

IOWA STATE UNIVERSITY

Department of Industrial and Manufacturing Systems Engineering

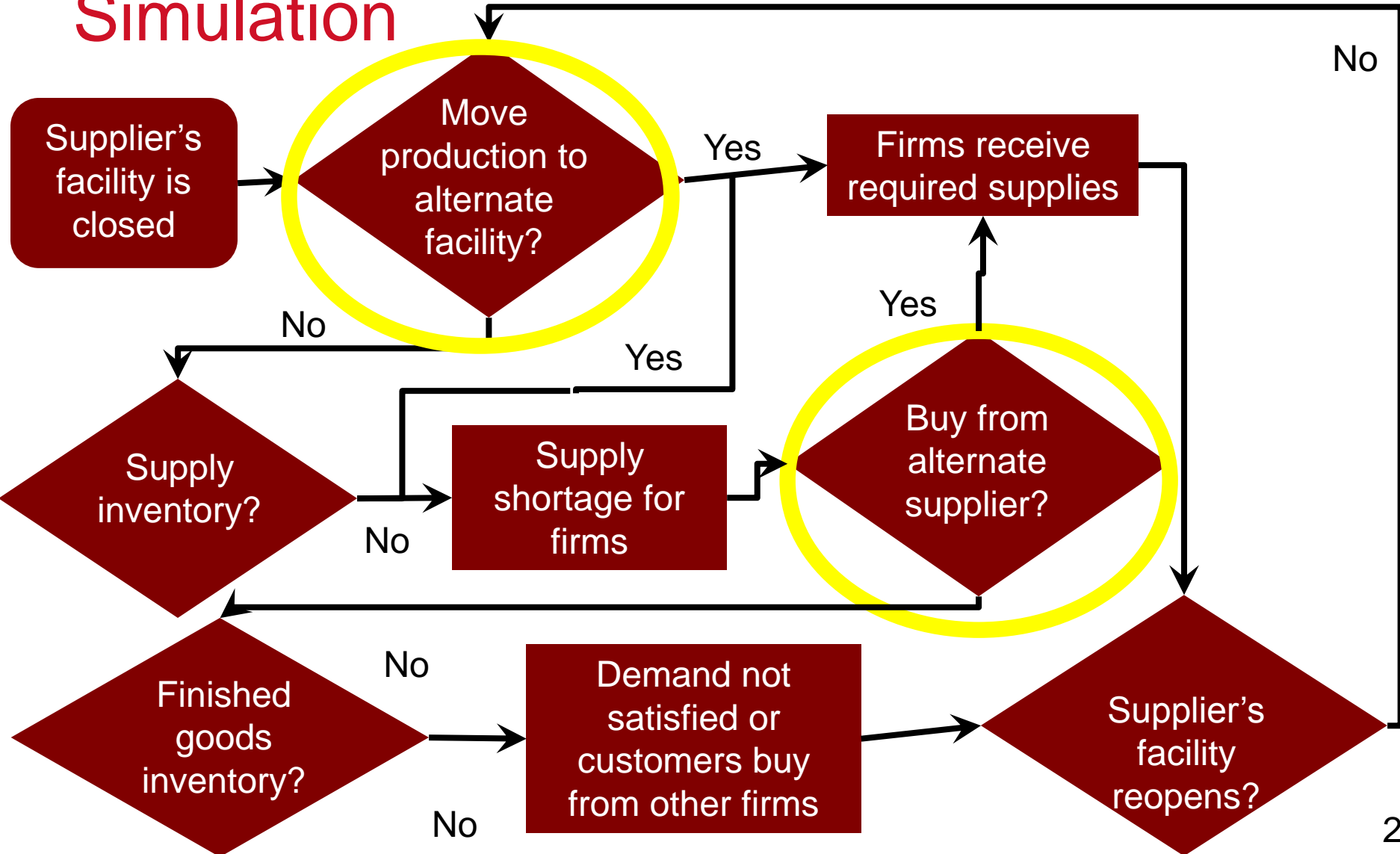
Simulating Severe Supply Chain Disruptions with Multiple Suppliers and Firms

Cameron MacKenzie, Xue Bai, and Andre Friso

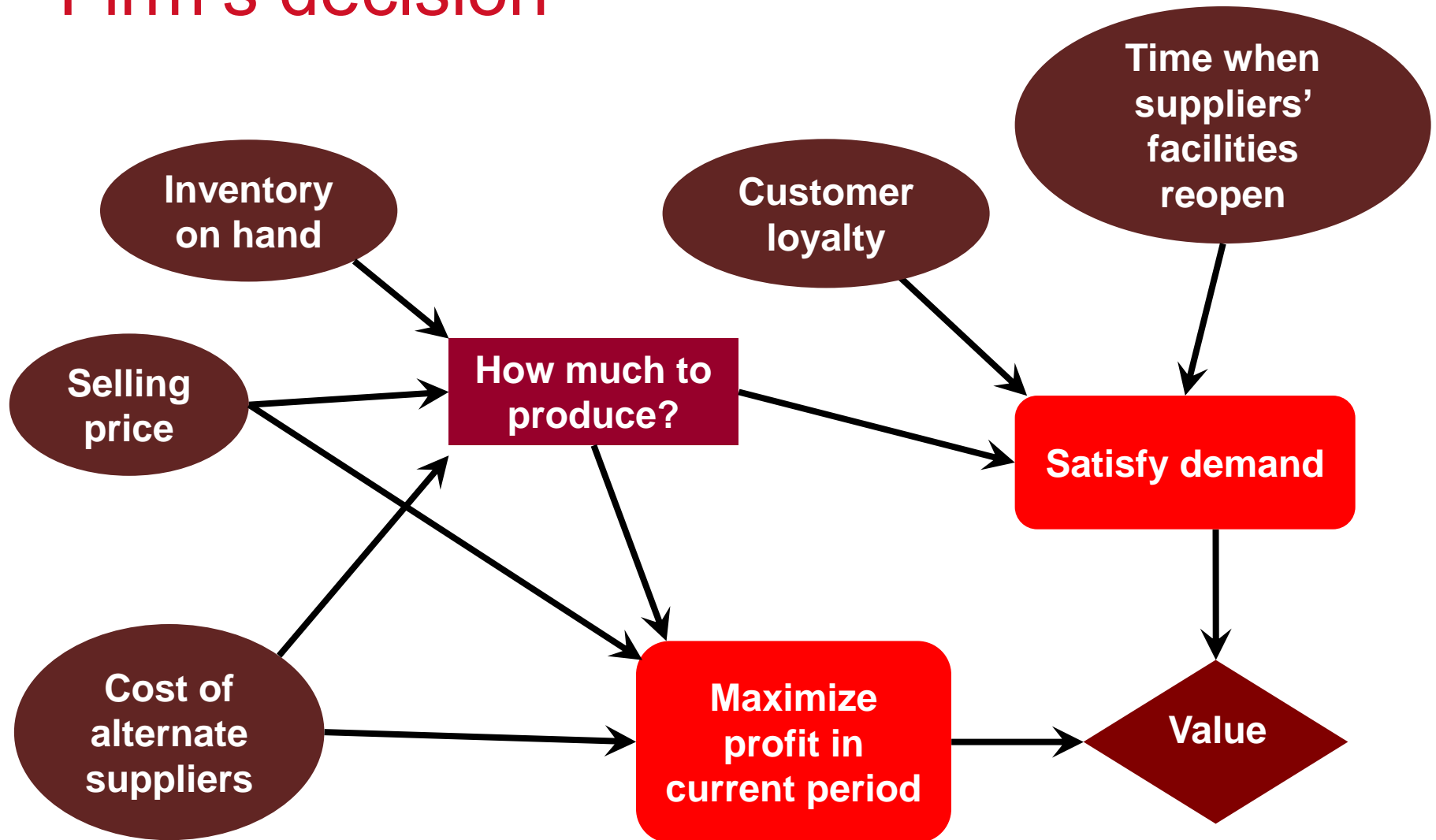
INFORMS Annual Meeting

October 24, 2017

Simulation



Firm's decision



Results in automobile sector

Average percent of total demand satisfied

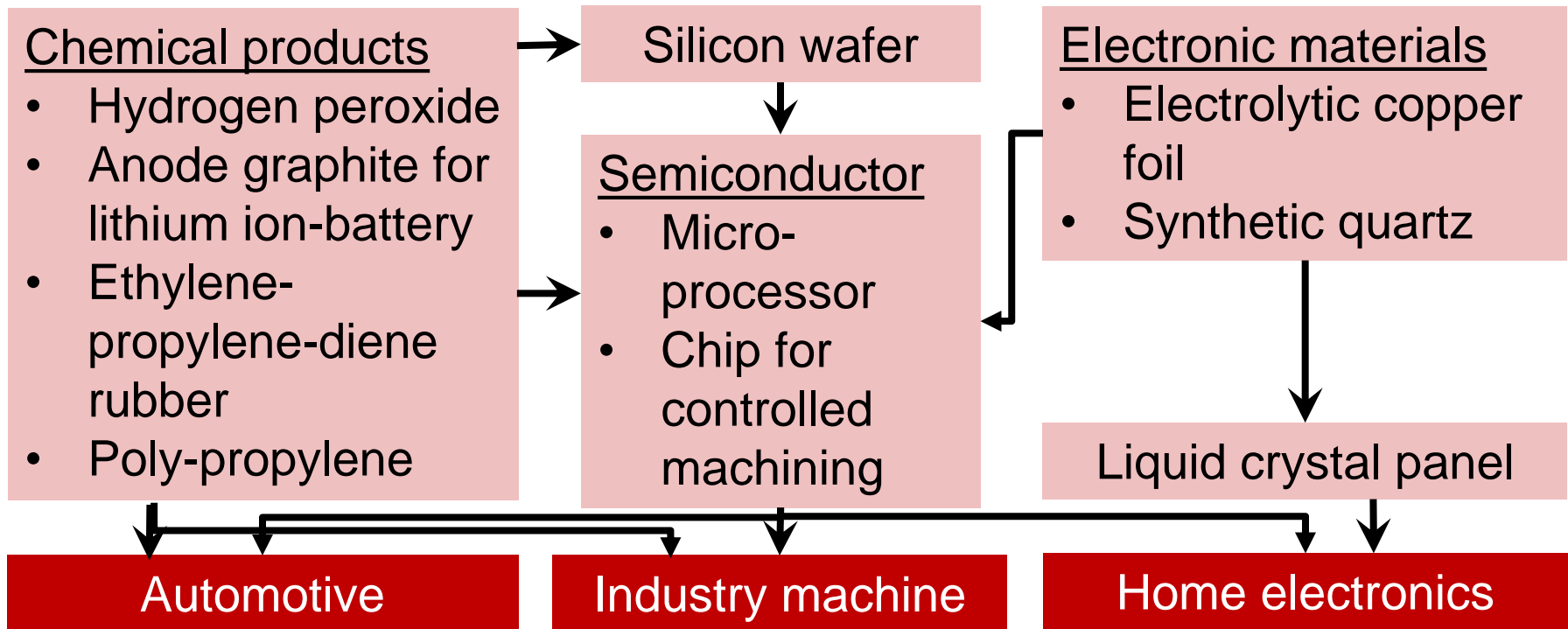
	Maximize profit and no alternate facility	Sacrifice profit to meet demand and no alternate facility	Sacrifice profit to meet demand and alternate facility
Ford, GM, and Chrysler	91.7	98.7	99.0
Toyota and Honda	68.7	86.7	93.4
Nissan	82.5	92.7	96.1

MacKenzie, C.A., Barker K., & Santos, J.R. (2014). Modeling a severe supply chain disruption and post-disaster decision making with application to the Japanese earthquake and tsunami. *IIE Transactions*, 46(12), 1243-1260.

Research extension

- Previous work had 4 suppliers and 3 firms
- Can we extend the simulation to include more firms and suppliers?
- Extend to multiple industries with multiple firms
 - Automobile
 - Electronics
 - Chemical

Previous work

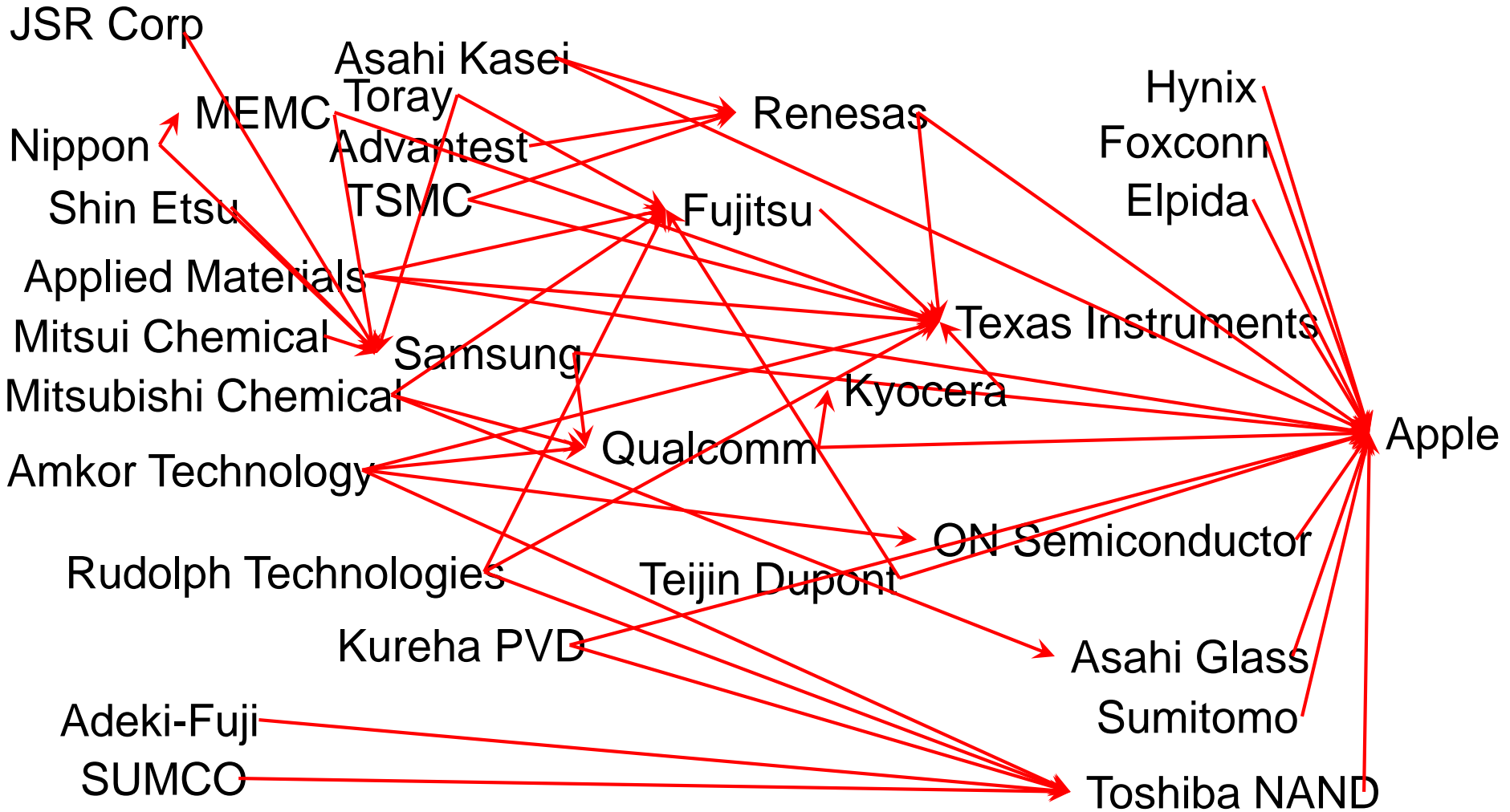


Ono, K., Akakura, Y., Kanda, M., & Ishihara (2015). Analyzing and simulating supply chain disruptions to the automobile industry based on experiences of the Great East Japan Earthquake. *Journal of Integrated Disaster Risk Management*, DOI10.5595/idrm.2015.0102

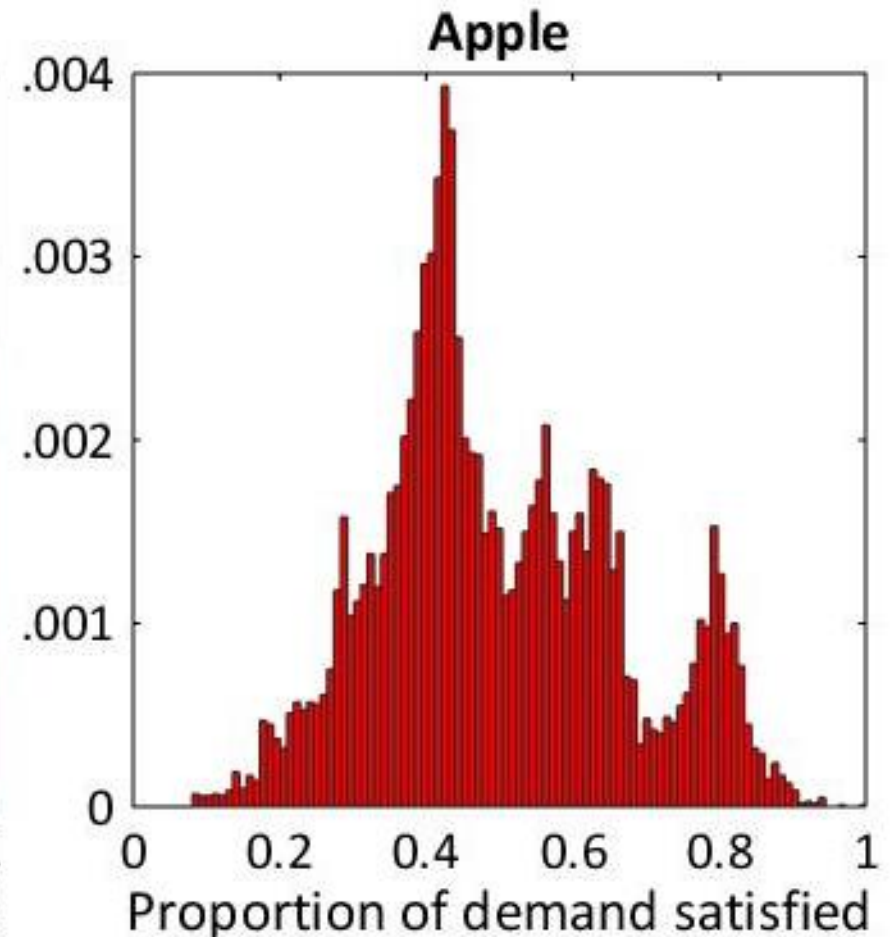
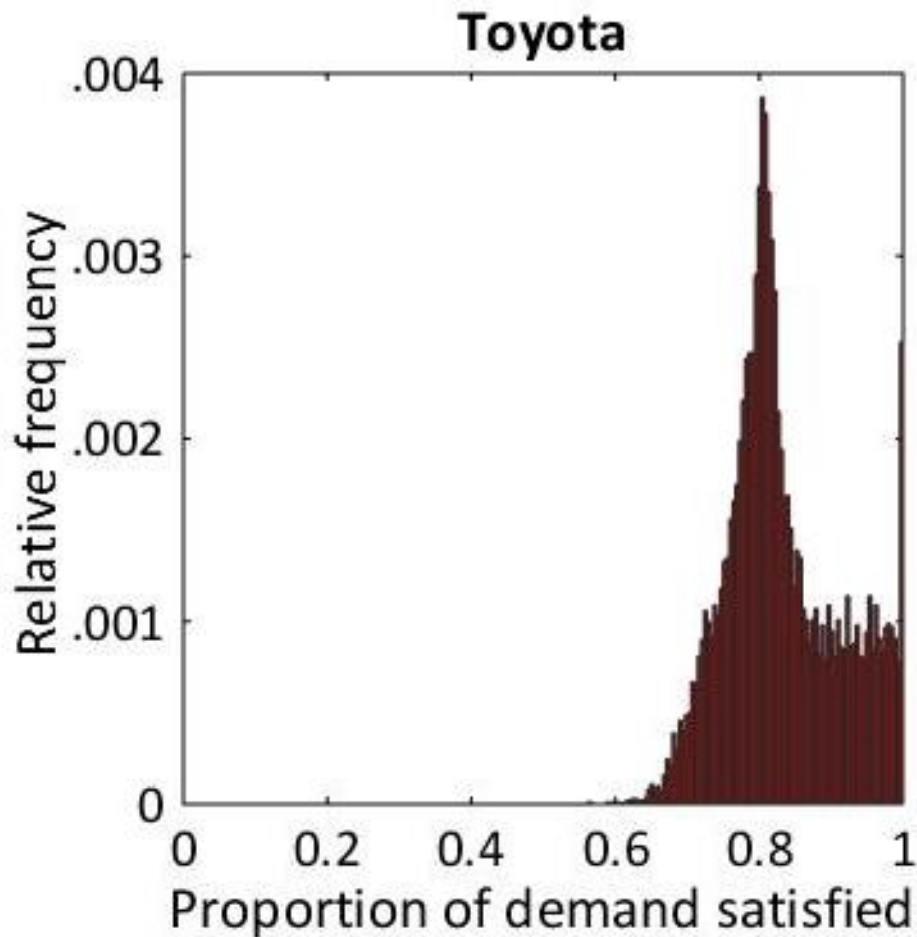
Simulation extension

- 8 automobile firms (Toyota, Honda, Nissan, GM, Ford, Chrysler, Mazda, Isuzu)
- 6 phone / tablet firms (Apple, Sony, Nokia, HTC, Huawei, Samsung)
- 6 other electronic firms (Sony non-phone, Nintendo, Sega, Panasonic, Nikon, Canon)
- 5 automobile suppliers (e.g., Renesas, Merck)
- 15 electronics suppliers (e.g., Qualcomm, Texas Instruments)
- 11 semiconductor / wafer suppliers
- 12 petrochemical suppliers

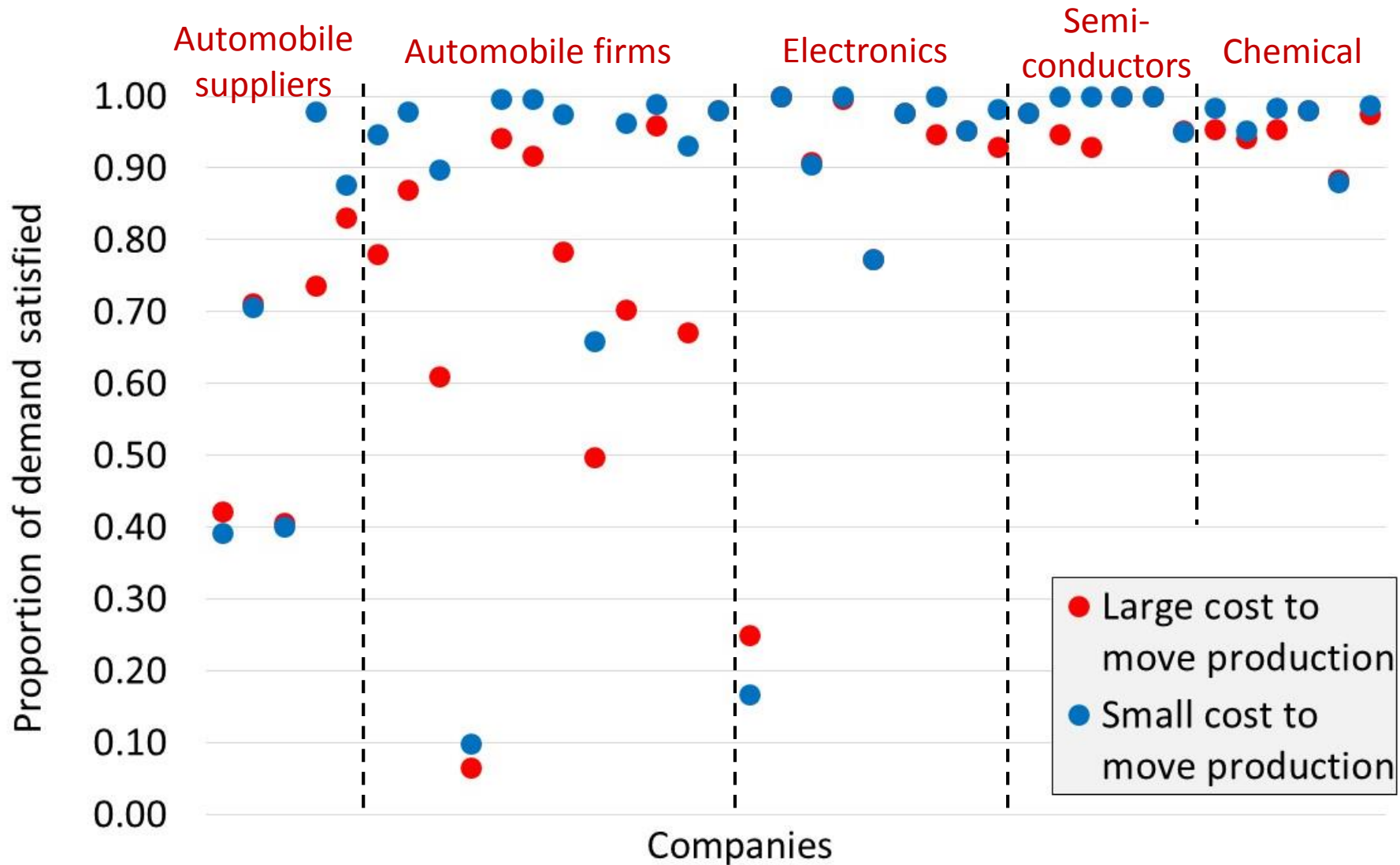
Supply chain for Apple



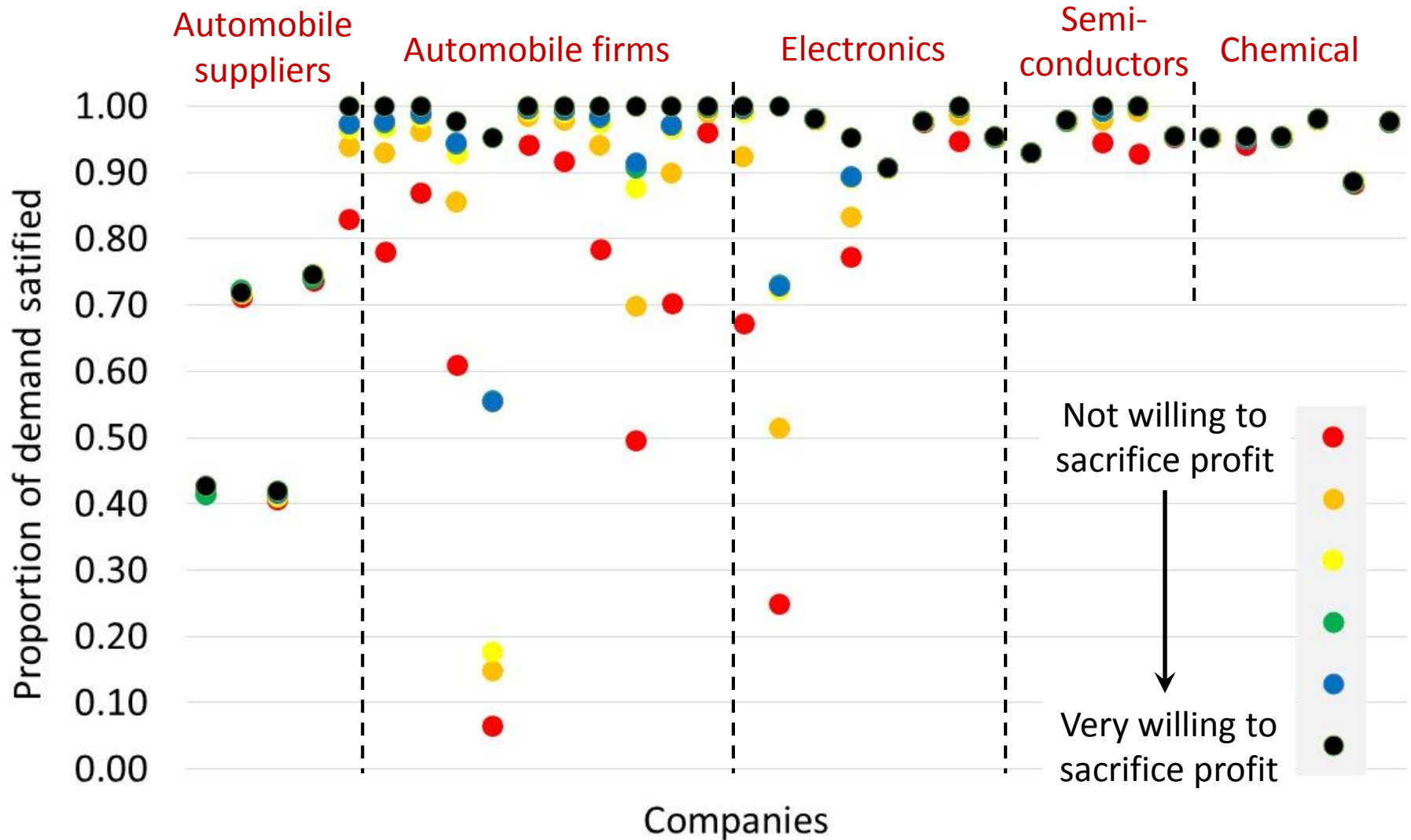
Production impact



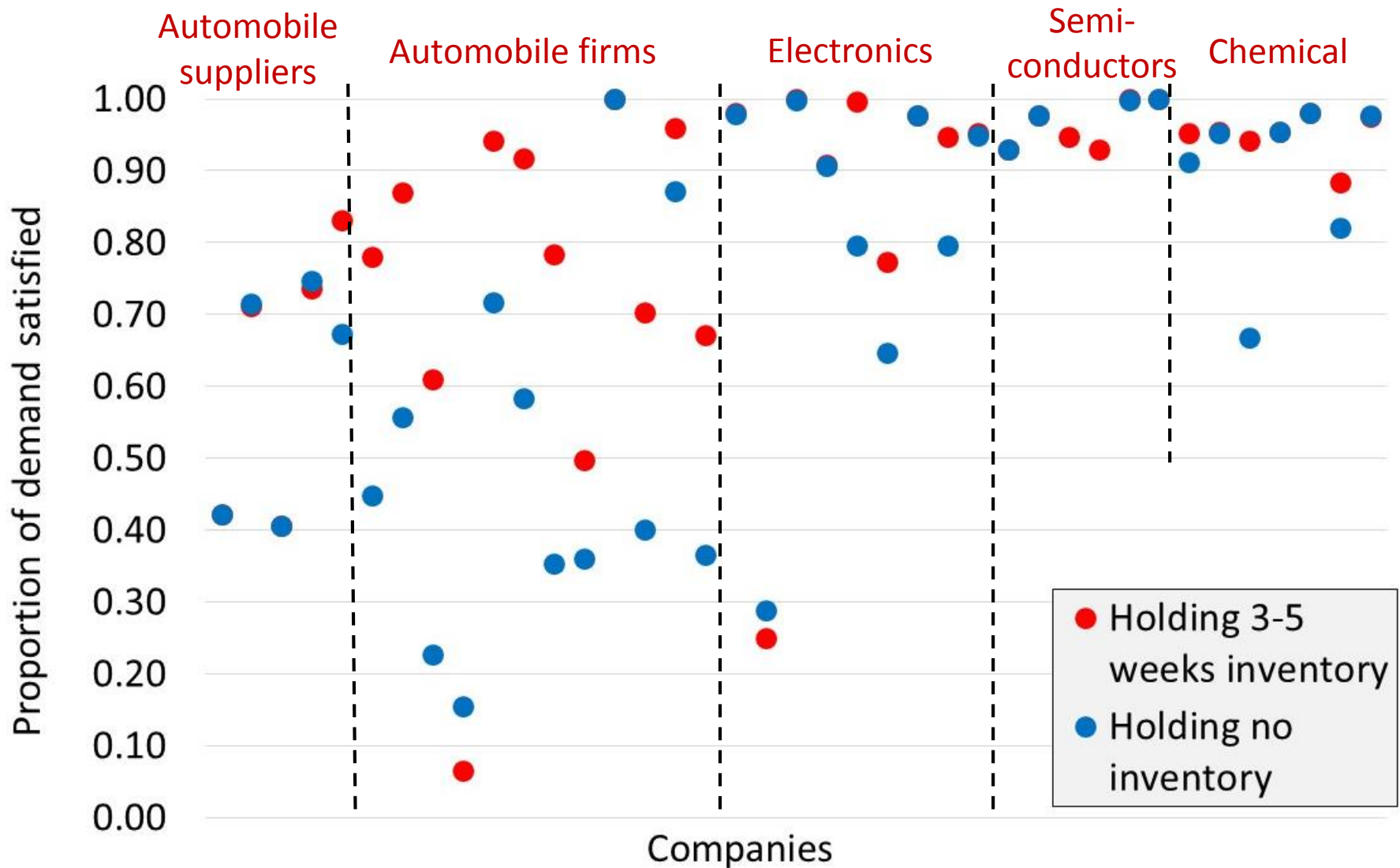
Impact of moving production



Impact of willingness to sacrifice profit



Impact of inventory



Conclusions

- Create more complex model of supply chain to simulate disruption after tsunami with 64 firms
- Automobile sector
 - Toyota, Honda, Isuzu impacted the most
 - Ford, GM, Chrysler impacted to lesser degree
- Some electronics firms (Apple, Sony, Huawei) impacted severely but also vary variable
- Petrochemical and semiconductor industries had inventory or other production sites
- Need for validation