

# Luca Verginer

ECONOMIST · DATA SCIENTIST

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**PROFILE:** Empirical economist and network scientist researching *pharmaceutical supply chain resilience* and drivers of pharmaceutical *innovation*.

## Experience

### Chair of Systems Design, ETH Zürich

SENIOR ASSISTANT

- Leading the “Pharmaceutical Supply Chain Resilience” project.

Zürich, Switzerland

Mar. 2024 – Present

### Chair of Systems Design, ETH Zürich

POSTDOC

- Assisted in teaching three courses and Supervised BSc and MSc projects.
- Developed a research line focusing on innovation in biotechnology.
- Contributed to popular Open Source Software: *Pathpy*, *NetworkX*, and *Matplotlib*.

Zürich, Switzerland

Apr. 2019 – Feb. 2024

### AXES Lab, IMT Lucca

RESEARCH ASSISTANT

- Created and maintained patent and firm Knowledge Graphs (*Neo4j* and *PostGIS*).

Lucca, Italy

Feb. 2016 – Apr. 2019

## Skills

### METHODS

<b>Deep Learning</b>	Graph & Recurrent Neural Networks (GNN & RNN), GRUs, Autoencoders
<b>Network Analysis</b>	Temporal Networks, Community Detection, Network Visualization
<b>Machine Learning</b>	NLP, Sentiment Analysis, Topic Modeling, Word Embeddings (Word2Vec, BERT), Named Entity Recognition
<b>Econometrics</b>	Synthetic Controls, Event Studies, Instrumental Variables, Heterogeneous Difference-in-Differences (DiD), Panel
<b>Experimental</b>	Online Experiments, oTree, MTurk, Prolific

### TECHNICAL

<b>Programming</b>	Python <sup>•</sup> , R <sup>•</sup> , Mathematica <sup>•</sup> , Matlab <sup>°</sup> , Stata <sup>•</sup>
<b>Machine Learning</b>	PyTorch <sup>•</sup> , PyG <sup>•</sup> , JAX <sup>°</sup> , Neptune.ai <sup>•</sup> , Tensorflow <sup>°</sup> , MLFlow <sup>°</sup>
<b>Databases</b>	SQL <sup>•</sup> , Neo4j <sup>•</sup> , PostgreSQL <sup>•</sup> , PostGIS <sup>•</sup> , TimescaleDB <sup>°</sup> , MongoDB <sup>°</sup>
<b>DevOps</b>	Docker <sup>•</sup> , AWS <sup>•</sup> , GitHub Actions <sup>•</sup> , Azure <sup>°</sup> , Google Cloud <sup>°</sup>
<b>Web Development</b>	Hugo <sup>•</sup> , JS <sup>•</sup> , React <sup>°</sup> , CSS <sup>°</sup>
<b>Other</b>	Git <sup>•</sup> , SVN <sup>•</sup> , Selenium <sup>•</sup> , Spark <sup>°</sup> , Adobe Illustrator <sup>°</sup>
	<i>Professional</i> <sup>•</sup> <i>Advanced</i> <sup>°</sup>

**Languages**   English (*fluent*), German (*fluent*), Italian (*fluent*), Ladin (*native*, a Rhaeto-Romance language)

## Education

### Ph.D in Economics and Data Science

IMT SCHOOL FOR ADVANCED STUDIES LUCCA

Work on Economic Complexity and the Economics of Innovation.

Lucca, Italy

Nov. 2015 – Feb. 2019

### MSc in Economics

UNIVERSITY OF TRENTO

Agent-Based Modeling of Labor Markets: Keynesian vs. Neoclassical Perspectives

Trento, Italy

Oct. 2012 – Feb. 2015

### BSc in Accounting and Finance

UNIVERSITY OF BRADFORD

Bradford, UK

Nov. 2009 – Feb. 2012

# Selected Research in Progress

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## Resilience of Pharmaceutical Supply Chain Networks

Drug Shortages

**KEYWORDS:** STRESS TESTS, SUPPLY CHAIN RESILIENCE

- Developing *Key Resilience Indicators (KRIs)* for regulators.
- First study published in *Science Advances*.

## Predicting Innovation with Graph Neural Networks

Deep Learning

**KEYWORDS:** GNN (GRAPH NEURAL NETWORKS), INNOVATION

- Developing a novel neural network architecture to predict patent content, utilizing temporal GNNs and BERT embeddings.
- Objective: Developing a "*Radical Innovation Index*" for firms and industries.
- Challenge: Training models on millions of texts and billions of citation paths using GPU clusters.

## Quantifying Intellectual Property (IP) Competition from Patent Litigation

Economics of Innovation

**KEYWORDS:** INTELLECTUAL PROPERTY, COMPETITION

- Creating an "*IP Competition Index*" and litigation risk model for firms.

# Teaching

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## Agent-Based Modelling of Economic Systems

ETH Zürich

GRADUATE COURSE

2024 – Present

- Teaching simulation and scientific computing portion of the course.

## Economic Dynamics and Complexity

ETH Zürich

GRADUATE COURSE

2023 – Present

- Managed tutorials for a class of approximately 50 students.
- Developed interactive coding lessons to solve ODEs.

## Complex Networks

ETH Zürich

GRADUATE COURSE

2020 – 2023

- Teaching the networks analysis and coding portion of the course, focusing on algorithm development and code optimization.

# Professional Activities

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## JOURNAL REFEREE

Proceedings of the National Academy of Sciences (PNAS) | Journal of Economic Dynamics and Control (JEDC) | Frontiers in Physics | Industry and Innovation | Journal of Economic Interaction and Coordination | Nature Scientific Reports | PLOS One | Policy Studies | Research Policy | APJ Data Science | Advances in Complex Systems

## CONFERENCE REFEREE

NetSci | NetSci X | Conference on Complex Systems | Geography of Innovation (GeoInno) | International Conference on Computational Social Science (IC2S2) | Druid | The Web Conference

## EDITORIAL ACTIVITIES

- *Guest Editor* for Special Issue in *Advances in Complex Systems*, 2022.

## OPEN SOURCE SOFTWARE CONTRIBUTION

- *Core Developer* of **Pathpy**, a library for temporal network analysis (> 90k installs).
- *Contributor* to **NetworkX** and **Matplotlib**, popular network analysis and data visualization libraries.

# Supervision

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## PhD Theses

CO-SUPERVISION

- **Amico, Ambra**, "*Modeling the Dynamics of Distribution Networks: A Data-Driven Approach to Supply Chains*", Graduated **2023**

## Master and Bachelor Theses

CO-SUPERVISION

- Paride Crisafulli, "*Time Evolution of Signed Networks Sparkling with Conflicts*" (MSc Thesis), Department of Physics, 2022
- Tai Hong, "*Critical Nodes in a Distribution Network*" (MSc Thesis), MTEC, 2021
- Jan Thurnheer, "*Modelling Distributed Production and Flow of Investments*" (BSc Thesis), Department of Mechanical Engineering, 2021
- Yansong Yun, "*Modelling Characteristic Distribution Times in Supply Chains*" (Semester Thesis), Department of Physics, 2021
- Tai Hong, "*Reconstructing Distribution Networks from Transaction Data*" (Internship), MTEC, 2020
- Amirhossein Kazemi, "*Stochastic Actor-Oriented Models in R&D Networks*" (Semester Thesis), Department of Mathematics, 2018

# Publications

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## PEER-REVIEWED

Adapting to Disruptions: Managing Supply Chain Resilience through Product Rerouting

Ambra Amico, Luca Verginer, Giona Casiraghi, Giacomo Vaccario, Frank Schweitzer

*Science Advances* 10.3 (Jan. 2024) eadj1194. 2024

Understanding Online Migration Decisions Following the Banning of Radical Communities

Giuseppe Russo, Manoel Horta Ribeiro, Giona Casiraghi, Luca Verginer

*Proceedings of the 15th ACM Web Science Conference 2023*, 2023, Austin TX USA

Spillover of Antisocial Behavior from Fringe Platforms: The Unintended Consequences of Community Banning

Giuseppe Russo, Luca Verginer, Manoel Horta Ribeiro, Giona Casiraghi

*Proceedings of the International AAAI Conference on Web and Social Media 17* (June 2023) pp. 742–753. 2023

The Impact of the COVID-19 Pandemic on Scientific Research in the Life Sciences

Massimo Riccaboni, Luca Verginer

*PLOS ONE* 17.2 (Feb. 2022) e0263001. 2022

When Standard Network Measures Fail to Rank Journals: A Theoretical and Empirical Analysis

Giacomo Vaccario, Luca Verginer

*Quantitative Science Studies* 3.4 (Dec. 2022) pp. 1040–1053. 2022

Analysis and Visualisation of Time Series Data on Networks with Pathpy

Jürgen Hackl, Ingo Scholtes, Luka V. Petrović, Vincenzo Perri, Luca Verginer, Christoph Gote

*Companion Proceedings of the Web Conference 2021*, 2021, Ljubljana Slovenia

A Network Approach to Expertise Retrieval Based on Path Similarity and Credit Allocation

Xiancheng Li, Luca Verginer, Massimo Riccaboni, P. Panzarasa

*Journal of Economic Interaction and Coordination* (July 2021). 2021

Reproducing Scientists' Mobility: A Data-Driven Model

Giacomo Vaccario, Luca Verginer, Frank Schweitzer

*Scientific Reports* 11.1 (Dec. 2021) p. 10733. 2021

Stem Cell Legislation and Its Impact on the Geographic Preferences of Stem Cell Researchers

Luca Verginer, Massimo Riccaboni

*Eurasian Business Review* 11.1 (Mar. 2021) pp. 163–189. 2021

Talent Goes to Global Cities: The World Network of Scientists' Mobility

Luca Verginer, Massimo Riccaboni

*Research Policy* 50.1 (Jan. 2021) p. 104127. 2021

Foreword to the Special Issue on Success in Science

Luca Verginer, Giacomo Vaccario, Alexander M Petersen

*Advances in Complex Systems* (2021) p. 2. 2021

Should the Government Reward Cooperation? Insights from an Agent-Based Model of Wealth Redistribution

Frank Schweitzer, Luca Verginer, Giacomo Vaccario

*Advances in Complex Systems* 23.07 (Nov. 2020) p. 2050018. 2020

The Mobility Network of Scientists: Analyzing Temporal Correlations in Scientific Careers

Giacomo Vaccario, Luca Verginer, Frank Schweitzer

*Applied Network Science* 5.1 (Dec. 2020) p. 36. 2020

Cities and Countries in the Global Scientist Mobility Network

Luca Verginer, Massimo Riccaboni

*Applied Network Science* 5.1 (Dec. 2020) p. 38. 2020

## PRE-PRINTS

Gender Bias in Emerging New Research Topics: The Impact of COVID-19 on Women in Science

Carolina Beccati, Luca Verginer, Massimo Riccaboni

Tech. rep., 2024

The Impact of Acquisitions on Inventors' Productivity in the Biotechnology Industry

Luca Verginer, Federica Parisi, Jeroen van Lidth de Jeude, Massimo Riccaboni

Tech. rep., 2023

The Robotic Herd: Using Human-Bot Interactions to Explore Irrational Herding

Luca Verginer, Giacomo Vaccario, Piero Ronzani

Preprint, 2023

The Role of Network Embeddedness on the Selection of Collaboration Partners: An Agent-Based Model with Empirical Validation

Frank Schweitzer, Antonios Garas, Mario V. Tomasello, Giacomo Vaccario, Luca Verginer

*arXiv:1403.3298 [physics]* (Jan. 2022). 2022

The Impact of Acquisitions on Inventors' Turnover in the Biotechnology Industry

Luca Verginer, Federica Parisi, Jeroen van Lidth de Jeude, Massimo Riccaboni

*arXiv:2203.12968 [econ, q-fin]* (Mar. 2022). 2022