# COVID-19 in New York: lives vs livelihoods

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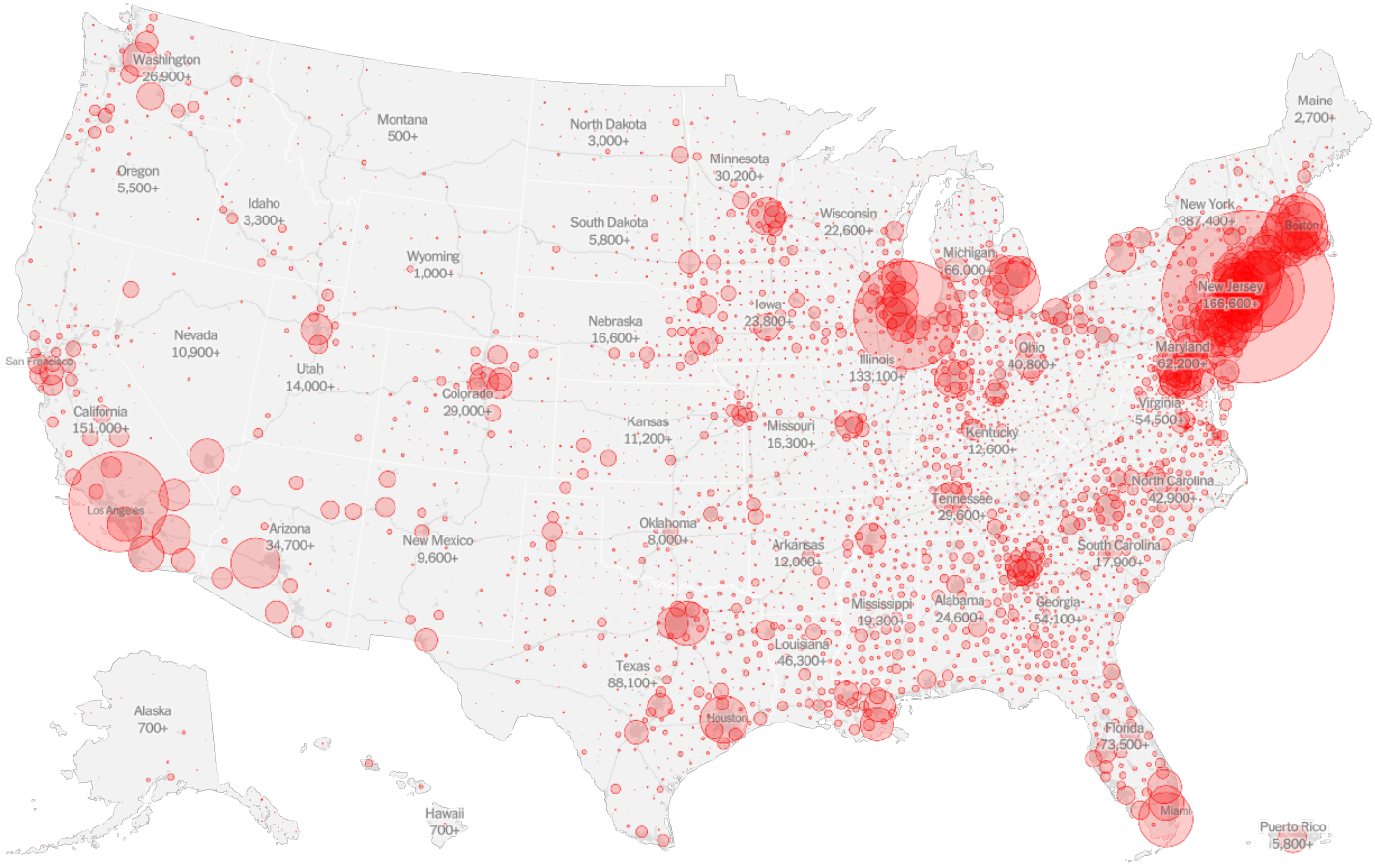
FEDERAL RESERVE BANK
OF MINNEAPOLIS

# COVID-19 in the US

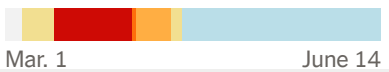
- New York has been one of the most affected states in the US during the COVID19 pandemic




Source: [NY Times](NY Times).

# COVID-19 in NY

- A vast majority of the cases, to date, are concentrated in NYC and surrounding areas.

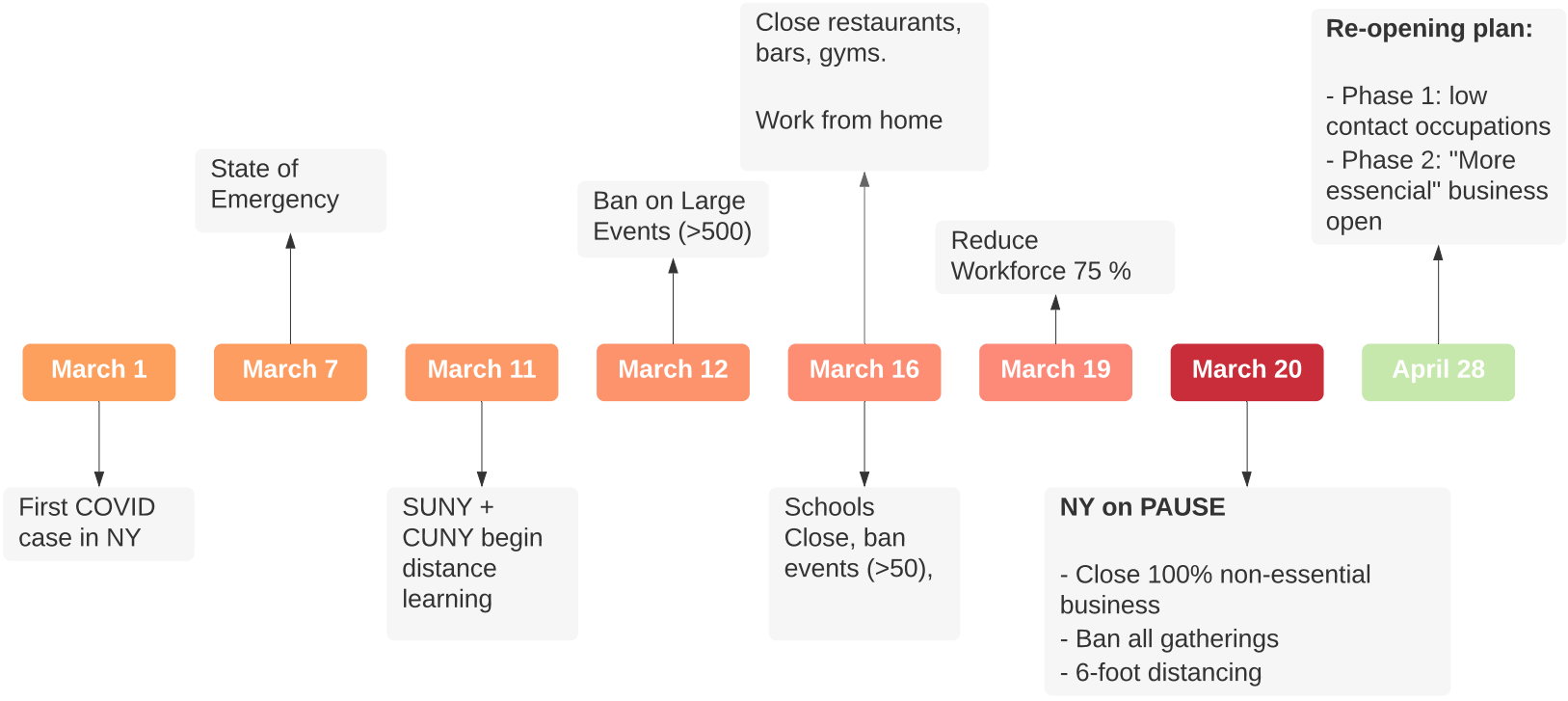
| | ▼ CASES | PER 100,000 | DEATHS | PER 100,000 | TWO-WEEK CHANGE IN CASES: FALLING FLAT RISING |
|---|---|---|---|---|---|
| New York | 388,096 | 1,995 | 30,605 | 157 |  |
| New York City | 214,627 | 2,542 | 21,578 | 256 | |
| Nassau | 41,204 | 3,037 | 2,670 | 197 | |
| Suffolk | 40,659 | 2,733 | 1,997 | 134 | |
| Westchester | 34,289 | 3,539 | 1,535 | 158 | |
| Rockland | 13,423 | 4,147 | 466 | 144 | |



Source: [NY Times](NY Times).

# Timeline of Shutdown Policies

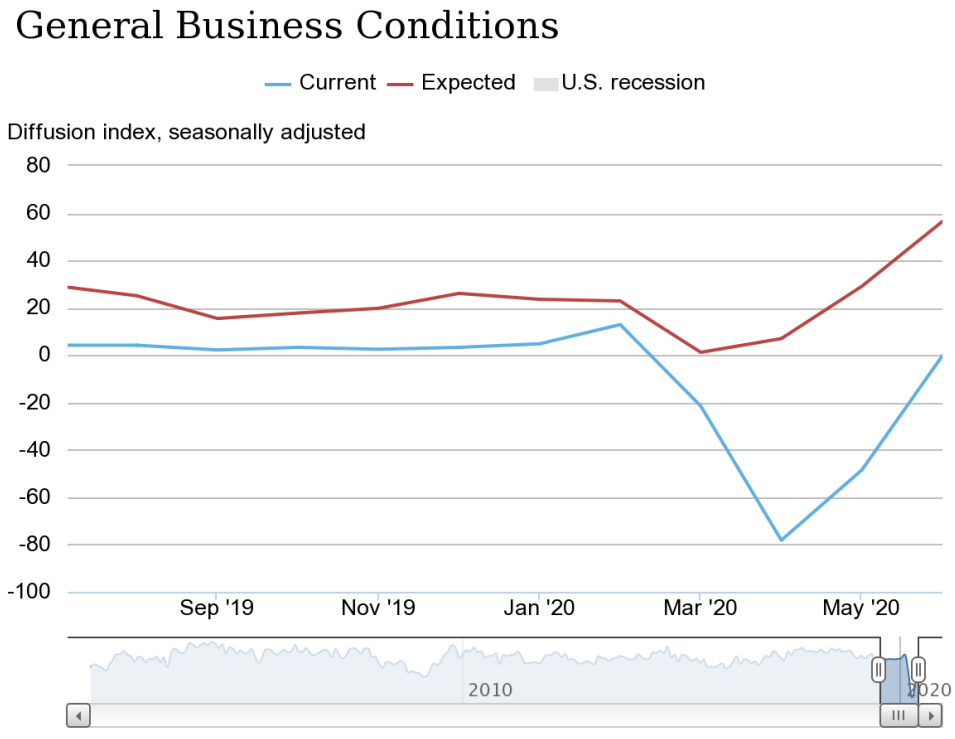
- Government officials enacted stricter policies as cases raised.




Source: Own calculations using newspaper information.

# Manufacturing Activity Survey

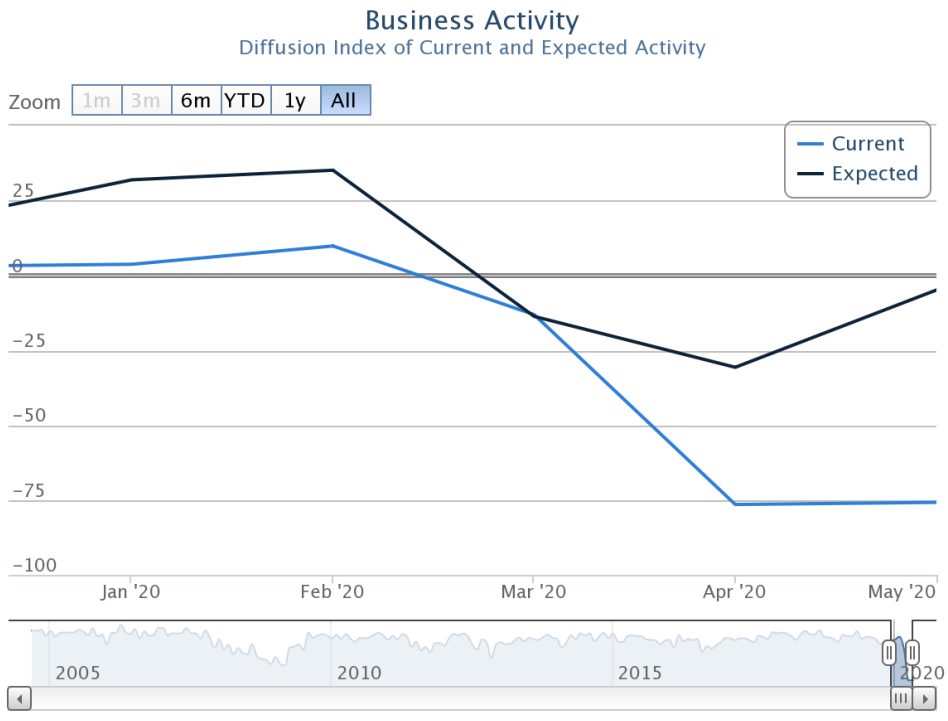
- Activity in the manufacturing sector declined 21% in March and 78% in April.
- This was totally unexpected by manufacturing sector leaders.




Source: [Federal Reserve Bank of New York](#).

# Business Activity Survey

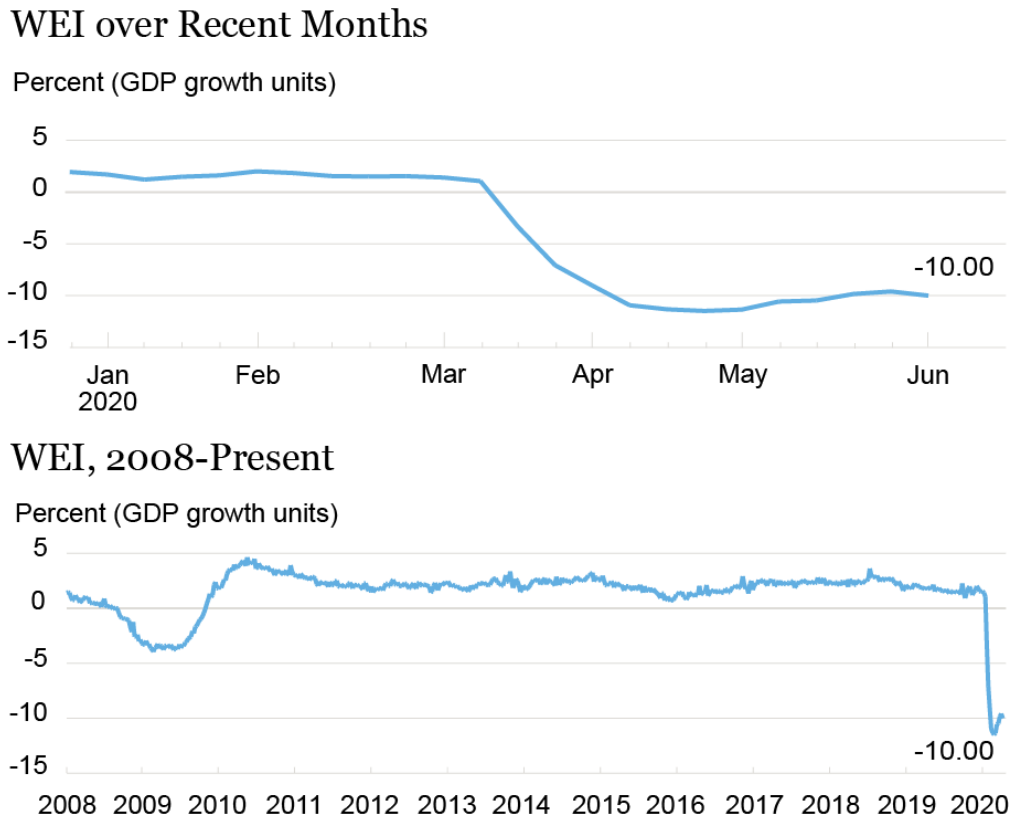
- Businesses activity declined 13% in March and 76% in April.
- Business leaders expectations were negative, but still fell short of the actual decline.




Source: [Federal Reserve Bank of New York](#).

# COVID-19 and the Economy in NY

- A combination of mitigation policies, actual infections and 'fear' resulted in a sharp decline in economic activity in NY State

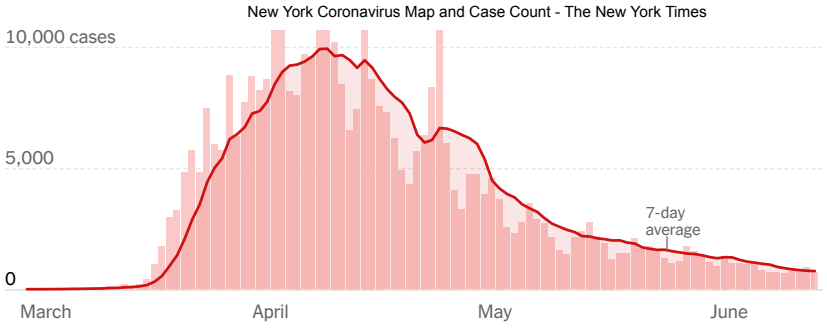



Source: Authors' calculations based on data from Haver Analytics, Redbook Research, Rasmussen Reports, the American Association of Railroads, and Booth Financial Consulting.

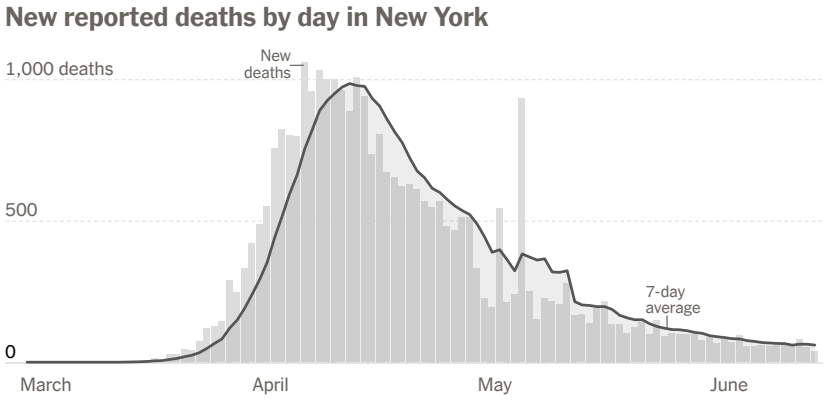
Source: Weekly Economic Indicators, Federal Reserve Bank of New York.

# Trade-Off

- Shutdown policies have been effective:




Note: The seven-day average is the average of a day and the previous six days of data.




Note: Scale for deaths chart is adjusted from cases chart to display trend.

- But there is a trade-off between the epidemiological cost (lives) vs the economic cost (livelihoods).

# KEY question

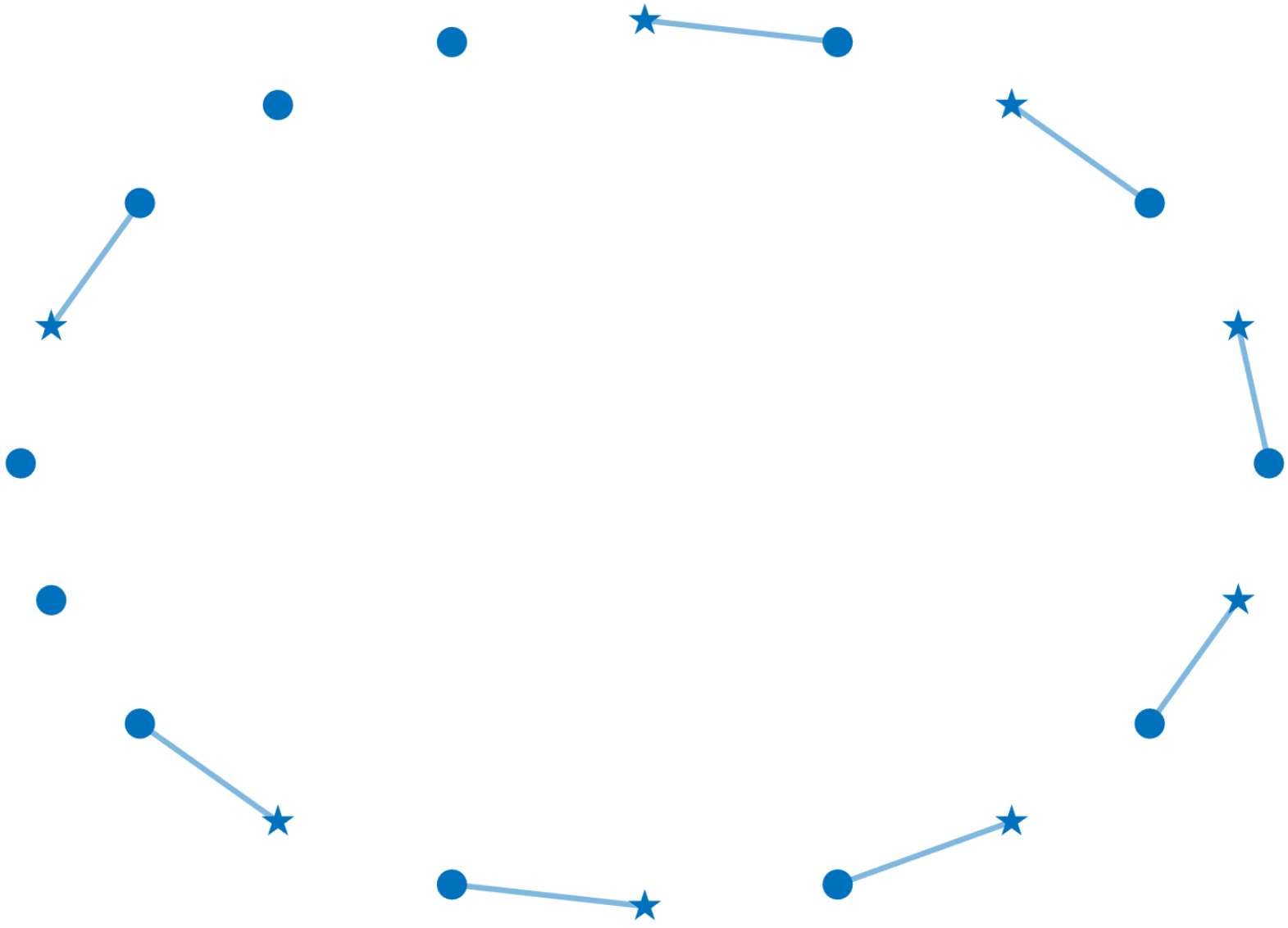
- How to design *smart* mitigation policies, which are effective in reducing disease spread but have low economic consequences.
- Network theory useful tool: infections and economic activity happen through same network of human interactions

ECON-EPI network

# The three components of the ECON-EPI Network

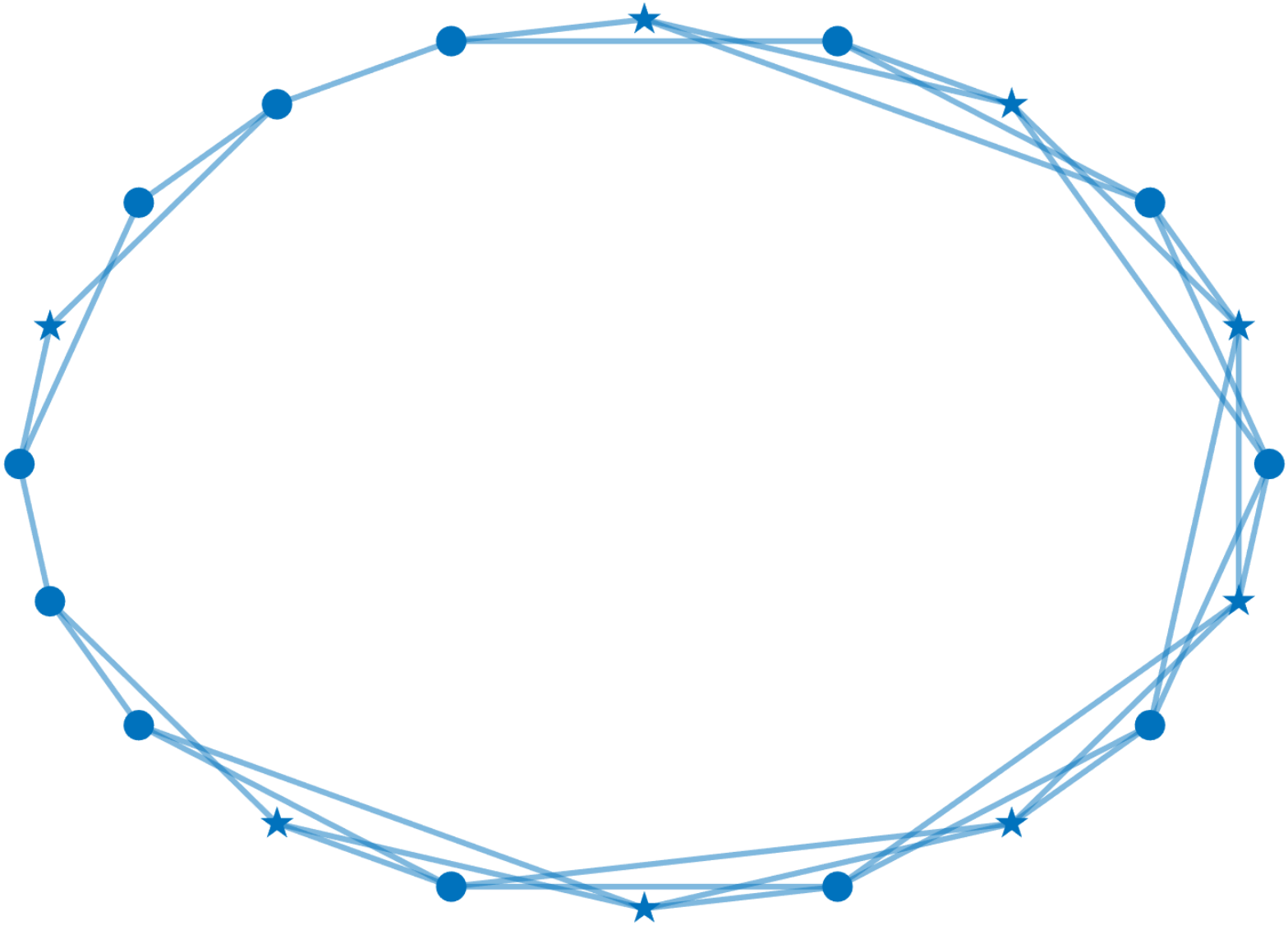
- The NETWORK: Human contacts
- The ECON: How economic activity is created on the network
- The EPI: How disease spread through the network

# A multilayered network



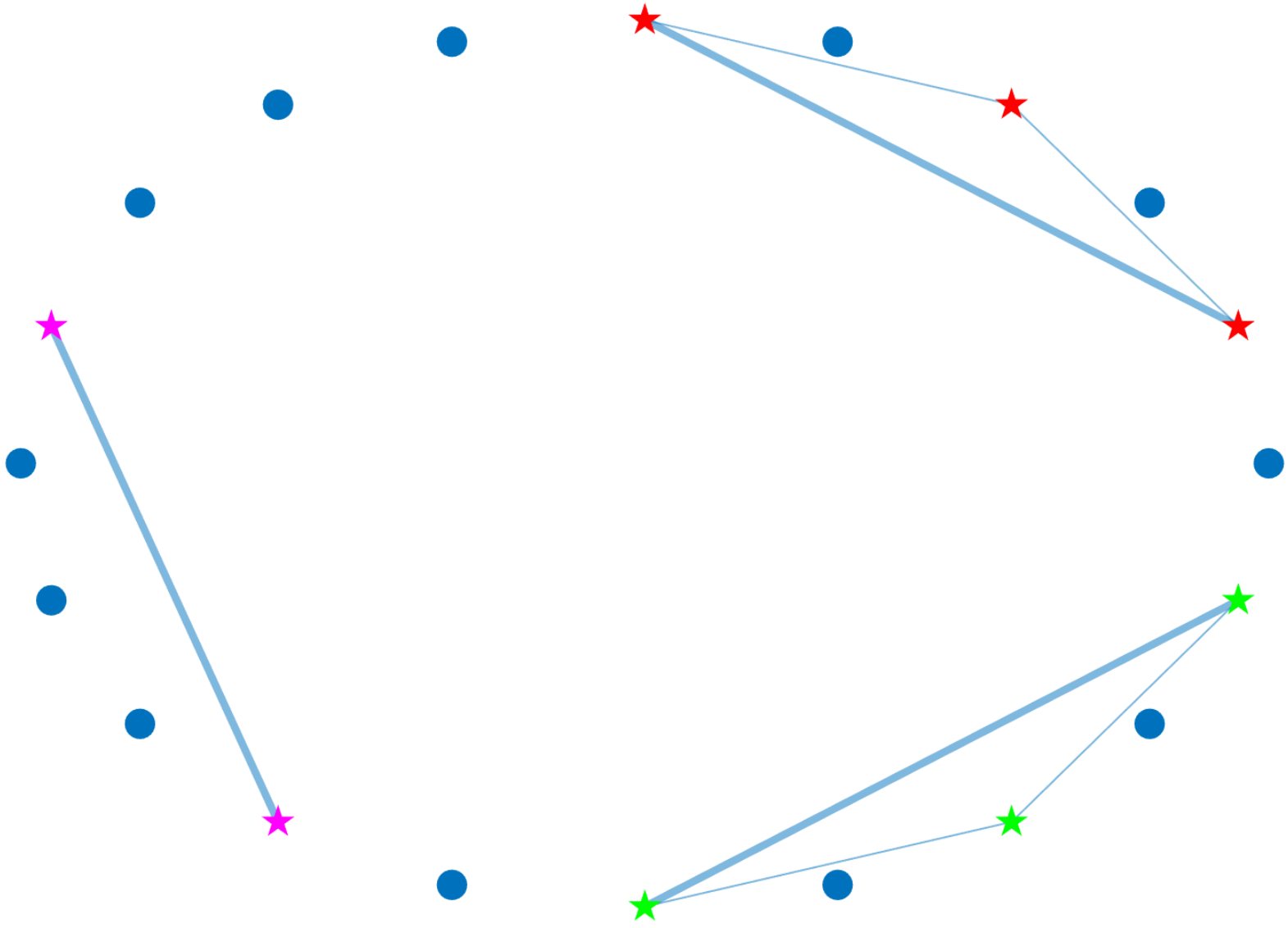
Layer 1. Households: short, stable, H-contact

# A multilayered network



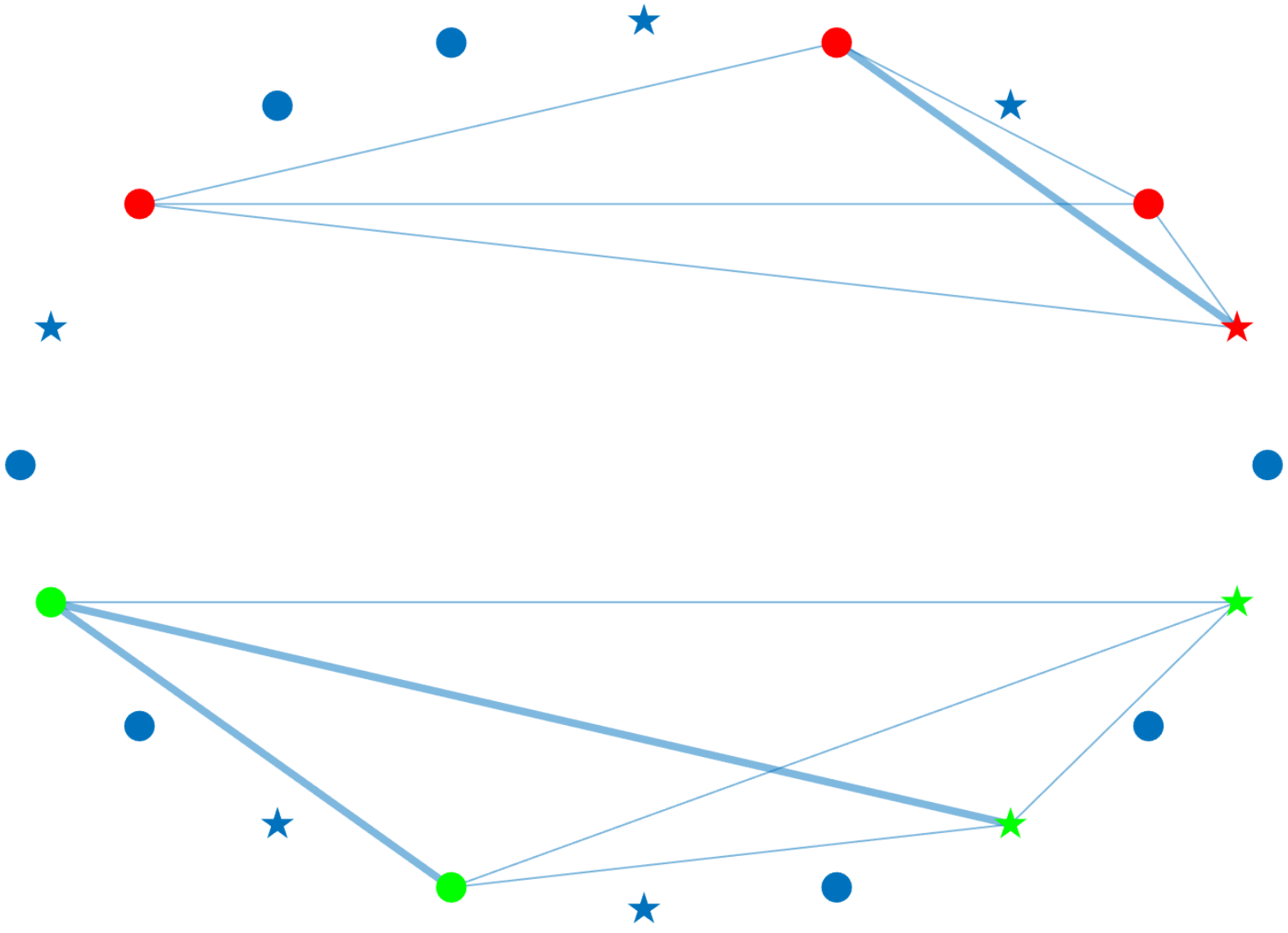
Layer 2. Neighborhood: short, stable, H-contact

# A multilayered network



Layer 3. Schools: short, unstable, H-contact, only kids

# A multilayered network



Layer 4: Public Transportation: short, unstable, L-contact, all

# Workplaces

## H-Sector

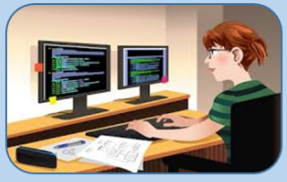
High K establishment

Small K establishment

More and unstable contacts, lower wages

## L-Sector

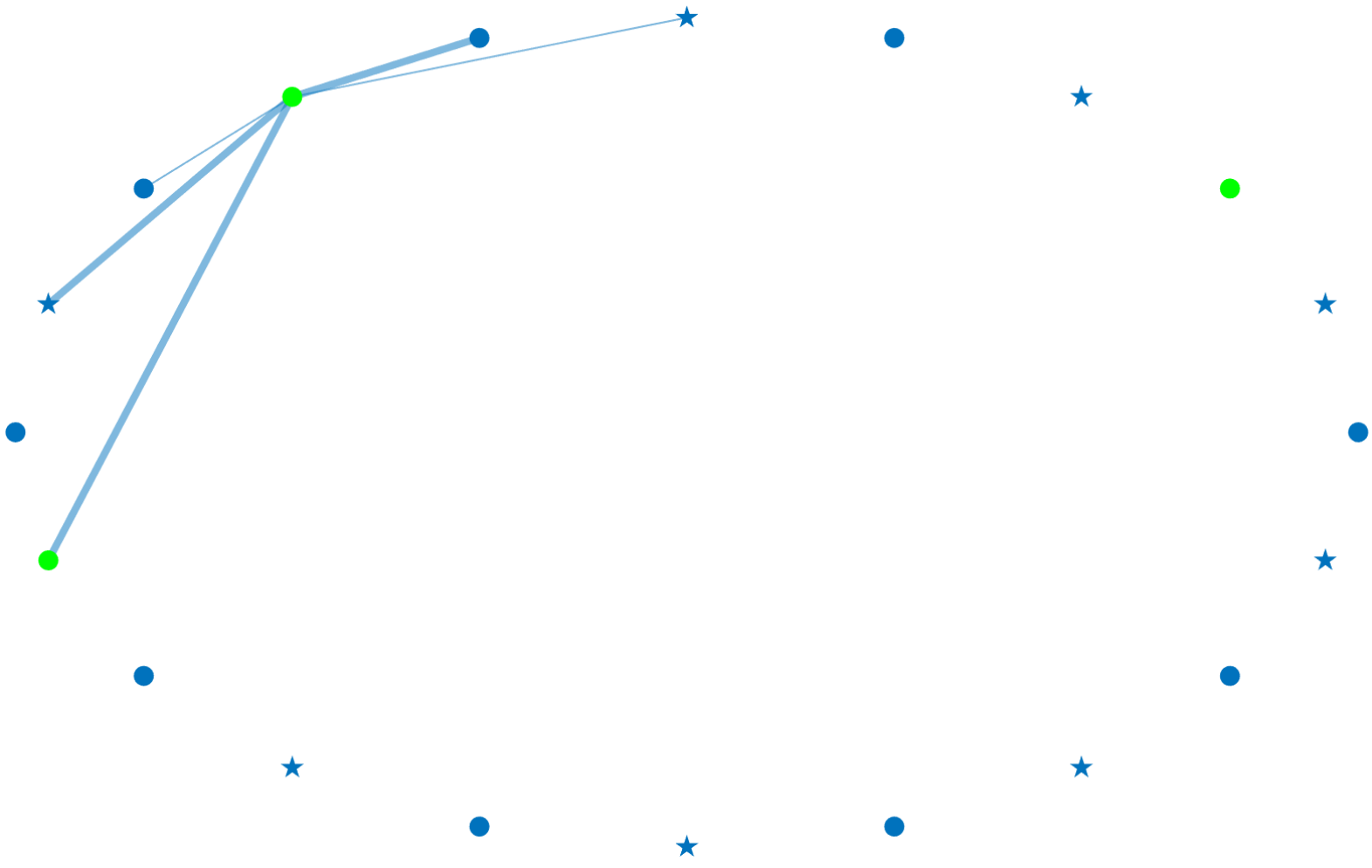
Non-home workers



Home workers

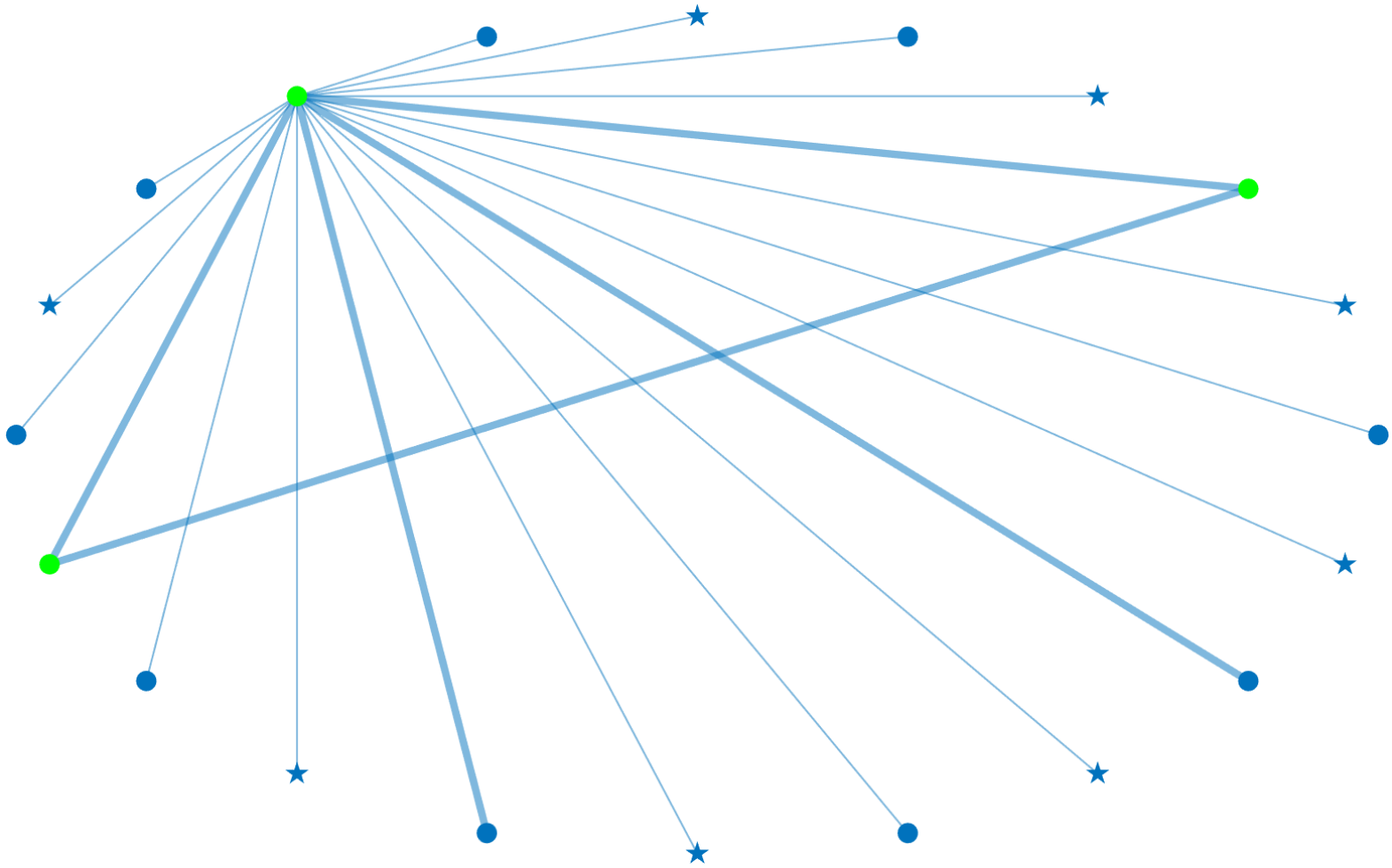
Less and stable contacts, higher wages

# Workplaces



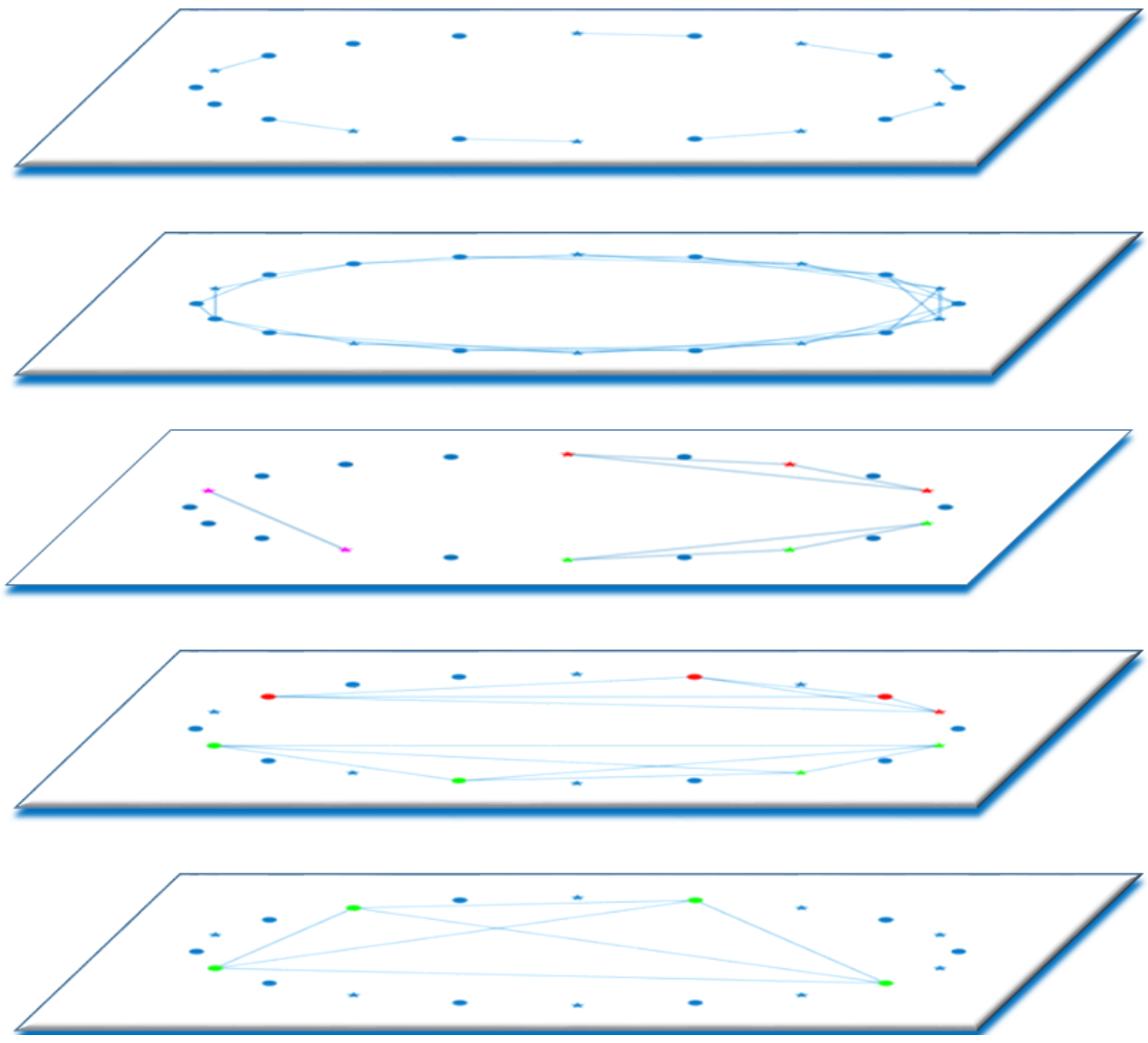
Type 2. High contact, local base: short, unstable, mixed, only adults

# Workplaces



Type 3. High contact, wide base: long, unstable, mixed, only adults

# A multilayered network



Household:$G^H$

Neighborhood:$G^N$

Schools:$G_t^S$

Transportation:$G_t^P$

Workplace:$G_t^W$

- Each person belongs to MANY of these layers. Each with a different chance of getting sick and economic productivity.

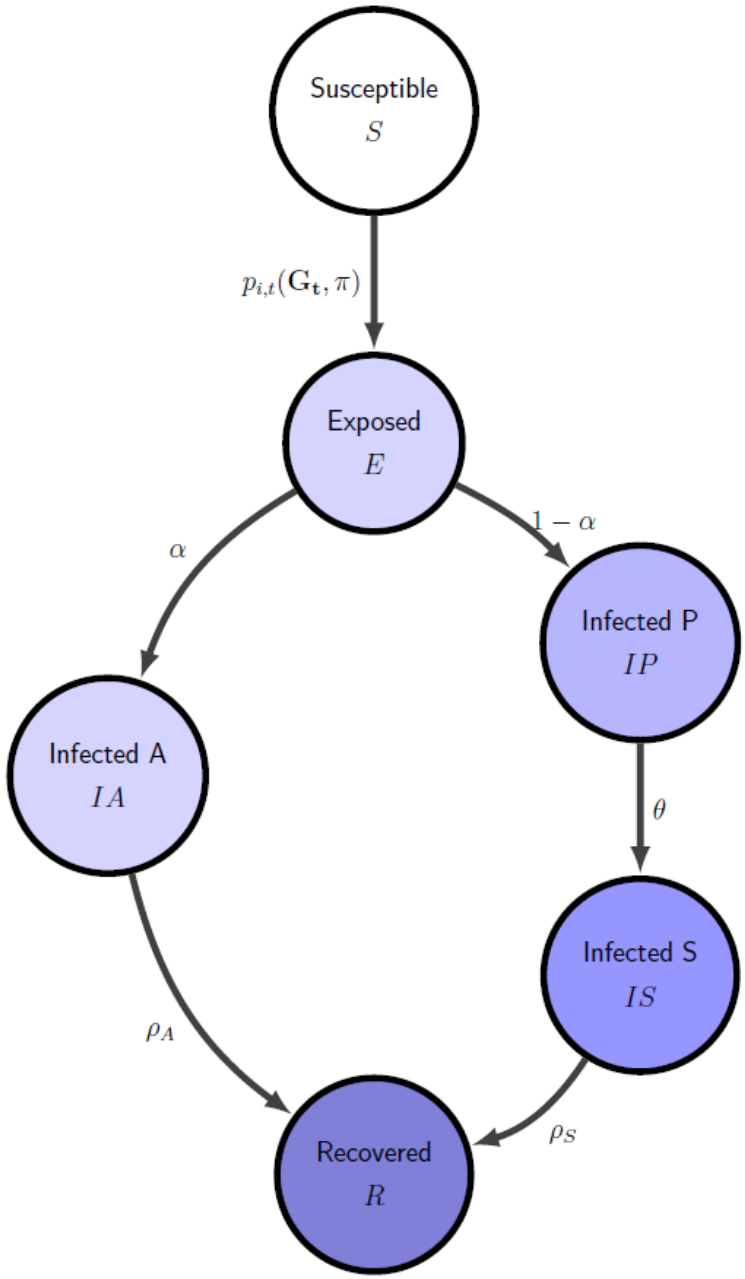
# Production during a pandemic

Before pandemic, model is in equilibrium (Supply=Demand in all sectors).

Pandemics affects output

- Some workers don't work (quarantined or non-essential)
- Sick shoppers do not shop

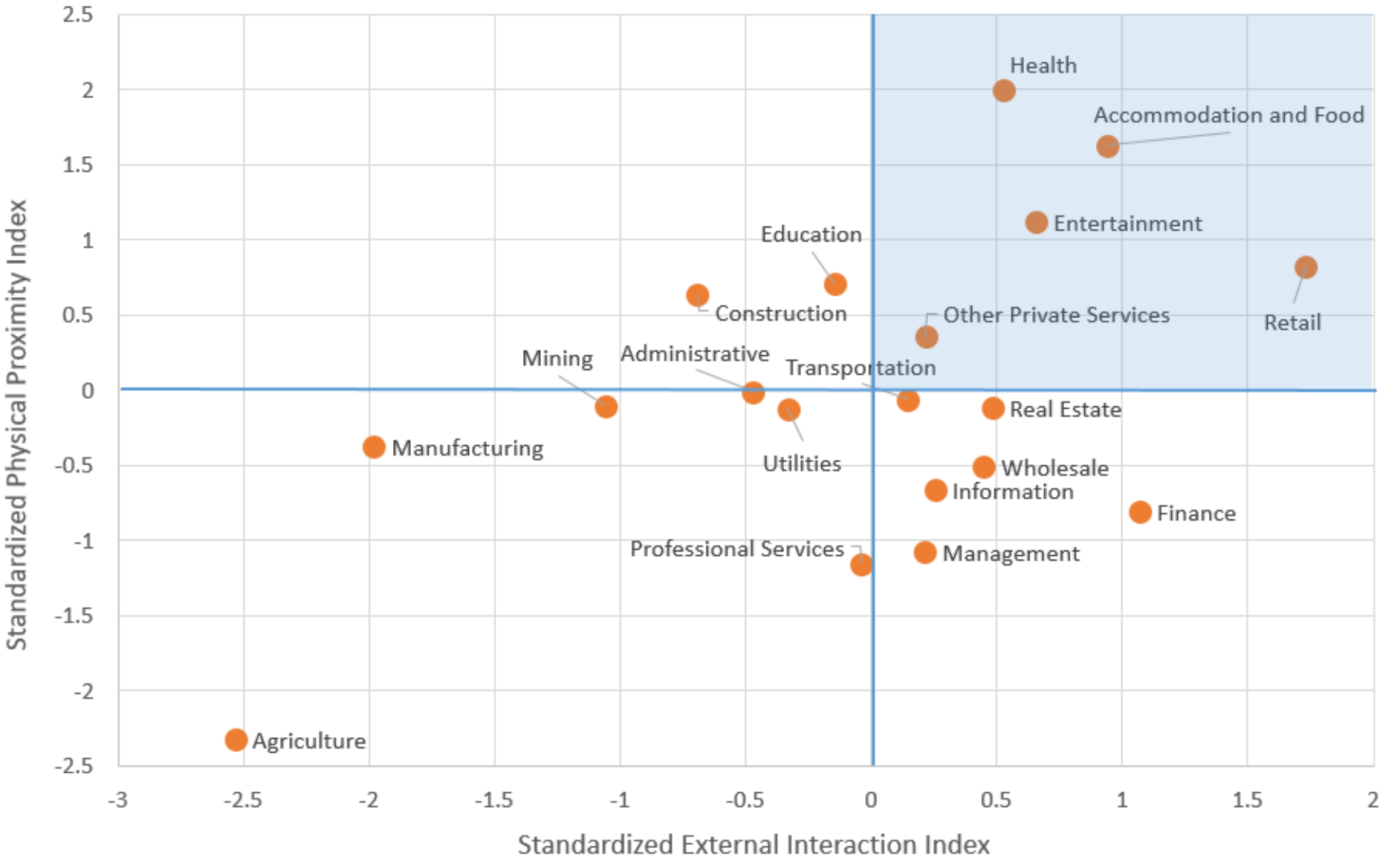
# The EPI component



# Calibration (1 million people)

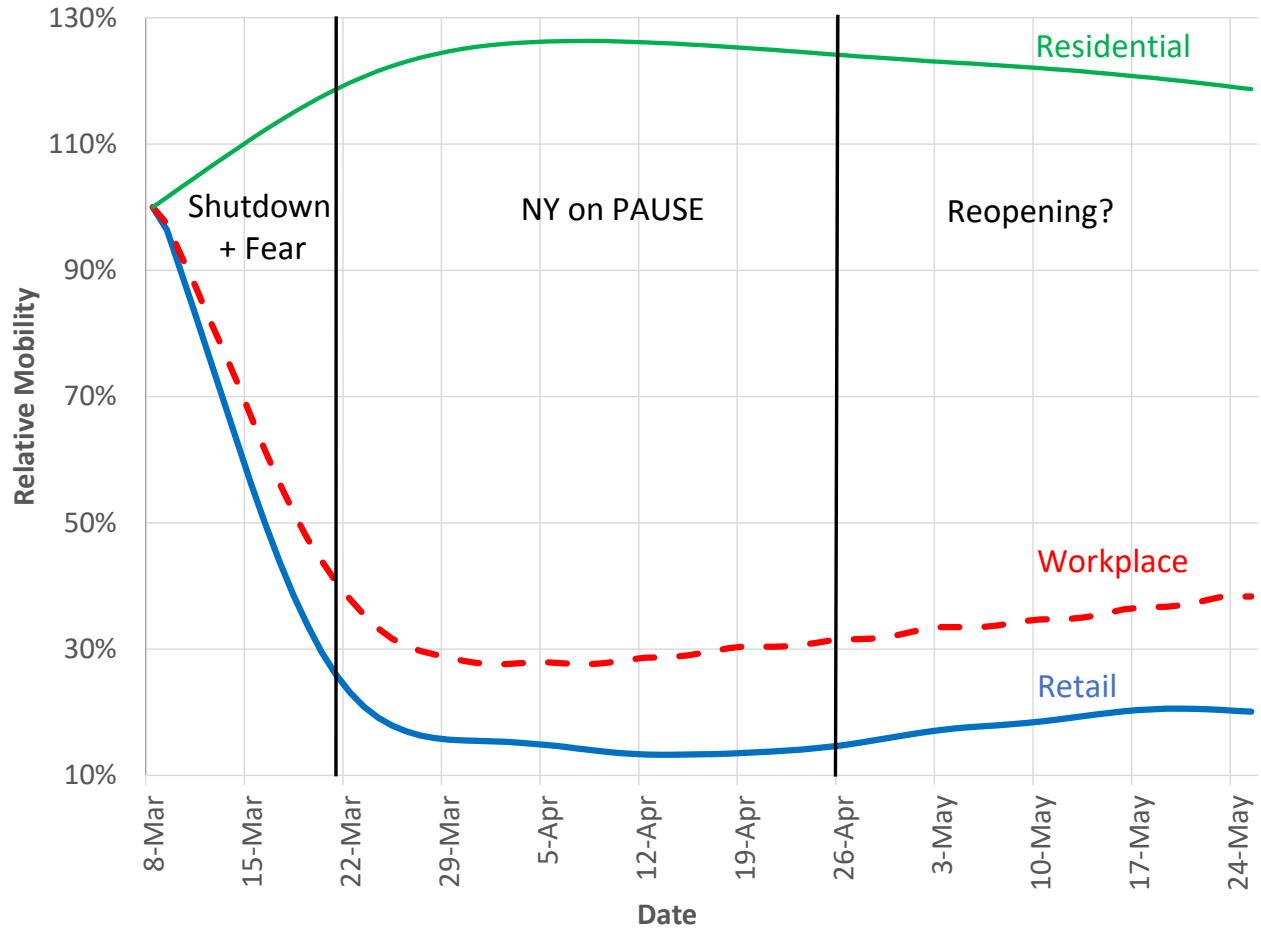
- Data for New York Metro
- Network ontacts: Diary of face to face daily contacts (Mossong, 2008).
- Technology: manufacturing Cobb Douglas, retail: Cobb Douglas, but fixed shopper / worker ratio.
- Identifying H and L sectors
  - ONET Questions: physically proximity + interaction w/ customers
  - Crosswalk from occupation to sector

# H and L sectors



# Mobility in NY

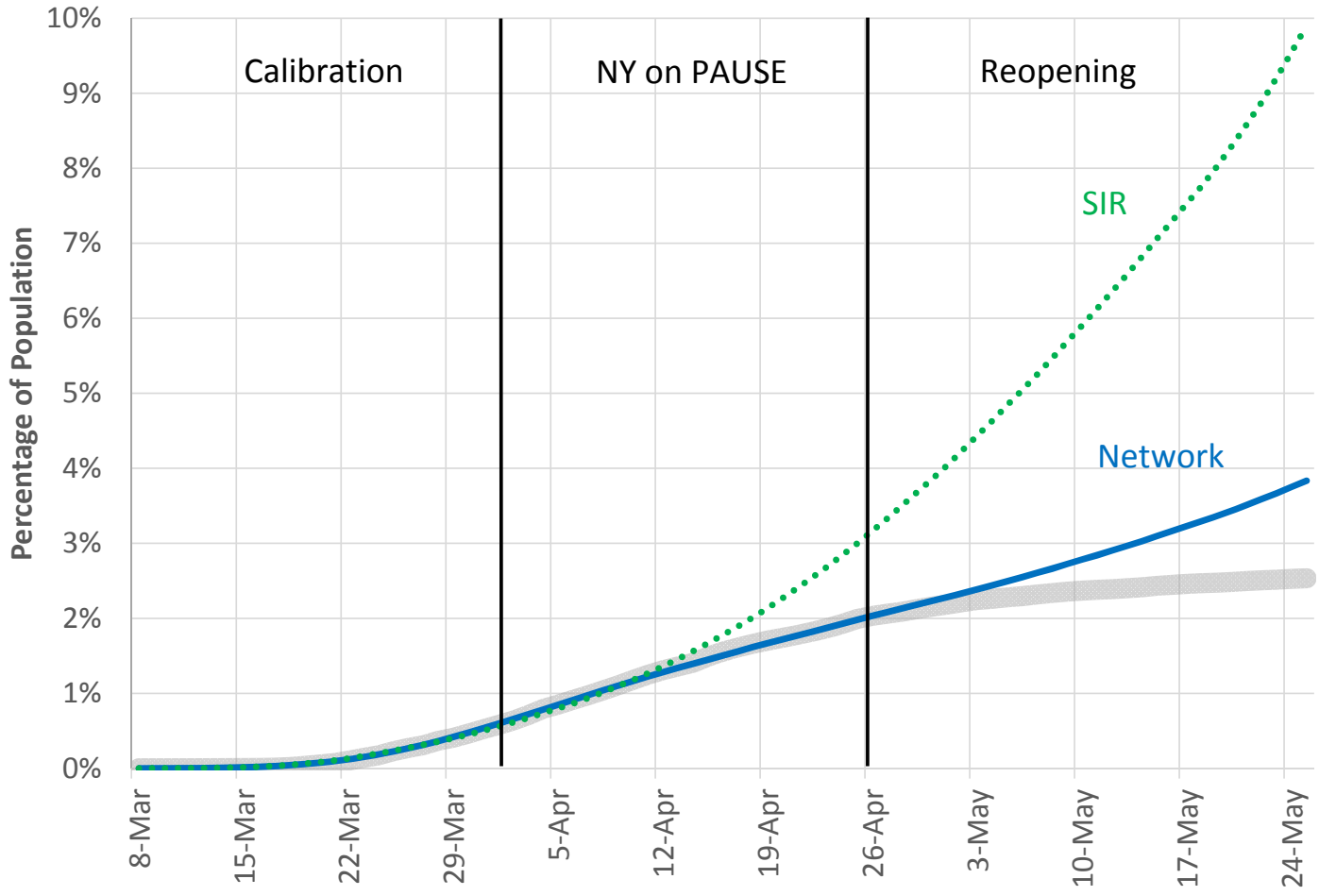
- Mobility patterns from Google phones illustrate how patterns changed in NY (Metropolitan area))




Source: Own calculations using Google Mobility Data.

# Pandemics and Shutdown

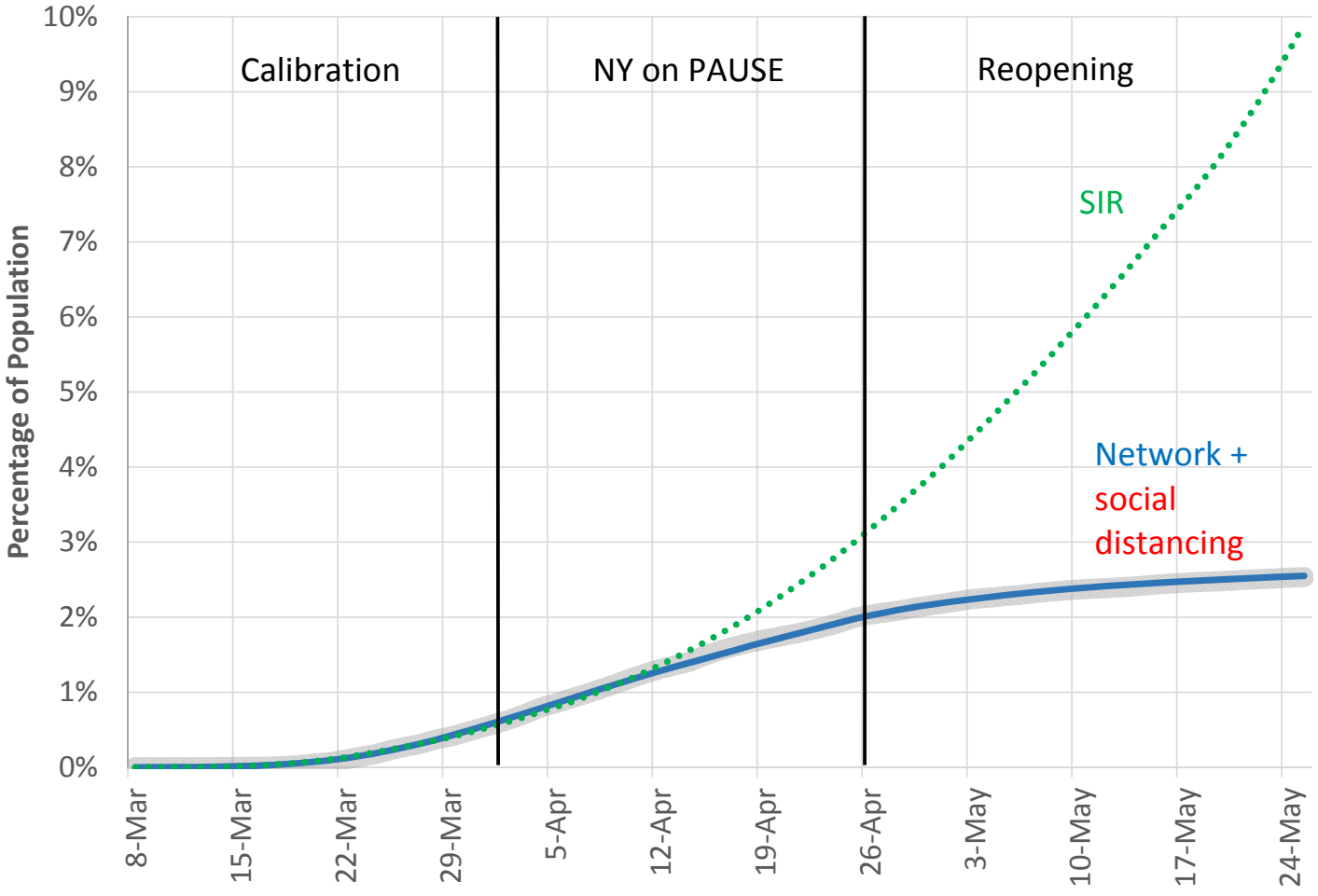
## Match Google mobility (shutdown + fear)




Note: The shaded gray area represents a 0.1% band around the infection series in the data

# Pandemics and Shutdown

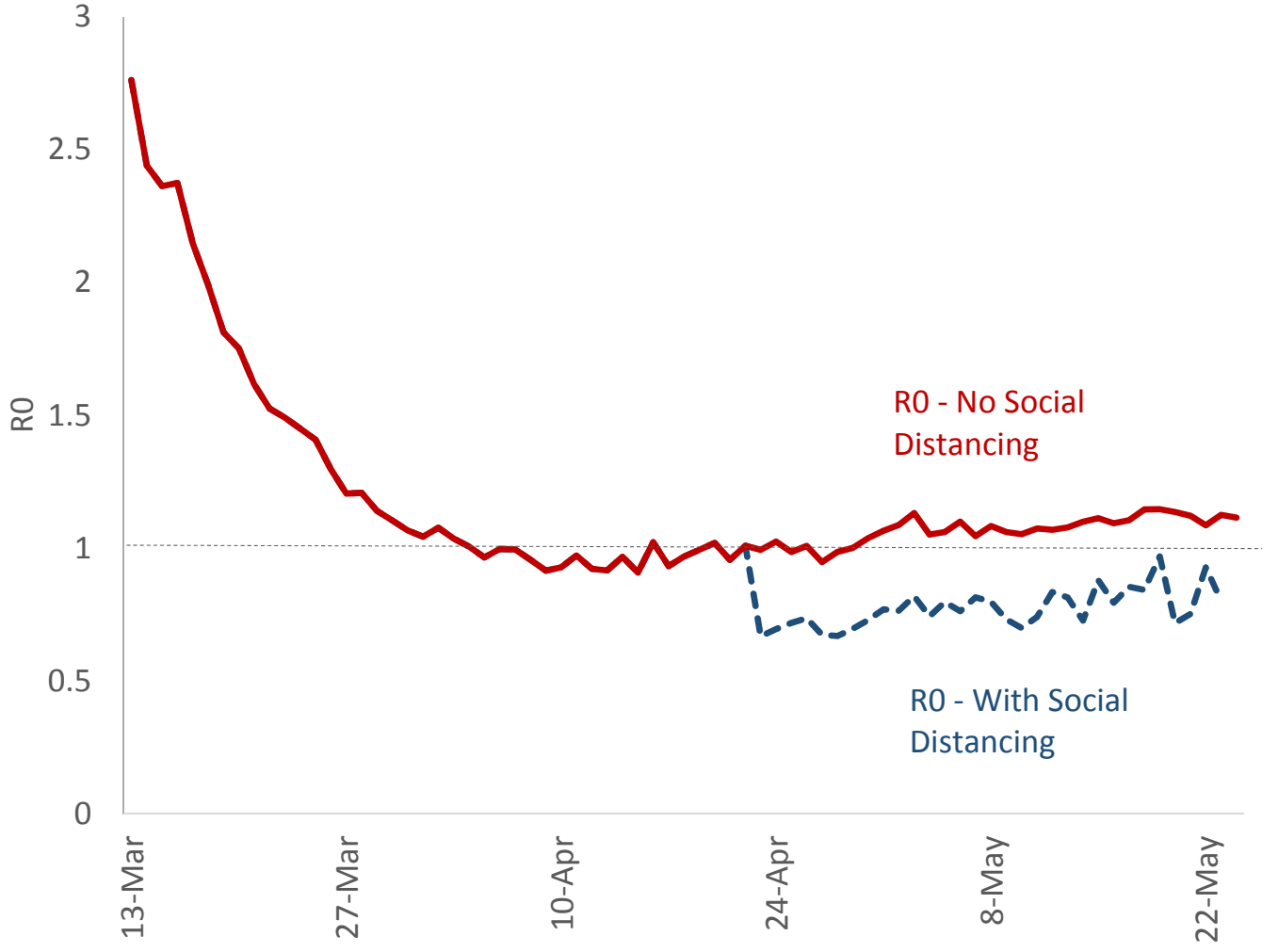
## Match Google mobility + social distancing



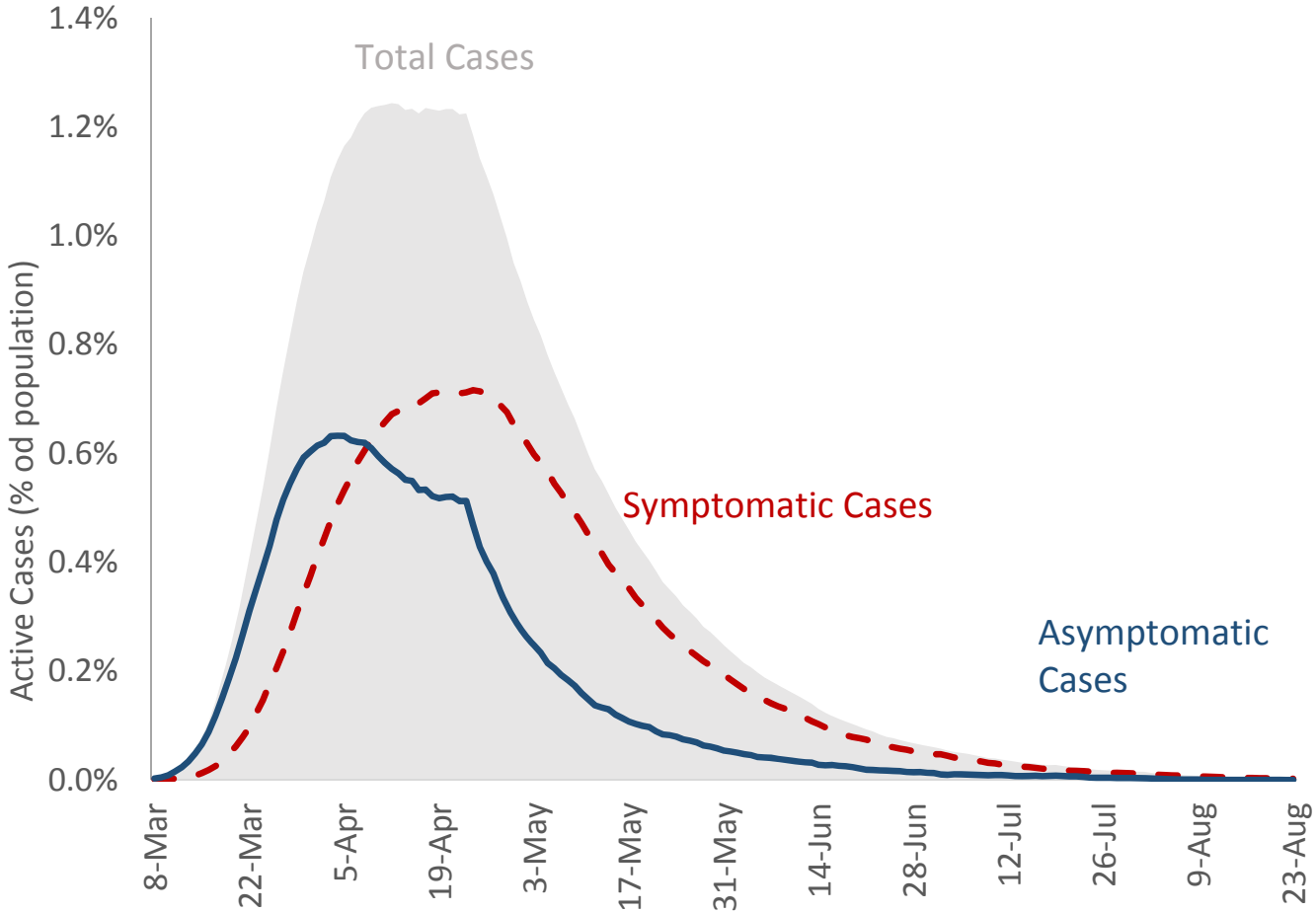

Note: The shaded gray area represents a 0.1% band around the infection series in the data

# Social Distancing Effectiveness

Social Distancing policies push $R_0$ below 1, and help slow down the pandemic.



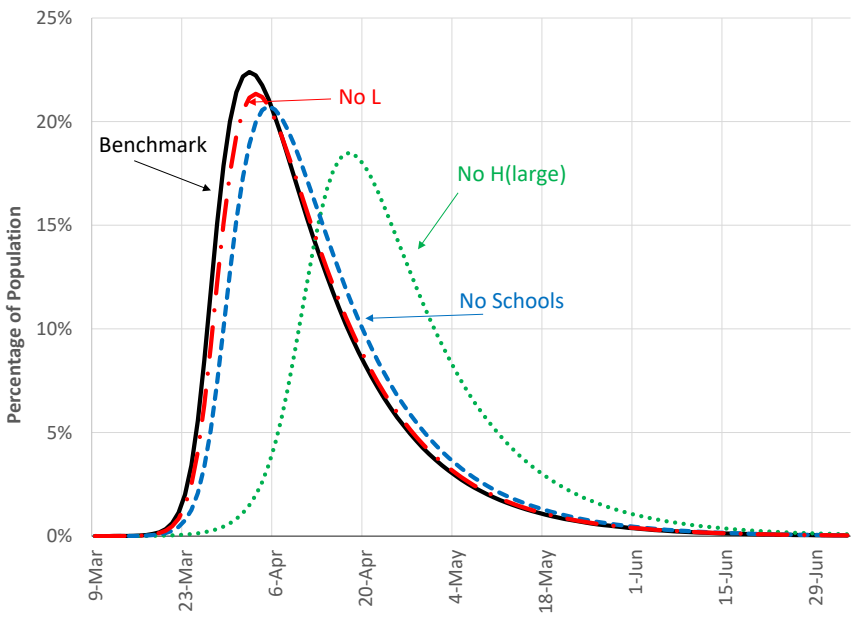
# Forecast with current policies



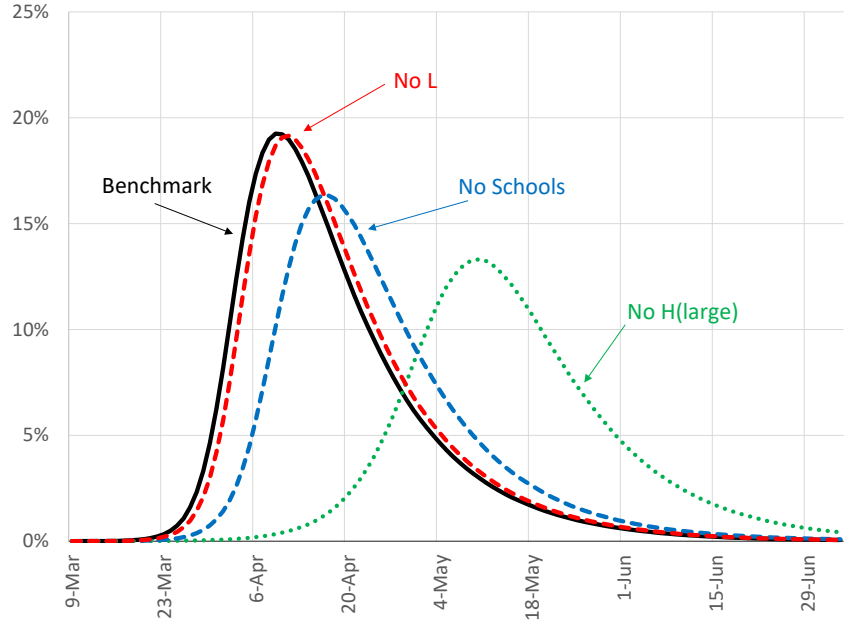

- With current shutdown policies + social distancing, pandemic would die by end of August.
- But too costly for output. What to open up?

# Infection accounting

## Active cases




## Active cases (w/ social distancing)

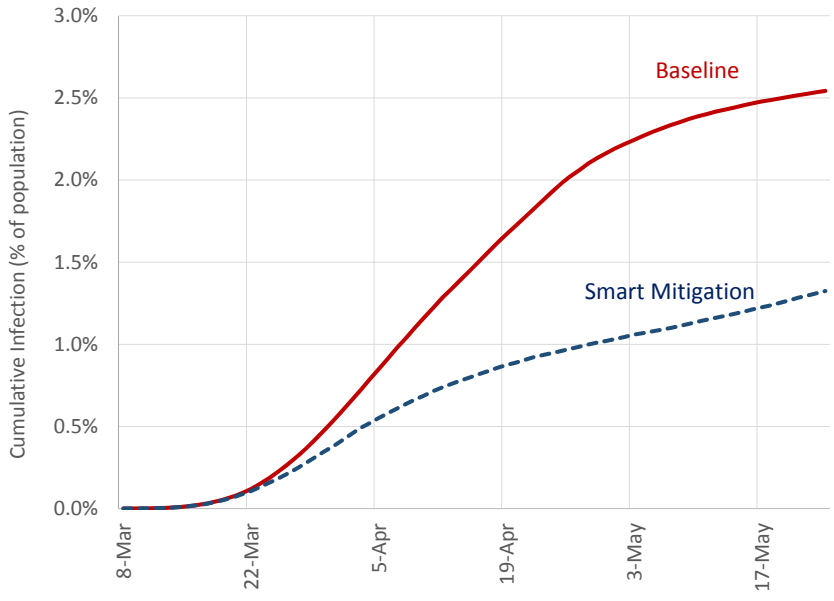



- H-large causes 1/3 initial infections, 1/3 at home. Schools about 13%.
- Soon after H-large > 60% of infections => Super-spreaders! [Interaction terms]

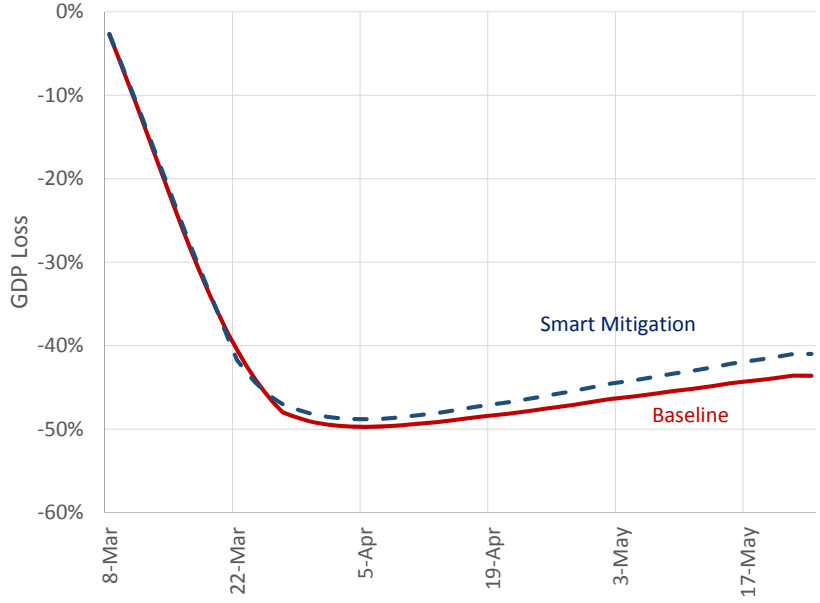
# Could we have done better?

- Close large retail earlier, allow more manufacturing

## Infections



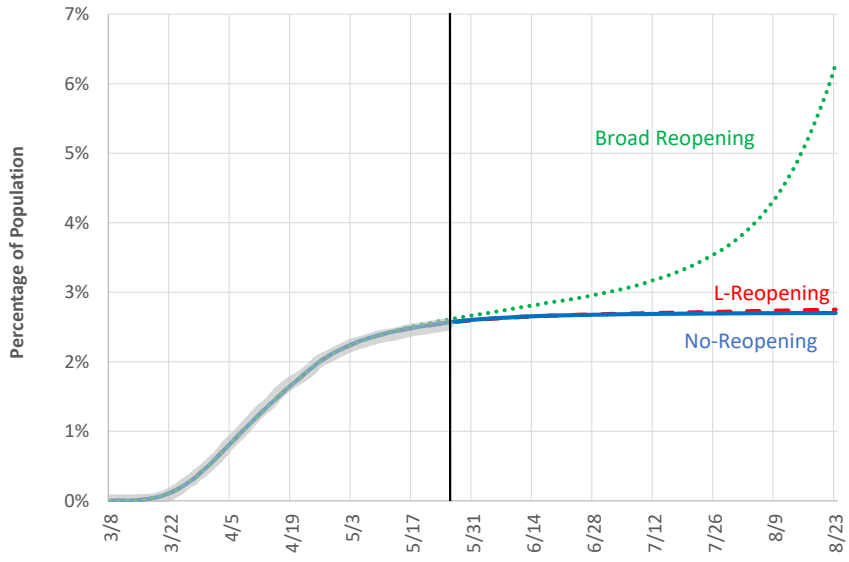

## GDP Loss



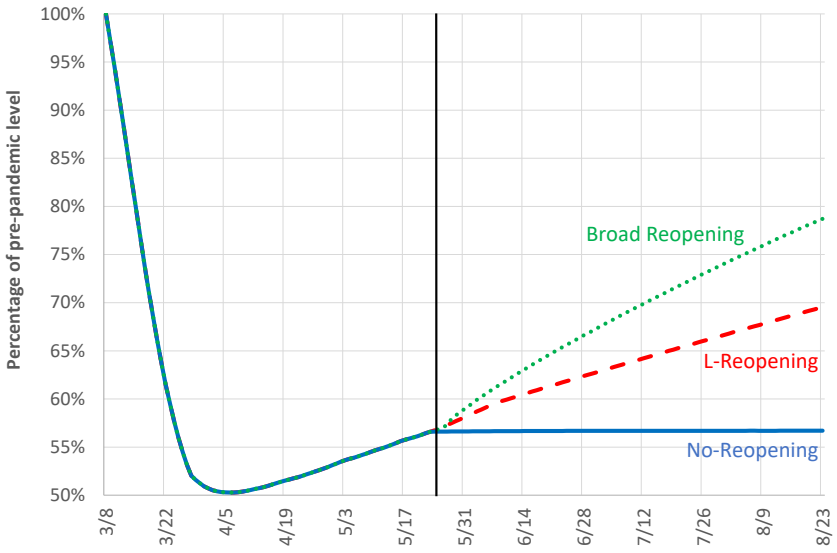

- Less infections + (a bit) more output!

# Business Reopening Scenarios

## Infections

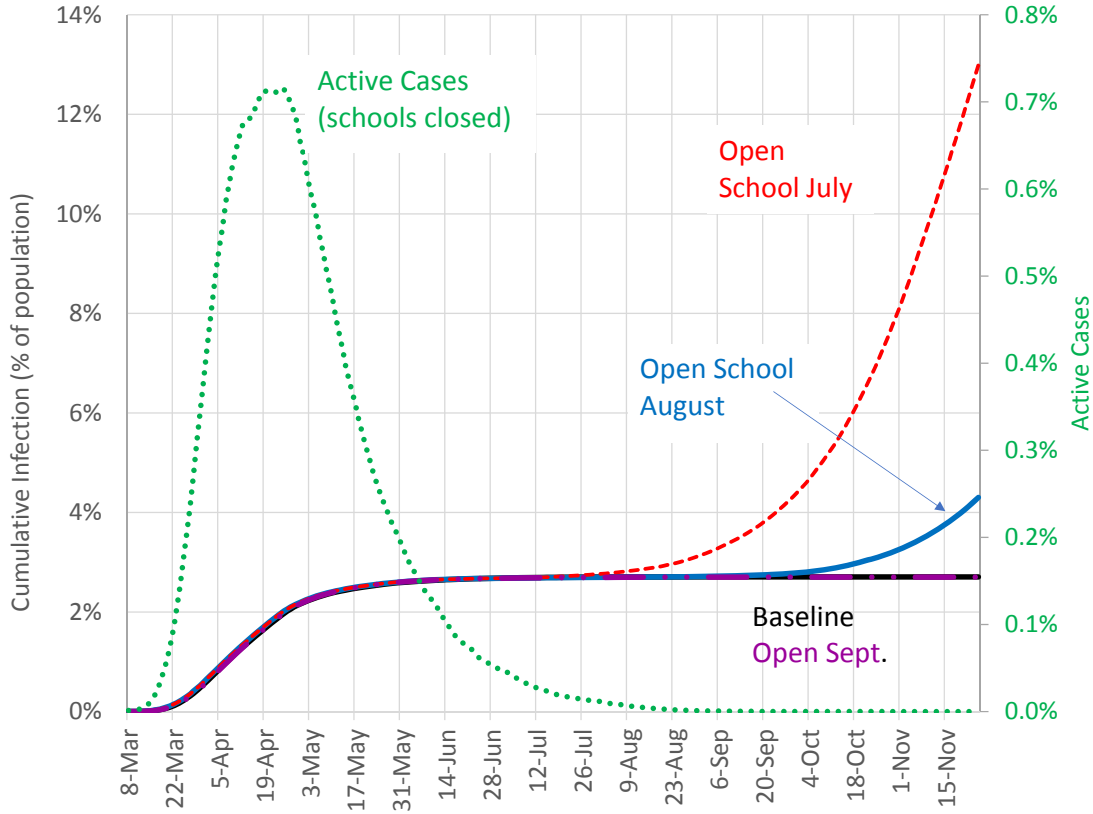



## Output




- Broad reopening generates output gains but leads to second peak (late)
- Smart reopening (L-sector) avoids second peak, with significant output recovery

# School Reopening Scenarios




- Effects of reopening depends on current level of infection
- Early reopening leads to second peak

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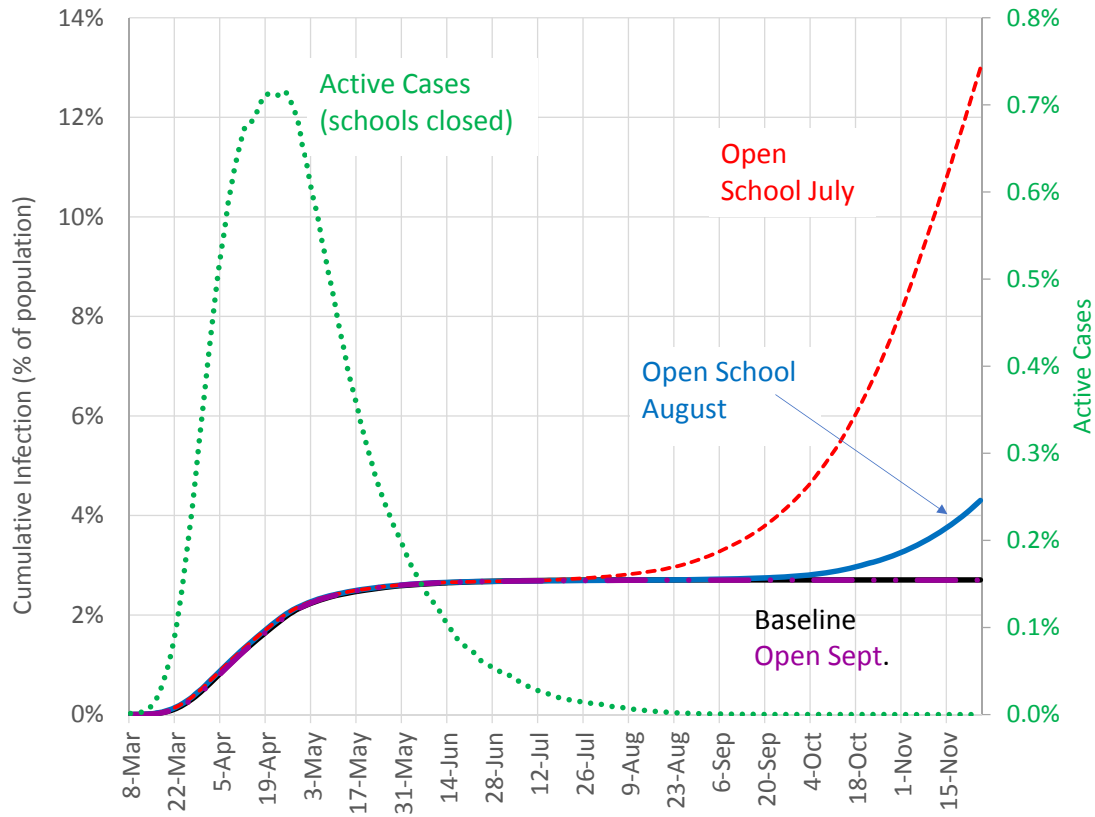


- Effects of reopening depends on current level of infection
- Early reopening leads to second peak
- Want open schools on Labor Day? Keep pools closed on 4th of July!
- Reopening together with large events much worse

# Conclusions

- Network modelling captures well infection patterns in NYC
- Use set-up to evaluate mitigation/reopening policies

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- Use set-up to evaluate mitigation/reopening policies
- Shutting down highly unstable connections (concerts/games) critical in containing infection with small output costs

- Extend analysis to other metros
- Endogenous shopping/working behavior (behavioral response)
- Thank you!