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David Thorns

Les Oxley

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National Accounting Frameworks for Measuring Information and Knowledge Economies

David Thorns^a and Les Oxley^b

^aSchool of Sociology and Anthropology, University of Canterbury, Christchurch, New Zealand (david.thorns@canterbury.ac.nz)

^bDepartment of Economics, University of Canterbury, Christchurch, New Zealand (les.oxley@canterbury.ac.nz)

Abstract:

The paper explores the problems and challenges posed by the growth of the information and knowledge economies for national accounting frameworks and measurements. The conventional approach has been to add to rather than reconstruct such indices. One of the consequences is the focus this leads to on “information technologies” and their prevalence and fails to fully appreciate the transformation that is required to enable “information” to be transformed into “new knowledge” and therefore create the “new economy. The paper argues for a recasting of the analysis of the new economy around an appreciation of the changing nature of physical capital brought about by the creation of new global data bases and transaction information. However alongside of this is an increased importance to intellectual assets, human and cultural capital and the rise of new networked relationships none of which are easily incorporated into national accounts

Keywords: *Information Technologies; New Economy; Human Capital; eResearch*

1. INTRODUCTION

One of the key questions that persists in the literature and discussions about the arrival or otherwise of the knowledge economy relates to the lack of consensus around what would constitute such an economy and whether there is indeed a significant transformation taking place in the basis of advanced economies so that knowledge is increasingly the driver of production [Carlaw et al., 2006]. Economists typically (but not exclusively) focus more narrowly than sociologists upon the changed role of knowledge in economic activity. For example the OECD defined a KBE as “*economies, which are directly based on the production, distribution and use of knowledge and information* [OECD, 1996]. In both the work of sociologists and economists it is the importance of the digital technologies, the Internet, computers, information and globalized networks that these technologies enable that have been stressed. It is now the “age of speed” time and space have been compressed [Harvey, 1989; Virillio, 2004]. There is an increasing shift of activities to computers rather than these being carried out in specific locations. Testing of products can now be done through simulation on the computer. People can work from home [Felstead et al., 2005]. People can create virtual worlds in “my space” and live out their lives in cyberspace [Castronova, 2001]. Whilst not all are involved in these activities it does extend the range of possibilities and gives more prominence to ‘mental’ labour rather than physical labour carried out in discrete places. Knowledge is now seen as the primary source of competitiveness and the desire of governments is increasingly to create innovative and ‘smart citizens’ to work in the “smart economy”. Incorporating into what constitutes knowledge the “cultural and creative” sector extends the discourse on the knowledge

economy and gives recognition to this sector as a potential contributor to economic growth. Through this emphasis on knowledge as the driver of economic activity knowledge itself has become a commodity and becomes traded across global networks creating new patterns of international migration – the brain drains and brain gains. New Zealand data shows that there is a brain exchange taking place with both inflows of highly qualified and losses of New Zealand nationals, especially those under 30 [MRST, 2006; Wang, 2007].

Given that the idea of the knowledge economy is somewhat imprecise it is little surprising that the measurement of this change to the basis of economic activity has similarly been problematic. One of the problems that is encountered here is the shift back to an emphasis on information when measurement is required. Consequently we have a raft of “measures” that are now widely used by national and international organisations of “information based activity and these usually comprise distributional measures of such things as the ownership and spread of computers and internet connections, attempts to plot changes in the occupational structure and the rise of “information or ICT related workers”. These measures are then generally used to infer that we are becoming more “knowledge dependant”. However, at a more robust theoretical level it is necessary to identify the transformation that takes place between the possession of information and the creation of knowledge. Here educational level and skills are crucial and hence a focus has been upon the levels of formal education and qualifications within advanced economies. Though here again simply counting the number and courses covered does not in itself indicate that the recipients had obtained or continue to utilise “knowledge” gained. The problem here is that quantifiable measures are not sensitive to the qualitative changes that are part of moving from the acquisition of information to the deployment of “knowledge”. Nor are they sensitive to the relationship between explicit – formal and codefiable knowledge and tacit – more informal knowledge often acquired through experience

The knowledge economy we see as involving a change in the relationship between physical and human capital in production with a greater emphasis moving to ideas and innovation rather than the creation of large scale physical plant. This encourages new forms of economic organisation such as the partnership rather than joint stock companies and may create the possibilities of firms which do not have physical assets – all their wealth lying in the collective knowledge and experience they have accumulated. This raises interesting questions about the role of intellectual property and how ideas would be traded in such changed markets. In this new “weightless” economy intellectual assets usually seen by economist in terms of human capital, but maybe in such economies there is now also the need to appreciate the role of social and even cultural capital as knowledge creation may engage people in new forms of association and networking – both virtual and real. Such networks can be facilitated by ICT technologies that are extending our capabilities to interact face to face with people in real time across the globe. Here the expansion of “social networking” has been an important illustration of the power of such connectivity to create new forms of social connection and new commercial opportunities as people begin to trade in virtual space and virtual goods.

For the national and international bodies trying to provide “measures” of this changing economic and social world and at the same time retain the existing frameworks of measurement such as in national accounting systems many problems are presented. Often national and international bodies are slow to change as they are protective of their data and the need to ensure comparability between data sets over time. This can lead to resistance to shift outside of the existing measurement frameworks thus we tend to see additions being made to accommodate change rather than a more radical rethinking of the framework themselves. This raises the critical question of whether or not this can be achieved.

In the next section we ask the question whether the present system of national accounting introduced during WW11 as a measure of wartime production capacity, can be adapted to allow us to see the emergence of information and then knowledge economies.

2. NATIONAL ACCOUNTING FRAMEWORKS AND MEASUREMENT OF THE KNOWLEDGE ECONOMY

Many authors have discussed the requirements for, and problems with, measuring the knowledge\information economy most of the data on which the measures are based comes from the national accounts of the various countries involved. This does raise the question as to whether or not these accounts are suitably designed for this purpose. There are a number of authors who suggest that in fact the national accounts are not the appropriate vehicle for this task. For example Howitt argues that “. . . the theoretical foundation on which national income accounting is based is one in which knowledge is fixed and common, where only prices and quantities of commodities need to be measured. Likewise, we have no generally accepted empirical measures of such key theoretical concepts as the stock of technological knowledge, human capital, the resource cost of knowledge acquisition, the rate of innovation or the rate of obsolescence of old knowledge” [Howitt, 1996: 10]. Howitt goes on to make the case that because we cannot measure correctly the input to and the output of, the creation and use of knowledge, our traditional measures of GNP and productivity give a misleading picture of the state of the economy. Howitt further claims that the failure to develop a separate investment account for knowledge, in much the same manner as we do for physical capital, results in much of the economy’s output being missed by the national income accounts.

In Carter [1996] six problems in measuring the knowledge economy were identified: 1) The properties of knowledge itself make measuring it difficult, 2) Qualitative changes in conventional goods: the knowledge component of a good or service can change making it difficult to evaluate their “levels of output” over time, 3) Changing boundaries of producing units: for firms within a knowledge economy, the boundaries between firms and markets are becoming harder to distinguish, 4) Changing externalities and the externalities of change: spillovers are increasingly important in a knowledge economy, 5) Distinguishing ‘meta-investments’ from the current account: some investments are general purpose investments in the sense that they allow all employees to be more efficient, 6) Creative destruction and the “useful life” of capital: knowledge can become obsolete very quickly and as it does so the value of the old stock drops to zero. Carter argues that these issues result in it being problematic to measure knowledge at the level of the individual firm. This results in it being difficult to measure knowledge at the national level as well since the individual firms’ accounts are the basis for the aggregate statistics and thus any inaccuracies in the firms’ accounts will compromise the national accounts.

Haltiwanger and Jarmin [2000] examine the data requirement for the proper measuring of the information economy. They point out that changes are needed in the statistical accounts which countries use if we are to deal with the information\knowledge economy. They begin by noting that improved measurement of many “traditional” items in the national accounts is crucial if we are to understand fully IT’s impact on the economy. It is only by relating changes in traditional measures such as productivity and wages to the quality and use of IT that a comprehensive assessment of IT’s economic impact can be made. For them, three main areas related to the information economy require attention: 1) the investigation of the impact of IT on key indicators of aggregate activity, such as productivity and living standards, 2) the impact of IT on labour markets and income distribution and 3) the impact of IT on firm and industry structures. Haltiwanger and Jarmin outline five areas where good data are needed: 1) measures of the IT infrastructure, 2) measures of e-commerce, 3) measures of firm and industry organisation, 4) demographic and labour market characteristics of individuals using IT, and 5) price behaviour.

In Moulton [2000] the question is asked as to what improvements we can make to the measurement of the information economy. In Moulton’s view additional effort is needed on price indices and better concepts and measures of output are needed for financial and insurance services and other “hard-to-measure” services. Just as serious are the problems of measuring changes in real output and prices of the industries that intensively use computer services. In some cases output, even if defined, is not directly priced and sold but takes the form of implicit services which at best have to be indirectly measured and valued. How to do so is not obvious. In the information economy, additional problems arise. The provision of information is a service which in some situations is provided at little or no cost via media such as the web. Thus on the web there may be less of a connection between information provision and business sales. The dividing line between goods and services becomes

fuzzier in the case of e-commerce. When internet prices differ from those of brick-and-mortar stores do we need different price indices for the different outlets? Also the information economy may affect the growth of Business-to-Consumer sales, new business formation and in cross-border trade. Standard government surveys may not fully capture these phenomena. Meanwhile the availability of IT hardware and software results in the variety and nature of products being provided changing rapidly. Moulton also argues that the measures of the capital stock used need to be strengthened, especially for high-tech equipment. He notes that one issue with measuring the effects of IT on the economy is that IT enters the production process often in the form of capital equipment. Much of the data entering inventory and cost calculations are rather meager and needs to be expanded to improve capital stock estimates. Yet another issue with the capital stock measure is that a number of the components of capital are not completely captured by current methods, an obvious example being intellectual property. Also research and development and other intellectual property should be treated as capital investment though they currently are not. In addition to all this Moulton argues that the increased importance of electronic commerce means that the economic surveys used to capture its effects need to be expanded and updated.

In Howitt's view there are four main measurement problems for the knowledge economy: 1) the "knowledge-input problem", 2) the "knowledge-investment problem", 3) the "quality improvement problem", 4) the "obsolescence problem". To deal with these problems Howitt makes a call for better data. But it's not clear that better data alone is the answer, to both Howitt's problems and the other issues outlined here. Without a better theory of what the "knowledge economy" is and the use of this theory to guide changes to the whole national accounting framework, it is far from obvious that much improvement can be expected in the current situation. As Howitt himself says, "[i]f the critical component of this paper has been larger than the constructive component, this is mainly attributable to the fact that the issue at hand is not likely to be fixed by minor tinkering with national income accounting practice. The underlying problem is that the very conceptual foundations on which national income accounting is based assume away the mainspring of long-term economic growth, by taking knowledge as unchanging and freely available. In such a world, market prices and quantities are all one needs to measure economic activity. In a world where growth is based on the creation, acquisition and use of knowledge, however, we need to look at other magnitudes, and a better conceptual foundation is needed before we know just what magnitudes to look at and how" [Howitt, 1996: 26].

One simple question is to which industry or industries and/or sector or sectors of the economy can we tie knowledge/information production? When considering this question several problems arise. One is that the "technology" of information creation, transmission and communication pervades all human activities so cannot fit easily into the national accounts categories. It is language, art, shared thought, and so on. It is not just production of a given quantifiable commodity. Another issue is that because ICT exists along several different quantitative and qualitative dimensions production cannot be added up. In addition if much of the knowledge in society is tacit, known only to individuals, then it may not be possible to measure in any meaningful way. If on the other hand knowledge is embedded in an organisation via organisational routines then again it may not be measurable. Organisational routines may allow the knowledge of individual agents to be efficiently aggregated, much like markets aggregate information, even though no one person has a detailed understanding of the entire operation. In this sense, the organisation "possesses" knowledge which may not exist at the level of the individual member of the organisation. Indeed if, as Hayek can be interpreted as saying, much of the individual knowledge used by the organisation is tacit, it may not even be possible for one person to obtain the knowledge embodied in a large corporation.

3. KNOWLEDGE ECONOMY AND KNOWLEDGE SOCIETY

A further measurement complexity is introduced by the lack of clarity between the concepts of the knowledge economy and society. This has resulted in many of the same variables being used to measure both these entities yet they are differentiated in their content with the Knowledge society being more encompassing and largely about normative aspirations to

create a society where there is universal access to information and information technology on the grounds that these are essential enabling technologies that increase equality of opportunity and democratic citizen participation.

Considerable effort has been made to measure the information\knowledge society by national and international organisation such as UNESCO, the UN and the EU. Despite the difference in frameworks and indicators, there are some common themes. These include human capital, innovation, ICT development and the context dimension. The human capital theme includes variables on the levels of people's skills and education which reflects the size of the pool of educated people. Included in the innovation theme are variables showing innovation investment, procedures, capacities and networks. There are diverse indicators under the ICT theme; yet, they can be categorised as either resources or access. The former refers to the information infrastructure while the latter is related to the accessibility of information in people's life and work. The context dimension always includes variables on socio-economic, political and institutional conditions for knowledge production.

Obviously, these themes are crucial for measuring the knowledge society. However, these measures are not without their pitfalls. One basic problem for these measures is caused by the "knowledge problem". In some cases, knowledge is understood partially and information and knowledge are treated as exchangeable terms. As a result, some documents focused entirely on measuring the information economy while talking about the knowledge economy and society. Other documents mentioned the difference between tacit and explicit knowledge, the distinction between information and knowledge, and thus, the distinction between the information society and the knowledge society while they failed to employ appropriate variables to reflect the distinctions, due to data availability. Among these documents, we do see a gradually shifting understanding and discourse on the knowledge society. For example, "UNESCO World Report: Towards Knowledge Societies" could be seen as a leading document in initiating the paradigm shift from the information society to the knowledge one. It acknowledges that "the idea of the information society is based on technological breakthroughs. The concept of knowledge societies encompasses much broader social, ethical and political dimensions" [UNESCO, 2005: 17]. At the same time, another document prepared by UNESCO on statistical challenges shows difficulties in identifying the relevant data within the existing measurement frameworks.

In addition the knowledge problem raises other issues to do with the choice of indicators in each of the major themes. For example, human capital is measured according to people's formal education and skills based on human capital approaches. This inevitably ignores people's tacit knowledge and knowledge between people. There are a number of sociological studies which show that even within the economic domain people are not rational actors but their economic performance is significantly affected by social, cultural and political structures in which they are embedded. Thus, social capital is a crucial complement of any attempt to measure human capital.

Similarly, the measurement of innovation in these documents seems to focus mainly on the production of scientific knowledge in laboratories. This is inconsistent with the Mode-2 knowledge production initiated by Gibbons [1994] in the knowledge society in which science and society co-evolve. Also the measurement of innovation fails to distinguish the role of inventions from that of innovations. Consequently, it is difficult to see how they can measure the economic value of innovation and at the same time attach a social value to it. Regarding ICTs, it seems that the widely accepted practice is to enumerate the physical infrastructure or, at best, measure access to information. There is a misunderstanding on the relationship between technology and human beings here. It is not technology but human beings and their interactions that constitute so-called society and its institutions. Thus, the function of ICTs is not only their capacity to provide additional new connections but also their potential for opening or closing forms of personal, social and economic capacities, relationships and power-plays [Dutton, 2004]. Mansell and Wehn's INEXSK approach would be a valuable endeavour to integrate the dimension of human beings, their knowledge and ICTs in the knowledge society measurement [Mansell and Wehn, 1998].

Another problem with measures of the knowledge society is confusing the knowledge economy with the knowledge society. Generally, there are two kinds of documents on the

measurement of the knowledge society. One group focuses on measuring the knowledge economy although they mentioned the concept of the knowledge society. The foci of the measurement are human capital, innovation and ICT development. A representative document is “Measuring a Knowledge-based Economy and Society: An Australian Framework” prepared by the Australian Bureau of Statistics. The document’s author claims that this framework “does not attempt to cover all knowledge in the economy and society . . . [and] over a comprehensive treatment of a knowledge-based society although it does address those social elements which potentially affect economic change or are affected by it” [Australian Bureau of Statistics 2002, 15]

Another group of documents considers both economic and technological features and social conditions and outcomes of the knowledge society. Two representative documents here would be, “Advancement of the Knowledge Society: Comparing Europe, the US and Japan” [European Foundation for the Improvement of Living and Working Conditions, 2004] and “Knowledge Society Barometer” [European Foundation for the Improvement of Living and Working Conditions, 2004a] published by the European Foundation for the Improvement of Living and Working Conditions. There are some variables reflecting social issues such as social inclusion, quality of life and gender equality in the two documents. However, they failed to see that both the economic and the social are equally important and integrated components in the measurement frameworks. Instead, the social is still treated as the ‘leftover’ after having identified ‘significant’ and ‘measurable’ components for national accounting.

In light of these issues it would seem that a necessary first step along the path towards the correct measurement of the knowledge society/economy would entail the development of a theory of the knowledge society/economy. Such a theory would tell us, among other things, what the knowledge economy is, how - if at all - the knowledge economy/knowledge society differ, how they change and grow, and what are the important measurable characteristics. Based on this, a measurement framework could be developed to deal with, at least some of, the problems outlined.

3. CONCLUSIONS: POINTS OF DEPARTURE AND POTENTIAL FOR PROGRESS

Some features and issues that arise with the KBE are:

1. The increasing (but not exclusive) importance of ICTs in economic and social activities. The access to such technologies will be both enabling (GPTs) and have the potential for exclusion and differential effects - ‘winners and losers’. This is not new - the introduction of new technologies has lead historically to winners and losers, both in the short and longer term.
2. The increasing proportion of ‘human capital’ involved in productive activities.
3. The changing role and importance (and ownership) of intellectual property in productive activities. When information is a key input in economic activity its ownership and control will assume greater importance. Intellectual ‘property’ v. Intellectual ‘commons, will affect access to this resource and there will be winners and losers in the Information Economy as a consequence.
4. The changing nature of the ‘theory of the firm’. The current economic theory of the firm is based upon firms having ownership and control of physical capital where ‘workers’ are employed by owner-managers to work with this owned physical capital. As we move to ‘human- capital intensive’ firms, the modern theory of the firm is left without much of its theoretical substance. The distinction between owners (of capital) and workers (human capital) becomes blurred and economic theory stumbles.
5. The Information Economy has typically focused upon ICTs, however, the KBE surely stretches into bio/genetic engineering issues where intellectual property, human capital and ‘knowledge’ have a dominant role. The economic and social impacts of genetic engineering and nanotechnology have typically not been established.

6. Measuring the extent and effects of the KBE can be done either directly (physical\ monetary values of its effects - both positive and negative) and/or indirectly via the consequences of the growth of knowledge where it impinges upon areas such as work practices, employment patterns, social inclusion, wealth\wellbeing\crime\surveillance, environmental and especially energy use consequences etc.

From this it is clear that the key to a quantitative measure of the size, extent and effects of a KBE is a theoretical definition which would necessarily have an important (but not exclusive) role for ICTs., a measure of the size and distribution of 'human capital' and some boundaries where knowledge does and does not contribute to the economy\society.

On the basis of currently available data from the System of National Accounts (SNA) we can measure "OECD-type" measures of the Information Economy. It is generally quite easy to measure the extent and growth of ICT-related goods and services such as, computers per person; internet hosts; IP addresses; email addresses: internet companies; mobile phones, etc., but without other data on things such as speed of connection; use of computers, these summary measures remain simply that, a largely uninformative summary. Furthermore, what are the critical levels of these measures that determine when the economy is to be deemed an "Information Economy" or a "developing Information Economy"? To answer these questions requires a clearer theoretical base to inform the statistical measurement.

We can focus more explicitly on some possible implications of a more networked economy\society. Possible indicators include the composition of labour force transitions including; Hours worked; Flexible work environment (i.e., home based work); Service workers, Knowledge intensive versus non-knowledge intensive sectors. In addition the size, composition and growth of new and emerging sectors could be measured and tracked. The role of ICTs as General Purpose Technologies (GPTs) is postulated to have had effects (mostly delayed) on productivity. One way to track the influence of knowledge on the economy is to measure productivity effects via Total Factor Productivity (TFP) as well as direct measures of technological change.

A key feature of the KBE is the prominence of human capital, Discussion of the role of human capital has a long history in economics going back to at least Smith [1776] and its measurement goes back even further, beginning with Petty [1690]. For up-to-date surveys on the area see Wößmann [2003] and Le et al. [2003]. However, these types of measures remain mainly 'academic' and the national systems of accounts would typically only include such things as occupational and industry level employment\participation\ hours of work data; employment by ethnicity; regional employment differences; qualifications of the employed workforce. These educationally related data can be enhanced directly from University Calendars., educational attainment and curricula composition shift data (from say arts to computer science etc.), however, these are typically anonymous and not linked to specific industry employment\ output effects.

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