Critical Firms in the COVID Crisis

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Objective

Economic Theory + Machine Learning + Computer Science
Supply Network

Raw Material 1

A1 -> A2 -> B1

B1 -> D1

D1 -> F1

F1 -> Final Demand

Raw Material 2

B2 -> B2

B2 -> E1

E1 -> E2

E2 -> G1

G1 -> G2

G2 -> Final Demand
Critical Firms
Critical Firms
The Economy as a system of pipes
Applications

Flexibility of the approach

- Can prioritise goods—set output requirements for (certain) goods
- Or equally, set an overall output / GDP target.
- Can ask which groups of firms are jointly critical
- Run counterfactuals
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In principle, provides a framework for thinking about
- Where to target resources aimed at saving businesses
- Which firms / industries to relax restrictions for
- Which firms to bailout
Practical Challenges and Solutions

Supply network has only the approximate structure required
- Make the minimal adjustment to give it the right structure
- Computationally hard problem (NP Complete)
- But there are good algorithms for approximate solutions
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Need to calculate maximum flows many times
- With and without firm (group of firms) of interest
- Linear programming problem—good algorithms exist
Proof of Concept—Uganda Pre-COVID

Economic Theory +
Machine Learning +
Computer Science