

Getting the Measure of Knowledge – Diane Coyle

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Economic statistics are perhaps the most important issue for economists today. To support this claim, which might seem surprising, I want to start by looking at it from an angle and asking: when did we understand that Communism was an economic disaster? The answer is: not until around mid-1980s.

For in terms of real GDP/person, the Soviet Union grew faster in real terms than the United States and many other capitalist countries until mid-1970s, and it was another 10 years before it became apparent the central planning system was an economic catastrophe. But what was its failure if not a big gap in growth in GDP per capita - for the adverse growth gap in favour of capitalism had existed only for a decade or so?

It was a failure of quality and choice. An important part of increased prosperity is better quality goods and services. In the Eastern bloc you had to choose Trabant cars and Red October chocolate. It was in the mid-1980s that the failure of communism to innovate in terms of variety and quality started to matter because there was a sudden blossoming in variety in capitalism itself at that time. That was when the impact of the ICT innovations of the 70s started to kick in. After all, up till then capitalism had been a mass production, mass consumption system as well.

In the Soviet Union, output of consumer goods such as TVs and radios was measured by weighing them. Producers were set quotas, which they met partly by putting bricks inside their products. This is amusing – but recall that until 1985 the volume of computers produced was in many countries also estimated by weight. The start of the rapid improvement in computing power and specifications, combined with miniaturisation, forced a change in the way imports were measured. And of course capitalism gave businesses incentives to innovate regardless of how statisticians measured what they were

up to. So from about that time, consumers in the west got more choice and better goods, while consumers behind the iron curtain were still getting TV sets with bricks in them.

Nobody ever said “quantity is the spice of life.” When our basic needs are met, we seek to meet additional wants in varied ways. We have seen in recent years an explosion in variety. Henry Ford famously said of the Model T: “The customer can have any colour he wants so long as it’s black.” The choice of new vehicle models in US is now nearly 300; Ford offers 46 colours. The paradigm now isn’t Ford but Dell. It gives customers ordering online 16 million theoretical combinations of specifications for a desktop PC.

This improvement in economic welfare isn’t well measured. GDP notoriously underestimates the gains from new products. William Nordhaus¹ has looked at the price of new technologies over long periods – not just computation but also lighting for example – and finds the statistics profoundly underestimate the impact of step-changes in technology such as the electric light bulb. Actually, measured GDP underestimates all kinds of gains in welfare². We need to adjust upwards for increased longevity, better health, shorter working lifetimes, new products, more choice, better quality – and these are substantial adjustments – as well as downwards for pollution and consumption of resources.

Why is the economic paradigm changing? The short-answer is IT.

The increase in computational power and corresponding decrease in cost outclasses any other technology in history. It has underpinned a cluster of other new technologies likely to deliver remarkable commercial applications over the next 10-50 years. They include biotechnology, nanotechnology, robotics and advanced materials.

There are different ways of describing this change or modification in the source of gains on consumer welfare, in what it is that creates value – some speak of the new economy, or knowledge economy. I prefer a more specific term – the weightless economy.

¹ Nordhaus

² Crafts

Originally (1996) I intended this as a metaphor for the transition towards services, and for the decreasing physical mass of goods because of miniaturisation, and the use of lighter materials. The source of value is increasingly not in the *stuff* but rather in innovation, design, marketing, after-sales support. Ultimately, we now have purely digital goods – software, movies, genetic code. Weightlessness turns out to be literally true, however. Estimates of the mass of material (including waste) used in the production of economic output show a big change from ‘weighty’ growth in the 1980s to ‘weightless’ growth in the 1990s.³

But this framework leaves us with two questions:

- what is it that’s changing about economic behaviour and structures? Are we closer to understanding what the so-called new paradigm is?
- what do we need to know to measure the changes, given that it’s likely to be qualitative? What new metrics do we need?

What on earth is the new paradigm?

The answer to the first of these lies in understanding that the era of mass production, mass consumption has ended. The radically reduced cost of processing and exchanging information has created the scope for innovation at ever-finer aggregations of demand, leading to an explosion in choice. Most of the product differentiation in the new goods takes the form of intangible attributes or service-like qualities – these are where value is added.

But technology by itself doesn’t change an economic system. It affects and is in turn influenced by social and political innovations.

No economic system can be distinguished from its political, legal and social context – even the freest markets don’t exist in an abstract vacuum. Legislative and regulatory co-inventions are almost always necessary to sustain innovation in business. Amongst the

³ Sheerin, ONS

required areas of innovation are:

- The contested definition of intellectual property, with the old model of IP belonging to the employer even though embodied in the brain of the individual employee or even the individual customer is increasingly fraught.
- The development of venture capital or other institutions able to invest in intangible assets and ideas as opposed to tangible assets and proven profits.
- Updated competition policy in the context of network goods where there is large consumer benefit in monopoly provision in some sense, and competition may need to be sequential or take place on the basis of open technical standards. Competition is vital to ensure innovation is translated into consumer welfare, but also to nourish future innovation.
- The modernisation of education and training, moving away from mass 'production' of standardised workers.

In addition to social innovations, internal organisational innovation is also needed if new technologies are to be implemented to their full extent. Firms are organisations which reflect the costs of managing and exchanging information⁴, so it's only to be expected that a dramatic decline in the costs of processing some kinds of information would have implications for their optimal structure. The boundary of the firm is the line across which price-mediated transactions take place. Inside the boundary are transactions where informational gaps and transactions costs mean markets can't operate. But the economic content of the two different types of transactions is often similar. So reduced information costs and increased information availability are likely to shrink the boundary of the firm. Increasingly the knowledge kept inside is tacit knowledge, the kind that can't be codified. But this firm-specific tacit knowledge is increasingly the source of the firm's comparative advantage, the way it adds value.

The internal organisation of enterprises can also be expected to change. When information is costly to process, hierarchies and standardisation make sense. When it's

⁴ Arrow, Coase, Williamson

cheaper, it will be more efficient to distribute decision-making and allow more variability.

So lower information costs, as opposed to pure management fads, seem to go a long way towards explaining phenomena such as delayering of corporate hierarchies, outsourcing, empowerment of workers, and networking with suppliers, customers and competitors. Certainly the size distribution of businesses is changing – more very large ones able to exploit big economies of scale without internal-decision making becoming impossibly unwieldy – and more very small ones able to use ICT to reach bigger markets and bigger pools of labour that will enable them to be profitable in small niches.

Globalisation itself is due to drop in transactions costs. Manufacturing production is radically globalised. What we've seen is the division of the supply chain across national borders to exploit comparative advantage at every stage of the production process, not just the level of finished goods. Increasingly this is happening in services too.

However, the adjustment costs and skill-needs make the process of corporate change long drawn out and disruptive. Firms that have undertaken the adjustments can very plausibly be thought to have invested massively in specific intangible organisational assets.

The scale of the effort needed explains the interest in corporate accountability. It's in effect asking companies to introspect about their management. In addition, the idea that maximising shareholder value is the appropriate touchstone for corporate governance fitted an era when the provision of capital by shareholders was a scarce factor of production. But it's arguable - now that it's relatively easy to raise financial capital, but relatively hard to hold onto human capital or to build organisational capital – that corporate governance rules and practices should change to reflect that. For some companies, perhaps the majority of large listed companies, are in fact (as Daniel Bell predicted more than a quarter century ago⁵) ongoing communities of self-selected

⁵ Bell 1974

members which don't have any value if those members, or employees as we usually call them, choose to leave. The public mood is concerned with the social responsibilities of private companies, but the governance question is more about metrics for assessing corporate performance and what information should be published about performance.

Change in the public sector is orders of magnitude harder to accomplish, with at best the slow and indirect mechanism of electoral change. Yet people won't continue to accept Model T Ford standards in public services when they're getting Dell standards in private services and products.

II. Measurement issues

Measuring the changes

I touched earlier on problems with GDP. No continuous series of figures can capture qualitative transformations in life – clean water, electric lighting, television, new drugs, paperbacks.

This difficulty was first framed in the economics literature as the productivity paradox – Bob Solow's "You can see computers everywhere but the productivity statistics." If there's so much change, where's the evidence, because it wasn't showing up in GDP growth? Sceptics said it was all going into playing games and sending dirty jokes round on the email.

Now there's a large literature which has reached the consensus that in the US and some other countries, figures for manufacturing confirm an increase in trend productivity growth. But there's a puzzle still concerning services – which make up 2/3 of GDP in the richest economies.

There's been next to no improvement in efficiency recorded for the past quarter century in the service sector. In some services measured productivity has actually been in decline.

According to the US statistics, the productivity level in medical care now is only 70% of its 1975 level, according to the figures. The trouble is, as Alan Greenspan has noted⁶, that such 'facts' are at variance with everyday experience. Experience tells us that in general healthcare has improved, not deteriorated, with advances in knowledge and medical technology. Thus a cataract operation today is a routine outpatient procedure, no longer requiring general anesthetic and a hospital stay, new drugs have transformed the likelihood of surviving certain cancers, and so on.

The problems are conceptual. In services, just like manufacturing, several types of capital are important for boosting productivity: physical capital in the form of new equipment, certainly, but also investment in human capital and organisational capital. But in services higher productivity can often only be manifested as an improvement in quality per worker, rather than quantity per worker. It is the very idea of the *quantity* of a service output that is troublesome. After all, the supply of a service is not independent of the demand for it. Better, not more, is what matters.⁷

In fact, start to think about the nature of output in all kinds of services, and problems spring up like weeds. Should US GDP be revised to take account of the fact that, post-Enron and WorldCom, the economy's output of accountancy services has turned out to be of much lower quality than we thought? If a nurse cares for more patients each day, or a teacher more pupils, is his productivity higher or lower? How in fact would you measure your own output? These questions are all the more interesting as differences in the levels and growth rates of productivity in services explain most of the difference between countries when it comes to aggregate productivity comparisons.⁸

The need for new metrics

In many cases, of course, the number of people employed is the measure of output in many services, ensuring measured productivity growth will be zero by definition. There

⁶ Alan Greenspan speech 13 June 2000.

⁷ Hill 1999

is reason for thinking this straightforward approach to measurement in fact makes some theoretical sense. Will Baumol⁹ suggested that because of productivity growth in agriculture and industry, where technological advance and investment mean ever more output can be produced by ever fewer workers, people would steadily shift to working in services, where because productivity is lower more and more workers are needed. In the limit machines will do everything machines can do, and we'll do everything they can't do, with no possibility of productivity gains.

In a sense this is a version of the fear or hope that technology can make everybody redundant, the 'leisure society', except that it reinterprets leisure as work. So the very idea of productivity growth is therefore a feature of industrial, not post-industrial, society. This implies that the attention in economics and statistics needs to switch from producers to consumers.¹⁰ Going beyond material scarcity (in the developed economies) makes demand, not supply, the binding constraint.

The insight that my leisure is increasingly your job underlines the value of the time-use approach to measuring the economy¹¹. The time spent, economy-wide, in consuming services corresponds to the time spent in either paid or unpaid work providing them. The boundary between paid and unpaid is fluid, of course. But somebody's effort will be needed to prepare the meal.

Time-use evidence is particularly interesting because it does focus attention on consumption rather than production. And time spent is one measure of real consumption that does not fall foul of the difficulties of adjusting for changes in price and quality. The time-use approach also offers an alternative accounting framework to the monetary one used in national accounts, because time spent on everything has to add up to 24 hours a day. Making the things that should add up do so is one of the most important contributions of economics.

⁸ Broadberry & Ghosal 2002, Crafts 2002.

⁹ Baumol 1967

¹⁰ Quah 2002

¹¹ Gershuny 2000, Short 2000

Time-use data account for activities regardless of whether they involve transactions that take place in a market or not, which is another merit if you accept that ICT is moving the boundary between marketed and non-marketed activities.

The shifting in the boundary between the transactions that can and can't occur in the market, mediated by price, seems to me fundamental to understanding the impact of ICT. On the one hand, more transactions can take place in markets – hence phenomena such as outsourcing, and the global reallocation of production. On the other hand, the value of tacit, non-marketable knowledge has been increasing as the economy becomes increasingly weightless, which makes greater demands on the quality of organisations – it raises the returns to organisational capital.

What is very striking is the sense today of reaching for a new framework of assessment. The framework of national accounts was very much of its era, a reflection of the nation-state economy and its economic policy imperatives. Foremost amongst these was the state's guarantee of the well-being of its citizens, particularly employment and welfare. The very term 'statistics' is linked etymologically to 'state', and started out being called 'political arithmetic'. The OED offers both 'statistician' and 'supporter of statism', or the state administration and control of economic and social affairs, as equivalent definitions. Perhaps it shouldn't be surprising perhaps that the concept of the nation-state is as contested in statistical terms as any other.

References & data sources

ARROW, Kenneth, *Essays in the Theory of Risk Bearing*, Chicago 1971.

ARROW, Kenneth, 'Control in Large Organizations', *Management Science*, April 1964 (10), 397-408.

BAUMOL, William, , *American Economic Review* 1967.

BELL, Daniel, *The Coming of Post-Industrial Society*, Heineman 1974.

BEST, Michael, *The New Competitive Advantage: The Renewal of American Industry*, OUP 2001.

BOBBITT, Philip, *The Shield of Achilles: War, Peace and the Course of History*, Knopf 2002.

BROADBERRY, Stephen and Sayantan Ghosal, 'From the Counting House to the Modern Office: Explaining Anglo-American Productivity Differences in Services since 1870', University of Warwick, April 2002.

BRYNJOLFSSON, Erik and Lorin Hitt, 'Beyond Computation: Information Technology, Organizational Transformation and Business Performance', *Journal of Economic Perspectives*, Vol 14, No 4, Fall 2000.

BRYNJOLFSSON, Erik, Michael D Smith & Yu Hu, 'Consumer Surplus in the Digital Economy: Estimating the Value of Increased Product Variety at Online Booksellers,' MIT Working Paper, April 2003, <http://ebusiness.mit.edu/erik/CSDE%202003-04-061.pdf>

BUREAU OF LABOUR STATISTICS data home page, <http://www.bls.gov/data/>

COASE, Ronald, 'The Nature of the Firm', first publ *Economica*, 1937 (4), 386-405.

COX, Michael and Richard Alm, 'The Right Stuff: America's Move to Mass Customisation', Annual Report, Federal Reserve Bank of Dallas, 1998.

COYLE, Diane, *The Weightless World*, Capstone/MIT Press 1997.

COYLE, Diane, *Paradoxes of Prosperity*, Texere 2001.

COYLE, Diane, 'Still Seeking the New Paradigm', paper presented at the International Association of Official Statisticians annual conference, August 2002, http://www.statistics.gov.uk/iaoslondon2002/contributed_papers/downloads/IP_Coyle.doc

COYLE, Diane and Danny Quah, Getting the Measure of the New Economy, The Work Foundation June 2002.

CRAFTS, Nicholas, 'Globalization and growth in the 20th Century' in *World Economic Outlook Supporting Studies*, May 2000, IMF.

CRAFTS, Nicholas, RES lecture, 'UK Real National Income 1950-98: Some Grounds for Optimism', <http://www.res.org.uk/society/pdfs/crafts.pdf>

DAFFIN, Chris, Geoff Reed and Prabhat Vaze, 'Labour productivity measures for the non-production industries', Economic Trends no 579 February 2002, Office for National Statistics.

DAVID, Paul, 'Computer and Dynamo: The Modern productivity paradox in a Not-too-distant Mirror', OECD 1991.

DAVID, Paul, 'Digital Technology and the Productivity Paradox: After Ten Years What Has Been Learned?' May 1999, US Department of Commerce.

DELONG, 'Productivity Growth in the 2000s', March 2002, <http://www.j-bradford-delong.net>

DELONG Bradford and Lawrence Summers, 'The New Economy: Background, Speculations, Questions,' working paper, August 2001.

DRAKULIC, Slavenka, *How We Survived Communism and Even Laughed*, 1988.

GERSHUNY, Jonathan, *Changing Times: Work and Leisure in Post-Industrial Society*, Oxford University Press 2000.

GREENSPAN, Alan, 'Business Data Analysis', New York Association for Business Economics, 13 June 2000.

HILL, Peter, 'Tangibles, Intangibles and Services: A New Taxonomy for the Classification of Output', Canadian Journal of Economics, 1999.

INTEL, <http://www.intel.com>

LAYARD, Richard, 'Happiness: Has Social Science A Clue?', Lionel Robbins Memorial Lectures March 2003.

NORDHAUS, William, 'The Progress of Computing', Cowles Foundation Discussion Paper 1324, September 2001.

NORDHAUS, William, 'The Health of Nations: The Contribution of Improved Health to Living Standards', NBER Working Paper 8818, March 2002.

QUAH, Danny, 'Technology Dissemination and Economic Growth: Some Lessons for the New Economy', March 2002.

SCHELLING, Thomas, *Micromotives and Macrobehavior*, Norton 1978.

SCHLOSSER, Eric, *Fast Food Nation*, Houghton Mifflin 2001.

SHEERIN, Caroline, 'UK Material Flow Accounting', Economic Trends no. 583 June 2002, Office for National Statistics.

SHORT, Sandra, 'Time Use Data in the Household Satellite Account', *Economic Trends* October 2000, Office for National Statistics.

UNDP, *Human Development Report*, 1991.

WILLIAMSON, Oliver, *The Economic Institutions of Capitalism*, Free Press, 1985.