Impact of External Shocks on Supply Chains

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Overwhelmed by the negative impacts of the COVID-19 pandemic, global supply chains are being restructured and improved worldwide. It then becomes essential to accurately assess their vulnerabilities to external shocks and understand the relationships between key influential factors to obtain the desired results.

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1. Introduction

The pre-existing supply chain challenges that were magnified by the COVID-19 pandemic continue to create pressure at the most global scale. Disruptions of manufacturing operations resulting from curfews and regulations keep slowing the flow of goods and raw materials. However, the COVID-19 pandemic has not necessarily created any new challenges for supply chains. A survey conducted by Ernst & Young on senior-level supply chain executives underscored their plans to increase investment in supply chain technologies, such as artificial intelligence, business analytics, and robotic process automation, as an attempt to create collaborative, resilient, and sustainable supply chains. The survey revealed that only 2% of the respondents were fully prepared for the disruptions caused by external shocks. On the bright side, these disruptions have forced business executives to prioritize their supply chain issues and invest in building technical capabilities.

Although many industries were deeply affected by the COVID-19 pandemic, some of them were hit particularly hard. Shortages of semiconductors, batteries, fabrics, and critical elements exposed vulnerabilities in the auto manufacturing, electronic good, and textile industries. Record-low inventories in many industries are still holding back business activities and causing disruptions in industrial supply chains. One of the most significant impacts of such shortages is on price increases. Between April 2020 and April 2021, the prices of commodities tracked using the producer price index rose by seventeen percent, while the change in commodity prices reached twenty-one percent between April 2021 and April 2022 [1]. To overcome such challenges, major companies in these industries have already started building more sustainable and resilient supply chains by geographically diversifying their supply sources, relying more on local suppliers, and investing in technological solutions throughout. Meanwhile, it is essential to start with identifying vulnerabilities before redesigning supply chains as there are many tradeoffs associated with potential solutions where supply source diversification is misaligned with efficiencies within the very same supply sources [2]. A recent analysis revealed the four top strategies being utilized by companies to mitigate the impact of COVID-19 on their supply chains. These are strengthening existing relationships, pursuing multiple and regionally diverse suppliers, relying on digital supply chain tools for increased visibility into their supply chain, and moving away from the just-in-time methodology to the just-in-case methodology [3].

2. Impact on Supply Chains

To evaluate the expectations for the evolution of supply chains in terms of geographic regions and industries, Vurdu examined the emergence of global value chains and the interdependence among countries [4]. Meyer et al. focused on the implications of the COVID-19 pandemic for supply chain constructs related to sustainability, resilience, and risk, using text mining [5]. Sarkis identified emerging consumer, organizational, policy, and supply chain behaviors by looking at the environmental sustainability of supply chains in a post-COVID-19 pandemic environment [6]. Carvalho et al. used an equilibrium model of production networks that took into account the macroeconomic disruption caused by the 2011 earthquake in East Japan along the supply chains [7]. Del Rio-Chanona et al. analyzed the constraints exerted on the U.S. economy after allowing shocks in its aggregate supply and aggregate demand to predict their impacts on factors, such as GDP, employment, and wages [8]. During the COVID-19 pandemic, Bekaert et al. studied output and price fluctuations, using real-time data on GDP growth and inflation, by modeling aggregate supply and aggregate demand shocks [9]. Around the same time, Brinca et al. measured labor supply and demand shocks at the sectoral level by estimating a Bayesian structural VAR model, attributing the drop in the rate of labor growth to supply effects [10]. Chen et al. studied the dynamic impact of the COVID-19 pandemic on consumption, using daily transaction data to reveal the sensitivity of demand to the pandemic severity [11]. Guerrieri et al. investigated whether supply shocks can lead to demand-deficient recessions and discussed the combination of monetary and fiscal policies [12]. Inoue and Todo used an agent-based model to simulate the impact of a complete Tokyo shutdown on the production losses in other prefectures and argued that the negative impact of the shutdown would rapidly propagate throughout because of supply and demand shortages [13]. Pichler et al. designed an economic model to address the features of the COVID-19 pandemic, including the inventory dynamics and feedback between the consumption and unemployment, and analyzed how shocks propagated through the production network [14]. Chetty et al. analyzed the heterogeneity of the impact of the COVID-19 pandemic across income levels, using weekly statistics on employment rates, job postings, consumer spending, and business revenues [15]. Khalfaoui et al. provided an empirical study on the roles of panic and stress related to the COVID-19 pandemic on green bond market volatilities [16]. Chen and Tillmann used a set of economic activity indicators, such as NO_2 emissions, maritime container trade, and mobility, to estimate the magnitude of lockdown spillovers [17]. Qian and Qiu examined the impact of political risk on corporate international supply chains and concluded that political risk decreased their number of purchases from foreign suppliers [18].

3. Responding to External Shocks

Freeman and Baldwin focused on the effects of the supply chain contagion of national lockdown measures on manufacturing industries [19]. Hyun et al. examined how global connectedness and market power affected the supply chain resilience and performance in response to the COVID-19 pandemic, using global stock market data, and concluded that higher global connectedness of supply chains led to more resilience to domestic shocks [20]. Bonadio et al. used a multi-industry quantitative framework covering 64 countries to investigate the impact that global supply chains had on GDP growth during the COVID-19 pandemic and argued that the nationalization of supply chains did not necessarily contribute to their resiliency because of an increasing dependency on domestic

inputs, which were also disrupted by the lockdowns. [21] Using international trade variables, Heidary presented a system dynamic model to simulate the impact of the COVID-19 pandemic on the global supply chain in various scenarios and concluded that higher levels of flexibility in production capacity were an important strategy to cope with such disruptions [22]. Diaz Pacheco and Benedito investigated the responses of manufacturing and service businesses during the COVID-19 pandemic, using a qualitative multiple case study, and reported that supply chains did adapt activities, such as product design and development, budgeting, human resources, and logistics [23].

To estimate the impacts of COVID-19 as well as government responses on e-commerce sales, Han et al. utilized city–day panel data to illustrate the digital resilience of e-commerce during the pandemic and identified the logistics capacity as a key operational driver [24]. Blom et al. developed an optimization model to maximize the audience in a theater while satisfying the limitations imposed by the governments during the pandemic [25]. Li et al. used a two-tier supply chain to investigate the impact of government subsidy schemes and the channel power structure on the level of innovation in the supply chain [26]. The study provided guidance for governments on how to design effective subsidy schemes to improve innovation, investment, as well as social welfare, which are particularly important during challenging times. Zhai et al. also considered a two-tier supply chain composed of a retailer and a manufacturer to investigate service investment and pricing decisions under various power structures in the presence of demand disruptions [27].

Although the literature on the effects of the COVID-19 pandemic on supply chains has started to build sharply, there is a lack of quantitative models for examining the relationships between key factors mainly owing to the limitations on data availability. This research fills this gap to enable decision-makers to implement informative decisions based on objective analytical results. Furthermore, the extant literature on the interrelations among factors does not account for the spillover effects of external shocks.

References

1. U.S. Bureau of Labor Statistics. Producer Price Index by Commodity: All Commodities . Retrieved from FRED, Federal Reserve Bank of St. Louis. Available online: https://fred.stlouisfed.org/series/PPIACO (accessed on 6 September 2023).
2. Shih, W.C. Global Supply Chains in a Post-Pandemic World. Harvard Business Review, September–October 2020.
3. Wellener, P.; Hardin, K.; Gold, S.; Laaper, S. Meeting the Challenge of Supply Chain Disruption. Deloitte Insights Magazine, 21 September 2022.
4. Vurdu, S.A. The Impact of Covid-19 Pandemic on Supply Chain Trade. Ind. Policy 2021, 1, 51–60.
5. Meyer, A.; Walter, W.; Seuring, S. The Impact of the Coronavirus Pandemic on Supply Chains and Their Sustainability: A Text Mining Approach. Front. Sustain. 2021, 2, 631182.

6. Sarkis, J. Supply chain sustainability: Learning from the COVID-19 pandemic. Int. J. Oper. Prod. Manag. 2021, 41, 63–73.
7. Carvalho, V.M. Supply Chain Disruptions: Evidence from the Great East Japan Earthquake. Q. J. Econ. 2021, 136, 1255–1321.
8. Del Rio-Chanona, R.M. Supply and demand shocks in the COVID-19 pandemic: An industry and occupation perspective. Oxf. Rev. Econ. Policy 2020, 36 (Suppl. S1), S94–S137.
9. Beakert, G.; Engstrom, E.; Ermolov, A. Aggregate Demand and Aggregate Supply Effects of COVID-19: A Real-Time Analysis; Finance and Economics Discussion Series; Divisions of Research & Statistics and Monetary Affairs, Federal Reserve Board: Washington, DC, USA, 2020.
10. Brinca, P.; Duarte, J.B.; Faria-e-Castro, M. Measuring Sectoral Supply and Demand Shocks during COVID-19; Federal Reserve Bank of St. Louis, Research Division: St. Louis, MO, USA, 2020.
11. Chen, H.; Qian, W.; Wen, Q. The Impact of the COVID-19 Pandemic on Consumption: Learning from High Frequency Transaction Data. In AEA Papers and Proceedings; American Economic Association: Nashville, TN, USA, 2021.
12. Guerrieri, V.; Lorenzoni, G.; Straub, L.; Werning, I. Macroeconomic Implications of COVID-19: Can Negative Supply Shocks Cause Demand Shortages. Am. Econ. Rev. 2022, 112, 1437–1474.
13. Inoue, H.; Todo, Y. The propagation of the economic impact through supply chains: The case of a mega-city lockdown against the spread of COVID-19. arXiv 2020, arXiv:2003.14002v1.
14. Pichler, A.; Pangallo, M.; del Rio-Chanona, R.M.; Lafond, F.; Farmer, J.D. Production Networks and Epidemic Spreading: How to Restart the UK Economy. arXiv 2020, arXiv:2005.10585v1.
15. Chetty, R.; Friedman, J.N.; Stepner, M. The Economic Impacts of COVID-19: Evidence from a New Public Database Built Using Private Sector Data. NBER. 2023. Available online: http://www.nber.org/papers/w27431 (accessed on 12 August 2023).
16. Khalfaoui, R.; Mefteh-Wali, S.; Dogan, B.; Ghosh, S. Extreme Spillover Effect of COVID-19 Pandemic-Related News and Cryptocurrencies on Green Bond Markets: A Quantile Connectedness Analysis. Int. Rev. Financ. Anal. 2023, 28, 102496.
17. Chen, H.; Tillmann, P. Lockdown Spillovers. J. Int. Money Financ. 2023, 137, 102890.
18. Qian, X.; Qiu, S. Political Risk and Corporate International Supply Chain. J. Int. Money Financ. 2023, 137, 102899.
19. Freeman, R.; Baldwin, R. Supply Chain Contagion Waves: Thinking ahead on Manufacturing ‘Contagion and Reinfection’ from the COVID Concussion. VoxEU. Available online: https://cepr.org/voxeu/columns/supply-chain-contagion-waves-thinking-ahead-manufacturing-contagion-and-reinfection (accessed on 12 August 2023).

20. Hyun, J.; Kim, D.; Shin, S.-R. The role of global connectedness and market power in crises: Firm-level evidence from the COVID-19 pandemic. Covid Econ. 2020, 49, 148–171.
21. Bonadio, B.; Huo, Z.; Levchenko, A.A.; Pandalai-Nayar, N. Global supply chains in the pandemic. J. Int. Econ. 2021, 133, 103534.
22. Heidary, M.H. The Effect of COVID-19 Pandemic on the Global Supply Chain Operations: A System Dynamics Approach. Foreign Trade Rev. 2022, 57, 198–220.
23. Díaz Pacheco, R.A.; Benedito, E. Supply Chain Response during the COVID-19 Pandemic: A Multiple-Case Study. Processes 2023, 11, 1218.
24. Han, B.R.; Sun, T.; Chu, L.Y.; Wu, L. COVID-19 and E-Commerce Operations: Evidence from Alibaba. Manuf. Serv. Oper. Manag. 2022, 24, 1388–1405.
25. Blom, D.; Pendavingh, R.; Spieksma, F. Filling a Theater During the COVID-19 Pandemic. INFORMS J. Appl. Anal. 2022, 52, 473–484.
26. Li, C.; Liu, Q.; Zhou, P.; Huang, H. Optimal innovation investment: The role of subsidy schemes and supply chain channel power structure. Comput. Ind. Eng. 2021, 157, 107291.
27. Zhai, Y.; Bu, C.; Zhou, P. Effects of channel power structures on pricing and service provision decisions in a supply chain: A perspective of demand disruptions. Comput. Ind. Eng. 2022, 173, 108715.

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