

# CURRENT SCIENCE

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EDITORIAL

## Animal Spirits: A Powerful Prescription

Economists have a way with words. Adam Smith's 'invisible hand' and John Maynard Keynes' 'animal spirits' seem to guide economies. Science can lay claim to few phrases which are comparable in their imagery. Even 'survival of the fittest', a phrase apparently first used by Herbert Spencer to explain Darwinian natural selection, has been used (and misused) more in discussions of economics. Prime Minister Manmohan Singh's recent exhortation to the guardians of government finance, to infuse the 'animal spirits' to revive a comatose and sinking economy, was a Keynesian call to action. For a naïve reader of the daily news, and I am one, the phrase 'animal spirits' immediately conjured up visions of a cocktail containing unmentionable ingredients which when administered to an ailing patient results in a miraculous restoration to full health and vigour. The Prime Minister was, of course, going back to his academic roots in recalling one of Keynes insights: '...there is the instability due to the characteristic of human nature that a large proportion of our positive activities depend on spontaneous optimism rather than mathematical expectations, whether moral or hedonistic or economic. Most ... of our decisions to do something positive, the full consequence of which will be drawn out over many days to come, can only be taken as the result of animal spirits—a spontaneous urge to action rather than inaction...' (Keynes, J. M., *The General Theory of Employment, Interest and Money*, Macmillan, 1936, pp. 161–162). Economics is rarely a mood elevating subject; in today's context it can be distinctly depressing. Ironically, the way out of both an economic and psychological depression may be to use one's last reserve to summon up the Keynesian 'animal spirits'.

The prolonged economic slowdown in the West and the runaway growth in China have engendered a great deal of discussion in recent times. America's long unchallenged preeminence in science and technology may be under threat as Chinese science expands dramatically. The rise of global competition and its effects on America's unrivalled position as the driver of world science and technology was first addressed in a National Academies of Science report in 2005. Five years later, as the economic crisis deepened, a second warning was sounded by the US Academies (*Rising Above the Gathering Storm Revisited*, National Academies Press, 2010; *Current Science*, 2011,

100, 443). This report and its predecessor made a powerful case for enhancing government support for the scientific enterprise in the United States, even as the recession deepened. The bogey of US leadership in the arena of science and technology being eroded, as other countries, most specifically China, enhanced their investments in science, was raised effectively. The Keynesian approach to stimulating an economy in recession would argue for infusion of public investments in key areas; science and technology which are the drivers of innovation and growth were projected by the US Academies. *Is American Science in Decline?* is a book, that crossed my desk, which answers its title question with 'a qualified no' (Xie, Y. and Killewald, A., Harvard University Press, Cambridge, Massachusetts, 2012). The authors are sociologists at the University of Michigan and Harvard University. The authors' thesis, that the health of American science is largely satisfactory, is based on an analysis of hard statistical data. The Academies' report and others that criticised them have led to a public debate that has proved instructive. Xie and Killewald marshal their facts well, producing a thesis which should draw the attention of policy makers worldwide.

The 20th century began with all the major centres of science being located in Europe. By the end of the century, which could well be labeled an 'American Century', the leadership of science had shifted decisively to the United States. Xie and Killewald recall a Japanese historian's prediction in 1962 that 'the scientific prosperity of the USA begun in 1920 will end in 2000'. They note, with some satisfaction, that 'American science is still going strong today'. The figures they present to buttress their assertion are striking. The United States with about 5% of the world's population accounts for '45 per cent of the world's Nobel Prize winners in physics, chemistry and physiology or medicine, through year 2009'. The US also accounts for '35, 49 and 63 per cent, respectively of the world's scientific publications, citations and highly cited publications'. For a very long time the US university system has been the envy of its competitors, accounting for '85 per cent of the world's top universities and 54 per cent of the world's top 100 universities'. The US presence as a leader in developing new technologies is substantiated by its share of '38 per cent of patented new technology

inventions by the industrialized nations of the Organization for Economic Cooperation and Development (OECD)'. This enviable position has been reached with '40 per cent of total research and development spending'. Despite this apparently impregnable position, a sense of unease seems to have pervaded the science policy establishment in the US. The China factor is now an obsession with science policy makers everywhere; India is no exception.

In considering the present and imagining the future, the past can sometimes provide insights. Xie and Killewald provide an absorbing account of the evolution of science in America. Science as it is practiced today traces its origins to Europe beginning with Copernicus in Poland in the 16th century, Galileo and Kepler in the 17th and Newton in the 18th century. France was a hub in the early 19th century, while Germany decisively dominated science until the misadventures of the 20th century. Britain fostered the tradition of the amateur scientist, with the transition to professional science becoming evident in the 20th century. 'The integration of science into universities' was first achieved in Germany, when 'research became not only legitimate but indeed a vital activity of a university professor'. American science developed, in Xie and Killewald's words, as 'two separate but interwoven strands: "pure science"... and "applied science"'. The latter's origins are traced to the fact that 'colonists and settlers struggling to survive in harsh new wilderness environments often had to find creative ways of making do with whatever materials were at hand... Rather than working to develop models of how the universe worked, American inventors such as Franklin, Bell and Edison worked independently to solve practical problems including fireproofing buildings from lightning, communicating over long distances and illuminating houses after dark.' The demands of colonial inventors for patents resulted in the American Constitution, framed in 1789, empowering the federal government 'to create a patent system' that 'allowed inventors to make handsome profits from their creative work and contributed to the unprecedented level of innovation in the late eighteenth and nineteenth centuries'. The founding of the Johns Hopkins University in 1876 and the University of Chicago in 1891 marked the beginning of the professionalization of science. 'Both schools explicitly incorporated the German model, but with one important difference: they contained research oriented graduate schools.' The authors note that these schools served as models for both private universities like Harvard and Yale and, 'somewhat later, large public universities such as the University of Michigan and the University of California'. Intriguingly, the Johns Hopkins model of a research oriented graduate university attracted the attention of J. N. Tata when he conceived of setting up the Indian Institute of Science, in the last decade of the 19th century.

The American university system has not really lost its edge in the 21st century. It remains as a model that many countries envy, but are unable to replicate. Xie and

Killewald do not subscribe to the many alarmist reports that ominously forecast a loss of American supremacy in science. They quote the White House Science Advisor John Holdren: 'We can't expect to be number one in everything indefinitely.' Their conclusion is sensible: 'If America loses its status as the dominant leader of the scientific world, this could merely mean that science in other countries is getting better, not necessarily that American science is getting worse.' The many recent analyses of scientometric indicators across countries often fail to recognize that upward mobility cannot be indefinitely sustained and, at times, may provide a misleading indicator of the health of a country's science and technology enterprise. The frequently expressed concern that American school education is deficient in mathematics and science instruction is misplaced, according to Xie and Killewald: '...there is no evidence that today's American school children are less prepared than their counterparts of three decades ago to enter advanced training in scientific fields.' They address another oft debated issue. Is there an impending shortage of scientists and engineers in America or is there an oversupply of Ph Ds, 'indeed a glut of scientists'? They reach an 'overarching conclusion' that while 'the labor market situation for scientists in the United States has remained healthy in recent decades, especially at the bachelor's and master's levels ... there may be reasons for concern among young doctoral scientists and engineers who aspire to be academic researchers.' The alarmist Academy reports on the decline of science have been influential, resulting in a 'large infusion of federal funds into scientific research as part of the American Recovery and Reinvestment Act of 2009'.

Reading Xie and Killewald's fact filled analysis, I could not help wondering whether there are lessons to be learnt and issues to be considered as the educational and research enterprise expands in India, even as the economy shows signs of fragility. There is little by way of informed debate based on reliable statistics. Planning and implementation are widely separated activities, with little guarantee that adequate fund flows will indeed be available over several years. Institutions are being recklessly created with populism and emotion being the driving forces. Growing institutions have been quickly shackled by restrictions on faculty recruitment, as the bureaucracy begins to apply the brakes on an expansion plan that may be financially unsustainable. The mindless calls to increase the number of Ph Ds produced do not address the issues of growing unemployment and underemployment of doctoral candidates emerging from our institutions. Recent downsizing of multinational R&D establishments in India will accentuate this problem. The science funding mechanisms show little signs of changing with the times. Science policy and governance may also be in need of a strong dose of 'animal spirits'.

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