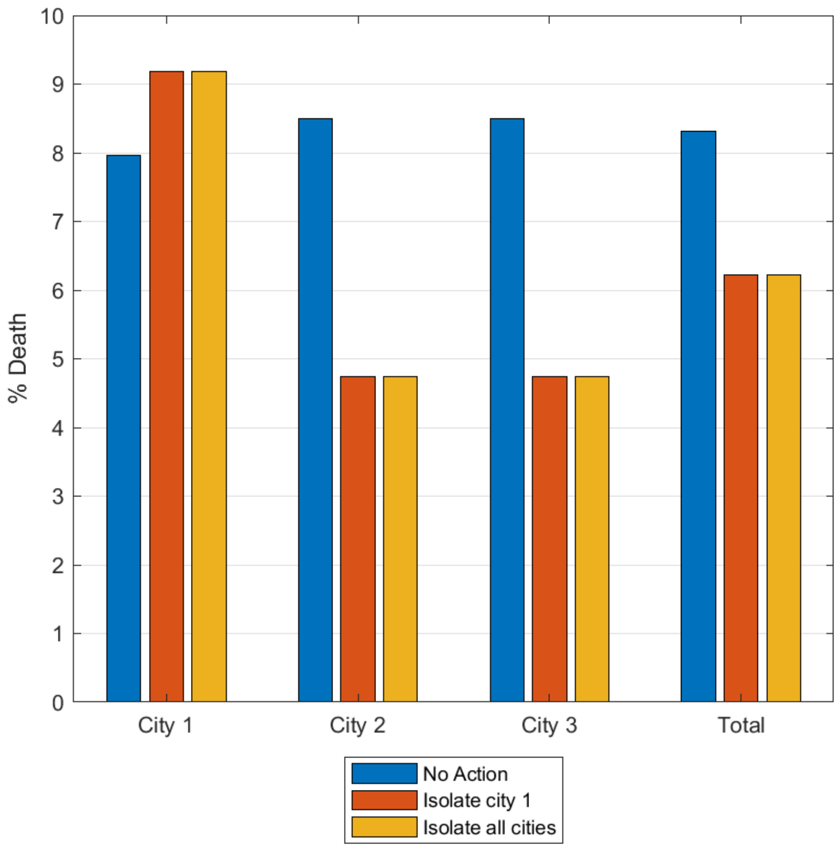


Infection dynamics (high-risk)

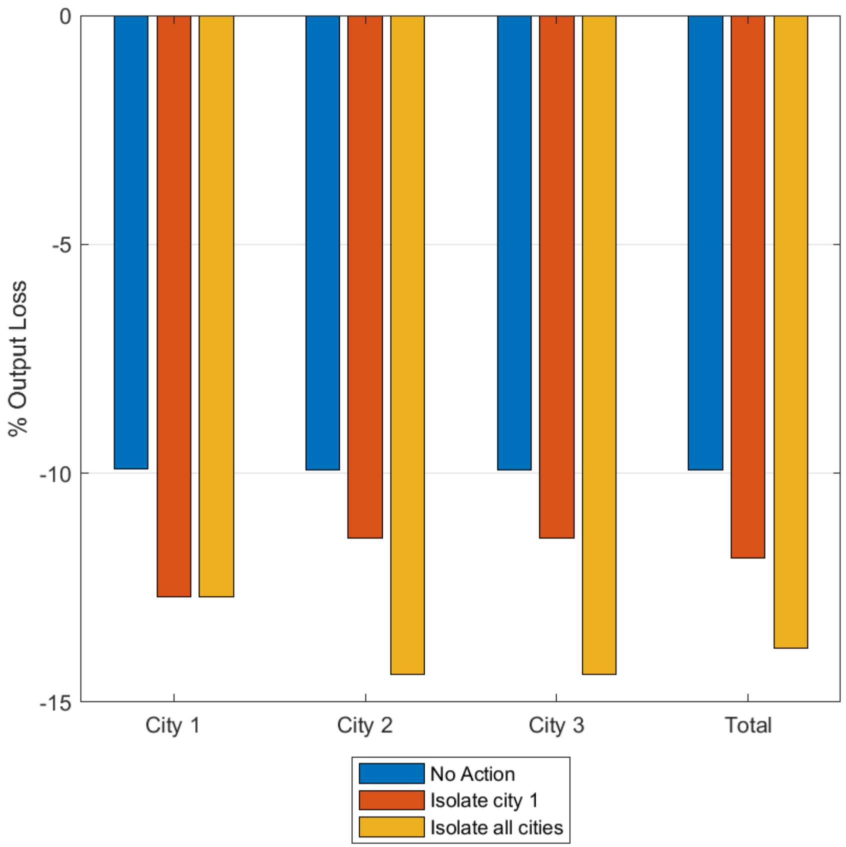


Cumulative deaths (high-risk)

Policy II - Isolate all cities

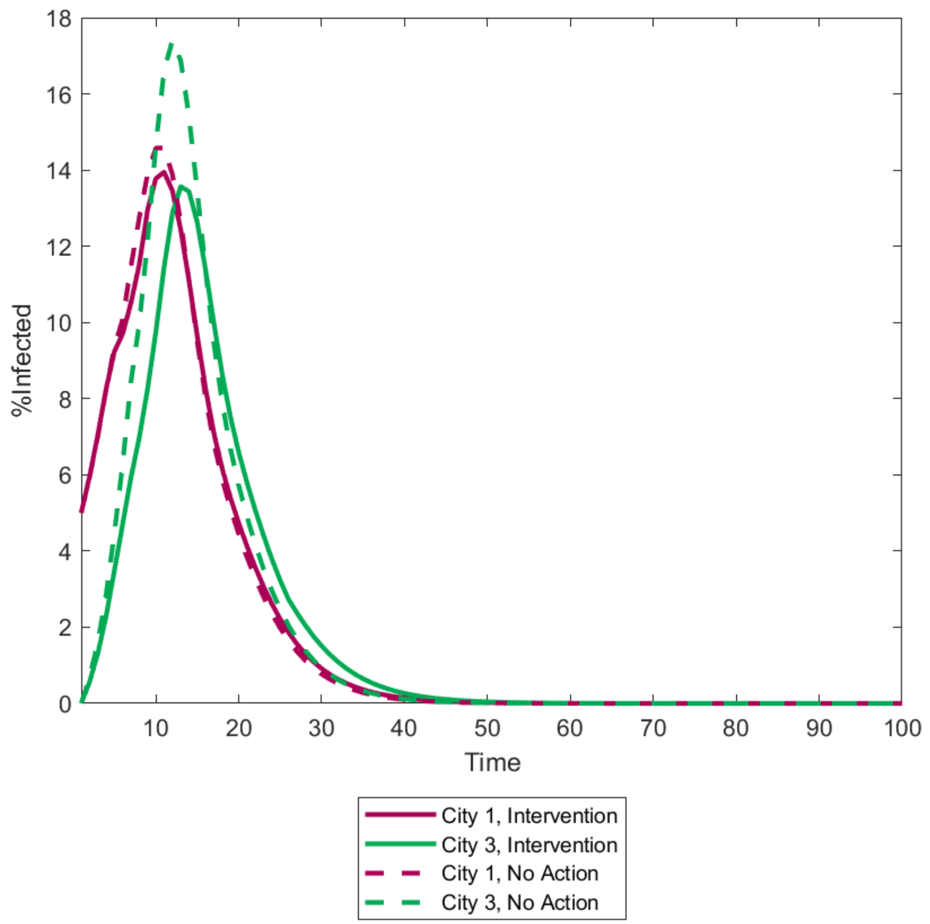


%Death (high-risk)

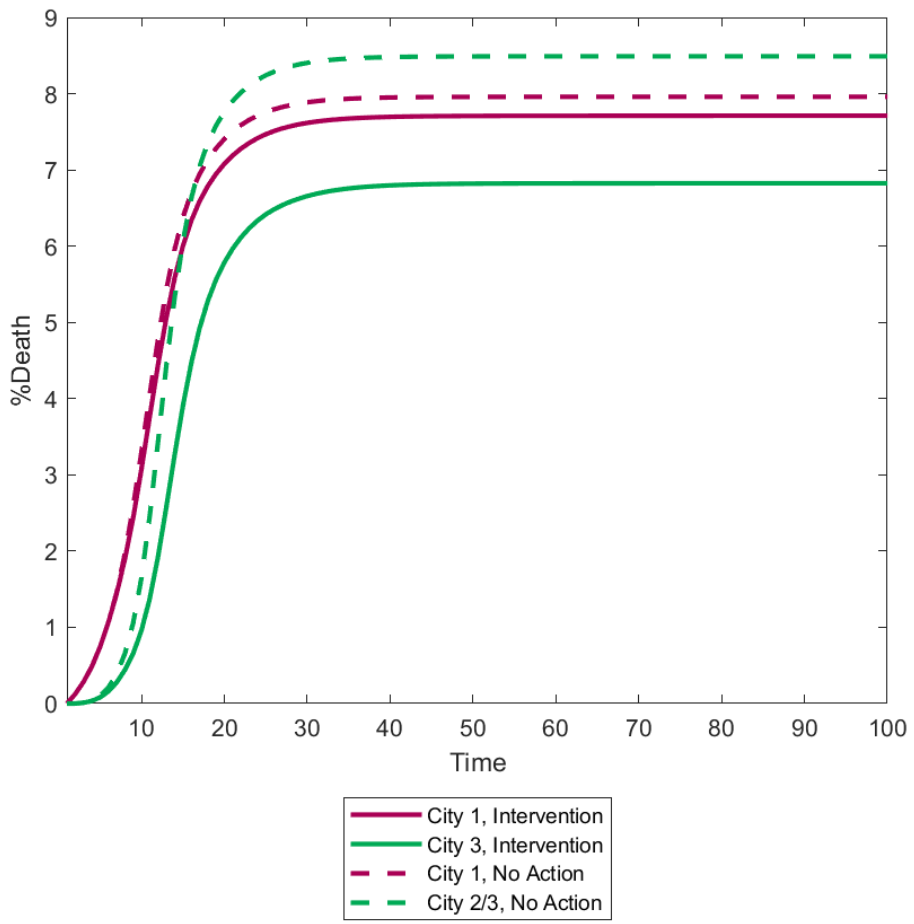


%Annual Output loss
(compared with pre-COVID19)

Policy III - Social distancing in city 3

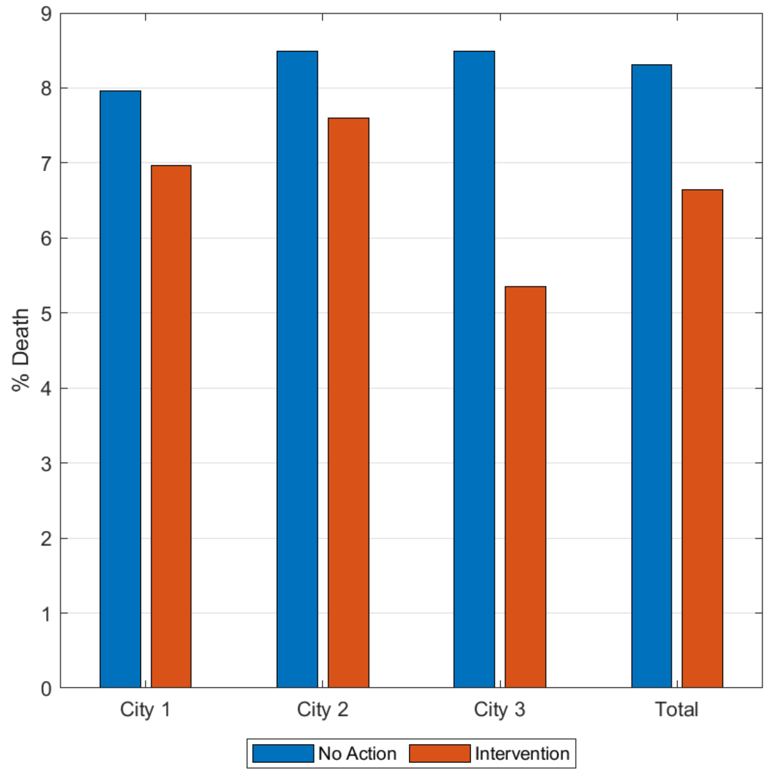


Infection dynamics (high-risk)

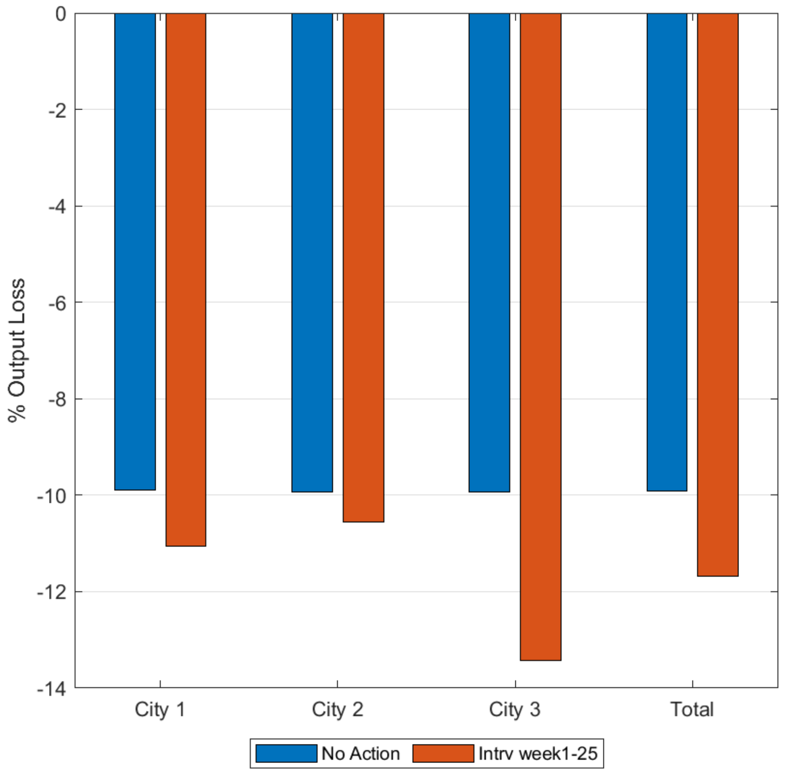


Cumulative deaths (high-risk)

Policy III - Social distancing in city 3

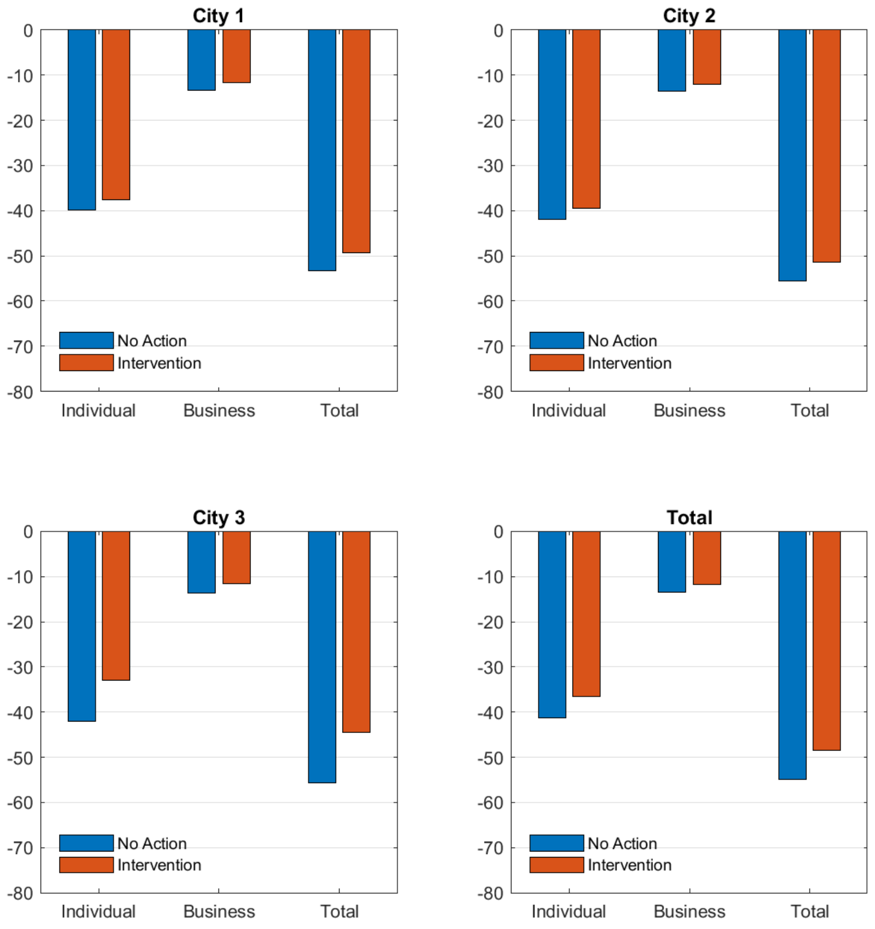


%Death (high-risk)



% Loss in annual output
(compared with pre-COVID19)

Policy III - Social distancing in city 3



Values (average discounted present)

Conclusion

- Labor mobility and spread of outbreak impact each other
- There are strong externalities across individual decisions as well as local policies
- Policy coordination at **federal** and **global** level is crucial
- Future work: Calibrate model using data

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