Application: NBER Digital Economics and AI Tutorial

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Course of graduate study and years of enrollment

I am a Ph.D. candidate in Econometrics and Quantitative Economics at Binghamton University (SUNY). I have completed more than two years of Ph.D. coursework, including the core microeconomics and macroeconomics sequences, graduate econometrics, and advanced empirical methods in causal inference, development economics and empirical industrial organization. My training is oriented toward empirical industrial organization and productivity analysis, with an emphasis on identification in settings with endogenous firm choices, unobserved heterogeneity, and imperfect competition.

Years of enrollment: 2022-present (expected completion: 2027).

Research interests, projects in process, and (when appropriate) dissertation information

My research agenda is at the intersection of *digital economics*, *AI-driven technological change*, and *market power*. I study how the adoption of digital technologies, automation equipment, numerically controlled machines, robotics, data-intensive systems, and AI-related practices, changes firms' production technologies and competitive conduct. Substantively, my work focuses on three linked objects central to empirical IO: (i) productivity and non-neutral technical change, (ii) markups and pricing power, and (iii) distributional implications operating through labor demand, task composition, and labor's share.

Primary project in progress: Digitalization, non-neutral productivity, and markups.

With my co-author, Prof. Subal C. Kumbhakar, I study the impact of digitalization on (i) *labor-augmenting productivity*, (ii) *Hicks-neutral productivity*, and (iii) *firm-level markups*. The empirical setting is Spanish manufacturing firms from the Encuesta Sobre Estrategias Empresariales (ESEE), 2000-2022. The project is motivated by a robust descriptive pattern in the data: digital technology adoption rises steadily while labor's share of output declines. Interpreting this joint movement is fundamentally an identification and measurement problem. A declining labor share may reflect labor displacement, but it can also arise when digitalization changes the effective productivity of labor, alters substitution patterns across inputs, and affects price-cost margins through market power.

Data and measurement.

The ESEE provides rich firm-level information on output, inputs, prices (as variations), and technology adoption. To measure digitalization, we construct a multidimensional index using the underlying adoption variables emphasized in related work (e.g., automation/robotics, numerically controlled equipment, ICT infrastructure, and digital commercial practices). Rather than imposing ad hoc weights, we summarize these components using principal component analysis to discipline aggregation and reduce measurement noise. Because input and output prices are not directly reported as levels, we follow standard procedures in this literature to construct Paasche-style indices that permit consistent deflation and demand-side estimation.

Empirical framework and methodological contribution.
On the production side, we develop an estimation framework for **non-neutral productivity** using a **translog production function** that **does not assume homothetic separability**. This is important in digital settings because digital adoption can reshape the interaction between capital, labor, and materials. For example, automation may require complementary skilled labor, while AI-enabled planning can change materials management and effective utilization rates. A translog specification accommodates such interactions and delivers **firm-year elasticities** rather than constant elasticities implied by CES-based approaches.

Our approach separates labor-augmenting productivity from Hicks-neutral productivity. In the first stage, we recover labor-augmenting productivity using cost-share conditions for flexible inputs together with a dynamic structure (persistent productivity with innovation and digitalization as a predictor). In the second stage, we recover Hicks-neutral productivity using a quasi-differenced specification that allows persistence and a time-varying digitalization effect, capturing diffusion and maturation of technologies.

Markups and imperfect competition.
To connect digitalization to market power, we estimate **firm-level markups** using the method developed in Kumbhakar (2013). This allows us to study digitalization jointly as a force shaping both costs, productivity and pricing power. From an empirical IO perspective, this is central: if digitalization increases markups, the interpretation is not mechanical. Higher markups may reflect (i) improved efficiency plus strategic pricing, (ii) differentiation and demand-side advantages, or (iii) changes in competitive pressure through scale economies, switching costs, or technology-based barriers to entry. The project therefore treats productivity and markups as jointly determined outcomes of digital adoption rather than analyzing them in isolation.

Current findings (preliminary).
Our preliminary results suggest three main patterns:

- **Labor-augmenting productivity:** Digitalization is positively associated with labor-augmenting productivity for most industries, consistent with complementarities between digital tools and effective labor input.
- **Hicks-neutral productivity:** Digitalization is also positively associated with Hicks-neutral productivity, indicating broader efficiency improvements beyond labor augmentation.
- **Markups:** Using the Kumbhakar (2013) markup approach, digitalization is associated with **higher markups** (higher price-cost margins).

Taken together, these findings imply that a declining labor share can be consistent with productivity gains that reduce unit labor costs and reweight factor contributions, even when labor is being augmented rather than purely displaced. At the same time, the positive relationship between

digitalization and markups points to a market-power channel that is relevant for welfare and distribution. In ongoing work, we are exploring heterogeneity across industries and baseline technology intensity to separate mechanisms (efficiency, scale, differentiation, and strategic pricing) and to discipline interpretation of the markup results.

Dissertation information:
Provisional dissertation title: *Digitalization, AI Adoption, Non-Neutral Productivity, and Markup: Evidence from Spanish Manufacturing Firms*
Committee: Prof. Subal C. Kumbhakar (Chair), Prof. Yingjin Su, Prof. Ivan Korolev

Why I wish to attend the NBER Digital Economics and AI Tutorial.
The NBER Digital Economics and AI Tutorial is an excellent fit for my research because it convenes leading work on digital transformation, AI, productivity, and market power, this is exactly the ingredients my project combines. I would particularly value feedback on: (i) measurement of digitalization and AI-related practices in firm data, (ii) identification and estimation of flexible production technologies when firms have market power, and (iii) how to interpret joint movements in productivity, markups, and labor share within a coherent empirical IO framework. The opportunity to participate in the associated NBER Digital Economics and AI meetings would also be valuable for positioning my dissertation within current debates and building connections with researchers working on related questions.

Faculty references
Prof. Subal C. Kumbhakar, Distinguished Professor of Economics, Binghamton University
Prof. Yingjin Su, Assistant Professor of Economics, Binghamton University
Prof. Ivan Korolev, Assistant Professor of Economics, Binghamton University