# Regulating Financial Networks Under Uncertainty

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## Research Question

How can policymakers regulate a network of interdependent financial institutions that is prone to contagion when those policymakers are uncertain about its precise structure?

## Why should we care?

The financial crisis that began in 2007 underscored the relevance of interdependencies among institutions in the functioning of modern economies. While, in normal times, these interdependencies—in the form of contractual obligations or common exposures—can be beneficial, as they help institutions manage liquidity or diversity risk, they can also create channels through which shocks propagate in times of economic stress. These channels might cause problems at one institution to spread to others, potentially leading to cascades of distress with economy-wide implications.

In light of the potential harmful side effects of these interdependencies, policymakers across the globe implemented responses that directly or indirectly take into account the interconnected nature of modern financial systems so as to preserve the benefits of interdependencies while managing their unintended negative consequences.

When designing these responses, however, policymakers are confronted with an inconvenient truth: it is hard to determine the precise structure of the network of exposures among institutions because of the opacity, complexity, and multifaceted nature of their connections. Importantly, this problem becomes particularly acute in times of economic stress, as spirals of fire sales may become relevant.

## Model

- Three-period economy with $n$ banks. Time is indexed by t = {0,1,2}.
- Banks are linked via an exogenous network of exposures.
- At t=0, a planner imposes liquidity restrictions on certain banks to maximize the representative investor's smooth ambiguity certainty equivalent. Before imposing restrictions, the planner decides whether to improve network transparency. To do so, she must pay $\kappa$.
- At t=1, restricted banks react to regulation.
- At t=2, cascades of distress occur as some exposures serve a channels through which distress propagates. <u>Importantly, these exposures are unknown when designing interventions</u>.

### Key assumptions

- Banks fail to internalize the consequence of their actions on the spread of distress.
- While restrictions decrease banks' likelihood of distress, they are not costless as they limit banks' ability to allocate funds towards productive projects.

## Motivating Example

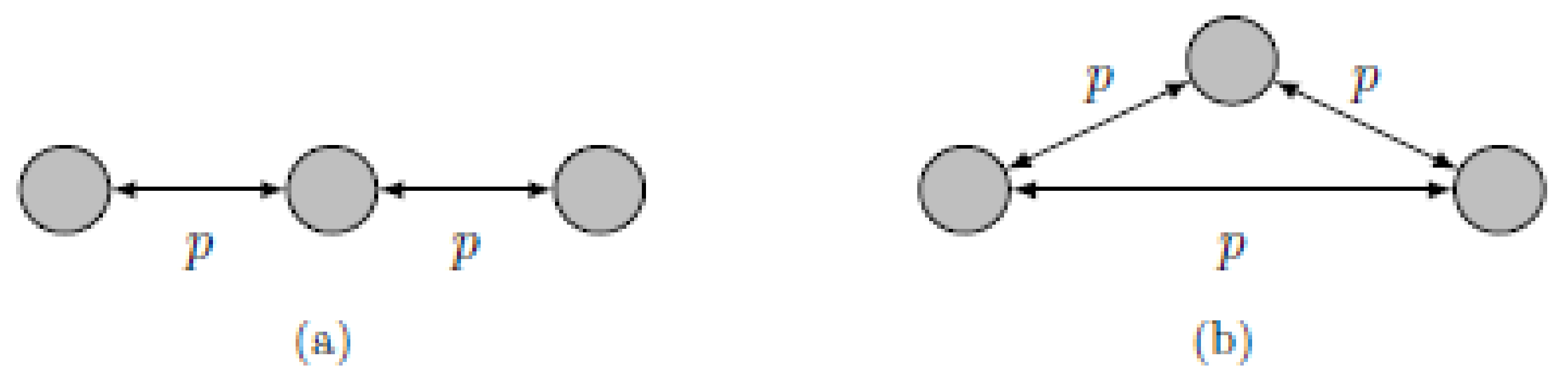


**Figure 1.** Two network architectures among three banks.

### Propagation mechanism

- One bank (chosen uniformly at random) faces an adverse liquidity shock.
- If that bank is affected, the shock can propagate to others via randomly selected exposures. Each exposure is contagious (independently of others) with probability $0 < p < 1$. Bank i faces a liquidity shock if (1) there is a sequence of contagious exposures between i and the first bank that faces the liquidity shock, and (2) every bank within that sequence is affected by the liquidity shock.

### Regulation matters

- Restricted banks become resilient to shocks. As a result, they do not face or propagate shocks.
- Restricting a bank entails paying a cost $c$.

## Two Cases

<u>**Case 1: p is known**</u> If the network is as depicted in figure 1(a), the optimal number of restricted banks is then

$$x_p^*(c) = \begin{cases} 3, \text{ if} & c \leq \frac{1}{3} \\ 2, \text{ if} & \frac{1}{3} < c \leq \frac{1}{3} + \frac{4}{9}p \\ 1, \text{ if} & \frac{1}{3} + \frac{4}{9}p < c \leq \frac{1}{3} + \frac{8}{9}p + \frac{2}{3}p^2 \\ 0, \text{ if} & \frac{1}{3} + \frac{8}{9}p + \frac{2}{3}p^2 < c. \end{cases}$$

Suppose that before implementing restrictions, the planner could learn the identity of the bank in the middle of figure 1(a) by paying $\kappa$. When would the planner decide to do so? Pairs ($\kappa$, $c$) for which the planner decides to improve network transparency are illustrated in figure 2.

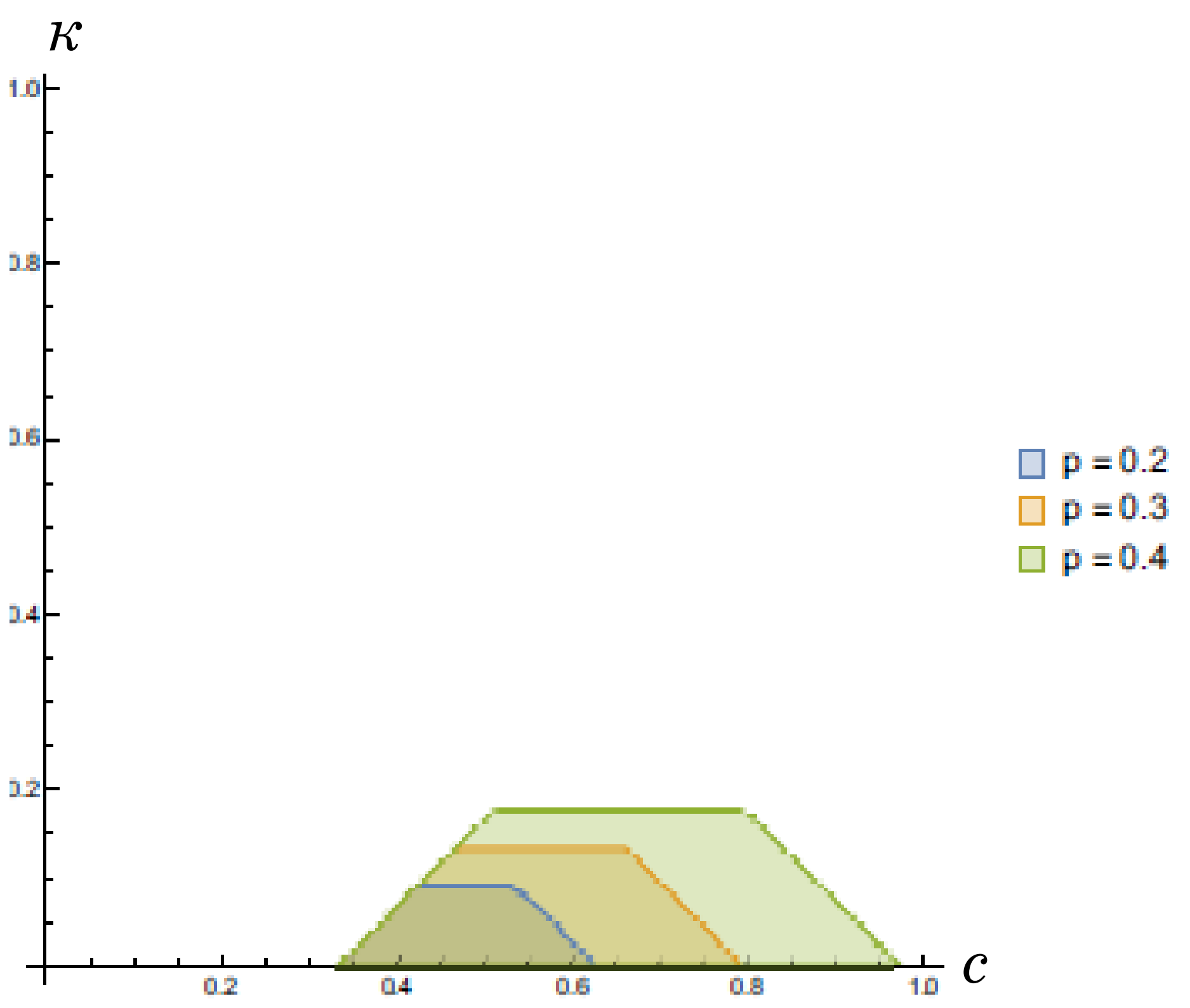
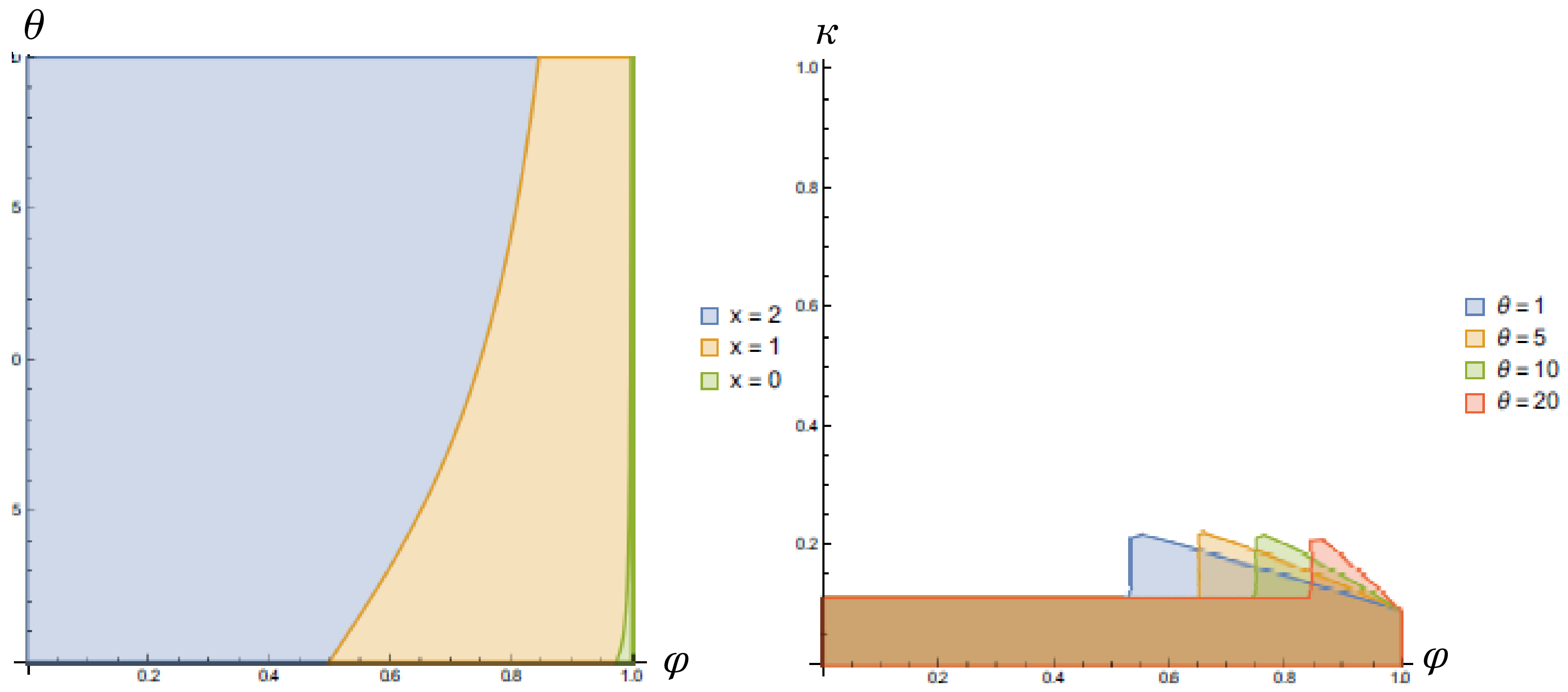


**Figure 2.** $T_p$ when $p \in \left\{\frac{2}{10}, \frac{3}{10}, \frac{4}{10}\right\}$.

*Should network transparency be improved if the network architecture was different?* If banks are linked as in figure 1(b), they are ex-ante identical from the perspective of shock propagation. Therefore, the effectiveness of interventions cannot be improved by learning the position of banks in the network. Hence, it is never optimal to improve network transparency.

<u>**Case 2: p is unknown**</u> Suppose p can take two values {1/5, 4/5}, with Prob(p=1/5)=φ. Let θ denote the representative investor's attitude toward model uncertainty. Assume the network is as depicted in figure 1(a). Figure 3(a) illustrates the optimal number of restricted banks if the planner does not pay $\kappa$. Figure 3(b) illustrates pairs (φ, $\kappa$) for which improving network transparency is optimal.



(a) $x_A^*(\phi, \theta)$. Random targeting.

(b) $(\phi, \kappa)$ for which improving network transparency is optimal.

**Figure 3.** Robust optimal interventions.

## Results

- Without model uncertainty (case 1), the optimal intervention is characterized by the interplay between three characteristics of the economy: (1) its susceptibility to contagion, (2) the marginal cost of regulation, and (3) the cost of improving network transparency.
- When model uncertainty is incorporated (case 2), beliefs regarding the nature of the network architecture reshape this interplay as they alter the expected susceptibility of the economy to contagion. Additionally, interventions are affected by investors' attitude toward ambiguity.
- **Main Challenge.** It is not clear what happens if the size of the economy grows large and how different network architectures can be incorporated into the analysis. **My paper shows that the aforementioned findings continue to be valid for economies with arbitrary sizes and network architectures as long as contagious exposures are randomly determined.**

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