The Challenges of Productivity Measurement — Review Article on *The Measure of Economies: Measuring Productivity in an Age of Technological Change*

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Abstract

This is an important book about an immensely important topic—productivity measurement. The editorial and author team, comprising some of our strongest experts on the subject, have compiled a collection of chapters that is both eclectic and timely. They marshal theoretical and empirical analyses to explore a wide range of issues now confronting researchers and practitioners. The chapters describe not just how measurement works at present, but also how things *might* be done better (often offering practical approaches for getting to that point). The book's target audience includes researchers, measurement practitioners, and specialized business- or government-sector analysts whose work involves productivity issues. It would serve as an excellent primer for those entering the productivity-analysis sphere, while at the same time offering something to the most seasoned experts. Overall, the volume can serve as a guide in the continued effort to improve productivity measurement.

Part of my job as a reviewer of *The Measure of Economies: Measuring Productivity in an Age of Technological Change* has been taken care of before I begin. I do not need to convince readers of the *International Productivity Monitor*, of all publications, about productivity's importance in determining the economic fortunes of people, businesses, and economies. The same could be said about the significance of accurate productivity measurement to economists, business people, and policymakers alike. All this would be preaching to the choir.

This is an important book about an immensely important topic. It should be

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read—and read closely—and can serve as a reference for years to come. Editors Marshall B. Reinsdorf and Louise Sheiner, along with their assembled team, embody an enormous amount of individual and collective talent. The volume harnesses their intellectual capabilities to explore and explain the many ways productivity measurement is being and should be done. ("Is being" and "should be" are not always the same, often for understandable reasons. One crucial function of the book is to explain where practice falls short of its conceptual ideal and why.) The result is a book filled with the accumulated knowledge and experience of some of our strongest experts in productivity measurement.

So, this book should be read. By whom is a bit more open for discussion. This is not an airport-bookstore tome. While perhaps not quite as technical as the median paper in an academic journal, much of the book's content operates near the level of a 400-level specialized undergraduate course, and some parts could easily fit into a PhD sequence. This not a critique (blessed is any popular-science writer who could make a book on productivity measurement an airplane page-turner), but rather guidance as to the intended audience.

For those equipped to handle this level of technical detail, the book conducts an excellent tour of many facets of productivity measurement. The target audience includes researchers, measurement practitioners, and specialized business or government analysts whose work involves productivity issues. The book would serve as an excellent primer for those entering the productivity-analysis sphere, while at the same time offering something to the most seasoned productivity experts. The breadth of the measurement issues covered within (perhaps not comprehensive, but moving in that direction) exceeds the knowledge of almost any individual. It certainly far exceeded mine.

A Summary

Reinsdorf and Sheiner have thoughtfully curated the covered topics. The areas aim at today's measurement and research needs while at the same time spanning some classic issues in productivity theory and empirics. (Perhaps their unfading relevance is why they are classics.) Indeed, if I were to ask myself what topics any course of study into measuring productivity these days should cover, the resulting list of desiderata looks awfully similar to a browse through the book's table of contents.

Chapter 1 Written by Karen Dynan (Harvard and the Peterson Institute for International Economics) and Louise Sheiner (Brookings), this logical leadoff uses economic theory to explain why growth in output per worker—labour productivity—is a good proxy for the change in average economic well-being in an economy. There is, of course, a long history of discussion inside and outside economics about the shortcomings of using GDP as a measure of welfare. These critiques apply to productivity as well, where output is the numerator—and arguably to the inputs in productivity's denominator, too. A common rejoinder is empirical: seemingly more inclusive welfare metrics end up highly correlated with GDP anyway. This chapter goes further,

showing theoretically that real output and productivity growth actually capture better than one might think the more expansive concept of welfare (essentially, the collected area between the demand and supply curves of every produced and consumed unit of every product).

Chapter 2 Brent R. Moulton (formerly Bureau of Economic Analysis) offers a very useful update on how the BLS's price-measurement programmes have changed in the years since the Boskin Commission. The Commission argued that shortcomings in price-index measurement implied true economic growth was being understated by more than one percentage point per year—about one-third of average reported real GDP growth at the time. After sketching the basic structure of the BLS price-measurement apparatus, the chapter details changes undertaken in response to the Commission's report and estimates how much they affected reported price indexes. Ultimately, the chapter surmises that these changes have brought inflation overstatement (and hence output-growth understatement) down from the Commission's mean estimate of 1.1 percentage points per year to 0.8 percentage points. (Of course, this implies that productivity and real-income growth are also both 0.8 percentage points higher per year than measured.)

Chapter 3 Carol Corrado (Georgetown) reckons with the effects—on both the numerator and denominator of the productivity ratio—of failing to account for intangible capital in a way consistent with our treatment of physical capital. Recent efforts, including the *System of National Accounts 2025* as just adopted by the UN Statistical Commission (editor Marshall Reinsdorf was an important contributor on valuing data assets), have brought some once-intangibles such as R&D and software into national accounting. This has been hugely beneficial, and other expansions are being considered. At the same time, producers still apply many resources to building what are conceptually capital inputs but are not counted as such (e.g. organisational capital, brand, supply-chain relationships). At creation, these intangibles are output in concept but not recorded as such; later, when applied to production, their use as factor inputs is ignored and their product attributed instead to productivity. The chapter exposits this and sketches potential magnitudes across different intangibles, stressing that some forms (or former intangibles such as R&D) are expressly aimed at raising productivity.

Chapter 4 Using a combination of empirics and theory, Diane Coyle (Cambridge) discusses the ways specific products influence productivity and its measurement. Three threads run through the chapter: (i) product churn affects the mechanics of price-index measurement and yields systematic biases; (ii) quality changes within products affect welfare and require special treatment; and (iii) the span of products available is itself a direct determinant of welfare and productivity. The first two deal with how product-level changes must be handled to obtain accurate price deflators for aggregate output; the third explores constructing output metrics that capture the direct effects of product-variety changes.

Chapter 5 David M. Byrne (Federal Reserve Board) investigates the most salient

aspects of productivity measurement in digital-goods industries. Rapid technological progress, high product churn, and wide price swings introduce numerous measurement challenges. After showing how fast these industries have grown—implying their increasing weight in productivity aggregates—the chapter lays out the many data and methodological hurdles and explains where current practice falls short. IT capital and digital services receive special attention.

Chapter 6 Authored by Louise Sheiner and David M. Cutler (Harvard), this chapter is another deep dive into an important but hard-to-measure sector—healthcare. The sector is enormous and still growing as a share of the economy, so its productivity matters greatly for aggregates. The authors argue that the sector's reputation as a productivity laggard is not justified. They grapple with measurement difficulties and explain how current approaches likely understate productivity growth, especially once quality changes in both inputs and outcomes are recognized. Other difficulties—such as the sometimes long lag between expenditures and health outcomes—are also considered, and the chapter closes with suggestions for improvement.

Chapter 7 Nicholas Z. Miller (Carnegie Mellon) steps outside traditional national accounting and considers how environmental goods might be treated alongside standard products in output and productivity measurement. The chapter lays out a growth-accounting model of environmentally-adjusted output that subtracts pollution "bads" from goods output. Quantifying the model with the empirical literature on air-pollution damages, the chapter calculates an environmentally adjusted total-output series for recent decades. The differences from reported GDP are profound. For example, while GDP growth averaged 2.3 per cent per year from 1957–1970, environmentally adjusted growth averaged only 1.1 per cent. By contrast, the pollution reductions following the Clean Air Act Amendments raised environmentally adjusted growth to 2.4 per cent per year over 1971–2016 versus 1.6 per cent for GDP. The chapter recommends ways to implement environmentally adjusted accounts.

Chapter 8 Erica L. Groshen (Cornell), Michael W. Horrigan (Upjohn Institute), and Christopher Kurz (Federal Reserve Board) close the book by confronting the practical realities of productivity measurement as traditional survey methods show fissures and outright breaches. After laying out conceptual issues in using alternative and non-traditional data sources, the chapter inventories approaches that statistical agencies have already adopted—e.g. a new car-price index from J. D. Power, detailed medical-records-based healthcare prices, and credit-card data to measure services. It then considers potential restructurings of the US federal statistical system.

Some Overarching Reactions

As different as the book's individual chapters are, certain thoughts arose repeatedly as I read.

One is—*not to put too fine a point on it*—that I have spent a considerable portion of my research career avoiding the various conceptual, theoretical, and practical

measurement considerations exposited in the book. In many of my studies I chose market settings where tricky considerations are ameliorated by the market's attributes, focusing on products where quantity and price data exist for easily comparable units: cubic yards of ready-mixed concrete, square feet of hardwood plywood, yards of 100-count cotton yarn, and so on.

That is great work if you can get it. Most productivity practitioners do not have this luxury, particularly statistical agencies that must deliver productivity metrics for the entire economy and virtually every major industry. There are markets with outputs so heterogeneous that direct unit comparison is impossible (e.g. passenger aircraft), markets with no clear countable units (e.g. business consulting), and even sectors where defining the output is hard (e.g. insurance). Moreover, output is merely the numerator of productivity; input quantities must also be measured well. Without applying the approaches discussed in this book, we would never be able to measure progress in measuring progress.

A second observation is how much productivity measurement is actually about *price* measurement. Conceptually, the dual tells us that productivity growth can be measured either via quantities or via prices. Yet practitioners rarely have both quantity and price data in buckets ready for use; they usually observe expenditures. To use quantities they must first divide expenditures by prices. Thus, whichever side of the dual one chooses, price measurement is inescapable.

Third, product composition matters—a lot, even within industries. The old defence that idiosyncratic micro factors cancel out at the macro level has never held for productivity measurement. For instance, non-random product entry and exit can bias price indexes, and the scope of product variety itself is in the productivity metric, while rapid technological progress and product churn in IT raise a surfeit of measurement issues.

Fourth, given the manifold difficulties in translating concept to practice, it is remarkable that our statistical agencies deliver productivity-growth metrics that are even approximately right. Yet they cover a broad set of sectors, strive to implement best practices, and do so with what appear to be very limited resources.

Where to Now?

The book makes two points simultaneously through the breadth and depth of its coverage: first, we have a lot of work to do; second, we have made a lot of progress. Many places remain where measurement falls short of the theoretical ideal, but imperfect measures still capture much and are less imperfect than they used to be. Going forward, the solid—if yet unattained—conceptual foundations of ideal measurement mean we know where the holes are. That directs our efforts as we work to fill them. I have no doubt this book will serve as a guide in those endeavours.