

SYMPOSIUM ON

TECHNOLOGY, INNOVATION

AND INCLUSIVE GROWTH:

Future Perspectives











Key messages

- New technologies may significantly improve income, health and welfare.
- Productivity growth, however, is weak to date. This can only partly
 be explained by inappropriate measurement. Some technologies
 are not mature enough to transform all industries.
- Digital innovation fosters social mobility through processes of creative destruction. However, digital innovation may also generate rents that may increase income inequality.
- New technologies may result in significant job displacement over the next decades. Policies need to manage the transition period, including offering opportunities to reskill workers to new demands.
- Developing countries have opportunities to leapfrog to new technologies to catch-up more quickly to leading economies, but for this to happen they need to invest in infrastructure and human capital.
- The impacts of new technologies vary across countries; emerging economies are not experiencing job polarisation when confronted with information and communication technologies.
- Despite "new" challenges arising from technological progress, the same "old" policy responses are offered. Are they still adequate?
- Policies should not only focus on high-tech industries but also promote transformation of traditional industries.

The 2000s...

...started with potentially "revolutionary" technologies (e.g. artificial intelligence (AI) and robotics) offering large transformative opportunities, alongside rather mixed growth performances across countries and growing income inequalities within countries (OECD, 2015). The question is, will new technologies bring strong economic growth with opportunities for all? The Symposium on Technology, Innovation and Inclusive Growth: Future Perspectives that took place in Paris on 28-29 April 2016, in the context of the OECD's projects on "Innovation for Inclusive Growth" and



To the question "What will be the impact of new technologies?" the symposium's participants responded:

1 Strong growth benefiting all 28%
2 Strong growth benefiting a few 67%

5%

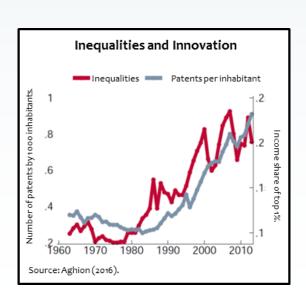
"Enabling the Next Production Revolution", brought together economists, policy makers, technology and industry experts to present their views on this central question.

3

Weak growth

Danny Leipziger (Growth Dialogue), William Maloney (World Bank) and Dominique Guellec (OECD) opened the Symposium, outlining the opportunities and challenges posed by technological progress. On the one hand, technological progress continues to be the engine of economic growth. The development of information and communication technologies (ICTs) has brought considerable improvement to consumers' welfare through the creation of new services, as well as enabling citizens to participate in policy decision-making. On the other hand, the impacts of new emerging technologies on productivity have so far been far below expectations, and economic growth may result in unwanted societal effects, including increased income inequalities. **Dominique Guellec** pointed out that the fundamental transformation of markets by new technologies may affect market structures and lead to higher concentration of market power but also more entry. So far, much attention has focused on how labour market dynamics and new technologies together affect the distribution of income. Answers to new impelling economic questions are needed to formulate adequate policy responses that will encourage inclusive growth.

What is the potential for new technologies to foster inclusive growth?



Philippe Aghion (Harvard University and Collège de France) pointed to the substantial growth potential of the current era. The debate on future economic growth is controversial among economists. Disagreeing with Robert Gordon, who claimed that "rapid progress made over the past 250 years could well turn out to be a unique episode in human history", Philippe Aghion argued that ICTs are changing the way in which ideas are produced, allowing international collaboration along with a fast diffusion of knowledge, and that this will benefit future technological progress. Moreover, he argued that, on the basis of research findings, some of the low growth could partly be explained by the difficulty of estimating the benefits deriving from quality improvements of high-tech products.

How does innovation affect inequality? Philippe Aghion presented evidence from the United States that innovation has an impact on high income inequality (i.e., the income share of the top 1%, or above) but not on general inequality, as measured by the GINI coefficient. The reason for this is that innovation generates rents for innovators. However, such rents are temporary, and a process of "creative destruction" fosters social mobility.

"Wherever you have innovation you also have social mobility."

- Philippe Aghion

Regarding policy implications, **Philippe Aghion** pointed to the need for structural reforms, both in the education sector, and with regards to the tax system and to labour markets. Policies should maximize the benefits of innovation while limiting excessive inequality. Sweden, the Netherlands and Canada have adopted successful reforms in these areas. Moreover,





continuous market competition is required in order to avoid the formation of interest groups with too much influence, capable of capturing government decisions.

Manuel Trajtenberg, of Tel Aviv University, stated that the measurement of productivity, which relies on old methods, could be improved by including the value created by digital innovations. He also referred to the downsides of the digital economy, including higher top income inequality, high levels of youth unemployment and especially the lack of "meaningful employment", which creates disillusionment about the potential of the digital "revolution" in many groups in society. He also advocated stronger evidence on the potential of innovation to foster social mobility. People at the bottom of the income distribution may experience fewer economic opportunities. He argued that policy recommendations should go beyond the general message of the importance of education, and indicate in more detail what role the education system should play and how different types of training and skills can best be provided.

An issue that remains crucial is the comprehension of the mechanisms that determine the impacts of innovation on inequality. **Caroline Paunov**, of the OECD, focused on the impacts of digital innovation on the modification of market structures. Digital innovation and intangible goods trigger larger economies of scale and foster "winner-takes-all" dynamics, leading to higher market concentration and rents for successful innovators. The intangible nature of new products and capital also goes hand in hand with "creative destruction", facilitating social mobility.

There is also a geographic dimension to inequalities in innovation performance and, consequently, in the opportunities for different individuals. **Dimitri Corpakis**, of the European Commission, noted that



scientific and innovation excellence is often concentrated in regions where the performance of innovative economic activities is strong. Regions unable to emerge as competitive centres of innovation remain laggards with regards to their income performance. Interestingly, despite the higher potential of knowledge diffusion thanks to ICTs, location remains important. Place-based innovation policies, such as smart specialisation, aim to help laggard regions to uncover potential areas of expertise.

New technologies, innovation, employment and growth: What are the key issues?

In the course of economic history, technological progress has shaped the types of tasks performed by labour, substituting or complementing different occupations, with major consequences for employment and wage inequalities. Carl Frey, of the University of Oxford, referred to research he had undertaken showing that roughly 47% of US jobs are currently susceptible to being automated (Frey and Osborne, 2013). The polarisation of the labour market, between high-skilled and low-skilled jobs, determined by the automation of middle-skilled jobs in recent years, is likely to grow further. However, while the potential scope of automation has expanded, creativity, complex social interactions, and the ability to manipulate remain unique "human objects competitive advantages". Furthermore, machines are far from being able to identify problems in our society.

Is the phenomenon of job market polarisation, identified in developed countries by David Autor and

"We do not see labour market polarization in developing countries."
- William Maloney

"We'll continue to see extreme job polarization."

- Carl Frey

others, also a feature of developing countries? **William Maloney**, of the World Bank, addressed this question and provided evidence to show that, on the contrary, we observe the opposite trend in several emerging economies, such as Brazil, India and Viet Nam. This can be explained by different factors, such as the different initial occupational distribution, the impact of off-shored jobs, the different relative supply of labour, and different impacts of ICTs and automation due to different business framework conditions.

Robert Atkinson, of the Information Technology and Innovation Foundation (ITIF), also pointed out that a high number of jobs are difficult to automate. He noted that inequality is increasing within – not between – occupations, and that a large share of the top 1% in the US is represented by financial and professional service jobs, rather than by entrepreneurs in the digital economy. For this reason, he concluded that the concerns about a trade-off between new technologies and inequality are unjustified.

What type of policy intervention is needed to ensure that technological change fosters inclusive growth? The different pieces of evidence reveal the complex relationship that governs innovation, employment and income distribution, as well as the institutional and political frameworks of different countries. Youngah Park, of the Korea Institute of S&T Evaluation and Planning, summarised the policy need as follows: "To plan and shape the future with our own hands, we need to break free of the old frame of mind that technological advancement drives economic growth. What we need to do, while there is still time, is to meticulously analyse the impact of future technologies on all aspects of life, including education, employment and social values, and to prepare for the time when they do happen."



How can policy best support new technologies that are inclusive?

Framework conditions and the characteristics of the business environment also affect how the benefits derived from innovation policies and R&D programmes spread to society. Investment in R&D and, in particular, high technology, tend to be concentrated in specific industries and regions, which in turn attracts highly skilled workers to these industries and regions, weakening opportunities for laggards to be able to catch up. This contributes to rising income divergences and increases inequality.

In order to address these challenges, **Manuel Trajtenberg** pointed to the need for structural reforms that facilitate, and create better conditions for, technology diffusion. If our aim is to ascertain the value created by the digital economy, we also need to develop methodologies that will allow us to better measure welfare, the ultimate priority for policy, rather than pure economic growth.

"The key to inclusive growth is to upgrade the quality of large, growing occupations."

- Manuel Trajtenberg

Much will also depend on our ability to train labour to adopt new technologies for greater productivity. To achieve this, **Manuel Trajtenberg** suggested



implementing programmes to upgrade the skills of workers in occupations that are growing in importance, notably health care and social assistance. This would require exposing those working in these sectors to the potential of ICTs, including for instance, technology or new methods designed to help doctors during surgery interventions, or, in the education sector, technologies that allow individual students' performance to be monitored more effectively. Clearly, the educational system would play a key role here.

Francois Bourguignon, of the Paris School of Economics, emphasised the lack of methodologies to correctly measure future labour demand across sectors in view of the fundamental transformation underway. Given the difficulties of forecasting future labour demand, mismatches in the labour market between the supply of and demand for different skills, may arise. He concluded that policy makers need to find ways to manage transitions, i.e. the period between the loss of





employment and the creation of new opportunities. In particular, a critical question is how to deal with unemployment stemming from possible disequilibria between the replaced jobs and the new ones for the retrained workers.

"The questions have changed, but the answers have all remained the same." - Montek Singh Ahluwalia

Montek Singh Ahluwalia, former Deputy Chairman of the National Planning Commission, argued that further thinking is needed on what are the main policy implications of the current economic and technological changes: many of the proposals, such as allowing for more competitive market competition and enhancing education, have been, he claimed, on the policy agenda for decades. More concrete guidelines are needed if policy is to address the new issues posed by technological change. This is a challenge for all countries, including developing economies. Several developing economies have increased investment in R&D and improved their participation in innovation, but some negative externalities for the environment from technology have received too little attention. Similarly, Montek Singh Ahluwalia pointed to the importance of focusing on spreading the benefits to all in society. This also required improving the measurement of the income distribution.

Why, in spite of manifold opportunities from digital innovations, has productivity slowed down?

Digital innovations are set to transform the entire energy value chain. Across industries, these innovations are enabling a shift to predictive,

condition-based maintenance: for instance, fixing machines only when needed and before they break. Yet while innovation is accelerating in many advanced economies, productivity has actually slowed down. What can explain this paradox? Marco Annunziata of General Electric pointed to two main explanations: first, digital innovations have only recently spread more intensively to industries' production processes — where they will translate in faster productivity growth once production processes adjust adequately. Second, subdued investment over the last few years has slowed the pace at which these innovations were scaled through the global industrial system.

To accelerate this transformation, industrial companies need to become "digital-industrial" companies, building strong digital know-how. Digital innovation advances at greater speed and requires greater flexibilities to reap full productivity gains. Business models need to change. Engaging in the digital economy also requires greater openness: success depends on a mix of new abilities and no single company can accumulate those capacities in isolation. Connecting to the right ecosystems and networks is essential. The opportunities for manufacturing raise fundamental questions regarding the boundaries of the firm i.e. what part of products is best produced within and outside of the firm. Policies

A few reactions from the audience

"Are today's innovators tomorrow's rentseekers?"

"The future of work will surely require we cultivate our entrepreneurial spirit."

"Technological changes may not have identical global effects, as countries do not share the same cultural characteristics."

"Productivity increase has not led to a decrease of inequality in the past; it is unlikely that it will lead per se to inclusive growth."

"To which extent can we really predict the labour demand of the future?"

"Does more access to new information increase our well-being?"

"Can countries alone cope with all challenges? Is there a need for international policies and agreements?"

Excerpt from Jennifer Blanke's Opinion Piece

[W]hile discussions of productivity and measurement remain somewhat theoretical, nothing can be more concrete than the impact on what is arguably most fundamental to our sense of economic worth: gainful employment. New products and processes can simultaneously open up sources of growth and displace workers. And this is no longer just about repetitive factory jobs: computing and robotics now threaten professions that had seemed "safe territory", such as accountants, taxi drivers and paralegals.

New technologies will create jobs we haven't even thought of. The main question in the meantime is how long this disruption will last and how far it will go. A recent study estimated that nearly half of total employment in the US is at risk, over the next decade or two. One can expect that low-skill activities will be progressively replaced by higher skilled ones. This will exacerbate inequality and as this happens social tensions will rise.

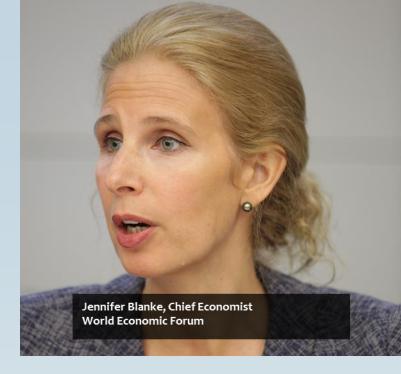
aimed at supporting technological progress should focus on (1) bolstering the right type of education firms actually need; (2) facilitating openness of firms' innovation processes; and (3) designing smart social safety nets, particularly to lifelong learning.

What is the key to global competitiveness in the emerging internet economy?

Robert Atkinson pointed to several trends that weaken the prospects of new technologies to bring about large revolutionary change. Silicon-based

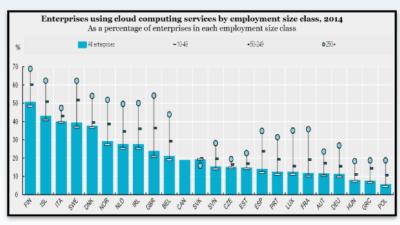
information technologies are reaching decreasing returns to investments. generally, expectations that a given technology could continue to improve exponentially are, he argued, unrealistic. This is evident from the past: periods of strong improvements precede slow and decreasing returns to investments, following an S-shaped curve, as suggested in Schumpeter's long-run theory of technology development. Currently, a series of new technologies are emerging: machine learning-AI, 3D printing, robotics, autonomous vehicles. These technologies are still in a development phase and it will take time (much beyond 2030), before we can jump on to the next strong growth curve.

To support progress countries need to put in place policies to increase competitiveness, without hindering innovation or productivity. Policies to increase



competitiveness do not necessarily enhance productivity-enhancing policies (e.g. ICT tariffs and protectionism) and some policies can harm both competitiveness and productivity (e.g. ICT taxes, labour and product market regulations and restrictions to FDI and data flows). Countries should instead focus on policies that serve both: tax incentives for ICT adoption, ICT skills development, open data policies, digital literacy, etc. Low ICT prices are the key to growth as they allow benefitting from the spillovers of their diffusion.

Alistair Nolan, of the OECD, presented insights from the Enabling the Next Production Revolution project. He argued that economies where the diffusion of technologies is faster are also more competitive. Other



Source: OECD (2015a).

important drivers of competitiveness include macroeconomic stability, low costs of energy supplies and the ability to put in place technology-specific policies. At the same time, a series of issues remain open to debate: Will geography matter more or less as a consequence of the internet economy? Are there any opportunities



for leapfrogging for emerging economies? Cloud technologies like cloud-computing may offset some disadvantages for small firms, what are the implications for competition?

Jennifer Blanke, of the World Economic Forum, noted that it is important to realise that new technologies can very quickly bring about fundamental

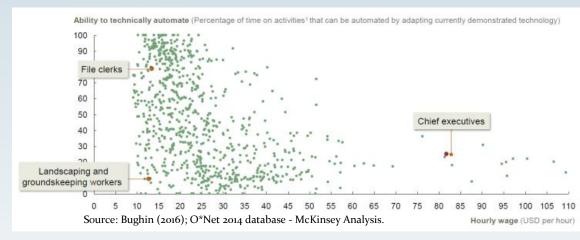
change (e.g. impacts of automation on the labour market). Based on her analysis, policy makers need to react and work with the business sector in order to establish adequate labour market policies that protect workers rather than jobs. Workers should to have the means to upgrade their skills to changing labour market demands.

The impact of new technologies differ may substantially where developing countries concerned. Carl Dahlman, of the OECD Development Centre, highlighted four key enablers of the Internet economy: infrastructure, regulation, skills and finance. Productivity in developing countries is far behind that of developed countries. This means that there is a high potential for gain by tapping into the existing knowledge pool. These countries can acquire such knowledge through various mechanisms, including

foreign direct investment (FDI), personnel mobility, technology licensing and reverse engineering. New technologies offer them the possibility of leapfrogging present leaders. But there are also risks of exclusion, particularly if infrastructure investments are not undertaken.

Disruptive technology and automation: What are the implications for industry and people?

A key aspect of new technologies (e.g. biotechnology, informatics and robotics), highlighted by **Jacques Bughin**, of the McKinsey Global Institute, is that many of these technologies will converge and develop strong complementarities that will likely result in even larger productivity gains for firms. Successful business models are changing drastically under the pressure of lowered entry costs. For governments to increase the competitiveness of national industries, it is also



important to ensure that adequate research is conducted by public research institutions. Framework conditions that allow greater employment flexibility and the adoption of complementary technologies are also important.

Mete Çakmakci, of the Technology Development Foundation of Turkey, suggested looking at the functions of new products to evaluate their potential contributions to enhancing welfare. For instance, the function of a car is to transport people physically from



"Among the priorities at the OECD is enabling the responsible development of technology for future inclusive growth."

- Douglas Frantz

one place to another; Time spent commuting continues to be important in spite of cheaper and better communication technologies. Disruptive technologies present solutions but implementing them will require major changes to the transportation infrastructure. A core domain where new technologies can help, for instance, is traffic management. While a number of digital solutions exist in this area, such as smart systems that track congestion and automatically reorient traffic, their implementation requires the engagement of public authorities.

Are machines about to replace human labour? José F. Saenz, of the Business Unit Robotic Systems of Fraunhofer, provided insights from his research experience on robotic technologies. He argued that while automation will continue to permeate increasingly many industries, particularly through robots, robots are not, at present, resembling humans in either form or function. He highlighted the potential and limitations of his field of research, emphasising that robots do not necessarily develop as substitutes to human labour but rather as complements to human labour. In the future, robots could be of similar complementarity to mobile phones today. Particularly in manufacturing industries, robots are increasingly assisting human labour in tasks that require additional precision and are less repetitive. This type of application has great potential to increase productivity and improve working conditions.

The SDGs: Where do innovation and technology fit in?

Douglas Frantz, Deputy Secretary General of the





OECD, discussed the sustainable development goals (SDGs). To point out the importance of this topic, among various examples, he highlighted the persistent gender gap in wages in OECD countries. Furthermore, he noted the importance of considering the interdependence among different SDGs and the role of technology in addressing SDGs. He argued that every possible innovation to address these goals needs to be taken into account, including, for instance, advanced space technologies, which make it possible to discover water, a scarce resource, in many parts of the world. Moreover, innovation itself has the potential to reduce access costs. He pointed out that access to certain technologies has to be as inclusive as possible, allowing all groups in society to benefit.

What are the implications for policy in developed and emerging economies?

R&D investment in developing countries has increased sharply over the past two decades most notably in China. However, some of the major emerging economies continue to lag behind with respect to innovation capabilities e.g. India, Brazil, South Africa, and Mexico, which constitutes a challenge for policy makers. (Global Innovation Index 2015) Shahid Yusuf, of the Growth Dialogue, identified the policies that the most innovative countries have implemented countries such as Singapore, Sweden and Switzerland. He also noted that none of these countries had managed to raise total factor productivity to desirable levels. For example, total factor productivity has barely increased in all three countries since 2005. This may well be due to lags in the diffusion of ICT and possibly also to mismeasurement of changes in productivity although the extent of the latter has been questioned by recent research. Even if some gains in productivity are being overlooked, it is perhaps desirable to take a



closer look at the conventional instruments for promoting innovation and productivity so as to determine which combinations might work better. In particular, the contribution of high quality education, workforce development, financial support for SMEs and measures to improve the regulatory environment deserve greater scrutiny. Although they are prioritized by many governments it is an open question as to whether they are delivering the outcomes being sought.

Montek Singh Ahluwalia pointed to the importance of policies related to the educational system. He stressed the importance of going beyond education in general, defining which skills should be developed and what curricula should be implemented to educate people for a new digital and technological era. Moreover, governments also have to decide how much emphasis should be placed on R&D, in view of urgent challenges such as the lack of infrastructures and extreme poverty. Such an assessment has to take into account the contributions of R&D and other types of investments in innovation towards addressing these challenges.

Christine Greenhalgh, of the University of Oxford, also placed the education system at the top of the policy agenda. Many developing countries, she argued, have tried to foster and enhance R&D. This is not only the case of China and India but also of several East African countries. Vocational education and training programmes have been crucial for success. These programmes should be targeted towards young people, school leavers and workers, ensuring continuous learning as demand for skills change over the years.

Finally, **Agrita Kiopa**, of the Ministry of Education and Science in Latvia, pointed out that governments should be careful when regarding the type of innovation and technology programmes they want to promote. This is crucial because strong public investment will not

"If new technologies affect trade patterns this will have an effect on developing countries."

- Montek Singh Ahluwalia

always result in the desired impact as other factors, such as macroeconomic shocks, may reduce impacts. Latvia was strongly affected by the economic crises in spite of its solid ICT infrastructure and innovation investment. **Agrita Kiopa** suggested that emerging and developing countries should develop programmes aimed at strengthening the local economy by scaling up technological capabilities, while at the same time promoting international connections with a view to attracting investment in R&D.

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Further readings

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List of speakers

Philippe Aghion, Professor at Harvard University and Collège de France

Montek Singh Ahluwalia, former Deputy Chairman of the National Planning Commission, India

Marco Annunziata, Chief Economist at General Electric

Robert Atkinson, Founder and President of the Information Technology and Innovation Foundation (ITIF)

Jennifer Blanke, Chief Economist, World Economic Forum

Francois Bourguignon, Professor Emeritus, Paris School of

Jacques Bughin, Director, McKinsey Global Institute

Mete Çakmakci, Secretary General, Technology Development Foundation of Turkey

Dimitri Corpakis, Head of Unit, Directorate for Open Innovation and Open Science, Directorate General for Research & Innovation, European Commission

Carl Dahlman, Special Advisor to the Director, OECD Development *Centre*

Douglas Frantz, Deputy Secretary General, OECD

Carl Frey, Co-Director of the Oxford Martin Programme on Technology and Employment, University of Oxford

Christine Greenhalgh, Professor of Economics (Emeritus), University of Oxford



Dominique Guellec, Head of Division, Directorate for Science, Technology and Innovation, OECD

Agrita Kiopa, Deputy State Secretary, Ministry of Education and Science, Latvia

Danny Leipziger, Managing Director, Growth Dialogue

William Maloney, Chief Economist, Equitable Growth, Finance, and Institutions, World Bank

Alistair Nolan, Senior Policy Analyst, Directorate for Science, Technology and Innovation, OECD: Perspectives from the Next Production Revolution Project

Youngah Park, President of the Korea Institute of S&T Evaluation and Planning (KISTEP), Korea

Caroline Paunov, Senior Economist, Directorate for Science, Technology and Innovation, OECD

Ganesh Rasagam, Trade and Competitiveness Global Practice, The World Bank

José F. Saenz, Business Unit Robotic Systems, Fraunhofer, Germany

Manuel Trajtenberg, Professor at Tel Aviv University

Shahid Yusuf, Chief Economist, Growth Dialogue





About the project

The OECD Project "Innovation for Inclusive Growth" analyses the impacts of innovation and related policies on inclusive growth. Addressing the needs of policymakers in both key non-member economies and OECD countries, the aims of the project are to:

- **Provide evidence** on the impacts of innovation and related policies on inclusive growth focusing on industrial, social and territorial inequalities; and
- Develop concrete policy solutions to support countries in reconciling their innovation and development agendas, including options for scaling up inclusive innovations.

More information can be found at: https://innovationpolicyplatform.org/inclusive.

