Old and New Asset Boundaries: A Review Article on *Measuring Capital in the New Economy*

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ABSTRACT

In modern economies, technical change is rapid and competitive edges of companies are closely related to 'intangible' capital. While some intangibles are covered by established capital measures in the national accounts, many are outside the measurement boundary. The NBER volume at hand brings together the most up-to-date empricial and conceptual work that aims at measuring intangibles comprehensively. The different articles show that there is neither a single definition nor a single method to measure intangibles. This is not surprising given the very nature of these assets. The many challenges for measurement also mean that more work needs to be done before considering a broad set of intangibles assets for recognition in the national accounts. This reduces in no way the value of current and future research on the issue and the NBER volume constitutes an excellent reference for analysts and national accountants.

THE VOLUME, *Measuring Capital in the New Economy*, edited by Carol Corrado, John Haltiwanger and Daniel Sichel and published as part of the NBER series on Studies in Income and Wealth, represents a valuable collection of papers.[2] The theme of the volume is capital measurement in modern economies characterized by rapid technical change and where the competitive edge of companies is more closely related to 'intangibles' than to 'brick and mortar' types of assets. In this context, difficult measurement issues arise. The papers in the volume raise the right questions, provide some answers and show the way for future research.

No review of reasonable length can do justice to all the material contained in this volume. I shall therefore focus on several issues related to the national accounts and productivity measurement. I have identified five, but there are many more and that the usefulness of the book is in no way limited to the points made below.

A Confirmation: Intangibles Are Hard to Define and Measure

The main contributions of the volume are twofold: it provides an analysis of the role of intangibles, and it develops a series of techniques for their measurement. Any discussion of intangibles must begin with a definition and the contributors use different definitions of intangibles and emphasize different assets. Probably

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2 Carol Corrado, John Haltiwanger, and Daniel Sichel, editors *Measuring Capital in the New Economy*. Series: (NBER-IW) National Bureau of Economic Research Studies in Income and Wealth, Cloth $99.00 ISBN: 978-0-226-11612-9 (ISBN-10: 0-226-11612-3), 2005, 552 p.

the most comprehensive concept is put forward by Carol Corrado, Charles Hulten and Daniel Sichel (Chapter 1). They cut through the conceptual problem of defining intangible assets by referring to a standard inter-temporal framework that leads to the conclusion that '*any* use of resources that reduces current consumption in order to increase it in the future [...] qualifies as an investment'. Then, all types of capital should be treated symmetrically, for example, 'investments in knowledge capital should be placed on the same footing as that of investments in plants and equipment'. Obviously, this leads to a very broad scope for capital measures, encompassing for example intellectual and human capital, but also organizational assets.

The authors do a remarkable job in their effort to value these assets empirically and show that the inclusion of intangibles into economic accounting could substantially alter pictures of growth and productivity. They estimate that business fixed investment in intangibles was in the order of $1 trillion annually by the end of the 1990s, or about 10 percent of U.S. GDP of which only around 2 percent are presently included in the U.S. national income accounts. As a rule of thumb, the authors indicate that business investment in intangibles roughly matches investment in tangibles. In terms of effects on measured real growth of nonfarm business output, the authors' estimates range between a very limited effect (0.01 percentage points per year) to a rather sizeable estimate of 0.25 percentage points per year in the late period 1995-02, depending on the deflators used in the calculation. Labour productivity growth would change accordingly.

A convenient consequence of the Corrado, Hulten and Sichel approach and their emphasis on the symmetric treatment of all assets is also that one does not have to worry too much about defining 'intangibles' by way of specific characteristics. It is more important to reason in terms of capital goods and to check whether spending activity meets the test of being an outlay now to enhance future consumption.

Other contributors to the volume adopt a different perspective and emphasize intangibles because they are inherently *different* from machinery, equipment or structures. The papers by Jason Cummins (Chapter 2) and by Baruch Lev and Suresh Radhakrishnan (Chapter 3) on organizational capital are cases in point. For example, they define organizational capital (a prominent type of intangibles), as 'whatever makes installed inputs more valuable than uninstalled inputs' (Cummins, p. 50) or '[...] the agglomeration of technologies – business practices, processes and designs, and incentive and compensation systems – that together enable some firms to consistently and efficiently extract from a given level of physical and human resources a higher value of product than other firms find possible to attain' (Lev and Radhakrishnan, p. 74). Lars Hansen, John Heaton and Nan Li (Chapter 4) connect intangibles to firm-specific risk, thereby differentiating them from traditional assets. There are implications for valuation and measurement when companies cannot order or hire intangibles such as organizational capital, as they do the usual factors of production.

Not surprisingly, those authors who assign intangibles such as organizational capital a special, and inherently different, role from traditional assets use specific methods to value them. They typically employ econometric techniques whose specification rests on the specific way in which intangibles are thought to interact with other capital goods or with output. Cummins treats intangibles are like adjustment costs in a model of investment and then estimates them econometrically. The basic idea is that investment in organizational capital, just like adjustment costs, has to be undertaken to make other assets productive, and that investment in organi-

zation assets is costly. For example, the adjustment costs of training workers to use new equipment or of integrating old and new equipment create intangible capital. In equilibrium, a cost-minimising firm will invest up to the point where the returns on the intangible asset equal the marginal adjustment costs. Empirically then, the estimated marginal adjustment costs will inform about the return to organizational capital. Lev and Radhakrishnan also use an econometric approach but explicitly introduce the sales, general and administrative spending of firms as a variable to capture movements in organizational capital. John Abowd, John Haltiwanger, Ron Jarmin, Julia Lane, Paul Lengermann, Kristin McCue, Kevin McKinney and Kristin Sandusky (Chapter 5) use firm-level data and develop an econometric approach towards measuring human capital and its link to productivity growth. Thus, where the special role of intangible capital is the basis for investigations, almost inevitably, measurement techniques are complex. The Corrado-Hulten-Sichel approach does not require explicit econometric techniques and would thus appear more practical from the perspective of monitoring intangibles as part of a periodic measurement program carried out by a statistical office.

In the current revision of the 1993 System of National Accounts (European Commission, IMF, OECD, UN, and World Bank, 1993), the classification of assets has been under review.[3] It has been decided to abandon the adjective 'intangible' because it was concluded that there was no clearly defined common characteristic for the assets hitherto subsumed under it. Also, the scope of intangibles in the 1993 SNA had been significantly narrower than the scope of intangibles presented in the NBER volume and so the SNA 'intangibles' did not do justice to the economic debate surrounding them.

Implications for Productivity Measurement

Progressively, national statistical offices have come to integrate multi-factor productivity (MFP) measures in their statistical work program.[4] Estimating MFP entails measuring capital input, which in turn requires computing a price of capital services as described, for example, by Dale Jorgenson, Mun Ho and Kevin Stiroh (Chapter 11) and Erwin Diewert (Chapter 12). Schematically, the price of capital services is composed of a rate of return (r) a rate of depreciation (δ) and a rate of asset price change (ζ). While there is typically direct information on depreciation and asset prices, the rate of return has to be imputed. Diewert discusses several methods of imputing such a rate of return. The most common approach, also employed in Jorgegson, Ho and Stiroh, is to choose the rate of return 'endogenously' such that the price of capital services, multiplied by the value of the capital stock exactly exhausts the gross operating surplus (GOS) as shown in the national accounts. Thus, GOS = $(r+\delta-\zeta)pK$ so that $r = GOS/pK-\delta+\zeta$ is an endogenous rate. It is apparent that the rate of return varies directly with the size of the *measured* capital stock (K). If there is *unmeasured* capital, as would be the case in the presence of intangibles that are not part of the traditional scope of capital, the measured rate of return would be overstated.

While this overstatement could be used as a practical argument in favor of imputing a rate of return that is not dependent on the scope of capital stock measures, there are other arguments for an exogeneous rate of return (see Diewert in Chapter 12 and further in Oulton (2007) or Schreyer (2007)). Unfortunately, there is no easy solution to this issue. Those implementing capital services measures can draw several lessons: the endogenous rate of return should be inter-

3 For more information on the SNA Revision, see http://unstats.un.org.

4 See for example OECD (2006) for a presentation of MFP measures published by official statistics.

preted as a rate of return *conditional on the scope of assets* chosen in measurement; and comparisons across firms, industries or countries should be made with caution.

Another measurement issue that can arise in conjunction with intellectual property assets is that investment in such assets is typically done in pursuit of temporary monopoly rights, which may be formal (legal protection of intellectual property rights) or informal (secrecy). Temporary or lasting monopoly rights on product markets are, however, at variance with the competitive model of producer behavior that underlies many models of productivity measurement. Diewert (Chapter 12) makes this point and Diewert (2007) argues that 'innovation almost always involves noncompetitive pricing and monopolistic markups'.

Diewert also points out that it is obsolescence, not wear and tear, that affects the depreciation of produced intellectual assets, with possible implications for measuring stocks. Thus, more general versions of the standard growth accounting model may have to be used to accommodate market imperfections associated with intangibles. At the same time, error margins in the estimation of intangibles are large, and it is unclear whether the finer point of positive mark-ups should play a large empirical role in aggregate productivity measurement. If not, one may be justified in neglecting this factor in developing first approximations for the measurement of MFP with intangibles à la Corrado, Hulten and Sichel.

R&D: a Prominent Type of Intangibles

Official statistics have started tackling measurement of intangibles, albeit prudently, due to the many uncertainties involved. The most prominent intangible investment is R&D expenditure whose capitalization has now made it into the revised 1993 System of National Accounts to be released in 2008. The integration of R&D capital assets will start by way of satellite accounts before full integration into the core of national accounts. Barbara Fraumeni and Sumiye Okubo (Chapter 8) show in some detail how an R&D satellite account can be constructed and the effects of capitalizing R&D on measured output, investment and government consumption in the United States. Work of this kind is tremendously helpful for statistical agencies that are just beginning to work in this area. Despite progress, many problems remain.The most important are the choice of service lives for R&D assets, the choice of deflators to measure constant-price investment in knowledge, and the decision on how much of an observed R&D expenditure flow should be capitalized and how much continued to be treated as current expenditure.

Fraumeni and Okubo also discuss the issue of international flows of R&D. On the basis of available data, they estimate that in the United States, these flows represent well under 0.5 per cent of total R&D expenditure. However, this share is likely to be higher in smaller economies with large multinational enterprises such as the Netherlands or Switzerland. The latest data for the United States show that the effects can also be sizeable in a large country (Yorgason, 2007). Large enterprises are big players in performing R&D. They are also most prone to operating internationally, often with R&D activity centralized in one location. How to identify and to value R&D expenditure that is carried out in one location and then traded or transferred internationally is a serious challenge for statisticians. In particular. imports appear difficult to measure, given current statistical sources. More work, also at the international level, will need to be undertaken in this area.

Should More Intangibles be Brought into the National Accounts Asset Boundary?

Given the importance that virtually all contributions to the volume attach to various types of intangible assets, one might think that this would imply a call for as wide an asset boundary as possible in the national accounts to systematically recognize intangibles. It is interesting to observe that many of the authors and commentators in the volume do not jump to this conclusion, partly for conceptual reasons, but mainly because the empirical basis for inclusion is too weak.

In Chapter 6, Sandra Black and Lisa Lynch use a helpful typology developed by Blair and Wallman (2001) that classifies intangibles into three categories, each with more measurement problems than the next: assets that can be owned and sold (category 1); assets that can be controlled by a firm but not separated out and sold (category 2); and assets over which a firm has only partial control (category 3). These categories can provide guidance to the feasibility of integrating intangibles into the national accounts. For example, the further one moves from category (1) towards category (3), the more assumptions that have to be made to justify the valuation of intangible assets by their input costs.

It is important to stress note that what is typically observed and measured is expenditures for *inputs* into an unobserved production function of the intangible asset, not the intangible asset itself. For example, when cumulating expenditure for R&D to construct an R&D asset, the assumption is that the 'knowledge' or blueprint asset produced by those who perform R&D investment, is worth the cumulated costs for its production. This may or may not be a good approximation to the discounted flow of future benefits from the knowledge asset which would be the conceptually correct basis for its valuation. R&D is probably still an asset located somewhere between categories (1) and (2), justifying its recognition in satellite accounts and ultimately, in the core national accounts. Some categories of intangibles, in particular software are of ready recognized assets. Indeed, software is a good example of a category 1 intangible. Bruce Grimm, Brent Moulton and David Wasshausen (Chapter 10) provide an excellent discussion of how software, along with information processing equipment was brought into the U.S. National Income and Product Accounts.

Mark Dom's work on prices of communication equipment (Chapter 9) reminds us that even for assets whose recognition as produced assets in the national accounts is beyond doubt, more needs to be done to correctly gauge developments in prices and volumes. After examining the existing information on communication equipment prices, Doms constructs an experimental overall price index for communications equipment under 'conservative', 'moderate' and 'aggressive' assumptions. Even under the 'conservative' scenario, he comes up with price declines that clearly exceed those in some of the official price indices for the United States. No doubt, the same would be true for many other OECD countries. By implication, measured real investment in communication equipment would have been understated.

Intangibles Within the Asset Boundary

The chapter by Jorgenson, Ho and Stiroh's on the growth of U.S. industries stays within the asset boundaries of the current national income accounts and yet has much to say about intangibles. First, it provides measures for the information technology content of production, broken down by industry and examines the respective contribution of IT and non-IT industries to growth. Second, it presents new estimates of labour input by industry, based on the work first

undertaken by Jorgenson, Gollop and Fraumeni (1987). Labour input measures take account of the compositional change in hours worked, by weighting each category of labour with its price, itself taken to reflect the marginal productivity of each type of worker. Behind it lies the idea that workers invest in their human capital, for example through education, and returns to human capital are reflected in wages. This human capital measure is different from the one computed by Corrado, Hulten and Sichel (Chapter 1) in several aspects: Jorgenson, Ho and Stiroh's human capital is part and parcel of labour input, and transactions are measured in terms of the price for human capital services (equal to wages by type of worker). The productivity-related characteristics of workers are such as experience and educational attainment reflect the investment decisions by workers rather than by firms. Corrado, Hulten and Sichel estimate the firm-specific accumulation of human capital through transactions on the input side (e.g., training expenditure). The stock of this intangible is thus not part of labour input. The two approaches do not appear to be contradictory. but it may be worth investigating further how firm-specific training would be dealt with in a Jorgensonian framework and what the implications are for resulting measures of inputs and productivity.

Conclusion

This volume is an excellent reference for the many issues associated with capital measurement, and with the measurement of intangibles in particular. It brings out boundary issues for national accountants that are difficult to tackle. But ignoring them would be worse given the important role of intangibles in modern economies. A central piece of information needed for capital measurement is the economic service life of assets and its trend over time. Thus, more empirical information is needed to improve existing capital measures. But empirical information on service lives for intangibles can also help alleviating some of the boundary decisions. For example, if there is evidence that the service life of the brand equity asset generated through advertising investment is short (maybe even less than a year) or significantly longer, this information can help in the decision of whether it should, or should not, be recognized as an asset. More generally, our deficient knowledge about intangibles should not discourage efforts from improving it. The papers in this NBER volume show that progress can indeed be made.

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