

V-,U-,L- or W-shaped recovery after Covid19: Insights from an Agent-based Model

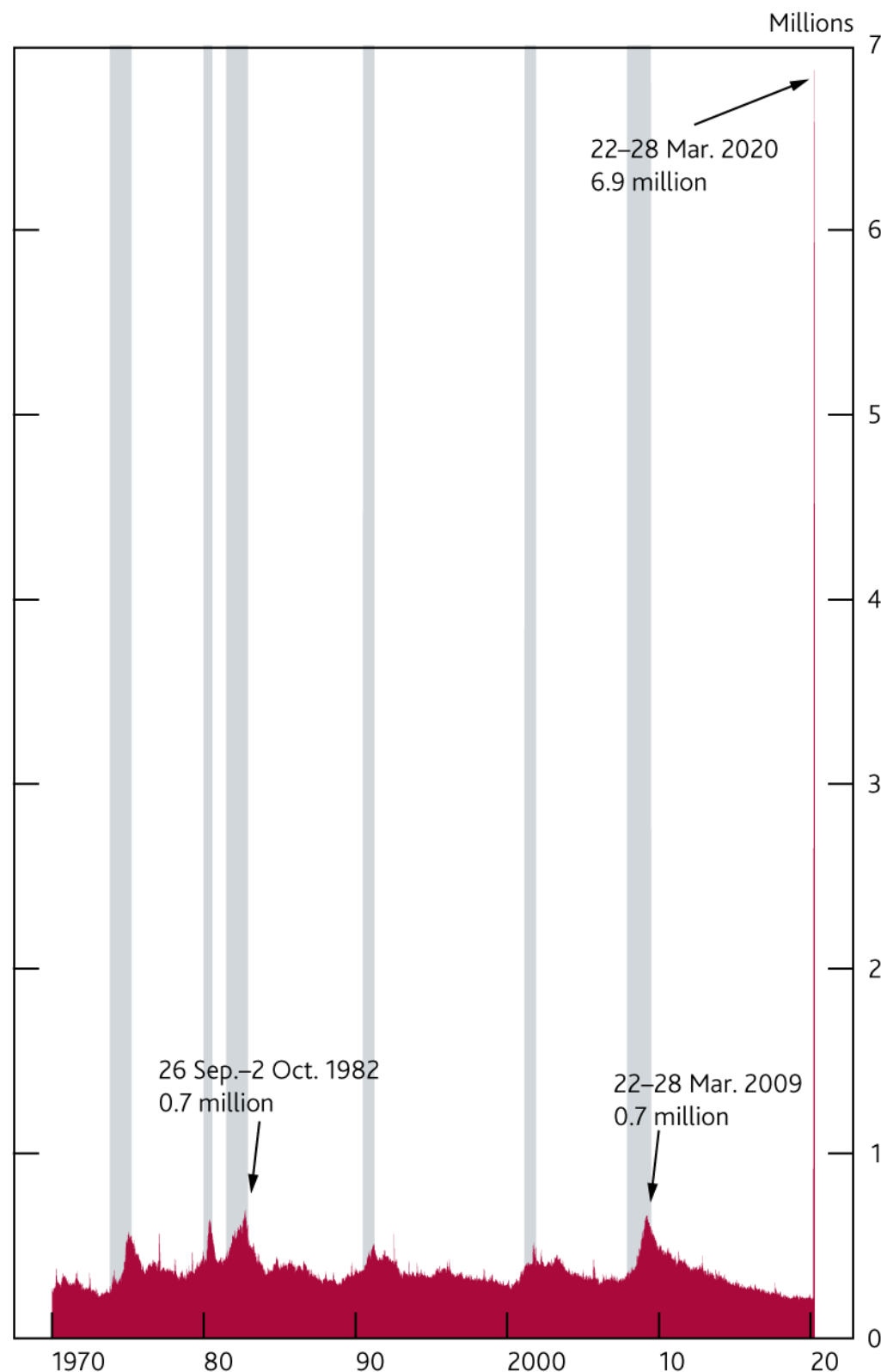
Dhruv Sharma, Jean-Philippe Bouchaud, Stanislao Gualdi,
Marco Tarzia, Francesco Zamponi

Laboratoire de Physique-Ecole Normale Supérieure

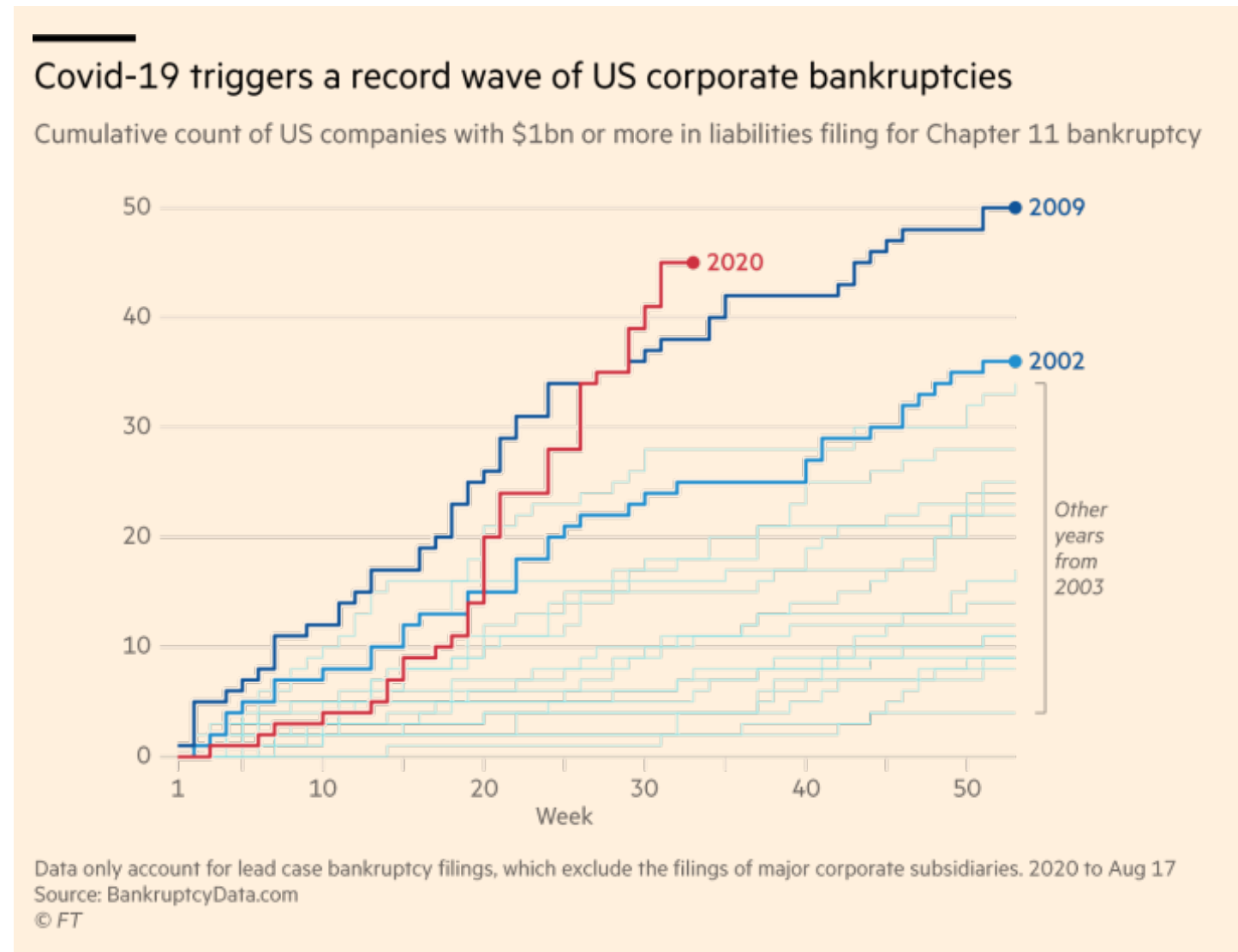
Conference on Complex Systems 2020
10 December 2020

Economic Impact of Covid

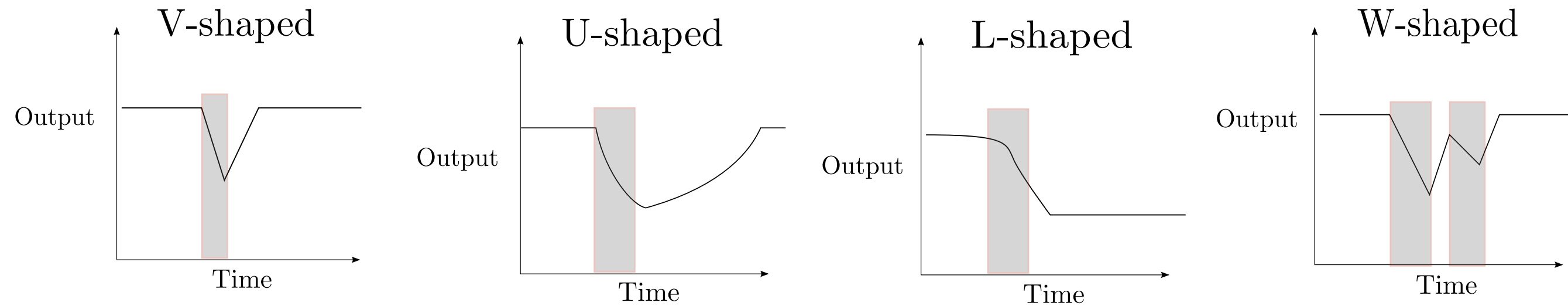
Record unemployment



Record level of bankruptcies



Recovery scenarios



FRED — Real Gross Domestic Product



U.S. recessions are shaded; the most recent end date is undecided.

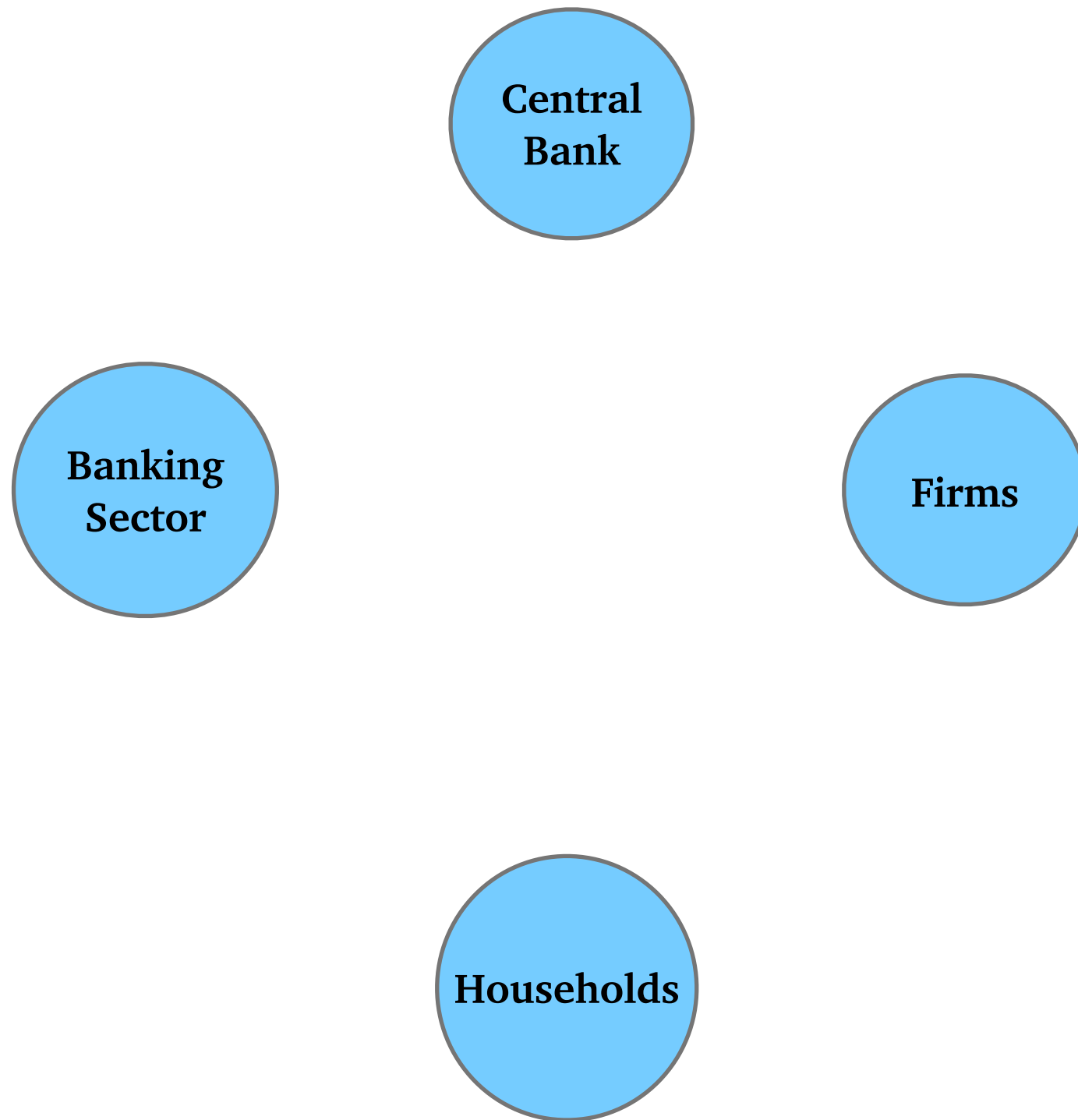
Source: U.S. Bureau of Economic Analysis

fred.stlouisfed.org

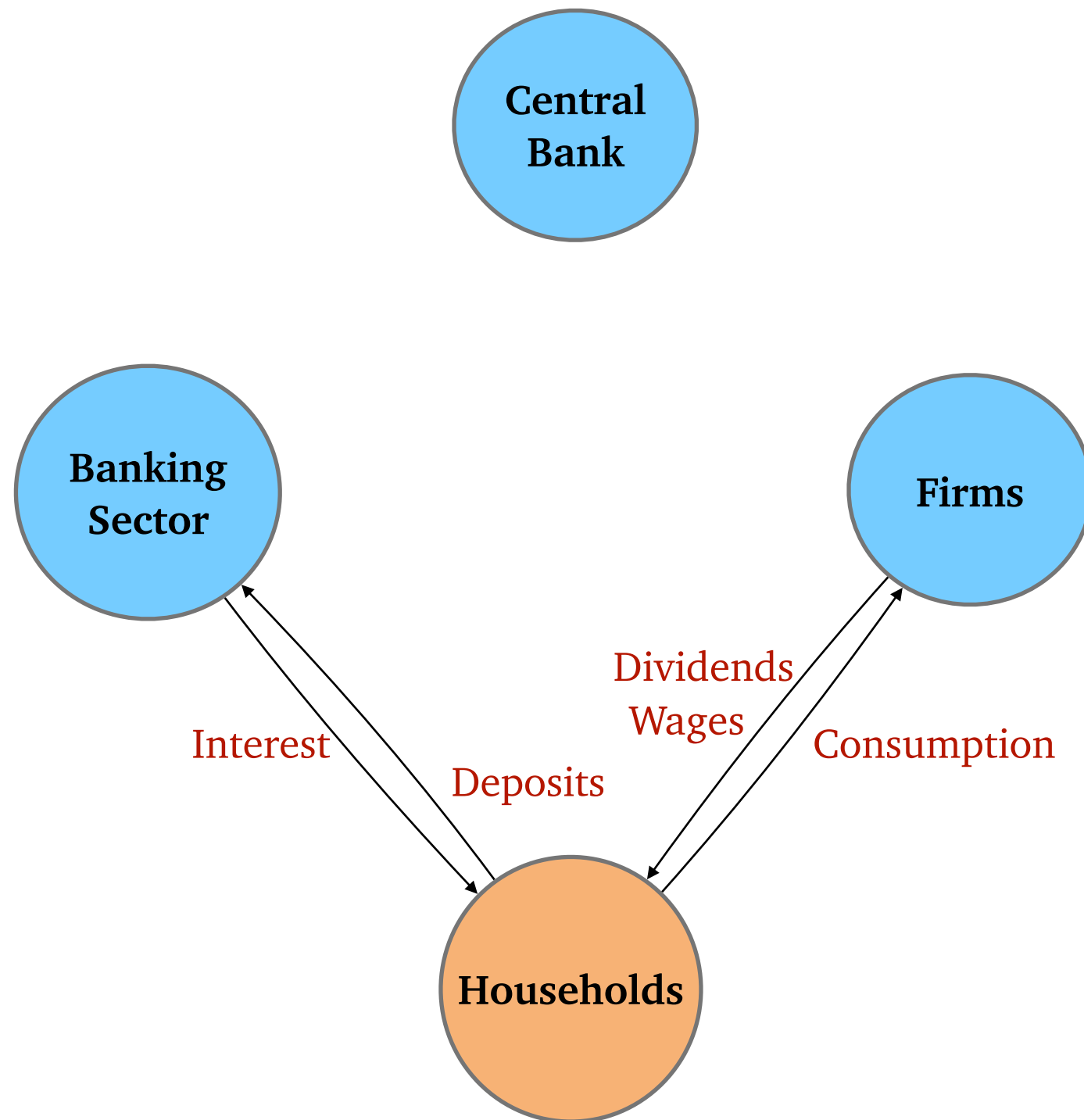
Modeling approach

- Understand recovery scenarios using a macroeconomic ABM
 - Dependence on amplitude and duration of shock
 - Dependence on the Policy mix used.
- Focus on economic consequences of the pandemic, not the pandemic itself.
 - Conditioned on lockdowns. Take the pandemic as given.
 - Time scales differ: pandemic is fast, economic recovery will be slower.

Model and its interactions



Model and its interactions



- ▶ Receive wages from firms.
- ▶ Consume a part of wages and the rest is saved.

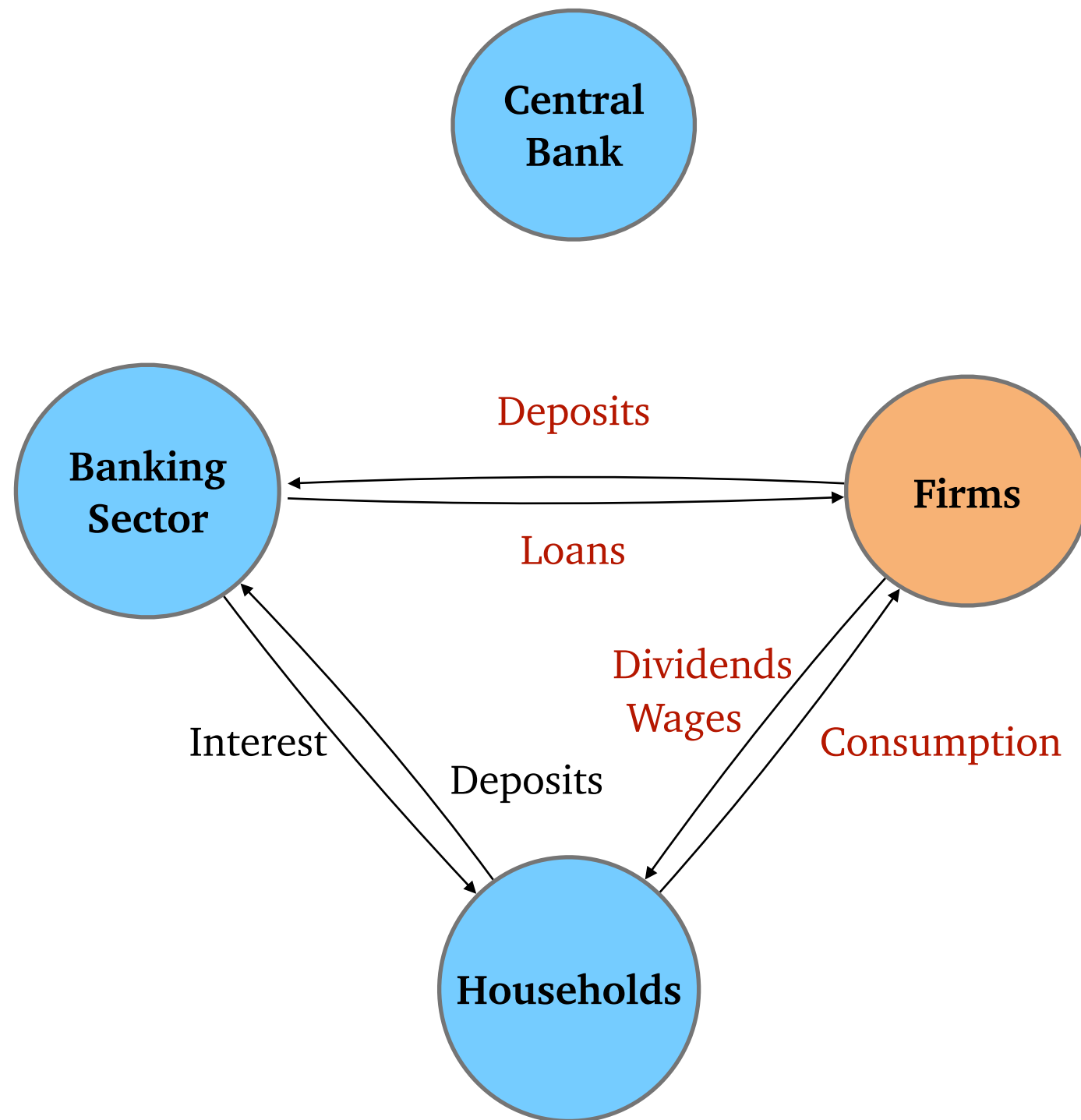
$$C = c \left(S(1 + \rho^d) + W \right)$$

Annotations for the equation:

- C : Consumption propensity (red text, arrow pointing down)
- c : Consumption propensity (red text, arrow pointing down)
- S : Savings (arrow pointing up)
- ρ^d : Deposit rate (arrow pointing down)
- W : Wages (arrow pointing up)

- ▶ Savings are deposited and earn interest.
- ▶ Firms share profits as dividends.

Model and its interactions



- Produce goods to satisfy demand.

$$Y_i = \zeta N_i \rightarrow \text{Workforce}$$

↓

Firm Productivity

- Hire/Fire Workers and set wages.
- Fund activity through loans from banks.

$$\Phi_i = - \frac{\text{Cash Balance}}{\text{Pay Roll}}$$

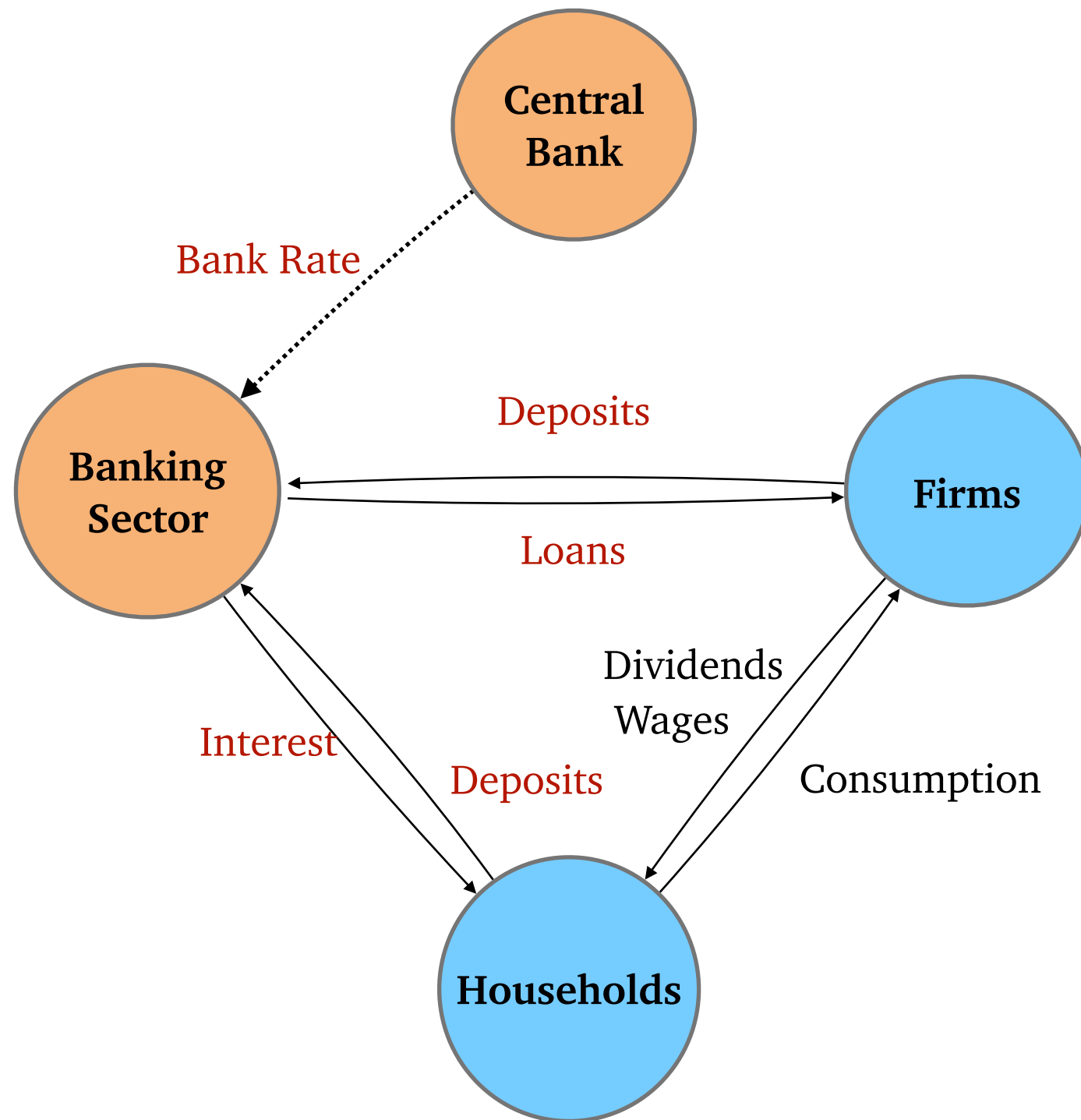
- Firm goes bankrupt if too fragile.

$$\Phi_i \geq \Theta$$

↓

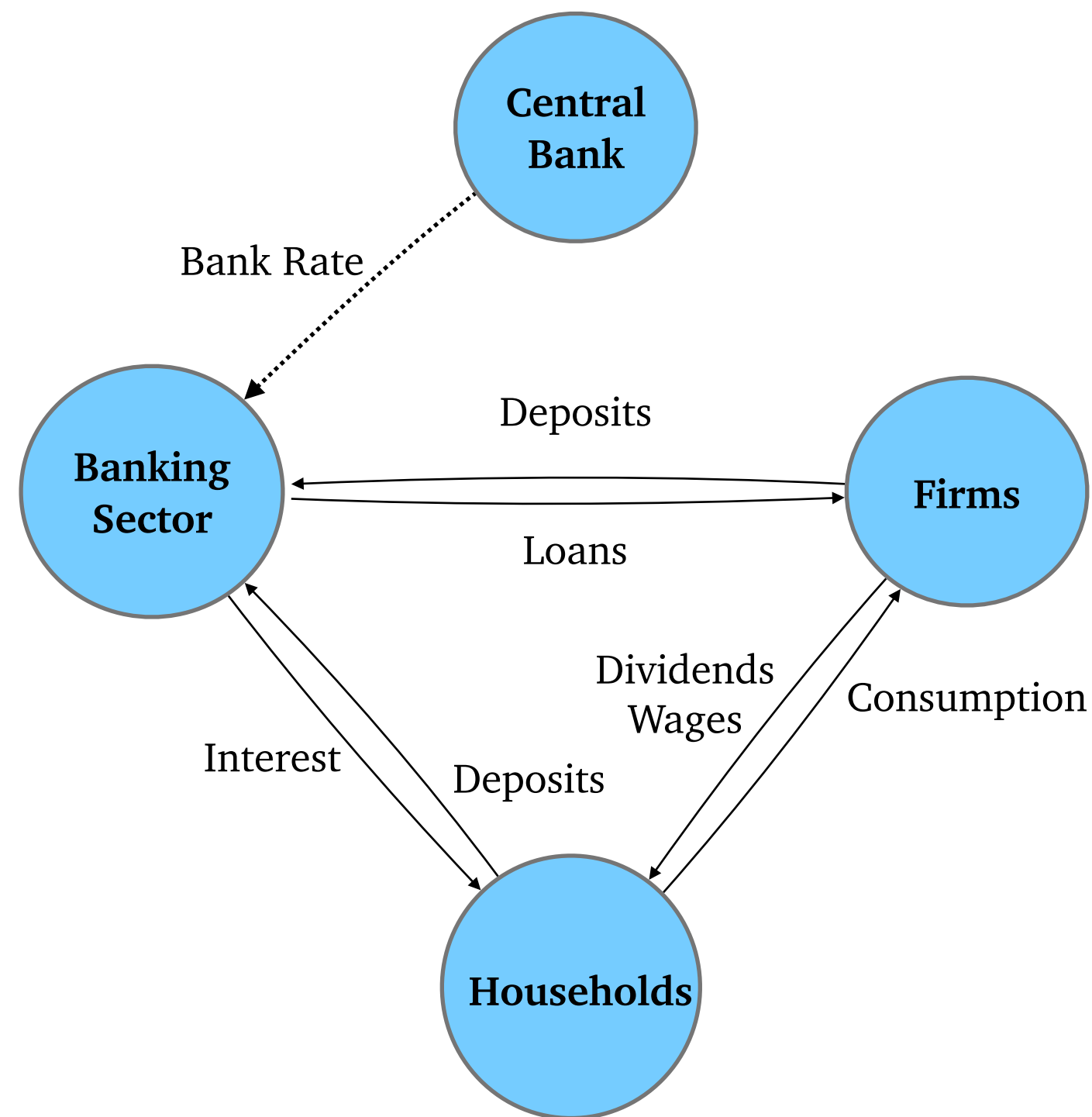
Baseline bankruptcy threshold

Model and its interactions

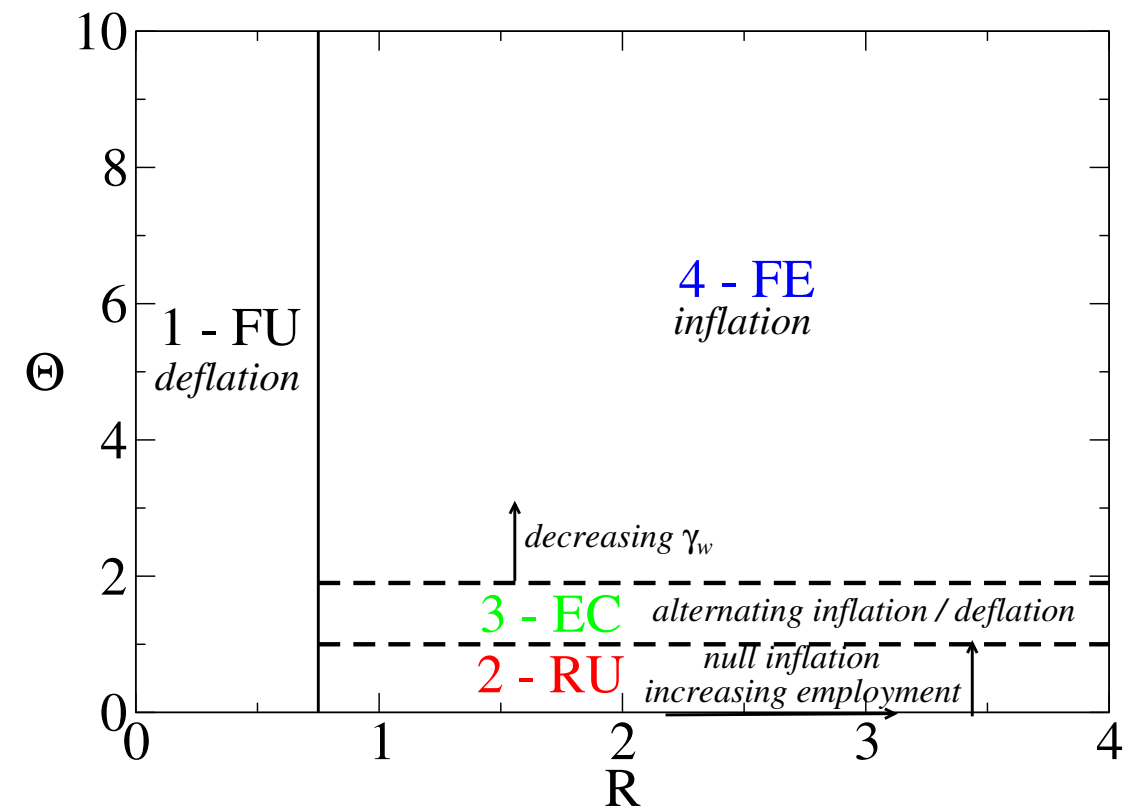


- Banking sector:
 - ▶ Sets rates on deposits and loans.
 - ▶ Rates set according to number of firm defaults.
- Central bank:
 - ▶ Sets bank rate.
 - ▶ Inflation targeting mandate.

Model and its interactions



Gualdi et al arxiv:1307.5319

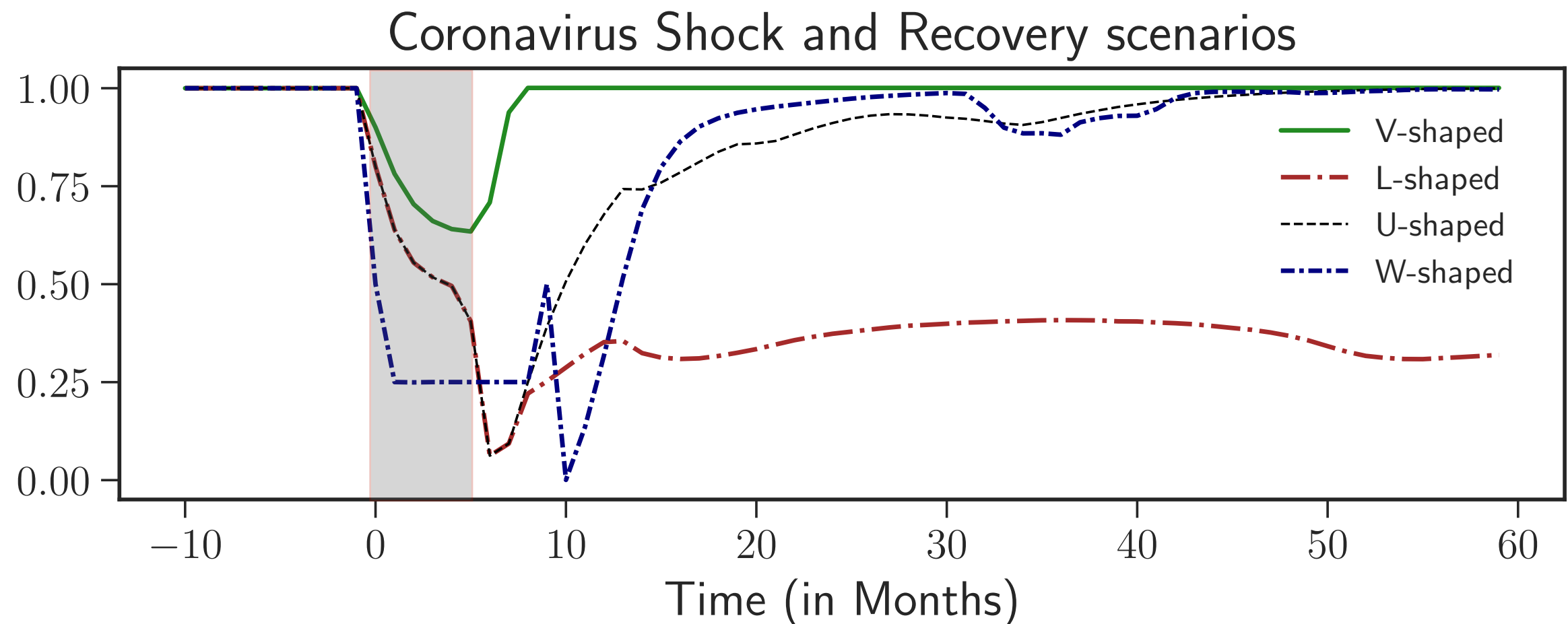


- 4 phases
 - Full Unemployment (1)
 - Full employment (4)
 - Residual unemployment (2)
 - Endogenous crises. (3)

The covid shock

- Lockdowns cause fall in demand and fall in production
 - Reduction in consumption propensity $c \rightarrow c - \Delta c$
 - Reduction in firm productivity $\zeta \rightarrow \zeta - \Delta \zeta$
- Duration of the shock is crucial
- Each time step is 1 month.
- Economy is set in a prosperous state: low unemployment, inflation 1.3% annual.
- Neglect monetary policy channel.

Scenarios

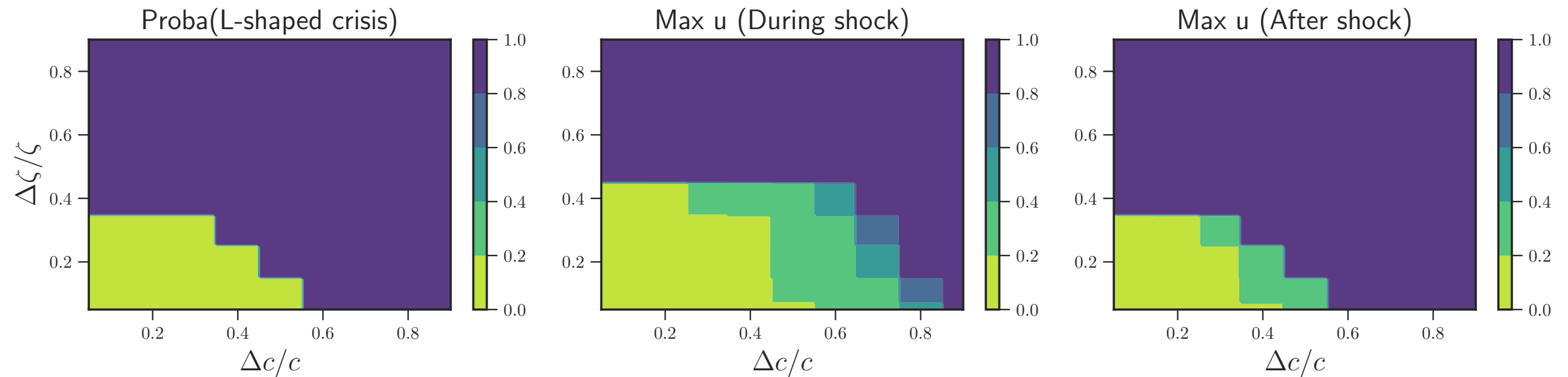


Sharma et. al. arXiv:2006.08469

- All recovery scenarios are retrieved.
- Worst case: L-shaped scenario.

Phase diagrams

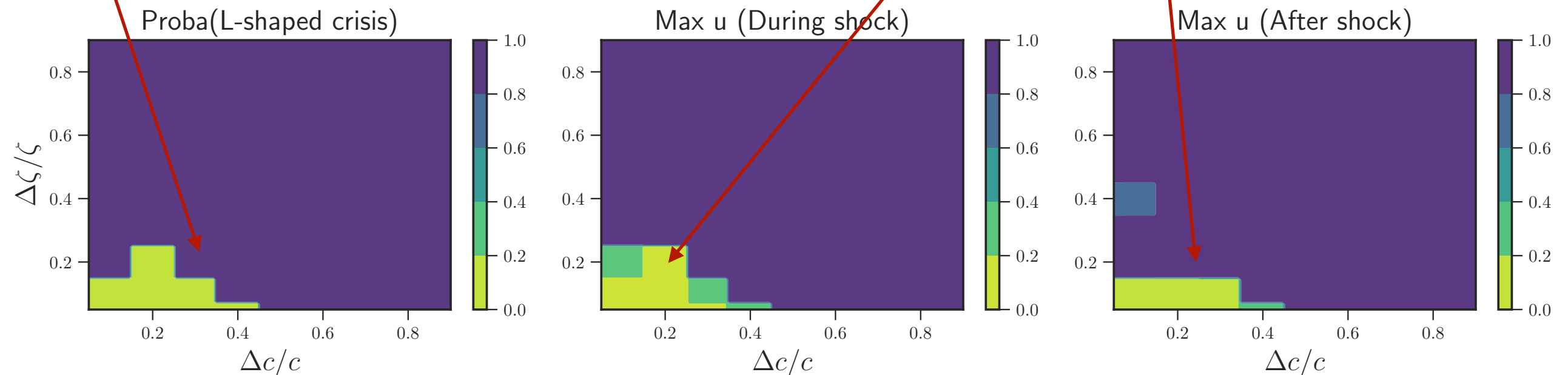
Consumption + Production Shock - Shock Length = 3



Small shock but L-shape recovery.

Higher unemployment after the shock.

Consumption + Production Shock - Shock Length = 9



Policies

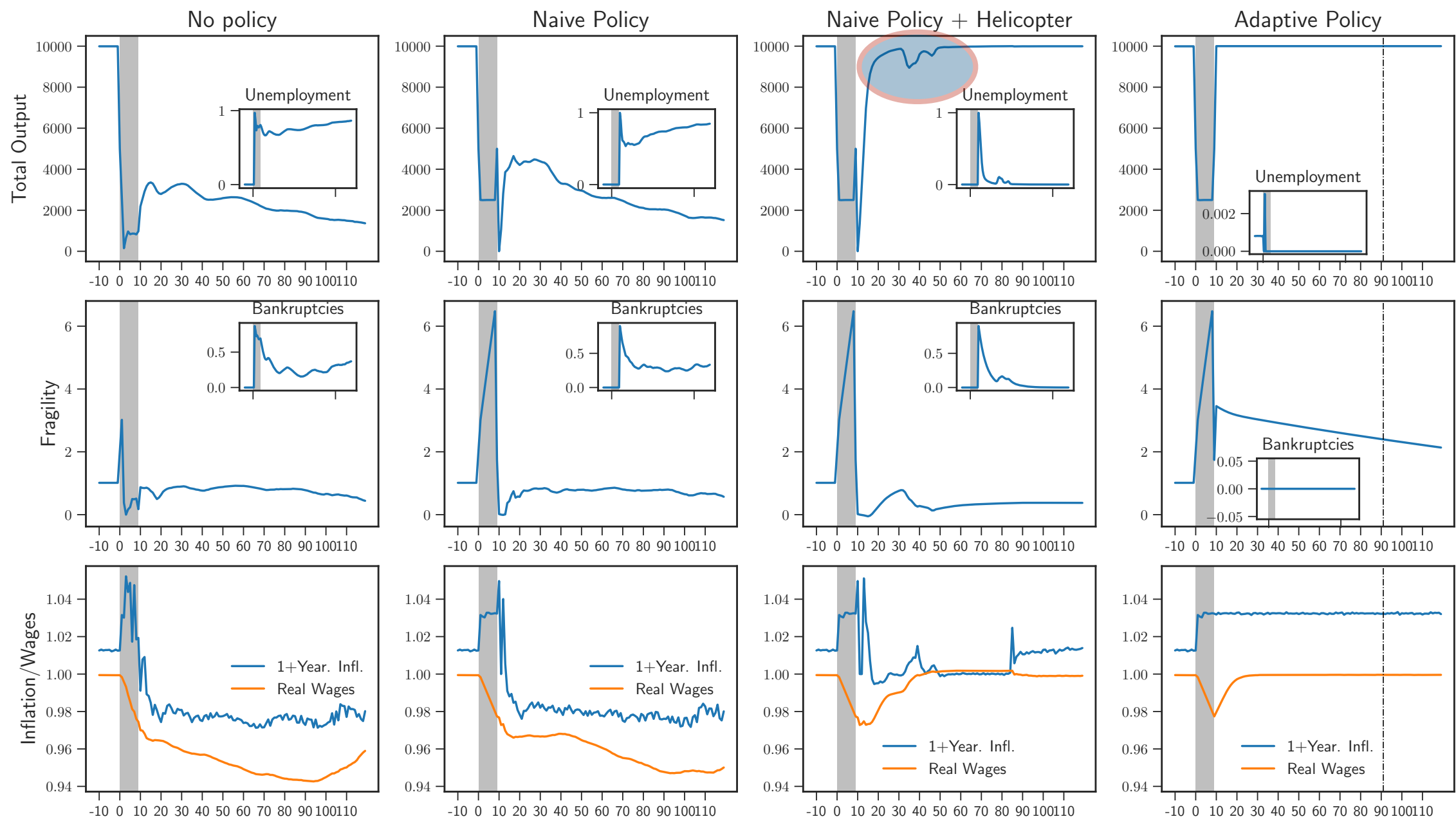
1. No policy: no intervention
2. Naive policy: increase bankruptcy threshold for duration of shock.
3. Naive policy + Helicopter drop: Direct cash injections into households.
4. Adaptive policy: Increase bankruptcy threshold as a function of firm fragility (only most indebted firms go bankrupt).

$$\Theta = \max(1.25\langle\Phi\rangle, 3) \quad t > T$$

Average fragility Baseline bankruptcy threshold

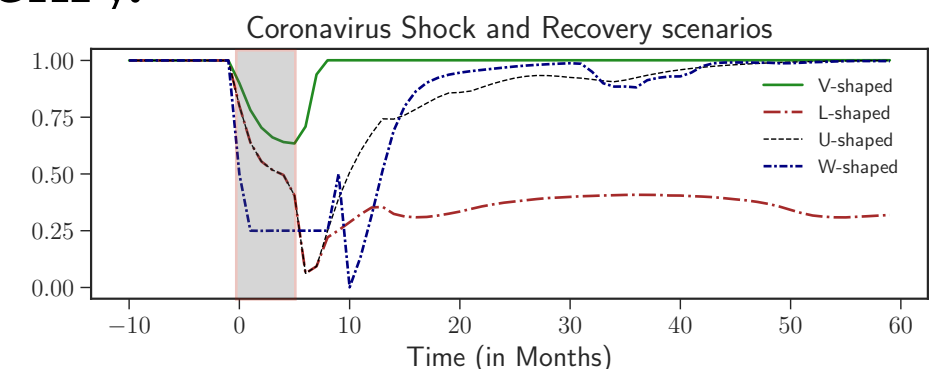
Policies

- Permanent loss of output.
- Bankruptcy rate is high.
- Indebted firms fail.
- High Unemployment. Low wages. Deflation.
- Economy recovers.
- Second recession. Higher inflation post-crisis.
- Prevents bankruptcies.
- Higher inflation $\sim 3\%$



Lessons

1. Even small shocks can cause lasting damage.
2. “Do whatever it takes”
 - i. Many sectors might never recover.
 - ii. Permanent loss of productive capacity (“90% economy”).
3. Successful policies lead to higher inflation
 - i. Direct lending to firms.
 - ii. Stimulating demand by boosting savings.
4. Focus on long-term economic recovery rather than short-term tradeoffs between health of economy vs health of citizenry.
5. All recovery scenarios within a single model.

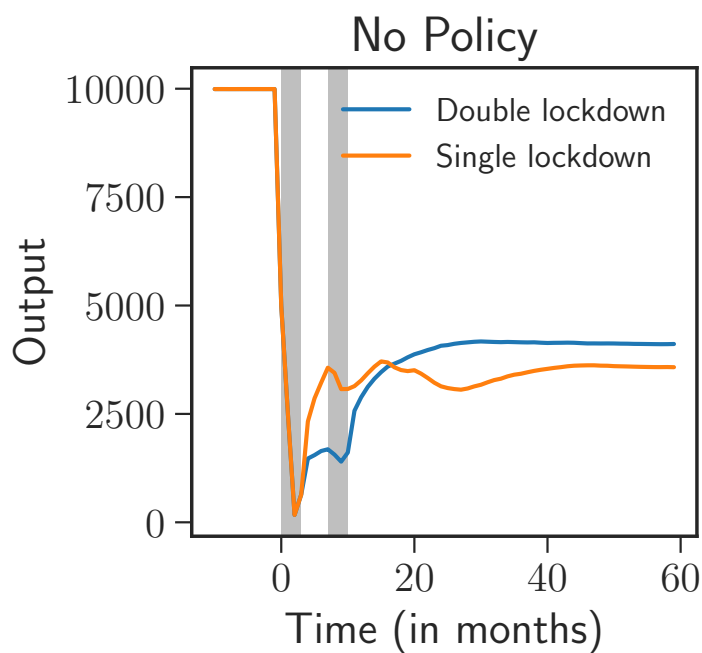


Multiple Lockdowns

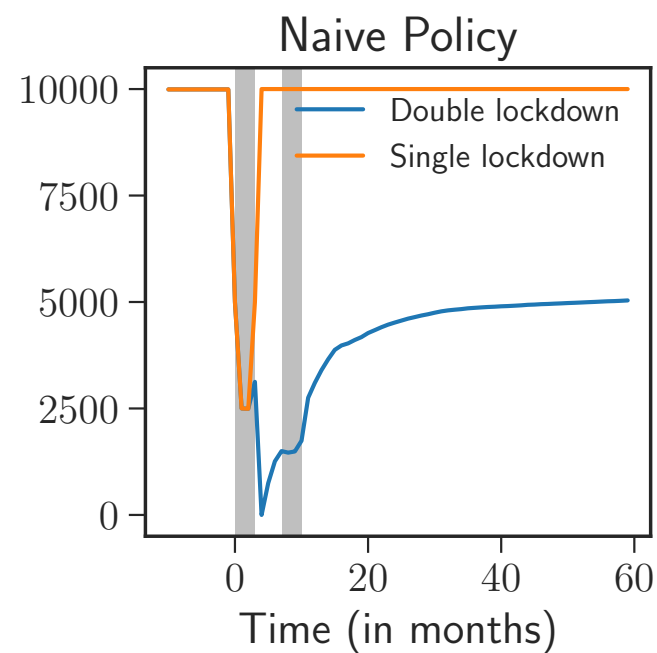
1. Second wave: 3 month lockdown → 4 month recovery → 3 month lockdown
2. Consumption and productivity recover gradually.

Multiple Lockdowns

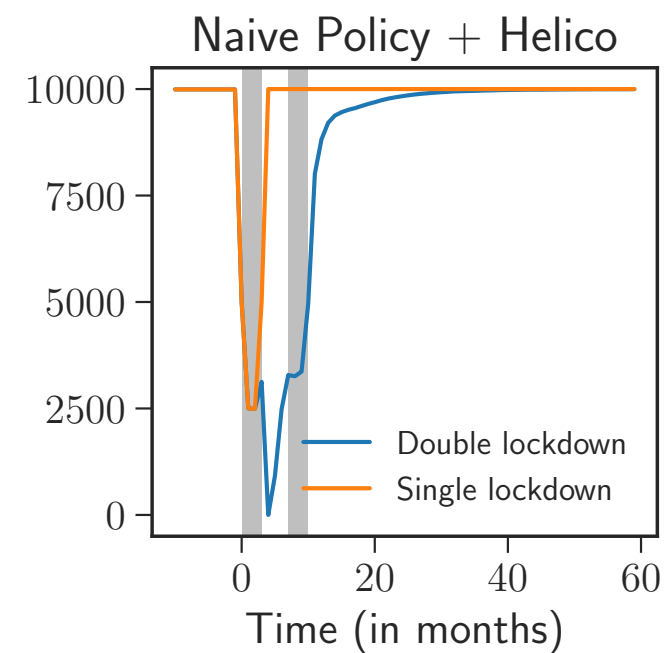
- Permanent loss of output
- Deflation



- Naive policy is not enough
- L-shaped recovery



- Injection of money at end of first shock boosts household demand



- “Exogenous” W-shaped recovery.
- Adaptive policy smooths recovery.

