Networks: Innovation, Growth and Sustainable Development

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Networks dominate our lives. They dominate our economic and social behaviour, yet until the last decades we knew little about how they behave and grow. This changed with the emergence as the Internet, not just as a communications tool, but as a measureable manifestation of our social and economic relationships. From about 2000, the internet has allowed us to study and understand the type of networks in which we live, and to model their behaviour. These insights have since been transferred across to economics, ecology and biology, providing new insights the nature of evolution in all areas. They have raised expectations that the science and modelling of networks can make a major contribution to economic policies, sustainable development and medicine.

There is now no doubt that social and economic systems have most of the characteristics of scale-free, "small-world" networks. Such network emerge naturally in nature and society, and give rise to the dominance of "hubs" – key individuals and businesses; to the inequalities we know so well as Pareto's 20/80 rule; to "non-linear" responses to change, and to the fluctuations we see in equity markets. The dynamics of such networks can also now be well modelled. They are in continuous evolution; don't have static equilibria, and are susceptible to "boom and bust cycles". However, the economic models used by all main-stream economic institutions are still "dynamic stochastic general equilibrium" models. Dynamic networks require new modelling approaches, notably "agent-based" modelling that explicitly recognise the interconnectedness of different agents (people, businesses and parameters).

The growth of scale-free complex networks generates inequalities in most of their key parameters. The Internet added and complemented this by fundamentally broadening and speeding-up our networks, and changed the distribution of wealth: The rich became richer simply because of the larger scale of the trading network and stretched national wealth distributions. Network effects are therefore likely to be responsible for much of the perceived increases in inequalities in the last 20-30 years, and policies to tackle poverty must therefore address the extent to which the poor can engage with society's networks of wealth creation.

However, complex networks are fundamentally robust, and their long-term behaviour is therefore relatively predictable. Assessments of probable world growth and prosperity to 2050 by the OECD and with the International Futures system, both using "agent-based" simulations, are very similar. Individual countries and regions go through crises, but overall changes in key global parameters such as employment rates, GDP and energy-use are projected to grow continuously over the next 40 years; as they have over the past 40 years:

World GDP could be 4-times larger by 2050, but with major increases in GHG concentrations and losses in bio-diversity.

However, this long-term resilience and adaptability poses new challenges to policies for sustainable growth. No single policy measure has a direct and linear impact on outcomes: Only complementary portfolios of policy measures can have significant impacts and the most effective long-term policies build around a small number of dominant drivers of change, and complement them with flanking policies to enhance adaptation.

The greatest challenge to continued growth and prosperity, and therefore to peace and justice, is climate change: The OECD[1] indicates that, with current policies, CO_2 concentrations could be 650ppm by 2050, and global average temperature could rise of 3-6 degrees C by 2100[2], with worsening air pollution. Assessments with the International Futures system for the European Commission[3] indicate that combination of accelerated deployment of "network innovations" (broadband communications and smart-grids), together with a global market price for carbon-emissions could cut global emissions after 2025 and stabilise CO_2 concentrations (again about 500ppm) by 2050. The OECD assessment indicates that global carbon pricing could be sufficient to lower GHG emissions by nearly 70% in 2050 compared to the Baseline scenario and limit GHG concentrations to 450ppm, and would slow economic growth by only 0.2 percentage points per year on average.

The potential cost of inaction on climate change could be as high. The "World in 2052" assessment by Jorgen Randers for the Club of Rome, published in 2012, estimates that the world could be 40% less prosperous in 2052 than the simultaneous OECD assessment, largely because of assumed lower population growth and the costs of adaption to and damage from extreme weather. We may soon be in the situation where we need to draw-down GHG concentrations to stabilise the climate. Sensitivity analyses using the International Futures and OECD systems have shown that the two key drivers of change to economic growth consistent with climate stabilisation are 1) a robust carbon-emission price, and 2) accelerated deployment of innovations such as high-speed communications to most people and businesses to enable structural change in life-styles. The key network infrastructures for low-carbon prosperity are a coherent and robust world "carbon-accounting infrastructure" of monitoring, reporting, labelling and trade, with credits for certified sequestrations, tradable against emissions, and high-speed internet connectivity everywhere for everyone.

Notes:

1. OECD Environmental Outlook to 2050: The Consequences of Inaction: March 15th 2012 http://www.oecd.org/document/11/0,3746,en_2649_37465_49036555_1_1_1_37465,00.html
2. The UK Royal Society estimated in 2011 that with 4 degrees warming, half the world's current agricultural land would become unusable, sea levels would rise by up to two metres, and around 40% of the world's species would become extinct.
3. Using state-of-the-art models and tools for the assessment of ICT impacts on growth and competitiveness in a low-carbon economy: DG-Information Society, November 2009.