Andrea Borsato

Curriculum Vitae

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67000 Strasbourg, France
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Personal information

Born in Oristano (Italy) on December 1993, 24th.
Nationality: Italian.

Personal webpages:
- University of Strasbourg: https://beta-economics.fr/annuaire/504/borsato_andrea/
- ResearchGate: https://www.researchgate.net/profile/Andrea-Borsato-3
- LinkedIN: https://www.linkedin.com/in/andrea-borsato-826723115/
- ORCID: 0000-0002-3458-672X

Current position

Dec. 2022 - Present

ITI-MAKErS Postdoctoral researcher in Economics - Bureau d'Economie Théorique et Appliquée, University of Strasbourg, *Strasbourg*
Research axes : Contemporary issues of European societies: inequalities, mobilites, and risks
Project: *European challenges in an evolutionary perspective*

Professional experience

June 2021 - Nov. 2022

Postdoctoral researcher in Economics - Bureau d'Economie Théorique et Appliquée, University of Strasbourg, *Strasbourg*
ANR project: *Artificial Intelligence in the scientific system: diffusion and impacts*
Supervisors: Stefano Bianchini, André Lorentz, Lorenzo Cassi

Mar. 2021 - May 2021

Research assistant in Economics - Bureau d'Economie Théorique et Appliquée, University of Strasbourg, *Strasbourg*
Supervisors: Stefano Bianchini, André Lorentz, Lorenzo Cassi

Nov. 2019 - May 2020

Visiting researcher - Leeds University Business School, *Leeds (UK)*
Main activity: PhD thesis
Supervisor: Marco Veronese Passarella

Apr. 2019 -   **Visiting researcher - Business School, University of Greenwich**, *London (UK)*
Oct. 2019   Main activity: PhD thesis
Supervisor: Alberto Botta

Oct. 2017 -   **PhD candidate in Economics - Department of Economics and Statistics,**
Apr. 2021   **University of Studi di Siena**, *Siena (Italy)*
Supervisors: Mauro Caminati, Riccardo Pariboni

Apr. 2017 -   **Intern - Cooperativa Produttori Arborea S.A.**, *Arborea (Italy)*
May 2017   Main activities: strategic business plan 2016-2020, marketing project analysis

Education

Oct. 2017 -   **"Doctor Europaeus" in Economics - Department of Economics and Statistics,**
Apr. 2021   **University of Studi di Siena**, *Siena (Italy)*
PhD programme in Economics of the Tuscan Universities: University of Siena, University of Pisa, University of Florence
Thesis: Essays on Secular Stagnation in the USA
Supervisors: Mauro Caminati, Riccardo Pariboni

Sept. 2015 -   **MSc in Economics - University of Cagliari**, *Cagliari (Italy)*
July 2017   Thesis: *Kaldor's models on economic growth: An application to the Italian case*
Supervisor: Emanuela Marrocu
Grade: 110/110 cum laude

Sept. 2012 -   **BSc in Economics and Finance, University of Cagliari**, *Cagliari (Italy)*
Sept. 2015   Thesis: *The theory of hysteresis: postulates and empirical evidence*
Supervisor: Giovanni Bella
Grade: 110/110 cum laude

Sept. 2007 -   **High school diploma - Liceo Scientifico Mariano IV Arborea**, *Oristano (Italy)*
July 2012   Grade: 97/100

Summer schools

Aug. 2021   **TI Summer School - Tinbergen Institute**, *Amsterdam (Netherlands)*
Title: *Behavioral Macro and Complexity*
Teachers: Cars Hommes

June 2021   **ISEO Summer School 2021 - Istituto per gli Studi Economici e per l'Occupazione**, *Iseo (Italy)*
Title: *The Post Pandemic World Economy*
Teachers: Michael Spence, Bina Agrawal, Joseph Stiglitz, Riccardo Valentini, Angus Deaton, Micheal Kremer

July 2020 **14th EAEPE Summer School - Roma Tre University**, *Rome (Italy)*
Title: *Pensions, Social Services and Welfare: What Future in the Age of Financialization?*
Teachers: Pasquale Tridico, Sergio Cesaratto, Eckhard Hein, Joao Rodrigues, Guglielmo Forges Davanzati, Nicolò Giangrande, Ilhan Dogus, Natascha Van der Zwan, Giuliano Resce

May 2020 **Advanced Course of Innovation and Growth - University of Roma "La Sapienza"**, *Rome (Italy)*
Title: *Innovation, Growth and International Production: Models and Data Analysis*
Teachers: Massimiliano Trancioni, Maurizio Franzini, Antonello Zanfei, Mario Pianta, Dario Guarascio, Michael Landesmann, Giovanni Dosi

June 2019 **8h PKES Summer School - University of Greenwich, Business School**, *London (UK)*
Title: *Introduction to Post-Keynesian Economics and Political Economy*
Teachers: Engelbert Stockhammer, Tomas Rotta, Rob Jump, Christina Wolf, Jo Michell, Rafael Wildauer, Gary Dimsky

Scholarships, honours and awards

Oct. 2017 - **PhD scholarship - University of Siena**, *Siena (Italy)*
Apr. 2021

2016 -2017 **Honours: "Best MSc student in Economics" - University of Cagliari**, *Cagliari (Italy)*

2016 - 2017 **Scholarship: "Best student in Economics" - University of Cagliari**, *Cagliari (Italy)*

Teaching experience

2023 - **Doctoral Lecture**, *PhD*, Faculty of Economics and Management, University of
Present Strasbourg, Strasbourg (France)
Agent-Based Models (English) 3h CM

2022 - **Travaux dirigés (TD)**, *BSc (L1-S2)*, Faculty of Economics and Management,
Present University of Strasbourg, Strasbourg (France)
"Microéconomie II" (French) 15h TD, Groups: 4

2022 - **Cours magistraux (CM)**, *BSc (L3)*, Faculty of Economics and Management,
Present University of Strasbourg, Strasbourg (France)
"European Macroeconomics" (English) 10h CM

Research experience

Research topics

Innovation and macroeconomic dynamics:

Inequality and growth: Secular Stagnation; technological change; structural change; productivity analysis

Industrial dynamics:

innovation and diffusion of technologies; science policy; recycling policies; Artificial Intelligence

Econometrics:

panel data econometrics; time series econometrics; applied economics; panel time-series econometrics

Keywords:

growth theory; economics of innovation and technological change; evolutionary economics; Post-Keynesian economics; agent-based computational economics; economics of science; economics of data and Artificial Intelligence

PhD thesis

2021 **Essays on Secular Stagnation in the USA**
Examination committee:
Simone D'Alessandro   President, internal member, University of Pisa
Marco Veronese Passarella   External member, Leeds University Business School
Alberto Russo   External member, Universitat Jaume I, Castellòn de la Plana

Articles in peer-reviewed journals

2023 **Data production and the coevolving AI trajectories: an attempted evolution-ary model**, *Journal of Evolutionary Economics, 33(5), pp. 1427 - 1472*
Authors: A. Borsato, A. Lorentz
DOI: 10.1007/s00191-023-00837-3
French journal rank:*CNRS 2/HCERES A*
Italian journal rank: A

2023 **The Kaldor-Verdoorn Law at the age of robots and AI**, *Research Policy, 52(10), n. 104873*
Authors: A. Borsato, A. Lorentz
DOI: 10.1016/j.respol.2023.104873
French journal rank:*CNRS 1/HCERES A*
Italian journal rank: A

2023 **Does the Secular Stagnation hypothesis match the data? Evidence from the USA**, *Journal of Post Keynesian Economics*
Author: A. Borsato
DOI: 10.1080/01603477.2023.2242346
French journal rank: *CNRS 2/HCERES A*
Italian journal rank: A

2022 **An agent-based model for Secular Stagnation in the USA: theory and empirical evidence**, *Journal of Evolutionary Economics, 32(4), pp. 1345-1389*
Author: A. Borsato
DOI: 10.1007/s00191-022-00772-9
French journal rank: *CNRS 2/HCERES A*
Italian journal rank: A

Invited contributions in edited volumes

2023 **Nicholas Kaldor: Faits stylisés, Progrès Technique et Croissance Cumulative**, *Les Grands Auteurs en Management de l'Innovation*, T. Burger-Helmchen, P. Cohendet, C.Hussler (eds.), Ch. XIV, Edition II, Editions Management et Société;
Authors: A. Lorentz, A. Borsato

Articles under revision in peer-reviewed journals

Open Science vs. Mission-oriented Policies and the Long-run Dynamics of Integrated Economies: An Agent-based Model with a Kaldorian Flavour, *Structural Change and Economic Dynamics*, under revision
Authors: A. Borsato, A. Lorentz
French journal rank: *CNRS 3/HCERES B*
Italian journal rank: A

Working papers

2023 **Open Science vs. Mission-oriented Policies and the Long-run Dynamics of Integrated Economies: An Agent-based Model with a Kaldorian Flavour**, *Working Papers BETA n° 2023-17*
Authors: A. Borsato, A. Lorentz

2023 **The Kaldor-Verdoorn law at the age of robots and AI**, *Working Papers BETA n° 2023-12*
Authors: A. Borsato, A. Lorentz

2022 **Data production and the coevolving AI trajectories: an attempted evolutionary model**, *Working Papers BETA n° 2022-09*
Authors: A. Borsato, A. Lorentz

2022 **The Kaldor-Verdoorn law at the age of robots and AI**, *Working Papers BETA n° 2022-25*
Authors: A. Borsato, A. Lorentz

2021 **An agent-based model for Secular Stagnation in the USA: theory and empirical evidence**, *LEM Working Paper Series n° 2021-09*
Author: A. Borsato

2021 **Simple Matching Protocols for Agent-based Models**, *Working Papers BETA n° 2021-35*
Author: A. Borsato

2021 **Does the Secular Stagnation hypothesis match with data? Evidence from USA**, *Working Papers BETA n° 2021-11*
Author: A. Borsato

2020 **Secular Stagnation and Innovation Dynamics: An Agent-based SFC Model. Part I**, *DEPS Working Paper n° 840*
Author: A. Borsato

Current works

2023 - **Trends in mission-oriented innovation policies: a bibliometric survey**
Present Authors: D. Abbonato, A. Borsato

2023 - **Innovation dynamics and structural change in the recycling sector**
Present Authors: A. Borsato, M. Compagnoni, A. Lorentz, M. Savona

2023 - **Exploring university trajectories with an evolutionary model**
Present Authors: A. Borsato, V. Erasmo, A. Lorentz

2023 - **Inside the Biotech: A dialogue between Rosenberg, Babbage, Smith, and**
Present **Chandler**
Authors: A. Borsato, P. Llerena

2023 - **The US university-industry link via AI: back to the origins?**
Present Authors: A. Borsato, P. Llerena

2023 - **From excellence to diversity: promoting complexity, innovation and pluralism**
Present **in economics**
Authors: V. Erasmo, A. Borsato

2022 - **Modelling AI&Science**
Present Authors: A. Borsato, A. Lorentz, S. Vannuccini

Conferences and seminars

The paper "Open Science vs. Mission-oriented Policies and the Long-run Dynamics of Integrated Economies: An Agent-based Model with a Kaldorian Flavour" presented at the following conferences :

29th International Conference Computing in Economics and Finance, 3-6 July 2023, Nice, France

The paper "The Kaldor-Verdoorn law at the age of robots and AI" presented at the following conferences:

American Studies Center (ASC) Conference, 28-29 September 2023, Cagliari, Italy

8th Regulating for Decent Work Conference, International Labour Organization, 10-12 July 2023, Geneve, Switzerland

The paper "Data production and the coevolving AI trajectories: an attempted evolutionary model" presented at the following conferences:

ABM4Policy Workshop, 15-16 November 2022, Pisa, Italy

1st International Workshop on Economic Growth and Macroeconomic Dynamics, 15-16 September 2022, Rome, Italy

19th International Schumpeter Society Conference, 8-10 July 2022, Changsha, China

19th Annual STOREP Conference, 26-28 May 2022, Viterbo, Italy

2nd Biannual LABOR Worshop on "Technological change, health, inequality and data for policy evaluation (Poster), 24-25 January 2022, Turin, Italy

The paper "An agent-based model for Secular Stagnation in the USA: theory and empirical evidence" presented at the following conferences:

4th ERMEES Macroeconomics Workshop, 3 December 2021, Strasbourg, France

WEHIA Workshop, 19 November 2021, Milan, Italy.

62nd Annual SIE Conference, 26-29 October 2021, Ancona, Italy

69th Annual JSPE Conference, 16-17 October 2021, Sapporo Hokkaido, Japan

33rd Annual EAEPE Conference, 2-4 September 2021, Online

TI Summer School on "Behavioral Macro & Complexity, 23-27 August 2021, Amsterdam, Netherlands

Workshop on Demand-led Growth, 19-21 July 2021, Rio de Janeiro, Brasil

18th ISS Conference, 8-10 July 2021, Rome, Italy

8th Workshop for Doctoral Students and Young Researchers in Economics of Innovation, Complexity and Knowledge, 10-11 December 2020, Turin, Italy

1st Workshop of the Italian Post-Keynesian Network, 27 November 2020, Online

The paper "Secular Stagnation and Innovation Dynamics: An Agent-based SFC Model. Part I" presented at the following conferences:

Scottish Economic Society Annual Conference, 26-28 April 2021, Glasgow, UK

61st Annual SIE Conference, 20-23 October 2020, Turin, Italy

17th Annual STOREP Conference, 1-2 Octobre 2020, Rome, Italy

32nd Annual EAEPE Conference, 2-4 September 2020, Bilbao, Spain

14th EAEPE Summer School, 13-15 July 2020, Rome, Italy

The paper "Does the Secular Stagnation hypothesis match the data? Evidence from the USA" presented at the following conferences:

18th Annual STOREP Conference, 17-18 June 2021, Varese, Italy

13th IISES Economics & Finance Virtual Conference, 23-24 June 2020, Prague, Czech Republic

The MSc thesis "Kaldor's models on economic growth: An application to the Italian case" was presented at:
13th ifo Dresden Workshop on Macroeconomics and Business Cycle Research, 25-26 January 2019, Dresden, Germany

Participations to research projects

Dec. 2022 - Present **ITI MAKErS - Making European Society;**
As part of the ITI 2021-2028 program of the University of Strasbourg, CNRS and INSERM, the project was supported by IdEx Unistra (ANR-10-IDEX-0002), and by SFRI-STRAT'US project (ANR-20-SFRI-0012) and coordinated by Hélène Michel, Amélie Barbier-Gauchard, Mélanie Schmitt

Mar. 2021 - Nov. 2022 **Artificial Intelligence in the scientific system: Diffusion and impacts**
Project funded by Agence Nationale de la Recherche (ANR), University of Strasbourg, University of Lorraine, AgroParisTech, CNRS, and coordinated by Stefano Bianchini, André Lorentz, Lorenzo Cassi; reference: DInnAMICS-ANR-18-CE26-0017-01

Evaluation of research and training

Peer review

Journals

Applied Economics
Computational Economics
Ecological Economics
Economic Modelling
European Economic Review
European Journal of Political Economy
International Economics
International Journal of Industrial Organization
Journal of Economic Behavior and Organization
Journal of Economic Dynamics and Control
Journal of Evolutionary Economics
Journal of Macroeconomics
Research Policy
SN Business & Economics
Structural Change and Economic Dynamics
Technological Forecasting and Social Change

Participation to the scientific committees of international conferences

Dec. 2023 **5th ERMEES Macroeconomics Workshop 2023**
Organized by University of Strasbourg, BETA, ERMEES, INFER.

Supervision of students

Nov. 2023 - **Sarah Pinel**
Present Second year *Magistère* student and first year Master's student *Macroéconomie et Politique Européenne*
Title of the report: *Robotique et compétitivité internationale : une étude empirique de la loi de Thirlwall.*

Expertise and evaluation of research or training projects

Nov. 2022 - Present — **REPRISE**

Registration to REPRISE (Register of Expert Peer Reviewers for Italian Scientific Evaluation) to *Ministero dell'Istruzione, Università e Ricerca* (MIUR) for the field: Basic research.

Software and programming languages

Programming languages Stata, Python, MATLAB, Laboratory for Simulation Development (LSD), R, EViews, E&F Chaos

Environments LaTeX, Microsoft Office

Operating systems Windows

Languages

Italian Mothertongue

English Read, written, spoken (IELTS British Council, 2018)

French Read, written, spoken

Affiliations

May 2021 - Present International Schumpeter Society (ISS)

Mar. 2021 - Present Scottish Economic Society (SES)

Jan. 2021 - Present European Economic Association (EEA)

Nov. 2020 - Present Italian Post-Keynesian Network (IPKN)

Oct. 2020 - Present Royal Economic Society (RES)

August 2020 - Present Associazione Italiana per la Storia dell'Economia Politica (STOREP)

July 2020 - Present Società Italiana di Economia (SIE)

May 2020 - Present European Association for Evolutionary Political Economy (EAEPE)

Dec. 2019 - Present LIBERA - Associazioni, nomi e numeri CONTRO LE MAFIE

Licence

A1, B

Further information

I hereby declare on my honour that all the information included in this curriculum vitae is true.

Tutto quanto affermato corrisponde a verità; le dichiarazioni contenute vengono rese ai sensi degli artt. 46 e 47 del D.P.R. 445/2000 (dichiarazioni sostitutive di certificazione e sostitutive dell'atto di notorietà).

Last updated: April 2024, 5th

Signature

Curriculum Vitae: presentation of academic career, research and teaching activities

Personal details

Name:	Andrea Borsato
Gender:	Male
Citizenship:	Italian
Place and date of birth	Oristano (Italy), December 1993, 24th
Address:	Room 323, 61 Avenue de la Forêt Noire, 67000 Strasbourg (FR)
Mail:	aborsato@unistra.fr
Degree:	Doctor Europaeus in Economics
Current position:	*ITI-MAKErS* Postdoctoral fellow,
	Bureau d'Economie Théorique et Appliquée (BETA), University of Strasbourg
Web pages:	https://beta-economics.fr/annuaire/504/borsato andrea/
	https://www.researchgate.net/profile/Andrea-Borsato-3
	https://www.linkedin.com/in/andrea-borsato-826723115/
ORCID:	0000-0002-3458-672X

1   Academic career

My university studies began in 2012 after *Liceo Scientifico*. I earned a Bachelor's degree and a Master of Science (MSc) at the University of Cagliari (Italy). The Bachelor degree programme focussed on *Economics and Finance* and lasted three years (2012-2015). The thesis explored hysteresis in unemployment rates (Supervisor: Giovanni Bella).

The years 2015 to 2017 were dedicated to the Master's degree in *Economics*. The courses could be grouped into two main categories. The first ensemble covered quantitative techniques for processing the increasing amount of data available to researchers, including advanced econometrics, market analysis, and impact evaluation. The second group concerned to advanced macroeconomics and microeconomics. The focus was on the analysis of regional and developmental issues. The final step of the Master's degree included a 150-hour *stage* at a local company, Cooperativa Produttori Arborea S.A., and a Master's dissertation on Kaldor's economic growth models (Supervisor: Prof. Emanuela Marrocu). The thesis involved an econometric application of these models to analyse the economic stagnation in Italy.

From 2017 to 2021, I was involved in the joint Doctoral programme in *Economics* at the Universities of Siena, Pisa, and Florence (Supervisors: Prof. Mauro Caminati and Riccardo Pariboni). The first year included 16 general economics courses (Tab. 1) about topics such as quantitative micro and macroeconomics, policy evaluation, and economic history. The doctoral programme emphasised a pluralist framework to provide students with the knowledge of the various methodologies that characterise the discipline.

The *quantitative* dimension of the PhD programme is evident in the advanced econometrics courses, evolutionary game theory, and economics of innovation and technical change. The econometrics courses were divided into three main blocks. *Econometrics I* strengthened my understanding of the main inferential statistical methods used in economic, social, and financial analysis. It also introduced regression methods and explained the associated assumptions and methods to be used when these assumptions are violated. The course covered econometrics of static and dynamic panel data models with a comprehensive approach to estimation and inference using GMMs and instrumental variables. As will be the case for *Econometrics III*, this course was not limited to pure and analytical theory but extended to practical exercises with *Stata*.

In contrast, *Econometrics II* focussed on time-series analysis. The course covered topics such as an introduction to time series models, VAR and VEC models, unit root and non-stationary series analysis, and cointegration analysis. The latter topic considered both the Engle-Granger single-equation procedure and the multivariate Johansen procedure. *R* and *EViews* were pivotal.

Econometrics III delved into advanced topics, precisely exploring the problem of identifying causal effects by introducing notation based on potential outcomes. The course investigated estimation techniques that can eliminate

selection bias in the estimation of the average treatment effect (ATE) and the average treatment effect on the treated (ATT). These methods include Difference-in-Difference, Propensity Score Matching, and Regression Discontinuity Design. Additionally, *Econometrics III* covered discrete choice models such as probit, logit, and multinomial logit. *Stata* was used throughout the course.

I also wish to mention *Evolutionary Game Theory*, a course which enabled me to learn the basics of *Python* in order to design and program a simple simulation code.

The economics of innovation and technical progress was deepened in two main courses. *Macroeconomics II* provided an in-depth presentation of Schumpeterian economics in its neoclassical and evolutionary reappraisals. The focus was not solely on theoretical modelling, but also on a thorough analysis of empirical studies regarding the effects of innovations on a company organisation. Furthermore, *Institutional and Evolutionary Economics* aimed at investigating the correlation between industrial economics and the theory of the firm to examine the basis of institutional and evolutionary economics. The topics covered included the analysis of economic transactions, technology, property rights, and the governance of the firm.

During the PhD programme, I spent 14 months as a Visiting Researcher abroad. From April 2019 to October 2019, I was at the University of Greenwich (Tutor: Alberto Botta). From November 2019 to May 2020, I was at the University of Leeds (Tutor: Marco Veronese Passarella). These stays were essential for the quantitative and historical assessment of Secular Stagnation in the USA. The PhD thesis was defended on 30 April 2021, and the jury was composed of Simone D'Alessandro (University of Pisa), Alberto Russo (Jaume I University), and Marco Veronese Passarella (University of Leeds). I was awarded the title of *Doctor Europaeus*.

After my PhD, I joined the University of Strasbourg in June 2021 as postdoctoral fellow. My work involved the ANR project on *Artificial Intelligence in the Scientific System: Diffusion and Impacts*, under the supervision of Stefano Bianchini and André Lorentz from the University of Strasbourg, and Lorenzo Cassi from the PSE - Paris School of Economics. The project aimed at enhancing our understanding of the diffusion process of Artificial Intelligence (AI) in science and its impact on the process of scientific development. The main goal was to provide novel perspectives on the broader question of how the adoption of AI influences the creation and dissemination of knowledge. The project developed original theoretical frameworks based on empirical evidence to define and support better policy actions in the field of science, technology, and innovation.

This project concluded in November 2022, and I was subsequently awarded a postdoctoral position by the ITI-MAKErS group at the University of Strasbourg to work on the project *European challenges in an evolutionary perspective*, coordinated by Héléne Michel, Amélie Barbier-Gauchard, and Mélanie Schmitt. The objective is to provide a theoretical understanding of the links between public policies and technological and structural changes in economies. The research analyses the role of national and supranational institutions, most in countries joined by a monetary union, with respect to science policy and the potential trade-offs that may arise between mission-oriented policies and generic and fundamental research. The programme is currently ongoing and lasts for two years. In addition to my research activities, I teach at the undergraduate and PhD levels.

I belong to two research groups in the *BETA* laboratory: *Creativity, Science and Innovation* (CSI); *Macroeconomics and Public Policy* (MPP).

The research and teaching aspects will be detailed below.

Sujet	Heures
Mathematics	22h
Econometrics I	36h
History of economic analysis	20h
Microeconomics I	30h
Production and prices	14h
Microeconomics II	40h
Macroeconomics I	30h
Public Economics	20h
Institutional and Evolutionary Economics	22h
Evolutionary Game Theory	20h
Macroeconomics I	30h
Economic History	16h
Econometrics II	20h
Microeconomics III	30h
Happiness, sustainability and wellbeing	20h
Econometrics III (advanced topics)	28h

Table 1: PhD mandatory courses

2 Research activity

My research focusses on the analyses of technological change, income distribution, and economic dynamics at micro, meso, and macro levels, as well as the history of economic thought. The overall endeavour includes four main domains.

Thematic A is about the economics of science and it explores the increasing deployment of AI technologies in the scientific arena. This theme aims at enhancing our understanding of the diffusion of AI in science and its impact on the scientific development process. The main objective is to provide new perspectives on the broader question of how the adoption of AI shapes the process of knowledge creation and dissemination.

Thematic B focusses on the economics of innovation and technical change, as well as the current challenges that the European Union faces in terms of science policies and Social Development Goals (SDGs). The research analyses the potential trade-offs that may arise when European countries pursue *symmetrical* or *asymmetrical* science and technology policies.

Thematic C concerns to the long-term dynamics of capitalist systems, including productivity growth, rates of innovation, structural change, and income distribution. The debate on secular stagnation in the United States is pivotal and analysed with both theoretical and empirical approaches.

Finally, *Thematic D* is about the economics of innovation and technological change from a historical perspective. The research questions and methodologies applied are various, but I analyse the emergence and development of innovation systems. This research offers a variety of methodological approaches, including theoretical agent-based modelling, numerical simulations, and empirical models using statistical and econometric tools. Additionally, a historical and epistemological approach is taken.

What follows details research contributions by Thematic.

2.1 Thematic A: Economics of Science, diffusion and impacts of Artificial Intelligence (AI) in the scientific systems

This Thematic aims to enhance our understanding of the diffusion of AI in science and its impact on the process of scientific development. The main objective is to provide new perspectives on the broader question of how the adoption of AI shapes the process of knowledge creation and dissemination. The project aims to provide original theoretical frameworks based on empirical evidence to define and support policy actions in science, technology, and innovation.

Together with André Lorentz from the University of Strasbourg, I focus on the significant increase in data collection and production, as well as the considerable advancements in AI-based technologies. This has raised the question of whether we are at the onset of a new industrial revolution (Borsato and Lorentz 2023a). We analyse how the nature of data and AI technologies mutually influence technological trajectories and selection mechanisms. We propose an agent-based model (*LSD* , *C++* language) in which companies compete in multiple markets by producing and selling data and data-processing systems. The modelling choice represents an alternative methodology and a challenge to the standard neoclassical paradigm. The quantitative paradigm that characterises agent-based modelling considers the economy as a complex evolving system, populated by heterogeneous agents whose interactions produce a certain collective order, even if the system structure is continuously changing. In this context, there is no isomorphism between the microeconomic and macroeconomic levels, and higher levels of aggregation may lead to the emergence of new phenomena, new statistical regularities, and completely new structures. At the model level, companies conduct innovative search to improve AI capacity, which is essential for increasing production efficiency and data quality. If markets share similar technological trajectories, non-technological peculiarities of each market define emerging market structures with marked differences. This result contrasts with established literature, which suggests that industrial dynamics and innovative business models can be described by technology-related factors on the supply side.

These results lead to three avenues of further research. Economies have indeed experienced a new wave of innovations that have radically changed production methods since the 1990s. The sharing of technologies around the Fourth Industrial Revolution has a major impact on businesses. However, recent developments have raised also concerns about widespread technological unemployment, given that the impact of digital technologies in general, and robots and AI in particular, is broader than previous waves of innovation.

In a first project (with André Lorentz), we examine whether and how the increasing robotization impacts the supposed ways in which the Kaldor-Verdoorn law shapes the dynamics of labour productivity growth at the sectoral and aggregate level (Borsato and Lorentz 2023b). First, we propose a simple and evolutionary view of the law that combines traditional Kaldorian and post-Keynesian arguments with evolutionary literature on innovation and

technical change. We then collect data for a panel of 17 industries in 25 OECD countries for the period 1990-2018. The evolutionary reinterpretation of the Kaldor-Verdoorn law considers interactions and feedback between each variable and the others. From an econometric point of view, the endogeneity of regressors, the panel structure of the dataset, the various feedback mechanisms linking current to past achievements, the long time period, and the stationarity of time series all require an estimator that differs from the OLS estimator. In this project, I apply the Generalized Method of Moments (GMM), which is a general estimator designed for dynamic panel data models where the dependent variable depends on its past realizations, the regressors are not strictly exogenous, and there is heteroscedasticity and autocorrelation within cross-sections and not between them. The econometric analysis is conducted via *Stata*.

The results are clear. A higher density of robots strengthens the positive effect of mechanisation and overall demand on labour-productivity growth. Additionally, there is some evidence of technological unemployment at aggregate level. The findings also have implications for policy. Firstly, conditioning productivity dynamics to a simple supply-side issue is short-sighted. Empirical data clearly shows that aggregate demand shapes productivity growth and that expansionary budget policies are essential to foster long-term economic growth. Additionally, policies must consider the impact of automation on industrial employment dynamics, both directly and via spillovers between upstream and downstream sectors. Evidence of some macroeconomic technological unemployment of uncertain magnitude calls for the establishment of safety nets to protect workers through increased diffusion of robots. Finally, the positive relationship between robot adoption and employment in the industry should discourage the implementation of taxes on robots that would counterbalance the ability of robots to increase the complementarity between capital and labour.

Conversely, the second project focusses on AI and how the development of AI-based technologies affects the collaboration between academia and industry in research (with Prof. Patrick Llerena from the University of Strasbourg). It is recognised that large technology companies and prestigious universities are increasingly collaborating due to the complementary nature of their resources, including hardware infrastructure, data, and skilled labour. Furthermore, beyond the crowding-out of researchers who do not belong to higher-level academic institutions and the potential reduction of thematic diversity, the main concern is the increasing interdependence between the academic world and the AI industry that could drive a university *third mission* towards avenues which lie outside a university main objectives. University autonomy for what concerns to research endeavour may then be compromised.

This second project challenges this general belief by tracing the different stages that have characterised the evolution of universities in Europe and the United States, as well as the history of the American National Innovation System (NIS). I argue that AI does not encourage universities to pursue a third mission that is traditionally outside their primary commitment. Since the advent of modern science, research funding has been linked to the expectation of returns in the form of newly developed or improved weapons, more precise instruments, better medicine, and other forms of technical progress. It is difficult to find examples of scientific research where the expectation of economic or social gain has not influenced the outcome, regardless of the funding source, whether it be a government, a company, or a prince. Furthermore, the historical account of the American NIS suggests that the third mission played a significant role in the functioning of universities in the 19th century, even in countries where the imported Humboldt model was implemented more effectively.

However, the field of AI presents certain peculiarities. Based on available empirical data, universities seem to be focussing on an *education-oriented* rather than *research-oriented* approach. In the AI ecosystem, universities appear to be more concerned to providing students with the skills and absorptive capacity necessary to improve their ability to conduct research in the private sector. This could alter the trajectory of the relationship between universities and industry. The knowledge taught at universities could acquire the characteristics useful to industry, similar to the utilitarian social contract that prevailed in some European institutes in the 18th and 19th centuries. Additionally, this could have implications for the division of labor and the division of knowledge.

The research questions of the latest project (with André Lorentz and Simone Vannuccini from the University Côte d'Azur) focus on the determinants of the trajectories of knowledge production in various scientific fields, with AI being a current particular case of interest. As suggested by the literature, the normal situation in the past, and to a large extent in the present, is that technological knowledge has preceded scientific knowledge, thus formulating the subsequent research program of science. Consequently, technology has served as a vast reservoir of empirical knowledge to be examined and evaluated by scientists. A significant aspect of a scientist's work involves systematising and restructuring the knowledge, practical solutions, and methods accumulated previously by engineers. Technology has significantly influenced science by acquiring empirical knowledge and providing data that have become the subject of scientific investigation. In this sense, AI is a tool that can increase the capacity to produce knowledge, both at the individual and global level.

References relative to Thematic A:

Borsato, A. & Llerena, P. (2024b, *mimeo*). The US university-industry link via AI: Back to the origins?

Borsato, A., & Lorentz, A. (2023a). Data production and the coevolving AI trajectories: an attempted evolutionary model. *Journal of Evolutionary Economics*. DOI:/10.1007/s00191-023-00837-3. *CNRS - 2, HCERES A*.

Borsato, A., & Lorentz, A. (2023b). The Kaldor-Verdoorn Law at the age of robots and AI. *Research Policy*, Vol. 52(10). DOI:10.1016/j.respol.2023.104873. *CNRS - 1, HCERES A*

Borsato, A., Lorentz, A. & Vannuccini, S. (*work-in-progress*). Modelling AI&Science.

2.2 Thematic B: Economics of innovation and European challenges in an evolutionary perspective

This Thematic aims at providing a theoretical understanding of the links between public policies and technological and structural changes in economic systems. It analyses the role of national and supranational institutions regarding scientific policies and the plausible compromise that could arise between *mission-oriented* policies and generic and fundamental research.

The first article (Borsato and Lorentz 2023) develops a multi-sectoral, agent-based model of endogenous structural change (*LSD* software), consisting of countries joining a monetary union. We show that government intervention through scientific policies alone is a sufficient condition for growth divergence, even if countries pursue symmetric scientific policies. Furthermore, it is important to highlight the significant role played by open-science policies in reducing productivity differentials between sectors and countries. However, the increase in the proportion of mission-oriented projects exacerbates sectoral productivity gaps. In this case, even if economic growth is largely driven by sectors with absolute technological advantages, even a tiny flow of investment in open science allows weaker industries to survive and innovate. Additionally, scientific policy alone can break and counter monopolistic tendencies by triggering competition and the country's diversification.

This introduction outlines three avenues for further research. The first avenue is a project with Diletta Abbonato from the University of Strasbourg, which involves a bibliometric study analysing changes in connections between *technology-oriented* and *performance-related* indicators with combinations of mission-oriented initiatives and solutions in response to social challenges. In particular, we exploit the *OpenAlex* repository which collects all articles from 1940 to 2019 about science and technology policy. Several million articles were found. To obtain the best documents, we used three-digit descriptions corresponding to the letter *O* in the *JEL* classification system as the main keywords. In the second step of the analysis, we investigated to what extent an article addressed the 17 Social Development Goals listed by the United Nations. This time-series bibliometric analysis is essential to highlight the emergence of different trajectories in scientific research concerning innovation studies. The project demonstrates how commitment to different objectives has evolved over time and how innovation policies have shifted from promoting technological change *per se* to supporting the dissemination of new technologies to address major societal challenges. Finally, we analysed the citations to determine which knowledge elements were more or less important for scientific policies over time, with the possibility of identifying cycles in the themes.

The second avenue concerns to universities and involves two complementary tasks. As pivotal players in the economy, universities are increasingly being called upon to support economic development at the local, regional, and national levels by providing education and research. To meet these needs, a university organises its teaching and research activities while also considering how the government distributes funds for knowledge production and adapting its behaviour accordingly. The university is far from being a passive institution; it embodies evolutionary traits that change based on interactions with other universities and the surrounding environment. Various organisations engage in teaching and research activities, as well as pursuing a *third mission*, which can lead to a flow of trajectories based on interactions and competition for public funds.

The aim of the first paper (a work-in-progress with Valentina Erasmo from the University of Turin and André Lorentz) is to explore the development of these trajectories and their determinants. We highlight the conditions that shape the emergence and survival of a university as an evolving entity, and how different trajectories stem from any university tendency to interact with and adapt to a higher-level institutional framework. The analysis of a university behaviour and the resulting competition for funding and students are not unexplored issues at the frontier of economics. However, unlike works that mainly deal with the optimal structure of a university organisation and the static role of governments, we are developing an agent-based model (software *LSD*) in which a group of universities is assessed according to three dimensions that reflect the endogenous choice of an institute between teaching and research, pure and applied knowledge, and commitment to a social contract, i.e., what the economy expects from the university. Although we define the university as a place where both teaching and research take

place, the emergence of different trajectories can lead some of them to specialise in one or the other of the two extreme dimensions, or in both at the same time. This means that the notion of university adopted here is quite pluralistic and includes other institutions that are not generally qualified as universities.

In our second contribution (currently in progress with Valentina Erasmo), we propose a methodological framework for the evolution of scientific research funding criteria. The emphasis on *excellence* has marked the allocation of available resources for several decades in several advanced countries. Excellence has responded to some calls for *meritocracy* in funding distribution. However, empirical and bibliometric data show that diversity may have a greater impact on the quality of scientific research than excellence, regardless of how it is defined. In this article, we aim at contributing to this body of literature by suggesting that for meritocracy to be an effective means of improving the quality of scientific research, it must be accompanied by consideration of uncertainty and excessive competition. We examine some empirical work from a methodological and evolutionary perspective that shows it is preferable to award small-scale grants to a larger number of researchers than to concentrate resources on a narrow elite. The benefits of a shift from excellence to diversity are illustrated by the growing examples of new pluralistic programs that encourage complexity and novelty in economics.

Finally, a project with André Lorentz, Marco Compagnoni from the University of Trento, and Maria Savona from LUISS University in Rome aims at elaborating upon the relationship between technology policy, structural change and *extended producer responsibility* (EPR) configurations in an economic system that integrates various points along the value chain, from the initial production process with virgin or recycled raw materials to consumption and circular waste recycling industry. With the advent of the circular economy paradigm, EPR has long been recognised as the most suitable approach to address the challenges posed by the circular economy. Although guidelines have been established at the European Union level, EPR programs vary from country to country and across waste streams. Additionally, the introduction of EPR has led to the creation of organisations to which producers transfer waste management tasks. These collective producer responsibility organizations (PROs) have an increasing market power and influence the organization of production activities upstream (product manufacturing) and downstream (recycling industry). Therefore, the diversity of institutional arrangements in EU countries raises questions about their relative strengths and weaknesses.

With this analytical framework, we aim to formally introduce the mechanisms by which the growth and composition of final and intermediate demand shape structural change and the transition of economies that primarily use virgin raw materials as inputs in the production process towards productive systems that favour the use of recycled inputs. Subsequently, favourable demand conditions for recycled materials encourage upstream businesses to respond to downstream technological shocks, as intermediate demand factors influence the transmission of micro-behaviors into macroeconomic structural changes. In this context, we focus on the emergence of compromises and complementarities between supply-side technology policies that impact upstream sectors, demand-side policies for a general reorganization of consumption habits, and competition policies that establish the REP/PRO system in the downstream recycling industry.

In conclusion, this Thematic contributes to interdisciplinary knowledge of the European society construction by measuring the impact of public policy at the microeconomic, mesoeconomic, and macroeconomic levels. It is important to elaborate on the effects of policies on firms, industries, and countries. However, the presence of a supranational institution such as the EU allows for the consideration of European specificities that are not shared by other unions, such as the USA.

References relative to Thematic B:

Abbonato, D. & Borsato, A. (*work-in-progress*). Trends in Mission-Oriented Innovation Policies: A Bibliometric Survey.

Borsato, A., Compagnoni, M., Lorentz, A. & Savona, M. (*work-in-progress*). Innovation dynamics and structural change in the recycling sector.

Borsato, A., Erasmo, V., & Lorentz, A. (*work-in-progress*). Exploring university trajectories with an evolutionary model.

Borsato, A. & Lorentz, A. (2023), Open Science vs. Mission-oriented Policies and the Long-run Dynamics of Integrated Economies: An Agent-based Model with a Kaldorian Flavour, *Documents de travail du BETA*, n° 2023-17, Université de Strasbourg.

Erasmo, V., & Borsato, A. (*work-in-progress*). From excellence to diversity: promoting complexity, innovation and pluralism in economics.

2.3 Thematic C: Secular Stagnation and long-period dynamics of economic growth

The Thematic concerned the PhD dissertation (Borsato 2021b) and is about Secular Stagnation, which re-emerged during the Great Recession of 2007 with the work of Prof. Summers. He adopted it to outline a situation in which the evolution of economic fundamentals could have impacted on the natural balance between savings and investments. I approach this debate along three lines. First, I present a systematisation of the concept of Secular Stagnation with a new and longer period of analysis than usual (Borsato 2023). The focus is on the historical annual aggregate data of the United States regarding employment dynamics, real GDP per capita, potential production, productivity measures, and population from 1870 to 2022 (via *EViews* and *Stata*). This framework allows to investigate whether Secular Stagnation is a *stylised fact*. I depart from Hansen's definition about persistently high unemployment rates and from current fears on very low GDP growth rates. On the one hand, unemployment rates fluctuate around values half as high as those observed by Hansen. On the other hand, the current low per capita GDP growth represents a return to the average growth rates recorded before the Golden Age of capitalism, from 1950 to 1972. Conversely, we should refer to Secular Stagnation in terms of the growth rate of labour productivity and TFP, as their decline is more significant than all previous deficits.

The methodology applied and the definition given to Secular Stagnation suggest at least three implications. Firstly, the definition is important for evaluating whether Hansen was correct when he first introduced the idea. Additionally, the definition allows to ascertain whether current debates are based on data. In fact, my conclusions cast doubt on Summers' hypothesis of negative natural rates, which suffers from theoretical inconsistencies. Furthermore, it is possible to distinguish the most relevant mechanisms through which this issue emerges, i.e., supply-side vs. demand-side determinants. Finally, as long as Secular Stagnation is confirmed as an empirical phenomenon, it is possible to draw political implications from the different theoretical approaches. I highlight the complementarity of what policymakers should do to escape this trap, despite the current debate presents a high degree of heterogeneity in viewpoints. It is worth noting that such an exercise is no longer common nowadays, although it is highly necessary given the increasing complexity of macroeconomic phenomena, such as secular stagnation, that are at stake.

In the second axis, I focus on the evolution of American capitalism since the 1950s by studying how the distribution of income between wages and profits may have influenced innovative activity and subsequent productivity gains (Borsato 2022).

The contribution to the literature is both theoretical and empirical. The article develops an agent-based model (via *R*) to analyse the relationship between the functional distribution of income and innovative search in determining productivity and economic growth. It is noteworthy that the reduction in the share of labour has a negative impact on the propensity and ability of firms to innovate. A decrease in the share of wages reduces the incentive for capitalists to invest in both physical capital and innovative search at the microeconomic level, due to the lower aggregate demand. I suggest that the continuous transfer of income from wages to profits may have led to a reduced incentive to invest in R&D activities with the evident decline of aggregate productivity growth that characterises US Secular Stagnation. In addition to this, I observe that the interest rate has weak and nonlinear effects on both economic growth and innovative activity. This non-linearity results from the contrasting effect that the interest rate has on consumption and innovation. Higher rates increase employment through the redistribution of bank profits, while simultaneously mitigating the problem of personal income inequality.

The contribution is also empirical and aims at testing the main theoretical results on a sample of American manufacturing industries between 1958 and 2011 (via *EViews*). A double empirical analysis based on *panel time-series co-integration* techniques is proposed, and empirical evidence of a positive long-term causal link between sales and wages and R&D expenses is found. I also test the existence of a long-term relationship between R&D investments and the effective federal funds rate, on the one hand, and with the banks' prime lending rate, on the other hand. I show the interesting result that there is no strong long-term link between innovative effort and interest rates. This result is not in contradiction with model predictions.

It is worth mentioning an article from the doctoral thesis as a secondary project (Borsato 2021a). The aim was pedagogical: three matching protocols were presented and detailed, which find or already found direct application in the literature of agent-based models. The implementation of simple linear matrix algebra could be useful for non-expert students who aim to develop agent-based models from scratch, or it could provide a boost in tackling highly complex issues by integrating these protocols into their analyses. Although these protocols are inherently simple, they can be rearranged into more complex frameworks and integrated into Monte Carlo cycles and sensitivity analyses. Finally, while the code was written for *R*-type environments and implements linear matrix algebra, modellers could adapt the corresponding philosophy to the software they prefer and their own needs.

These research findings raise additional questions that require further investigation. Has COVID-19 pandemic

triggered a cyclical conjunctural crisis or a profound structural change? Although the data analysis extends until 2022, it does not account for the impact of the COVID-19 pandemic. In this case, will the structural change lead to a broad reorganisation of the socio-economic fabric that eliminates productivity problems or worsens Secular Stagnation? Are EU countries suffering from a similar Secular Stagnation? If so, do they suffer from a secular stagnation of productivity like the United States? These questions will be the subject of future developments.

References relative to Thematic C:

Borsato, A. (2023). Does the Secular Stagnation hypothesis match the data? Evidence from the USA. *Journal of Post Keynesian Economics*. DOI: 10.1080/01603477.2023.2242346. *CNRS - 2, HCERES A*.

Borsato, A. (2022). An agent-based model for Secular Stagnation in the USA: theory and empirical evidence. *Journal of Evolutionary Economics 32*, 1345–1389. DOI: 10.1007/s00191-022-00772-9. *CNRS - 2, HCERES A*.

Borsato, A. (2021a). Simple Matching Protocols for Agent-Based Models. *Documents de travail du BETA*, n° 2021-35, Université de Strasbourg.

Borsato, A. (2021b). Essays on Secular Stagnation in the USA. *PhD Thesis*, Department of Economics and Statistics, University of Siena.

Borsato, A. (2020). Secular Stagnation and innovation dynamics: an agent-based SFC model. Part I. *Quaderni del Dipartimento di Economia Politica e Statistica*, n° 840, Department of Economics and Statistics, University of Siena.

2.4 Thematic D: Economic history and history of economic thought in the economics of innovation

This research field is heterogeneous and far-reaching, aiming to reinterpret certain episodes of economic development from a historical perspective. The first project focusses on the United States' national innovation system and the institutional framework that enabled the emergence of biotechnology (with Patrick Llerena from the University of Strasbourg). We begin with the overwhelming empirical evidence that in every industry, there are several sources of knowledge that involve actors and institutions other than firms, which can significantly impact firm innovation performance. Industries differ greatly in terms of these dimensions, and it is neither possible nor very useful to propose an ideal type of sectoral system. For instance, the pharmaceutical and biotechnological sector comprises a range of actors, from large corporations to small start-ups, as well as universities, venture capital, and regulatory institutions. Innovation, therefore, results from the combination of scientific advancements, networks, and division of labour. These institutions complement each other, and the way they are combined differs from that of other industries, such as specialised machines, software, etc.

This project makes three contributions to the literature. Firstly, we explain the emergence of biotechnology as a co-evolutionary process, drawing on Nathan Rosenberg's perspective. This process involves multiple innovations in the fields of law, government policy, and science. Secondly, we provide a clear and concise explanation of the causal connections between these innovations. Molecular biology and finance have been integrated to create an architecture that has opened up new technological opportunities. This includes a new organisational model based on horizontal and information flows, and porous boundaries that have strengthened inter-institutional cooperation in R&D.

Secondly, this paper analyses the implications of this architecture for the division of knowledge and labour in the first generation of biotech start-ups. According to the classic Smithian interpretation, the progressive specialisation of labour leads to the creation of capabilities and a gradual increase in specialised knowledge through learning-by-doing. However, things may not be as straightforward when the environment becomes more uncertain. Companies must create new knowledge internally and cannot rely on a pre-existing division of labour, as Charles Babbage argued long ago. We demonstrate that the co-evolutionary process that characterises biotechnologies makes the mechanisms of Smith and Babbage more or less evident depending on the specific link between institutions.

Finally, we interpret the emergence of two start-up variants and their scientific and financial success/failure by emphasising, as Alfred D. Chandler Jr. did, the entrepreneurial functions as opposed to administrative functions and the ability of each start-up to recruit managers with a long-term vision that should characterise companies operating in high-tech sectors.

The last research axis proposes a review of the works of major authors in the economics of innovation to describe and circumscribe innovation phenomena. In this context, I focus (with André Lorentz) on the resurgence of Kaldor's thought in present-day debates about the Fourth Industrial Revolution.

Although Kaldor is not strictly an innovation theorist, his work on economic growth is still noteworthy for the study of innovation, both theoretically and methodologically. Kaldor was one of the first to give increasing importance

to facts, history, and an inductive approach, which has since been widely adopted in research on innovation. From a theoretical standpoint, Kaldor introduced his *function of technical progress* in the late 1950s and developed his theory of *circular cumulative causation* in the second half of the 1960s. This approach considers technological change, beyond just innovation, as an endogenous factor and suggests that growth is self-sustaining.

A limitation of the Kaldorian approach is its simplistic representation of the mechanisms that guide technological change, which can be seen as either deterministic or automatic. This approach lacks a complete understanding of the process behind. The evolutionary theory of technological change can address this gap by focusing on the occurrence and diffusion of techniques within the economic system. This intriguing combination of Kaldor's theories and evolutionary economics of innovation is particularly evident in its modelling. The technical progress description through research and development activities in the company refers to a stochastic version of the technical progress function. Furthermore, sustained cumulative growth is driven by external demand, and exports depend on competitiveness and increasing returns, similar to the typical selection mechanisms of the replicator. This indicates a dynamic vision of Kaldorian theory, where changes in labour productivity at the industrial or firm level respond to micro and macro stimuli.

Among evolutionary economists, as with Kaldor, beyond the analysis of innovation, the implications for practitioners and managers are as follows: innovation cannot be conceived in the abstract but only in its embodiment in a technological object, whether it be machines or services. Innovation can only create wealth when it faces expanding markets. The economic context, both microeconomic (the organisation of firms, markets, and institutions) and macroeconomic (employment, income distribution, and effective demand), has become as crucial as technology itself in determining the success of innovation. The project on Kaldor is the first step in a comprehensive reinterpretation of famous economists from the past in an evolutionary perspective.

References relative to Thematic D:

Borsato, A., & Llerena, P. (2024a, *mimeo*). Inside the Biotech: A dialogue between Rosenberg, Babbage, Smith, and Chandler.

Lorentz, A. & Borsato, A. (2023). Nicholas Kaldor: Faits stylisés, Progrès Technique et Croissance Cumulative. *Les Grands Auteurs en Management de l'Innovation*, T. Burger-Helmchen, P. Cohendet, C.Hussler (eds.), Ch. XIV, Edition II, *Editions Management et Société*.

3 Teaching activity and student supervision

My teaching activities have so far covered three subjects: *European Macroeconomics* (10 hours in English), *An Introduction to Agent-based Modelling* (Doctoral Lecture, 3 hours in English), and *Microeconomics II* (60 hours of tutorials in French).

European Macroeconomics is about innovation economics, technical change, and innovation policies with a particular focus on the European context. Firstly, I propose an evolutionary interpretation of technology and technical change, integrating various elements concerning the nature and structure of technological knowledge, sources of new opportunities, the dynamics by which they are exploited, and the results revealed in terms of progress in production techniques and product characteristics. The explicit recognition of the evolutionary nature of technological change has profound implications for how economists theorise and analyse a number of essential subjects in the discipline, such as the theory of the firm. The course includes both theoretical and practical sessions. The courses on the evolution of the following technologies are accompanied and enriched by the analysis of several case studies drawn from contemporary and past issues. For instance, the time-consuming implementation of continuous steel casting among advanced economies. I also discuss the differences between civilian and military trajectories in aircraft production, the role of patents in the pharmaceutical industry, the Moore's Law in electronics, and episodes of collective innovation in England during the First Industrial Revolution.

The second step examines national innovation systems, broadly defined as the network of public and private sector institutions whose activities and interactions enable the initiation, importation, modification, and diffusion of new technologies. In this case, the analysis of the specificities of national innovation systems (e.g., France, Italy, Germany) is combined with empirical studies dealing with the emergence of a European innovation system after the development of the European Monetary Union.

Finally, this course assesses the theoretical and empirical literature on the innovation-employment nexus. It compares the relative explanatory power of competing economic theories while detailing macroeconomic, sectoral, and microeconomic evidence on the issue, with reference to advanced economies. The main objective is to provide a critical meta-analysis of both the theory and recent empirical achievements resulting from the relationship between

technology and employment. Special attention is given to the technologies that characterize the Fourth Industrial Revolution.

An Introduction to Agent-based Modelling is a doctoral lecture that introduces doctoral students to a theoretical methodology that is an alternative to the standard neo-classical paradigm. I begin with presenting a famous issue in all sciences, i.e., the *aggregation problem*. The discussion continues with a historical analysis of macroeconomics as discipline, providing students with the methods proposed by classical-Keynesian and neoclassical literature to solve this problem. A thorough critique of both schools of thought paves the way for the study of agent-based computational economics, which admits that some outcomes cannot be attributed to the conscious or unconscious behaviour of identifiable microeconomic components. This alternative paradigm considers the economy as a complex evolving system, an ecology populated by heterogeneous agents whose far-from-equilibrium interactions produce a collective order, even if the system structure constantly changes. In such a framework, there is no *isomorphism* between the microeconomic and macroeconomic levels, and higher levels of aggregation may lead to the emergence of new phenomena, new statistical regularities, and completely new structures.

Microeconomics II focusses on tutorials (TD). The course aims to enable students to understand both consumer and producer behaviour analysis by modelling and quantifying their decisions, and to develop a critical mindset towards the obtained results. The introduced concepts can be used to quantify the responses to questions such as how a consumer should allocate their budget in purchasing different goods to maximise their satisfaction, how one can represent individuals' tastes and preferences, given that they are subjective characteristics, and how production technology does create constraints on a producer's production and supply choices, or more generally, on a company choices.

Alongside my teaching activities, I am supervising Sarah Pinel, a second-year *Magistère* and first-year Master's student in *Macroéconomie et Politique Européennes* at the University of Strasbourg. Her dissertation focusses on the re-appraisal of Thirlwall law as a means of explaining country international competitiveness. The report has a dual objective. Firstly, it conducts a long-term econometric analysis of OECD countries to provide new empirical evidence of this regularity. The sample structure, growth framework, and potential bidirectional causality between the different variables of interest recommend the use of the GMM estimator. Next, the student aims at investigating the potential impact of increasing automation in most advanced economies on the general validity of the law.

Date: 05 April 2024

Signature