Max Planck Institute for Innovation and Competition

MAX-PLANCK-GESELLSCHAFT

National Bureau of Economic Research

1050 Massachusetts Ave.
Cambridge, MA 02138

Kathrin Wernsdorf
Junior Research Fellow

Tel.:+49 89 24246-582
Fax:+49 89 24246-599
kathrin.wernsdorf@ip.mpg.de

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**Application for NBER Economics of Digitization Tutorial**

To whom it may concern:

I am writing to apply for participation in the Economics of Digitization Tutorial taking place in March 2021. I am a Ph.D. candidate at the Max Planck Institute for Innovation and Competition in Munich as well as at LMU Munich. I am also a member of the International Graduate Program "Evidence-Based Economics" funded by the Elite Network of Bavaria.

It was already during my three years of Bachelor studies in Economics at the University of Mannheim that I developed an interest in the field of digitization. The two-year graduate program at LMU Munich broadened my focus by introducing me to the field of innovation through several courses, which I attended. I wrote my Master thesis at the intersection of my two fields of interest, namely digitization and innovation and earned my Master of Science degree in Economics, with a specialization in Applied Econometrics, in 2019. Since then, I am a Ph.D. student under the supervision of Prof. Dr. Monika Schnitzer and Prof. Dietmar Harhoff, Ph.D.

Broadly speaking, my current research interests range from digitization over innovation to topics in labor economics and competition. I am particularly intrigued by questions that combine insights from two or more of the aforementioned fields. A project in this area that I am currently working on is concerned with the impact of an early version of the Internet on inventors' productivity. This project has been short-listed for the EPIP 2020 Young Scholar Award in Economics and Management. I am looking forward to conducting additional research at the intersection of both digitization and innovation as well as digitization and labor economics.

I believe that digitization is a rising phenomenon, which will play an increasingly important role in many areas of the economy and our daily lives. Consequentially, it requires further research to unveil the impact of this technical revolution – something, I would like to contribute to. Developing research projects in this area, in turn, requires exposure to leading scholars and state-of-the-art research, for which the NBER Economics of Digitization Tutorial provides an ideal platform.

Thank you in advance for considering my application; I look forward to hearing from you.

Sincerely,

K. Wernsdorf

Kathrin Wernsdorf

**Summary of Relevant Course Work Related to Digitization and Innovation**

The course *"The Economics of Science and Innovation"* provides an overview about current topics in the area of innovation. Broad topics include: innovation and economic growth, the supply of inventors, incentives for innovation, cumulative innovation, entrepreneurship and organization of innovation and market structures, Artificial Intelligence.

The course *"Labor Markets in the Knowledge Economy"* covers topics in labor and innovation economics with a focus on the intersection of both fields. Broad topics include: skill-biased technological change, automation at work, labor shares and superstars, the supply of inventors, migration and invention, compensating differentials and rent-sharing, incentives for ideas, human capital, peer effects and collaboration, gender wage gap.

The course *"Firms in the Knowledge Economy"* covers topics in firm organization and innovation with the objective of providing an understanding of how technological change affects production in firms. Broad topics include: skill-biased technological change and its impact on firms' labor demand; the organization of knowledge; data as assets; intangible assets, internationalization and profit shifting; incentives to innovate for firms, and within firms, for employees; knowledge diffusion and knowledge spillovers between firms.

**Summary of Relevant Methodological Courses**

The course *"Structural Microeconometrics"* introduces students to state-of-the art methods in structural microeconometrics. Broad topics include: Methodology and Identification, Numerical Methods, Discrete Choice Models, Dynamic Discrete Choice Programming Models, Demand Estimation. The course draws heavily on the programming language Python.

The course *"Methods and Tools in Data Science"* introduces several techniques for data analysis with a focus on big data and machine learning techniques. Topics include: Databases (e.g. SQL), Web-scraping and API, Google Cloud (e.g. Big Query), ML techniques (e.g. Lasso, Ridge, Elastic Net), Natural Language Processing, Random Forests, Deep Neural Networks. The course draws heavily on the programming language Python.

The course *"Computational Methods in Economics"* covers essential topics in scientific computing (e.g. function approximation) as well as concepts in machine learning (e.g. gradient descent algorithm, neural networks). It further covers methods for solving dynamic models in economics, such as dynamic programming. The course draws heavily on the programming language Python.

The course *"Microeconometrics"* covers state-of-the-art estimation methods in detail. Broad topics include: Maximum Likelihood Estimation, Binary Response Models, Multinomial and Ordered Response Models, Limited Dependent Variables, Count Data Models, Nonparametric and Semiparametric Estimation.

The course *"Causal Inference for Policy Evaluation"* complements topics introduced in Microeconometrics and applies them in the context of policy evaluation. It provides a detailed coverage of the following topics: Social Experiments (in particular, RCTs), Difference-in-differences Estimation, Synthetic Control Methods, various matching techniques, Instrumental Variables, Regression Discontinuity.

**Current Research Projects Related to Digitization**

*ICT, Collaboration, and Science-Based Innovation: Evidence from BITNET* (joint with Markus Nagler and Martin Watzinger)

Does access to information and communication technologies (ICT) increase innovation? Significant resources are spent to extend access to ICT to every region in the developed world, hinging on the belief that ICT fosters productivity and innovation. However, it is far from obvious that there should be strong effects of ICT on innovation. On the one hand, ICT might induce innovation by giving inventors easier access to a wider range of ideas and potential collaborators. On the other hand, ICT might have no effect at all because relevant information for inventions is difficult to codify, people are reluctant to share valuable information, or collaborations are costly.

In this paper, we exploit the staggered adoption of BITNET among U.S. universities between 1981 and 1990 to provide evidence whether access to ICT affects local innovation. BITNET, an early version of the Internet, enabled e-mail-based knowledge exchange and collaboration among academics. Using a difference-in-differences approach, we observe that after the adoption of BITNET, university-connected inventors increase patenting substantially.

In additional analyses, we provide evidence that collaboration among new inventor teams in areas where knowledge can be codified is the mechanism behind our effects. The results from these analyses are in line with the notion that BITNET facilitated the exchange of knowledge in written form among collaborators. We further show that the increase in patenting induced by ICT is exclusively driven by patents that either directly cite research articles ("science-based") or at least cite other patents that are science-based ("science-related"). In contrast, we neither find an effect on patents not building on science nor on inventors unconnected to universities.

Our paper finds that there is a positive effect of ICT on patenting, likely due to increased collaboration among new inventor teams. Most importantly, these new collaborations seem to translate scientific insights into innovation. Since patents close to science are particularly valuable and, so far, the literature does not completely understand under which circumstances they emerge, this is a valuable contribution.