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Applied production analysis unveiled in open peer review: introductory remarks

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1 Introduction

This special issue of the *Journal of Productivity Analysis* is the outcome of a unique modeling session organized at the 9th European Workshop on Efficiency and Productivity Measurement (EWEPA9) between June 29 and July 2, 2005 in Brussels (see http://www.ewepa.org). The overall goals of this special issue are twofold.

First, this issue seeks to illuminate the "context of discovery" in applied production analysis in the sense of identifying the forces motivating the actual choices of applied economists as they undertake their empirical research. Since economic knowledge is uncertain and the process of knowledge creation is highly speculative, we want to showcase how a set of scholars undertake the critical examination of a common problem, select what they perceive to be the proper models to analyze the data, and then make some final judgments and formulate some policy conclusions in an imperfect world.

Second, this venture provides a means to transfer academic expertise from seasoned scholars to emerging scholars (graduates, Ph.D. students, young researchers, etc.) by observing scholars engage in problem solving. Observing social scientists in action is hardly ever informative, since social sciences researchers normally do not share a common life in a laboratory (except when collecting experimental data—still a rather exceptional data collection method in economics). It is indeed less obvious how young researchers receive informal training in their respective social science disciplines in addition to their formal training (e.g., their participation in Ph.D. programs). Being able to witness (not by direct observation, but indirectly reviewing the written record) how established scholars go about tackling a problem can prove valuable for Ph.D. students and young researchers.

Of course, this does not amount to denying that some close substitutes for our project do exist. For instance, there are some excellent econometrics textbooks with many hands-on exercises (e.g., Berndt 1991; Greene 2003). But, these books focus on duplicating streamlined (often published) results, not on how these results actually emerged in the first place. As yet another possibility, one could simply ask successful researchers about their methodologies and underlying motivations when they introduced major new theories. This may partly explain the existence of a growing number of books with collections of interviews with eminent economists. Some of these interview books are rather general in nature (e.g., Szenberg 1992 or Samuelson and Barnett 2006), other books focus on particular topics (e.g., Klamer (1984) focuses on the then hot debate on the new classical macroeconomics, Swedberg (1992) sheds light on the boundary between economics and sociology) or contribute to the intellectual history of the field (e.g., Colander and Landreth (1996) explore the introduction of Keynesian ideas in US academic life). However, these books tend to focus on eminent scientists only. While everybody can no doubt benefit from understanding how

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eminent scientists deliver major breakthroughs and do their job, in general, this may not tell us very much about how "ordinary" scientists go about doing research. Further, these books are mainly aimed at reconstructing theories and controversies retrospectively, with all the dangers of uncritically ignoring important details, retrospective illusions, selective memory, window dressing, etc. Finally, most interview books are at best a dialogue, with a more or less passive interviewer or editor interacting with the eminent scientist. Rare are the open discussions with more than two participants (a notorious exception is the interview of the three econometricians, Hendry et al. 1990).

The key instrument selected to achieve these goals is a process of open peer review, a variation on the widespread use of single- and double-blind refereeing processes in most economic journals where the identity of both authors and referees is common knowledge throughout the refereeing process. Often, open peer review is chosen because it promotes a complete transparency and makes all parties fully responsible in that process. However, our reason for opting for open peer review is more instrumental and pragmatic. Since the refereeing process in the social sciences is part and parcel of the process transforming newly discovered results into the body of accepted scientific knowledge (basically the stock of articles and textbooks published), open peer review is an ideal instrument to highlight how new discoveries are integrated and streamlined into the existing knowledge stock.

This special session involved a four-phase process. First, a set of scholars, (i) Lilyan Fulginiti, (ii) Quirino Paris and (iii) Rolf Färe and Shawna Grosskopf, were invited in early January 2005 by the session organizers to address a common research question with a common set of data available to them. These scholars were allowed to recruit collaborators, with Alejandro Onofri joining Lilyan Fulginiti, and Dimitrios Margaritis joining Rolf Färe and Shawna Grosskopf, and Quirino Paris elected to go at it alone!

The second phase involved the special session at EWEPA9 where the three teams presented their "finished papers" to the conference audience in an effort to initiate an open discussion on the scope of the adopted approaches and the resulting empirical results and policy conclusions. The third phase was the start of the open peer reviewing process based on (i) an explicitly solicited set of referees contacted by the session organizers with relevant expertise for the research question, the theoretical modeling, and on methodologies in applied economic analysis, and (ii) unsolicited members of the audience interested in participating in the discussion. Many of the solicited referees were also present during the special session. This phase has led to a series of written and signed reports with comments and suggestions on some or all of the presented papers. The final phase of the process involved the authors preparing a series of formal responses to the open peer review reports.

This special issue assembles the (i) initial manuscripts as presented on the conference, (ii) the open referee reports received in the subsequent phase, and (iii) the authors' replies to these open referee reports. The availability of the referee reports is the essence of the open peer reviewing process with the clear separation between initial manuscripts and the replies to the referees shedding light on the context of discovery. It is the closest we can possibly get to revealing the exchange between authors and referees in any ordinary refereeing process.

This introductory essay addresses what we mean by the context of discovery in the next section followed by a description and clarification of the pros and cons of open peer review, a procedure that seems to be almost unknown presently in the economic discipline. We then present the common research question and the common set of data available to the research teams. The penultimate section offers a comparative analysis of the contributions of the manuscripts followed by our concluding comments.

2 The context of discovery in economic research

The context of discovery is a term borrowed from the philosophy of science, where it is invariably opposed to the context of justification. Most often, this distinction between context of discovery and context of justification is attributed to the work of Reichenbach (1938), a distinguished positivistic philosopher of science who in his early years was related to circles linked to the Wiener Kreis. However, the same distinction did occur in the works of earlier writers like Popper, Carnap, Schlick and others (see Hoyningen-Huene 1987).

Although not all of these writers offer exactly the same meaning to this distinction (Hoyningen-Huene 1987), in the current context we want to employ this distinction to denote, on the one hand, the historical process of discovering a new element of scientific knowledge and, on the other hand, the historical process of justification of this same discovery. Although one frequently pretends the first process precedes the second, it is often the case that both processes are deeply intertwined. The context of discovery can include, among others, the various sources of inspiration and creativity that lead to the formulation of certain hypotheses, the structured contacts and spontaneous social interaction within a research team that further lead to the discovery of certain results. The context of justification consists of the attempts to rationally reconstruct the newly discovered theory-laden facts and hypotheses against the existing background of knowledge and carries mostly a normative connotation. It is all about validating the new

knowledge with respect to a given body of knowledge in a field.

Economic methodologies attempt to formulate the philosophical basis for the validation and justification of scientific procedures in economics, thus focusing on the context of justification while mostly ignoring the context of discovery. To provide one example, Blaug (1980), in an influential book in the best of the Popperian tradition, insists on the use of a falsificationist methodology, whereby the focus is on purposively trying to falsify conjectures and to build new formulations starting off from any eventual refutations. An open question is whether such general principles (or any other similar book in the literature for that matter) offer adequate guidelines for the applied economist. To this purpose, some economic methodologists have attempted to be more specific on the role of mathematical modeling and statistical estimation in economics. For instance, Dharmapala and McAleer (1996) try to define the role of econometrics and its relation to economic theory in what they see as mainstream methodologies.[1]

These authors distinguish between three main approaches. First, the traditional Cowles Commission approach sees economic theory as a priori true and the role of econometrics is then simply to estimate unknown parameters. Second, the instrumentalist approach associated with Friedman (1953) sees economic theory as a useful fiction and the key role of econometrics is to test theories in terms of their predictive power. Finally, the falsificationist position forces economic theory to formulate potentially falsifiable conjectures that can be put to a test by econometrics. We do not pretend that this article contains the final word on the precise role of economic theory and econometric modeling, estimation and testing, but we are convinced that these distinctions can prove helpful when reading the contributions to this special issue.

3 Open peer review: a brief description

Single- and double-blind refereeing processes are the dominant modes of quality control in academic publishing. The recent advent of web-based journals has led to new questionings of this ancient model and has opened up a whole range of alternative modes of control for scholarly journals. Also the open-access movement has, amongst others, led to question traditional modes of governing journals (e.g., Chesler 2004 or Wellen 2004). The academic journal *Behavioral and Brain Sciences* has been functioning for decades under open peer review. More recently, *British Medical Journal*, *Nature* and others have moved towards this mode of operation. Finally, new Internet journals like *Atmospheric Chemistry and Physics* and *Electronic Transactions on Artificial Intelligence* have equally adopted open peer review as at least part of their refereeing process (Gura 2002).

Single- and double-blind refereeing processes streamline the story and leave out the trials and errors on the way to the finished product. Often these are hidden in footnotes, implicit statements, or, at worst, in letters and exchanges between authors, referees, and editors that are never published. The open peer review is a mechanism bringing the entire refereeing process into the open (see Gura 2002 or Williamson 2003, for a general discussion). As such, the refereeing process is central to the context of discovery. This interesting alternative to single- and double-blind refereeing has been ignored in economics.[2]

A frequent argument against the open peer review format is that junior scholars may be apprehensive critiquing the work of more senior scholars for fear of retaliation (a perceived danger that is particularly pronounced in specialized journals). In instances where careers depend on the acquisition of grants, the concern for reprisals can loom as a significant factor in deciding whether to contribute as an open peer reviewers.

In direct response to such concerns, Smith (1999) summarizes evidence from several trials showing that open peer review does neither improve nor deteriorate refereeing quality: this is why the *British Medical Journal* in the end adopted open peer reviewing for purely ethical reasons.[3] Indeed, ethical reasons linked to an increased accountability of referees (but also editors), the eventual availability of the complete publishing history of manuscripts, identification of both poor and excellent reviewers, loom large in this debate (see Turner 2003). However, a final verdict on the viability of open peer review as a refereeing procedure for general or specialized scientific journals is unnecessary for our purpose, since in our case its use is purely instrumental.

4 The experiment

This unique scientific event commenced in early January 2005 when the three teams of scholars commenced their respective investigations of a common research question, *What are the policy impacts of research and development*

[1] See Mirowski (1995) for a complementary view on testing in economics.

[2] In this same context, it is probably worthwhile mentioning that medical journals have paved the way by developing explicit policies about declaration of competing interests for editors, authors and reviewers.

[3] Bingham et al. (1998) found similar results in a trial study for the *Medical Journal of Australia*.

on US agricultural productivity patterns? using the same data series on aggregate US agricultural production, and to present their efforts at a special session of the EWEPA9. The invitees were free to confront the common question as they saw fit and were not instructed or coached to pursue a particular methodological framework.

These data were compiled in two phases. The core of the data series provided was developed by Thirtle et al. (2002) (henceforth TST) and David Schmmelpfennig was gracious to share their data series which runs from 1880 to 1990 for use in this project. The TST data series include input prices and quantity indexes for land, labor, fertilizer, and machinery using USDA and US historical statistical sources. TST also compiled indices on public R&D expenditures, private R&D expenditures and public extension indexes for the same time period using Huffman and Evenson (1993) with extrapolation.

The TST series is augmented with a series we assembled from similar sources on farm output prices and quantities indices. Two outputs are specified: (1) Livestock and Products, which includes meat animals, milk cows & poultry and (2) Total Crops, which include feed grains, hay and forage, food grains, vegetables, fruits and nuts, sugar crops, cotton, tobacco, and oil crops. An aggregation of these two outputs is also presented. This series runs from 1910 to 1990 and these data and their documentation are available in Appendices A and B at the end of this issue.

These finished papers were presented to EWEPA9 participants in an extended session that included an invited discussion by Steven Buccola as well as open discussion from the audience which was recorded to account accurately for what transpired. Within a few weeks after the presentation of these papers, the open peer reviewing period commenced. An invitation was extended to a collection of referees with expertise on the context of the research question, the theoretical modeling, and on methodologies in applied economic analysis. We acquired seven different sets of open peer reviews. The guidelines to the referees were drawn from the format used in *Behavioral and Brain Sciences*; specifically,

- Do not devote the limited space in your commentary to repeating the content of the initial articles. All in all, commentaries should be no more than 1,000 words.
- Redundant portions (with the initial articles or with other accepted commentaries) would be deleted by the organizers. The organizers also reserve the right to edit commentaries for relevance, style and deportment.
- In the interest of speed, commentators will only be sent the edited copy for review when there has been a major editorial change. Commentators are asked to carefully check the final draft of their remarks which they wish the authors to respond. Only small non-substantive corrections that would not impact the author's response may be possible at a later stage.
- All open referee reports are reviewed editorially.

The final phase of this event was to invite the authors to prepare formal responses to open peer reviews. The authors had the liberty to express and defend themselves as they saw fit. Authors were encouraged to represent a balance between integrating the general themes in the commentaries and providing specific, thorough replies to the substantive points made (again drawing heavily on the guidelines from *Behavioral and Brain Sciences*).

5 Comparative analysis of the contributions

The three contributions present a broad range of approaches to modeling production decision making with a view toward the contribution of R&D. Färe, Grosskopf and Margaritis undertake an index number approach using an approximation to the Luenberger productivity indicator know as the Bennet-Bowley indicator, followed by a time series analysis of the indices. The indices generated suggest sluggish growth. These authors then undertake an interesting investigation into the time series character of productivity growth and R&D expenditures series. Even when we ignore the potential R&D spillovers across sectors and restrict analyses to one sector's R&D and productivity growth, initiatives to engage in R&D may arise from a need to enhance productivity growth. However, productivity growth implies resource use decisions affecting the quantity of resources available for investment in R&D, in particular, and activities, in general. Thus, it is reasonable to consider the prospect that there is a simultaneous relationship between productivity growth and R&D expenditures. Baumol and Wolfe (1983) develop an analytical characterization of such a feedback between R&D and productivity growth that points out some dynamic disincentives of R&D. When R&D succeeds in increasing productivity growth, it automatically increases its own relative costs in comparison with production cost leading to a reduction in the financial incentive of the R&D investment. Thus, the success of R&D activity serves to undermine its own demand. Unfortunately, the more impressive the record of past success of R&D activity the more strongly it tends to constrain private demand for R&D. In addition, autonomous levels of R&D expenditures maintained at significant levels that are unresponsive to budgetary pressures facing the private providers of R&D tend to discourage a strong presence of the private sector R&D. The private sector can free ride off the autonomous R&D activity in times of budgetary pressures implying the private sector will not reinitiate its R&D efforts until well

after the financial pressure has lifted. Periods of sluggish productivity growth may be a foreseeable consequence of the incentive mechanism for R&D.

Onofri and Fulginiti address the impact of public R&D and private infrastructure on the performance of the US agricultural sector by acknowledging the provision of non-rival (public) goods to rationalize the private and public decision making. A dynamic dual model of cost minimization is used to explain growth based on the existence of public inputs. Firms are minimizing intertemporal costs of production and the social planner is maximizing the intertemporal welfare using the *AK* model of endogenous growth (Barro 1990), where nonconvexities are explained by the presence of non-rival inputs and serve to rationalize the public provision of non-rival inputs. Branching out to include a data set covering the period 1948–1994 with a data set constructed by Ball et al. (1997), they pose the hypotheses that (1) increasing returns to scale are present for all inputs (private and public), (2) there is a positive impact of additional public inputs on the long-run demand for private capital, and, and (3) there is a negative impact of public inputs on total costs. On average, an additional dollar spent on public R&D stocks reduces costs by $6.50, implying a rate of return on to public R&D of 1990%, while the rate of return on public infrastructure investment offers a negligible rate of return. They find evidence of positive effects of public inputs on the steady state level of private capital, positive endogenous prices for R&D and public infrastructure and increasing returns to scale. However, the results are sensitive to the data series used.

Paris parts company with the other contributions by starting off with the assumptions: (1) technical progress is induced by price changes and (2) the data are necessarily flawed. The question of growth is interpreted in terms of innovation and the directions innovations take in terms of how inputs are used. Mixing the price-induced theory of technical progress with explicit account of the errors-in-variables problem, Paris develops the comparative static analysis of the primal-dual relationships. Three models of increasing complexity are estimated. The core notion focuses on prices playing the double role of signalling information on factor scarcity as well as encouraging the development or adoption of new technologies (or, technologies new to the firm). The first, benchmark model takes technical progress driven by price-induced forces, with no impact of R&D and extension expenditures on technical progress. The second model includes a lagged relationship between prices of expected inputs attributed to price-induced technical progress and expected relative prices, as well as the public and private R&D and extension expenditures as explaining the input decisions interplay with the PITP hypothesis. The final model specifies a lagged structure of all prices to the modeling of price-induced technical progress. The analysis presents both a price-induced technical progress impact as well as factor bias results. The model specification leads to different conclusions about the character of technical progress. For example, technical progress is land-using (but falling over time) in the benchmark model but land-saving in the most general model specified.

6 Concluding comments

On their own, each of the articles offers unique perspectives on how the research question can be addressed. However, the full richness of this issue is realized when the reader takes on the collection of the manuscripts jointly with the commentary and rejoinders, one starts to catch a glimpse of "scholars at work". We hope this collection of articles and comments contributes both to illuminate the context of discovery in applied economic production analysis and to transfer academic expertise towards novice researchers. If on top of all this it also could catalyze the debate on the refereeing process in economics, then we would consider our project to be a complete success.

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