

“For the times they are a-changin’...”

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London, 11 November 2015

¹ This text draws on the first chapter of *Perché i tempi stanno cambiando*, Bologna, Il Mulino, 2015, which originated from the author's “Il Mulino Lecture”, 18 October 2014. I wish to thank Andrea Brandolini, Salvatore Rossi and Francesco Spadafora for their many useful comments.

“For the times they are a-changin’”. This is what Bob Dylan famously sang over fifty years ago. And in this half-century, the times truly have changed.

The history of humankind is in itself a story of change: demographic, technological, religious, social, political, economic. Economists often distinguish between “growth” and “development”. The former refers to the production of goods and services exchanged in markets, which is an ingredient, and an important one, in economic and social well-being. It needs to be considered, however, together with the other components of a society’s development, such as the distribution of natural resources, health and living conditions, or the quality of the environment. All these elements are often but imperfectly correlated with measures of economic activity like the gross domestic product, itself a useful but limited indicator whose utilisation as an exclusive gauge has at times come under comprehensible criticism.

In this regard, let us start with two issues. The first concerns labour, work. As Voltaire’s Turk explains to Candide, work serves to ward off not just need, but also boredom and vice. If our living conditions have improved so enormously over the past few centuries, we owe it largely to one fundamental institution, the market, which made it possible to transcend the old subsistence economy based on barter. In the long run, market failures – which may range from monopolies and positional rents to laws and customs unfavourable to business activity or rules and supervisory practices incapable of deterring excessive risk-taking – engender disequilibria, impede growth, undercut labour and hinder development.

The second question bears on the models used by economists. Often, these models depict economic growth as a balanced, linear process, but in reality it is far from regular, a fact that does not escape economists themselves. Yet over the past two centuries the market, demographics and technical progress have produced wealth, work, and better living standards for steadily increasing masses of people. This has come about through a series of social, individual and collective travails that have made the process non-linear, yet not random.

In what follows I will discuss the theme of change, in particular the rapid and constant change now associated with technological developments, and the multiple interactions between the legacy of the global financial crisis and new challenges. An increasingly important issue in the debate is the impact of new technologies on jobs and on the skills required to seize the opportunities and govern the risks of the digital revolution.

From industrial revolution to sustainable development

The industrial revolution of the late eighteenth century gave rise to the “first machine age” (the second is the age we are now living in, as described by Erik Brynjolfsson and Andrew McAfee).² Innovation and automation have gradually transformed material production, in agriculture and industry alike, and especially in manufacturing. The new opportunities created over the course of this extraordinary period of human history have more than offset the jobs destroyed by the new general purpose technologies: the steam engine, the internal combustion engine, electric power.

In *Why the West Rules – for Now*,³ the Anglo-American historian Ian Morris develops an index of social development based on energy use, civil organisation, military capability and information technology. Brynjolfsson and McAfee observe that his index points to an astonishing conclusion: none of the crucial innovations antedating the industrial revolution – the domestication of livestock, the development of agriculture, the foundation of cities, the rise of philosophy and the great religions, the invention of writing, the introduction of numbers – had anything like the importance for socio-economic development of the exceptional discontinuity of the late eighteenth century. This break was accompanied by the growth of world population from 800 million in 1750 to over 1.5 billion in 1900, 2.5 billion in 1950, 3 billion fifty years ago and over 7 billion today.

It was precisely the postwar exponential demographic acceleration – the “population explosion” – that prompted discussion on the “limits to growth.” At the start of the 1970s the Report of the “Club of Rome,”⁴ which centred on the predicted depletion of natural resources, raised alarm about the survival of the Earth’s ecosystem and of the human species itself. Consisting, as is frequently the case for forecasting activity, in linear extrapolations of current trends, these projections received great attention from the mass media and political leaders, but they were greeted skeptically by many economists, including some of the most eminent of the time. Without seeking to downplay the limits and risks of the exploitation of natural resources implicit in the population explosion and exponential growth, the critics noted that the Report failed to take due account of two major stabilisers: the ability of relative prices to rebalance supply with demand and the response of technology.

² E. Brynjolfsson and A. McAfee, *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*, New York, W.W. Norton & Company, 2014.

³ I. Morris, *Why the West Rules – for Now: The Patterns of History and What they Reveal about the Future*, New York, Farrar, Strauss and Giroux, 2010.

⁴ D.H. Meadows, D.L. Meadows, J. Rangers and W.W. Behrens III, *The Limits to Growth: A Report for the Club of Rome’s Project on the Predicament of Mankind*, New York, Universe Books, 1972.

Notwithstanding the demonstrated power of these two mechanisms, which makes such long-term projections hazardous, the concern has not abated. The debate on “sustainable development” – development that can “meet the needs of the present without compromising the ability of future generations to meet their own needs”⁵ – shows that today it is impossible to ignore the environmental balance of the planet and the reciprocal compatibility, or tradeoffs, between economic, social and ecological objectives.

Climate change is no longer a scientific curiosity; it is a fundamental theme of today’s public debate. A significant step was the 2006 Stern Report,⁶ which followed a series of important international agreements (chief among them the Kyoto Treaty of 1997) and thoroughgoing albeit undervalued studies by the World Bank and the OECD. Some of its assumptions were criticised, such as the discount rate it used to estimate economic costs, which was very low and thus – like *The Limits to Growth* – likely to neglect potential mitigating and feedback effects, such as those connected with technical progress. But two of the Stern Report’s recommendations appear to be of special importance: to tackle the challenge of climate change at a global level, with the cooperation of all concerned, advanced, emerging and developing countries alike; and to devise incentives for the invention and use of new technologies to drastically curtail emissions of carbon dioxide and other greenhouse gases.

Fifty years of great change

The transformations of the past half-century may not have been either linear or painless, but the gain in well-being for most of humanity has been extraordinary.

The driving force has been technological change. This is made clear in a recent article by Ayhan Kose and Ezgi Ozturk in the International Monetary Fund’s slender review, *Finance & Development*.⁷ The epoch-making impact of information and communications technology becomes self-evident if we compare the time, cost and process of drafting and publishing an article today and fifty years ago: a computer instead of a typewriter; the immediate online availability of data and bibliographical references, rather than their laborious acquisition in print, possibly requiring visits to more than one library; worldwide transmission with a single click via e-mail and Internet, in

⁵ United Nations, *Report of the World Commission on Environment and Development: Our Common Future*, New York, 1987.

⁶ N. Stern, *The Economics of Climate Change: The Stern Review*, Cambridge, Cambridge University Press, 2007.

⁷ M.A. Kose and E.O. Ozturk, “A World of Change”, *Finance & Development*, 51, 3 September 2014. A curious, and significant, coincidence: the authors took as epigraph to their article the verses of the same Bob Dylan song that I chose as the title for this piece.

place of print and the traditional distribution of paper copies by post. The progress generated by the exponential growth in the computing power of microchips (predicted fifty years ago by the legendary “law” of Gordon Moore⁸) transpires from two simple facts. Today’s typical smartphone has 3 million times the computing power of the first minicomputer marketed successfully in 1965, at one 225th the cost. And I presume that the power is improving and cost is decreasing even as we speak.

To add an example drawn from my own experience, back in the 1970s producing forecasts and economic policy analysis based on simulations from an econometric model – which at that time meant solving a hundred or so equations – could take several hours of data-processing time. Already by the early 1980s, when we built the Bank of Italy’s quarterly model of the Italian economy, the time needed for each simulation had fallen to just a few minutes. Today we can carry out complex stochastic simulations in just a matter of seconds.

Change gathered momentum following the end of the Cold War. The introduction of the Internet in 1991 changed our way of communicating, forever, and the mobile telephone has made communication incredibly widespread and incomparably cheaper. The first commercial communications satellite was put into orbit by the United States in 1965; we currently have about 400 active satellites worldwide. Whereas in 1980 there were 5 mobile phone subscriptions per million population, there are now 90 for every 100 people. Technological advance has brought about much more efficient energy use, saving more than 25 per cent on energy for the same volume of goods and services produced, in comparison with 1991.

Globalisation itself has been facilitated by the technological revolution. In transportation, the plunge in air travel prices has caused the number of passengers to soar, while rail travel has gained in speed and quality. The contribution to world growth coming from today’s emerging economies, which had been excluded from the economic integration of the twentieth century, has gone from 30 per cent in the 1965-1974 ten year average to 70 per cent over the last ten years. The world economy is six times larger now than fifty years ago and per capita output more than twice as great, even though world population too has more than doubled. At the same time, the mobility of labour has raised the number of people who live outside their native country, from under 80 million in

⁸ Moore – who was a cofounder of Intel – conjectured that the performance of microchips (broadly speaking, computing capacity) would double every twelve months (later re-estimated at 18-24 months); see G.E. Moore, “Cramming More Components onto Integrated Circuits”, *Electronics*, 38, 8, 1965. Another regular pattern in the speed of technical advance is “Wright’s law” by which the time (or the unit cost) of production (originally in the aeronautical industry) diminishes by a constant percentage every time the cumulative volume of output doubles: T.P. Wright, “Factors Affecting the Cost of Airplanes”, *Journal of the Aeronautical Sciences*, 3, 4, 1936.

1970 to nearly 250 million nowadays; and the migratory flow between developing countries now exceeds that toward the West.

These are clearly extraordinary changes. We are living in a different economy, a different society, from those of even a quarter of a century ago: a global society, with an exceptionally rapid and extensive diffusion of ideas and knowledge, an enormous mass of information available, and nearly 300 times the global financial assets, in dollar value, compared with 1970 (while US consumer prices have risen just sixfold). In particular, the effects of combining technological innovation with the opening of markets have been astonishing. The stepped-up growth in per capita incomes and employment that has been achieved, thanks to the new “supply chains,” in many emerging countries, headed by China, is the clearest testimony.

These changes, too, have not occurred in a straightforward, linear fashion, owing unquestionably but not solely to discontinuities in geopolitical equilibria. In the economic field, recurrent financial crises have struck single countries and regions, ultimately producing the extremely severe global crisis of which we still face the legacies. The world economy has gone through a recession every decade since the 1960s. The increase in welfare has not been evenly distributed among the world population.

Although near a billion people still live in extreme poverty and destitution (with incomes of less than \$1.90 a day, the new benchmark recently adopted by the World Bank), the objective of halving their number was attained in 2010, five years earlier than was called for by the UN Millennium Development Goals of 2000. And apart from the billion who have been lifted out of extreme poverty we should count another 2 billion added to the world population over the last twenty-five years, mostly in the emerging and developing countries, who have not entered this state. The gap in life expectancy between these countries and the Western world (where it has nevertheless continued to lengthen) has narrowed dramatically.

However, while the international inequality in income distribution has diminished, the fact remains that between 1990 and 2010 domestic inequality became more severe in two thirds of the countries for which data is available.⁹ In the United States, while per capita output expanded by some 40 per cent between 1990 and 2007, real median household income gained less than 10 per cent. After the sharp drop in output and employment due to the financial crisis, production has now regained and surpassed its 2007 level, but median income has fallen back to the levels of over

⁹ On the enormous improvement in living and health conditions practically everywhere in the world since World War II and on the uneven developments in the distribution of income and opportunities, with reference to environmental, health, and political disasters, see Angus Deaton’s profound, impassioned recent book, *The Great Escape: Health, Wealth and the Origins of Inequality*, Princeton, N.J., Princeton University Press, 2014.

twenty years ago. It is often remarked that the wealthiest 1 per cent of the population now accounts for about 20 per cent of US national income, compared with 8 per cent fifty years ago. And the increase in the incomes of the super-rich (the top 0.1 per cent) has been sharper still, with an accentuation of the concentration of wealth.¹⁰

“Secular stagnation” and the “second machine age”

The fact that development is a non-linear process is perceptible, among other things, in the lack of substantial productivity gains in the advanced countries consequent to the spread of the new information and communications technologies.¹¹ In most of these countries per capita output has risen only modestly, where it has not actually contracted, as in Italy. The global financial crisis, which stemmed from the bursting of the subprime mortgage bubble in the United States in 2007, and the euro-area sovereign debt crisis, which was triggered in early 2010 by the revelation of grave underestimates of the Greek budget deficit, have been accompanied by what has come to be known, as if in contrast to the “Great Moderation” of the previous two decades, as the “Great Recession.”¹²

Even in the United States and the United Kingdom, the countries that left the acute phase of the crisis behind them most quickly, the growth rate remains lower than in the pre-crisis years. In the euro area as a whole output is still below its pre-crisis level, which it is projected to regain by the end of this year. It is now quite generally held that the “potential” growth rate too has been lowered by the reduction in investment and the very high levels of long-term unemployment and underemployment.

The recession’s legacy, in other words, consists of numerous, varied problems that threaten to leave permanent, not just short-term scars on our economies. Today, there is renewed debate on the risk of hysteresis (i.e., the extent to which the short-term cycle influences the longer-term dynamics of the economy). Larry Summers has revived the “secular stagnation” hypothesis originally

¹⁰ A.B. Atkinson, T. Piketty and E. Saez, “Top Incomes in the Long Run of History”, *Journal of Economic Literature*, 49, 1, 2011; F. Alvaredo, A.B. Atkinson, T. Piketty and E. Saez, “The Top 1 Percent in International and Historical Perspective,” *Journal of Economic Perspectives*, 27, 3, 2013.

¹¹ D. Acemoglu, D. Autor, D. Dorn, G.H. Hanson and B. Price, “Return of the Solow Paradox? IT, Productivity, and Employment in U.S. Manufacturing”, *American Economic Review*, 104, 5, 2014.

¹² See, for one, C. Bean, “The Great Moderation, the Great Panic, and the Great Contraction,” *Journal of the European Economic Association*, 8, 2-3, 2010. For a discussion of the legacy of the financial crisis, see I. Visco, “The Aftermath of the Crisis: Regulation, Supervision and the Role of Central Banks”, CEPR Policy Insight, 68, December 2013. On the euro area sovereign debt crisis, see I. Visco, “The exit from the sovereign debt crisis: national policies, European reforms and monetary policy”, in P. Horvath, P. Mooslechner and A. Staribacher, eds., *Europäische Wirtschaftspolitik der Zukunft*, Festschrift zum 70. Geburtstag von Ewald Nowotny, Wien, New academic press, 2014.

advanced by Alvin Hansen in the 1930s and forcefully rebutted in practice by the protracted economic expansion that followed World War II.¹³ It is somewhat singular that there has been more (and earlier) discussion of this thesis in the United States than in the euro area, where the difficulties that impede a return to sustained growth are particularly evident and the deficit in employment and demand is so substantial.

The new secular stagnation hypothesis refers to the increasing propensity to save (in order to pay down excessive debt) and to the reduction in investment and in aggregate demand in recent years. The decline in the relative price of capital goods induced by technological innovation, despite having resulted in a substitution of capital for labour, may also have played a role in lowering investment expenditure in nominal terms. As Summers notes, unlike new business ventures in the traditional sectors, those in the digital economy may require a reduced amount of money to start up, thus resulting in a possible reduction in the aggregate capital expenditure. In circumstances like these, maintaining the balance between saving and investment – which is essential to achieving full employment – could require a level of negative real interest rates (that is, net of inflation), that monetary policy cannot deliver. Nominal interest rates, in fact, are now close to zero and the increase in prices is minimal. The consequence is stagnant economic activity and the underutilisation of resources. Furthermore, the legacy of the financial crisis – namely the need to reduce financial leverage and decrease public and private debt – would not appear to be temporary. Against the backdrop of low inflation and reduced potential growth, the global ratio of debt to output continues to rise.¹⁴

Apart from the short-run Keynesian effects linked to rigidity and constraints on the adjustment of relative prices, we should consider the possible medium-term repercussions that a protracted state of high unemployment and disinvestment could have on the economy's capacity for growth. In the longer run, poor expectations for demand in connection with population ageing can make the picture even gloomier. Moreover, we are certainly aware – even if the risk is still remote – that holding interest rates very low for very long periods may result in fueling excessive financial risk-taking, imprudent lending practices and, ultimately, dangers for financial stability.¹⁵

¹³ L.H. Summers, “U.S. Economic Prospects: Secular Stagnation, Hysteresis, and the Zero Lower Bound”, *Business Economics*, 49, 2, 2014; A.H. Hansen, “Economic Progress and Declining Population Growth”, *American Economic Review*, 29, 1939. See also C. Teulings and R. Baldwin, eds., *Secular Stagnation: Facts, Causes, and Cures*, VoxEU.org eBook, London, CEPR Press, 2014; and P. Pagano and M. Sbracia, “The Secular Stagnation Hypothesis: A Review of the Debate and Some Insights”, Banca d’Italia, *Questioni di Economia e Finanza (Occasional Papers)*, 231, 2014.

¹⁴ L. Buttiglione, P. Lane, L. Reichlin and V. Reinhart, *Deleveraging, What Deleveraging? The 16th Geneva Report on the World Economy*, London, CEPR Press, 2014.

¹⁵ See also L.H. Summers, “Reflections on the ‘New Secular Stagnation Hypothesis’”, in Teulings and Baldwin, *op. cit.*

A second version of the stagnationist hypothesis, put forward notably by Bob Gordon, does not consider demand and investment but instead focuses on the supply side, and in particular on the rate of growth of productivity, i.e. the economy's potential output for a given amount of available human and material resources employed in the production process.¹⁶ The key argument here is that the great inventions that have resulted in massive productivity increases have for the most part already been introduced, so that a return to more moderate growth rates is inevitable. This thesis is at once daring and perhaps over-simplified, even though it is supported by some careful analysis of the data and of historical trends, both aggregate and sectoral.

What truly characterises the new information and communications technology is its suitability for widespread use in practically every area of economic and social life. The introduction of personal computers and the Internet may have been gradual, not significantly different, in terms of the time taken, from electrification.¹⁷ However, as Brynjolfsson and McAfee have observed, it is perfectly possible that the digital revolution is still far from having worked all its effects on productivity.

Even if it is apparently gradual, the nature of technical progress in the digital age, they say, is exponential, as in the ancient (Persian) legend in which grains of rice placed on a chessboard must be doubled from one square to the next: the volume is almost negligible at first but in the second half of the board it becomes overwhelming. Not to mention other pioneering areas of research like robotics, genomics and artificial intelligence, which may have incredible applications that were once unimaginable (save for people like Jules Verne or Isaac Asimov), with an extraordinary impact on productivity and in the ultimate analysis on our well-being. This is the “second machine age.”¹⁸

The Challenge of Technology

Starting with the first industrial revolution, technical progress has regularly displayed the ability to engender not only widespread rises in per capita income and living standards but also expanded

¹⁶ R.J. Gordon, “Is US Economic Growth Over? Faltering Innovation Confronts the Six Headwinds”, NBER Working Paper 18315, 2012; and more recently, R.J. Gordon, “The Turtle’s Progress: Secular Stagnation Meets the Headwinds”, in Teulings and Baldwin, *op. cit.* For a contrary thesis, see J. Mokyr, “Secular Stagnation? Not in Your Life”, *ibid.*

¹⁷ B. Jovanovic and P.L. Rousseau, “General Purpose Technologies”, in P. Aghion and S.N. Durlauf, eds., *Handbook of Economic Growth*, Amsterdam, Elsevier, 2005.

¹⁸ These analyses pay little attention to the possible effects of computerization and the digital revolution on people’s cognitive capacities (beyond the impact on labour demand and the distribution of income), but other authors see them as anything but negligible. See for instance, N. Carr, “Is Google Making Us Stupid?”, *The Atlantic*, July-August 2008, and M. Näsi and L. Koivusilta, “Internet and Everyday Life: The Perceived Implications of Internet Use on Memory and Ability to Concentrate”, *Cyberpsychology, Behavior and Social Networking*, 16, 2, 2013. See also the theses of Norbert Wieser, mathematician and the inventor of cybernetics, on the severely depressing effect of automation on employment, in N. Wieser, *The Human Use of Human Beings*, Boston, Houghton Mifflin, 1950.

and more rewarding job opportunities. The destruction of jobs in the industries affected by process and product innovation has always been accompanied by a rapid creation of new jobs in the economy as a whole. What underlies this mechanism is the ability of technical progress to trigger a virtuous sequence of productivity gains, a reduction in unit production costs, increased demand for the new goods and services, and rising national income.

The digital revolution, which we experience every day in our ways of communicating and acquiring information, confirms the far-reaching benefits that the entire society obtains from technical progress. But digital technologies have a distinctive feature: the greater speed with which they tend to replace labour, even in fields in which human intervention has always appeared to be decisive. This suggests the revival of the concept of “technological unemployment” proposed by Keynes in his 1930 essay on the prospects for future generations¹⁹ and thus indicated as one of the forces behind the decline in job opportunities and the stagnation of wages and incomes observed in a number of industries and countries.

As we know, without bringing Ned Ludd or Karl Marx into it, this debate is not new. But we can recall Keynes’s own optimism and his prediction that given the tendencies of technical progress and the increase in productivity in the United Kingdom and the United States and “assuming no important wars and no important increase in population, the economic problem may be solved ... within a hundred years” with a fourfold to eightfold rise in per capita income. Today we are talking about a global economy, new technologies and population ageing; we note that exceptionally violent wars and population growth have not been lacking, but even so the order of magnitude of the rise in per capita income that Keynes projected for the century does not appear to be unreasonable. However, his fear that the most severe challenge would be how to occupy our leisure time, as we would be astonishingly more wealthy but technologically unemployed, has certainly not materialised.

Fifty years ago, when Dylan’s emblematic song first appeared in the United States, a small book was published in the United Kingdom that dealt with production efficiency, income distribution and corporate ownership. It was written by James Meade, an economist and Keynes’ disciple, well-known for his work in the field of international trade, which would eventually earn him the Nobel Prize in 1977.²⁰ More than pose the social and economic problem of what to do when automation means that “we need to work only an hour or two a day to obtain the total output of real goods and

¹⁹ J.M. Keynes, “Economic Possibilities for our Grandchildren”, in *Essays in Persuasion*, London, MacMillan, 1931.

²⁰ J.E. Meade, *Efficiency, Equality and the Ownership of Property*, London, Allen & Unwin, 1964. A similar view would be put forward a couple of decades later by another Nobel Laureate, Wassily Leontief, in “Technological Advance, Economic Growth, and the Distribution of Income”, *Population and Development Review*, 9, 3, 1983.

services needed to satisfy our wants,” Meade asked “What shall we do when output per man-hour of work is extremely high but practically the whole of the output goes to a few property owners, while the mass of the workers are relatively (or even absolutely) worse off than before?”²¹

What can we say on this point today? To my mind, we must consider the matter on three levels. First, the crucial question is to determine whether the net loss of jobs due to technological innovation is temporary or permanent. As I recalled above, history shows that, although automation has certainly brought about the substitution of capital for labour in given economic sectors, for the economy as a whole, technical progress has been the source of new and better work opportunities. It is legitimate to ask whether things may not be different this time around. So far, in the United States and elsewhere, new technology has created a polarisation of occupations, with employment gains concentrated in low-paid service jobs and high-paid jobs requiring considerable educational attainment, to the expense of mid-skilled jobs.

A recent, widely-cited study by two researchers at Oxford has estimated that 47 per cent of existing jobs in the United States risk being automated out of existence, possibly within a decade or two.²² Other analysts, at the Bruegel research centre,²³ have produced estimates of over 50 per cent for the main European countries, including Italy (which so far appears to have suffered more from globalisation and the heightened competition of the emerging market economies than from technological innovation). Such estimates will certainly make a powerful impression on readers, but they must be handled with great caution, given the patent difficulty of assigning risk percentages to jobs whose content may change radically thanks to the new technology itself. In the past we have seen drastic transformations in the composition of employment: just think of the drastic drop in agricultural employment in the industrial countries since World War II. The destruction of some jobs will certainly correspond to the creation of new ones, and the net result is anything but a foregone conclusion, though of course we cannot ignore the adverse effects characteristic of a phase of transition like the present.

As yet, the new information and communications technology is still complementary to managerial and intellectual jobs but substitutive of routine tasks. The new wave of technological innovation in the fields mentioned earlier (robotics, genomics, artificial intelligence) could

²¹ The implications of this terrifying prospect for income distribution – which Meade dubbed the “Brave New Capitalists’ Paradise” – are the centrepiece of a short, sharp article by Benjamin Friedman, “‘Brave New Capitalists’ Paradise’: The Jobs?”, *The New York Review of Books*, 7 November 2013.

²² C.B. Frey and M.A. Osborne, *The Future of Employment: How Susceptible are Jobs to Computerisation?*, Oxford Martin School, University of Oxford, September 2013.

²³ J. Bowles, *The Computerisation of European Jobs*, Brussels, Bruegel, July 2014.

nevertheless have a substantial impact on the labour demand relative to non-routine tasks that cannot, apparently, be standardised, at both high and low levels of skill.²⁴

The second question is the relationship between technological progress and the increase in income inequality so forcefully anticipated by Meade. Such a vast issue cannot be discussed in a few lines. The sensation made by Thomas Piketty's *Capital in the Twenty-First Century*²⁵ readily demonstrates how topical it is. Here the point seems to me to be not just to decry the emergence of entertainment superstars, top executives and the great rentiers (the top 0.1 per cent of the population), who would appear to be – thanks to skill, luck, or monopoly positions – the great beneficiaries of the economic transformation of recent decades, and accordingly call for income redistribution for reasons of social equity. Rather, it is to determine the extent to which current and prospective trends in technology can alter, for the purposes of economic growth, today's relationship between capital and labour, how great the risk is that substantial portions of the work force will be driven out of the production process, regardless of their level of education and competence. The question, therefore, is what to do to avert human, social and political consequences that are potentially very severe indeed.²⁶

These are clearly questions for the long term. We must be skeptical of extreme projections that would have all or almost all workers replaced by robots and the owners of capital expropriating, in the form of profit, practically all the income produced. Such predictions are afflicted by the obvious limits of linear extrapolation; they fail to consider the safeguards and feedback that have tended to arise, in a more or less spontaneous fashion, in the course of human history. Nor, however, can we fail to observe that in the years to come, such issues as the concentration of market shares, equality of opportunity, the progressiveness of tax systems, workers' employability, and ownership rights will inevitably be subject to political debate and decision, in a context that is difficult because, for one thing, it no longer corresponds to national borders.

The third consideration, given the re-emergence of issues like technological unemployment, income and wealth concentration and the domination of capital (machines) over labour, involves the

²⁴ For a review of the debate see A. Sabadash, "ICT-induced Technological Progress and Employment: A Happy Marriage or a Dangerous Liaison? A Literature Review", European Commission, Joint Research Centre, Institute for Prospective Technological Studies, Digital Economy Working Paper 07, 2013.

²⁵ T. Piketty, *Le capital au XXI^e siècle*, Paris, Seuil, 2013; English translation, *Capital in the Twenty-First Century*, Cambridge, Mass., Harvard University Press, 2014.

²⁶ The issue is broached with force in Friedman, *op. cit.* See also L.H. Summers, "Economic Possibilities for our Children", *NBER Reporter*, 4, 2013, and T.B. Atkinson, "After Piketty", *British Journal of Sociology*, 65, 4, 2014.

possible repercussions on aggregate demand. Those who argue that the fruits of technical progress and the relative increase in productivity will mainly benefit the relatively few owners of the new technology firms are certainly raising the question of distributive fairness. At the same time, however, if they are to be produced at all, those fruits need a sufficiently high level of effective demand. In other words, there is also a broader, macroeconomic question involving the distribution of income: in order for the goods and services that will make up tomorrow's output to be sold, income, jobs and property will have to be widely distributed throughout the population. In other words, for the enormous increases possible on the supply side to materialise, there will have to be consumers in a position to create effective demand for the new goods and services.

Supply and demand today

The matters addressed to this point concern a possible future, a future that is distant but perhaps not too much so. Accordingly, in discussing them we must keep an open mind, in the awareness that it is not about tilting at the windmills of machines dominating men, or capital irremediably crushing labour. We must remember that just as today's work is far different from yesterday's, so tomorrow's will differ from today's. And the same goes for capital: "digital" capital will have very little in common with the capital of the ironmasters. Yet we cannot ignore the problems engendered by the ever-increasing computerisation of so many occupations. At a time of far-reaching transformation like the present, systems of social security for the workers who lose their jobs will have to be reinforced.

In any event, the responses to the long-run slowdown in economic growth that many analysts fear cannot but be multiple, and very likely different from country to country. Benjamin Friedman, for instance, contends that at least for the United States, more and better education for an increasingly large portion of the labour force is a partial solution at best, insufficient to buffer the impact of technology on jobs and earnings.²⁷ On this issue, however, Ned Phelps observes that the solution is not the indefinite increase in the number of technical and scientific university graduates,²⁸ of whom there are already a good many in the main advanced countries, but to aim for innovation and individual dynamism, creativity and adaptability, which depend greatly on customs

²⁷ Friedman, *op. cit.* On the asymmetrical effects of the new information and communications technology on income distribution, owing to the differential complementarity between computerization and non-routine work of high and low human capital content, see C. Goldin and L.F. Katz, *The Race between Education and Technology*, Cambridge, Mass., Belknap Press, 2008.

²⁸ E. Phelps, *Mass Flourishing: How Grassroots Innovation Created Jobs, Challenge, and Change*, Princeton N.J., Princeton University Press, 2014.

and which must continue to be emphasised in schools and universities, through the humanities: history, philosophy, literature.²⁹

Brynjolfsson, McAfee and Spence suggest, with a new spirit, a strategy that is not new but, they stress, “intellectually simple, if politically difficult”: stimulus from public investment in fields where the social return is especially high: basic research in science, technology and health; spending on education; and infrastructure, not just highways and airports but also water supply, waste disposal, electric power grids and communications networks.³⁰ In its October 2014 issue, the International Monetary Fund’s *World Economic Outlook* returned forcefully to the theme of the possible impact of infrastructural investment on short-term demand and medium-term supply.³¹ In Europe, Bart van Ark, among others, maintains that if the main problem is still making good the deficit in productivity growth, then firms must rapidly catch up in adopting the new digital technologies.³²

Before asking what the future holds for us now, we must start from the recognition that there is a serious deficit in Europe, and especially in Italy, not only of growth but also of demand, hence of employment and incomes. Strong stimulus for investment, public and private, national and European, is accordingly essential. Even raising the rate of growth in productivity requires well-targeted investments in new technology, to be sure, but also in intangible infrastructures that can generate increasing returns over the medium-to-long term.

If there is a lack of investment due to the high cost of capital in some countries, doubts about demand, or uncertainty over the state and continuity of “structural reforms,” it is the responsibility of the political system and economic policy – and of those in leading positions in society, in the information industry and in training and education – to act with resolution, foresight and singleness of purpose to remove these impediments. In Italy, in particular, given an economy and a society that have been practically stalled since well before the onset of the financial crisis, there is great potential for improvement, by removing constraints and rigidity, accelerating the adoption of new

²⁹ Goldin and Katz, *op. cit.*, note that what matters most in the “race” between education and technology is cognitive skills and interpersonal relations.

³⁰ E. Brynjolfsson, A. McAfee and M. Spence, “New World Order: Labor, Capital, and Ideas in the Power Law Economy”, *Foreign Affairs*, July-August 2014.

³¹ IMF, *World Economic Outlook*, Chap. 3, October 2014.

³² B. van Ark, “Productivity and Digitalization in Europe: Paving the Road to Faster Growth”, Lisbon Council Policy Brief 8, 1, The Lisbon Council, Brussels, 2014. Van Ark refers in particular to “Metcalf’s law” (named after Robert Metcalfe, the inventor of Ethernet technology) to highlight the disproportionately large productivity effect engendered by investment in digital technology (in general, the network or interlinking effects of the technology).

technology, closing the gap that separates many industries from the productivity frontier, and refurbishing infrastructures, including the most traditional ones.

In the search for a new model of development, or at least a return to balanced, sustainable economic growth, we can start from Acemoglu and Robinson's observation on how important it is to maintain a pluralist society and renew our political and economic institutions in a more inclusive direction.³³ Specifically, it is not enough to set out reasonable objectives if the conditions for attaining them are lacking.

In some cases, these conditions are unlikely to present themselves. The objective of bringing manufacturing value added back up from its current 15-16 per cent of GDP to 20 per cent by 2020, as it was a decade and more ago, proposed quite emphatically in the European Commission's strategy for the next few years³⁴, will run into evident historical and methodological obstacles. On the one hand it is most likely, owing notably to the spread of automation, that value added will be derived increasingly from sectors outside manufacturing. As in the case of agriculture, this does not necessarily reduce its importance for a nation's economy or a society's value system. But it does spotlight the risk of overstating its potential to create jobs. On the other hand, the spread of new technologies is making even the very definitions of economic sectors obsolete.

Twenty years ago the Italian government announced a "three I's" programme, in Italian "impresa, inglese, informatica", which correspond, in English, to the "three E's" of Enterprise, English, and computer Education. Unhappily, there is no denying how far behind we still are on all three fronts – not because the objectives were vague or implausible but because the fundamental administrative, legal, cultural and political conditions for their attainment were not present. Certainly there are financial constraints. But I do not believe that the insufficiency of investment in knowledge, in environmental and territorial protection, or in the valorisation of our nation's incomparable artistic and cultural heritage depends solely on these constraints. There is a grave deficiency in the ability to grasp the fundamental importance of these factors as an investment in the future, including the near future.

We can invent future scenarios, but we cannot foresee what our economy or our society will be like twenty or thirty years down the line. When we ask ourselves what we must do to increase demand, income, and employment, or when we point to the necessity of designing new industrial

³³ D. Acemoglu and J. Robinson, *Why Nations Fail: The Origins of Power, Prosperity, and Poverty*, New York, Crown Publishing, 2012.

³⁴ European Commission, *A Stronger European Industry for Growth and Economic Recovery*, Communication 582, 10 October 2012.

policies, the primary objective can only be to put our economic and social system in a better position to face and foster change.

Unquestionably the competitive pressures of globalisation and the challenge of computerisation will require major changes in the organisation of work and the adaptation of education, training, and infrastructure. Slowness to adapt would constitute a third cause of stagnation, recently noted by Barry Eichengreen,³⁵ in alternative or in addition to the lack of demand, as posited by Larry Summers, and the slowdown in productivity growth prognosticated by Bob Gordon, a cause which could become the most important of all.

That said, the risks of technological unemployment are aptly, if somewhat controversially, summarised in Tony Atkinson's recent remark that "the direction of technological change should be an explicit concern of policy-makers, encouraging innovation in a form that increases the employability of workers and emphasises the human dimension of service provision".³⁶

However, what we should do is not so much fear the direct impact of the new technologies and computerisation on jobs, as work to take advantage of the enormous cost reductions that will derive from them. The growth of innovative industries is now the principal engine of growth in employment and in productivity. In an influential book, Enrico Moretti has shown that every high-tech job created in a particular US metropolitan area has been accompanied by five new jobs in the traditional, low-skilled, low-education sectors.³⁷ Perhaps the level of generality of this result still needs to be established, but it is indicative of the powerful effects of innovation. What is certain is that people will have to work in different ways, in different jobs and different places, over a career span marked by continuous, lifelong learning and training.

We must acquire the skills necessary for the twenty-first century: critical thinking, aptitude for problem-solving, creativity and acceptance of innovation, the ability to communicate effectively, and openness to cooperation and group work. This while we continue to invest in knowledge, in schools and universities, with the aim of rapidly overcoming the very serious deficit of "functional literacy and numeracy" observed in many countries (notably in Italy) by the 2013 OECD's Programme for the International Assessment of Adult Competencies.³⁸ Indeed, as famously stated by Benjamin Franklin in his almanac, "An investment in knowledge pays the best interest". This

³⁵ B. Eichengreen, "Secular Stagnation: A Review of the Issues", in Teulings and Baldwin, *op. cit.*

³⁶ A.B. Atkinson (2014), "After Piketty?", *op. cit.*

³⁷ E. Moretti, *The New Geography of Jobs*, Boston-New York, Houghton Mifflin/Harcourt, 2012.

³⁸ OECD, "OECD Skills Outlook 2013: First Results from the Survey of Adult Skills", Paris, November 2013. These issues have been examined by the author in I. Visco, *Investire in conoscenza*, Bologna, Il Mulino, 2014.

investment in knowledge must necessarily pay attention to scientific advances and technological progress, without losing sight of the value, the importance, the practical relevance, of humanistic traditions.³⁹

Italy is a case in point as to the central importance of a comprehensive design in setting out structural reforms. The clearest example is how hard it is to improve the conditions for doing business and for the creation and growth of new firms, including those providing the services required by the (new) needs of an older society. This means creating a more propitious environment by removing bureaucratic and administrative obstacles and significantly improving courts, schools and infrastructures; but it also means establishing a framework of respect for rules, countering illegality and combating crime.

A good deal of our progress depends on membership in the European community. The path towards full European Union appears rocky, today, but this is not the place for another discussion of that issue. Given the present theme, I should just like to recall that almost fifty years ago now the well-known Italian economist, and later politician, Nino Andreatta saw the technology gap between America and Europe as an essential “political prod for Europe.”⁴⁰ He cited the role of the US federal government in funding scientific research and creating a market for the products of “science-based industries” in order to stress how important it was to truly assess “the negative consequences of a multiplicity of procurement policies on the part of different national governments, policies that call forth an inefficient proliferation of research efforts in individual countries and slow growth in market size.” I am convinced that today there would still be much to be gained if the EU member states could pool certain substantial portions of their budgets – infrastructural investment, research, defence and security – as part of the process that will, or should, lead from Economic and Monetary Union through Banking Union to Political Union.

To conclude, the times are still changing. The times are always changing. More than seeking to anticipate change, what matters is to be ready, to seek out and create better conditions for seizing the opportunities and reducing the risks brought about by this change, to pave the way for progress that is broadly and equitably distributed.

³⁹ In Italy, this means to transcend once and for all the severe divide between these two areas that originated from the heated controversy involving as protagonists more than a century ago the great mathematician Federigo Enriques and the great philosopher Benedetto Croce.

⁴⁰ B. Andreatta, “Tecnologia ed economia nella controversia sul divario tra America ed Europa”, *il Mulino*, XVI, 2, 1968.