

Overview

My research lies in empirical industrial organization and structural econometrics. A major strand of my agenda develops structural estimation methods for production functions—a cornerstone of empirical IO and a workhorse for policy analysis. Methodologically, I address two limitations of conventional approaches: (i) imposing Hicks-neutral productivity and (ii) equating revenue with physical output. Empirically, I use these methods to quantify factor-biased technological change and to produce identification-transparent, robust measures of productivity, markups, and returns to scale.

Research Projects

Job Market Paper. In my job-market paper, *Identification of Gross-Output Production Functions with Nonseparable Productivity* (R&R, *Review of Economic Studies*), I extend the proxy-variable tradition—Olley and Pakes (1996), Levinsohn and Petrin (2003), and Akerberg, Caves, and Frazer (2015)—to production functions with nonseparable, potentially factor-biased productivity. The contribution is to move beyond Hicks-neutrality—often inconsistent with observed input-specific responses—while retaining nonparametric identification.

On the *perfect-competition* side, I build on Gandhi, Navarro, and Rivers (2020) to identify a gross-output production function when productivity interacts with inputs. On the *imperfect-competition* side, where physical output is unobserved and revenue mixes prices with quantities, I confront the well-known nonidentification of markups and returns to scale by calibrating returns to scale. Crucially, the paper **theoretically** shows that two policy-relevant conclusions—the direction of technical-change bias and markup trends, dispersion, and gaps—are **invariant** to plausible calibrations of returns to scale.

Applied to Chinese manufacturing, the estimates indicate predominantly *capital-biased* technical change, with productivity growth raising the marginal product of capital more than that of other inputs. Compared with the Hicks-neutral model, my nonseparable specification implies a much more muted upward trend in markups and substantially lower markup dispersion.

Timing, Information Sets, and Nonseparability. In “Nonparametric Identification Using Timing and Information Set Assumptions with an Application to Non-Hicks-Neutral Productivity Shocks” (with Daniel Akerberg and Jinyong Hahn; R&R, *RAND Journal of Economics*), we show that the timing and information-set framework of Akerberg, Benkard, Berry, and Pakes (2007) delivers nonparametric identification for a broad class of **nonseparable** models. Using a control-function approach (Imbens and Newey, 2009), we demonstrate how the model’s timing and information-set structure relaxes the strong support conditions commonly required in the literature. We then apply the approach to estimate a value-added production function with non-Hicks-neutral productivity.

Unobserved Price Index and Constrained GMM. In “Tracking Down the Unobserved Prices: A Constrained GMM Approach to Production Function Estimation” (with Daniel Akerberg), We show

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that the commonly applied Klette–Griliches (1996) estimator—intended to correct the inconsistency that arises when revenue is treated as physical quantity in production-function estimation—is consistent only when a CES price-index is used. In practice, such a CES index is seldom reported in the data. To address this, we propose a constrained GMM approach that treats the unobserved CES price index as parameters to be estimated, while imposing constraints implied by the model’s structure to ensure identification. In our application, the estimated returns to scale are even higher than those suggested by the Klette–Griliches estimator.

Markups and Marginal Costs from Financial Statements. In “Measuring Markups and Marginal Costs from Financial Statements,” I extend Klette–Griliches (1996) from a different perspective. Because the Klette–Griliches model is linear by design, it effectively restricts markups to be constant across firms—a major limitation when the research question centers on identifying markups. The production approach to measuring markups has become popular but has also faced criticism because treating revenue as physical output obscures the source of identification. To address this within the Klette–Griliches framework, I generalize the model to a nonlinear setting that allows heterogeneous markups, which may depend on observed demand shifters as well as unobserved prices and demand shocks. This requires identifying a nonseparable model, for which I adapt techniques developed in my other papers. Under our approach, even without observing physical quantities, we can recover heterogeneous returns to scale and marginal costs from financial statements.

Shape Restrictions and Allocative Efficiency. In “Shape-Restricted Production Functions: An Application to Allocative Efficiency” (with Daniel Akerberg), we develop a two-step nonparametric estimator that embeds economic shape restrictions. First, we recover productivity from the input-demand equation via sieve MLE. Second, conditional on this control, we estimate the production function using Bernstein polynomials, which permit direct enforcement of monotonicity and concavity. With these restrictions, the second step is a disciplined convex programming (DCP) problem, which has attractive computational properties. Applied to standard production datasets, concavity has limited effect, whereas enforcing monotonicity substantially reduces the dispersion of estimated marginal products across firms, indicating higher allocative efficiency.

Future Plan

I will continue advancing my research on production-function estimation while expanding into applied data work on the Chinese economy. I am particularly interested in SOE reform and the recent slowdown in firms’ productivity and profitability. A key objective is to disentangle *demand* forces from *efficiency* (technology/organization) forces. Because a large share of SOEs may not be strictly profit-maximizing, my coauthors and I develop in “From Revenue to Production: Identification and Estimation” an approach that identifies productivity and markups without assuming profit maximization. I plan to apply this framework to evaluate whether the observed slowdown is primarily demand-driven or efficiency-driven.

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