



Supply chains must become more resilient, sustainable, and socially fair. © Shutterstock

The next big thing at the Hub

As our institution is growing, new topics of interest emerge at the CSH. And a big one is gonna be supply chains.

Supply chains are interesting for a number of reasons. For one, governments have to ensure that people are properly supplied with food, medication, energy, and other important goods—especially in times of crises. We just experienced multiple (supply) crises in a very short succession, from COVID-19 lockdowns to the physical blocking of a seaway by a single vessel, up to energy distortions fueled by a war on European territory that no one really had anticipated. These shocks, with their immediate impact on supply chains, were truly eye-opening for most. We became aware *how* brittle and vulnerable our intertwined, world-encompassing production networks have become in the recent years of globalization and feel—all the way down to our wallets—how important it would be to design them to be more resilient.

Resilience alone is not enough though. We also, and urgently, must transform our support systems to become climate neutral, sustainable, and socially just. Only with a deep

understanding of the structure and dynamics of supply chain networks will we be able to re-design those lifelines of the economy accordingly.

The stakes are high and highly complex—which makes them interesting for the Hub. We work on both novel scientific approaches as well as practical recommendations for policymakers. For instance, we showed that with a simple and minor adaptation of tax reporting we could obtain the data necessary to reconstruct the supply networks of entire nations, ideally even for the whole of Europe. Such data, fed into our agent-based models, would eventually allow us to identify the weak spots of the economy—information necessary to systematically boost its resilience, circularity, and sustainability. We addressed the topic in this year's complexity panel at the Forum Alpbach.

More on supply chains is about to come soon. Stay tuned!

Stefan Thurner
CSH President

RESEARCH SELECTION

And how healthy is your healthcare system?

A stress test identifies strengths and weaknesses of an entire healthcare system.

Numerous reasons, like retirement waves or mass quarantine, can lead to higher-than-average closings of medical practices. The system can compensate for some shortfalls, but when a critical point is reached, the adequate medical treatment of the population can no longer be guaranteed. To identify such (tipping) points, the CSH medical team developed a stress test—a method that has long been employed in many areas such as the banking sector to be better prepared for crises.

Drawing patient-doctor-networks

The scientists used anonymized patient data and publicly available data on doctor's office hours in Austria to draw real-world patient-doctor-networks. (The method can be used by any country with such data.) They found surprisingly constant patient flows within the network. "If a gynecologist goes on vacation, her patients will usually

go to a particular other doctor as a substitute," the first authors **Michaela Kaleta** and **Jana Lasser** explain. "If that gynecologist retires, her patients are very likely to switch permanently to that colleague." The team fed the real-world networks into a computer model of the system. "We can now virtually shock the system by removing physicians one at a time and simulate where patients are moving on to within the network," says Jana. "We thus see the tipping points."

Large regional differences

The stress test shows precisely in which regions the Austrian healthcare system is resilient and where authorities should improve the situation. Regional differences are significant indeed: "We can remove four times more eye doctors, as an example, in Vorarlberg than in Styria before patients don't get properly treated anymore," says Jana—7% compared to 28%.

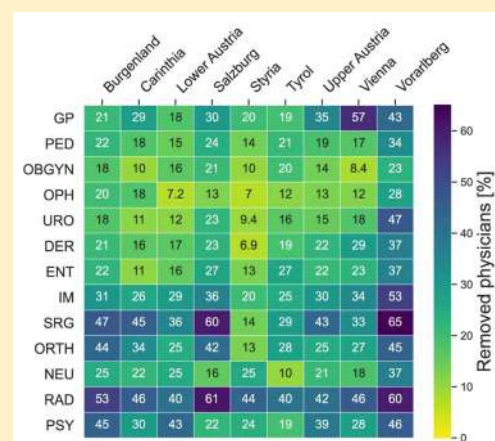
Project leader **Peter Klimek** emphasizes the importance of such insights: "Many countries will have to rebuild their healthcare system in a way that it is not only affordable but also more resistant to shocks. To find the right balance between cost efficiency and

crisis resilience, we need to know the weaknesses and strengths of the system."

The study "Stress-testing the resilience of the Austrian healthcare system using agent-based simulation" has appeared in Nature Communications.

Check out our cool interactive visualization of the multi-dimensional dataset via → <https://csh.ac.at/vis/>.

Percentage of physicians that can be removed in Austrian provinces before the healthcare system reaches a tipping point. © CSH



Women on boards lead to better financial results

Companies with female board members tend to perform better, an analysis of a huge dataset from Japan shows.

To examine the relationship between female board appointments and corporations' financial performance, CSH researcher **Matthias Raddant** and his colleagues got access to one of the largest samples ever analyzed for developed economies: data from 4,000 Japanese firms collected from 2004 to 2013. The team studied the evolution of a group of female board members and their professional networks and looked into the performance of those companies, including market value, income, total assets, business sector, largest shareholders, and shareholder composition.

"We see that the women started to change their positions in the executive networks. Relatively many female board members have multiple mandates, which made them become more central," Matthias points out.

More profitability with women on boards

The study shows that female board members tend to connect with each other and support one another, a concept known as homophily, or "birds of a feather flock



Appointing women to corporate boards can help make those firms more profitable. © Shutterstock

together." Enterprises with ties to other companies with female board members were also more likely to appoint women to their board," says Matthias.

Although the rate of women on corporate boards in Japan is very low—in 2022 it was still only 8%, compared to 29% of women on board seats in North America or Europe—, these female alliances turned out to be of great value for the compa-

nies: Firms with at least one female board member showed to be more profitable than firms without females on their boards, according to this analysis.

The study "Interdependencies of female board member appointments," was published in the International Review of Financial Analysis.



Attract smaller tech companies to boost innovation in cities

Counting on Big Tech may not be a good idea for cities aiming to become tech hubs.

Do you want to foster local cutting-edge technology? Then don't rely on Amazon, Google, or Microsoft for traction. Instead, put a focus on appealing, small multinationals, says a study co-authored by Frank Neffke, leader of the CSH Science of Cities team and an expert in economic transformation and growth.

To boost local innovation, better assemble second-tier multinationals. © Shutterstock



To determine whether foreign firms help kick-start innovation processes in places where they invest in research, Frank and his colleagues looked up regions that register first patents created by a multinational company and compared them to regions with similar socioeconomic characteristics—such as the same level of education and per capita income—but without foreign research activities. They used data from the United States Patent and Trademark Office, covering patenting activity in virtually all countries of the world for nearly four decades.

Smaller companies rather form local alliances

“We see that, contrary to much of received wisdom, big tech companies are not the main contributors to local innovation capabilities,” says Frank. It is rather the second-tier multinationals—those outside the top five percent of innovating firms—that are engaging in local alliances. “For the most innovative multinational companies, the risk of leaking knowledge to local competitors outweighs the benefits of learning from those same

competitors, thus reducing the incentives of ‘highly innovative multinationals’ to embed themselves fully into the local innovation system,” the authors write in the blog post “Making foreign direct investment work for innovation clusters.”

Foreign research activities may spill over to local economies

The scientists found that within five years, a region's patenting output rose an average of 14 points on a 100-point scale ranking all regions in the world by their innovation output, compared to similar regions without foreign research activities. “But such spillovers to local economies are exclusively generated by less prominent tech companies. Technology leaders do not boost innovation by local firms at all.”

The study “Innovation catalysts: How multinationals reshape the global geography of innovation” was published in Economic Geography.



HUBLIVE

CSH and CEU scientists get to know each other at the Hub.

A new connective format to meet 'n' greet (so cool!)

In June, young scientists from Central European University and the Hub met in our place to get to know each other and discuss shared interests. To bring a bit of change—and pep—into the third CEU-CSH encounter,

Vito DP Servedio and Elisa Omodei invented a new format to promote interaction.

Vito (CSH) and Elisa (CEU) asked the scientists to bring little posters with their portraits and a short description of their current research which were glued to a long roll of paper in our corridor and discussed there and then in the well-at-

tended first meeting round. This was already great fun: For hours the hallway was filled with cheerful chatter. Several reshufflings made sure that (almost) everybody met (almost) everyone. In the second part of the meeting, people wandered around and learned about “crazy ideas” that some of the scientists had brought with them: funny or puzzling questions to be discussed—and maybe even solved—in small teams during the following hours.

“The idea of this meeting was to have fun with a little bit of research,” said Vito with his typical broad smile. “If people like it, we could think about repeating such events with other institutions.” Well, Vito: Fun it was. Let's continue!

More Updates and further information:
→ www.csh.ac.at/events

CSH Workshop: “Evolution and geography of collective knowledge” October 17–19, 2022

Collective knowledge has been the driving force behind increased prosperity and is probably our best tool to fight the unintended consequences thereof. Machine learning and natural language processing have started helping to create large-scale datasets that describe not just the quantity, but also the contents of patents, scientific papers, educational tracks, and so much more in ways that were unimaginable just five years ago. Frank Neffke (CSH) and Dieter Kogler (University College Dublin) invited scholars to discuss how to best make use of such high-dimensional, multi-scalar descriptions of knowledge in (economic) models.

CSH Workshop: “Collective Resilience” October 19–21, 2022

Collectives emerge, change, grow, and dissolve across temporal and spatial scales. These processes have been studied and modeled in different species. But many underlying mechanisms and regularities remain elusive. The workshop, co-organized by Mirta Galesic (Santa Fe Institute & CSH External Faculty), will bring experts from biological, evolutionary, neurological, psychological, and sociological backgrounds together to discuss their insights regarding an applicability to human societies and the many challenges they face.

CSH-INET Workshop: “Firm-level production networks” November 28–30, 2022

Addressing challenges for production networks requires a better understanding of the mechanisms underlying their functioning, such as firms’ production processes, short- to long-term decision-making behavior, or firms’ interactions with their suppliers and customers. Anton Pichler, Christian Diem (CSH), François Lafond (University of Oxford), and Alexandra Brintrup (University of Cambridge), together with CSH President Stefan Thurner, invite scientists from different disciplines to foster a dialogue between existing modeling approaches and discuss specific applications such as the propagation of price increases, climate shocks, and the interaction of production networks with financial networks, labor markets, and innovation.

CSH Winter School 2023 | Obergurgl January 14–19, 2023

Want to become part of an ever-growing crowd of inspired and excited Winter School participants? The upcoming event in Tyrol, organized by CSH team leader Peter Turchin, focuses on “Integrative and Disintegrative Processes in Complex Human Societies.” Graduate students, PostDocs, and interested people of any other profession with proficient English and a background in science or mathematics are invited to apply until October 31, 2022.

The next CSH Winter School will take place in January 2023.



This is a selection of publications affiliated to the Hub. Find more at
→ www.csh.ac.at/publications

R. Prieto Curiel, A. Schumann, I. Heo, P. Heinrigs
→ Detecting cities with high intermediacy in the African urban network, *Computers, Environment and Urban Systems* 98 (2022) 101869

A. van Dam, A. Gomez-Lievano, F. Neffke, K. Frenken
→ An information-theoretic approach to the analysis of location and co-location patterns, *Journal of Regional Science* (2022)

H. Metzler, H. Baginski, T. Niederkrotenthaler, D. Garcia
→ Detecting potentially harmful and protective suicide-related content on Twitter: Machine Learning approach, *Journal of Medical Internet Research* 24 (8) (2022) e34705

T. Reisch, G. Heiler, C. Diem, P. Klimek, S. Thurner
→ Monitoring supply networks from mobile phone data for estimating the systemic risk of an economy, *Scientific Reports* 12 (13347) (2022)

G. De Marzo, F. Pandolfelli, V.D.P. Servedio
→ Modeling innovation in the cryptocurrency ecosystem, *Scientific Reports* 12 (12942) (2022)

A. Nerpel, L. Yang, J. Sorger, et al.
→ SARS-ANI: a global open access dataset of reported SARS-CoV-2 events in animals, *Scientific Data* 9 (438) (2022)

M. Kaleta, J. Lasser, E. Dervic, et al.
→ Stress-testing the resilience of the Austrian health-care system using agent-based simulation, *Nature Communications* 13 (4259) (2022)

P. Turchin, H. Whitehouse, S. Gavrillets, et al.
→ Disentangling the evolutionary drivers of social complexity in human history: A comprehensive test of hypotheses, *Science Advances* 8 (25) (2022)

F. Papst, N. Stricker, R. Entezari, O. Saukh
→ To Share or Not to Share: on Location Privacy in IoT Sensor Data, in: *IEEE/ACM Seventh International Conference on Internet-of-Things Design and Implementation (IoTDI)* (May 2022)

M. Oliviera, F. Karimi, M. Zens, et al.
→ Group mixing drives inequality in face-to-face gatherings, *Communications Physics* 5 (127) (2022)

J. Lasser, (...) D. Garcia, et al.
→ Social media sharing of low quality news sources by political elites, *PNAS Nexus* (2022) pgac186