THE ECONOMIC IMPACT OF AI AND AUTOMATION IN TERMS OF UNEMPLOYMENT, INEQUALITY AND ECONOMIC GROWTH

Abstract

The advent of automation and artificial intelligence (AI) has significantly transformed the global economic landscape over the past few decades. Advances in AI technologies have created new markets and potential for improvement in vital areas such as health, education, energy, economic inclusion, social welfare, and the environment. Over the past few decades, remarkable strides have been made in the fields of artificial intelligence (AI) and robotics. Forecasts indicate that upcoming advancements will be even more remarkable, with experts anticipating transformative changes in the global workforce. Simultaneously, the consequences of these technological strides, particularly in automation and AI, have taken centre stage in discussions about the future. The evolution of AI-driven automation has significant implications: (i) Shift in Labour Market Dynamics (ii) Diminished labour Income Share (iii) Impact on Economic Growth. Despite the potential for supply-side expansion through AI, the full benefits might not be realized due to sluggish wage growth and productivity. This chapter undertakes an exploration of the profound and far-reaching implications of AI and automation on various facets: the labour market, the distribution of income, and the trajectory of economic growth in the long term.

Keywords: AI, growth, labour, unemployment, aggregate demand, income distribution, wage, automation,

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I. INTRODUCTION

The world has undergone an enormous technological transformation in recent decades, which has transformed many facets of human existence. Artificial intelligence (AI) and automation are two of the most transformational inventions of this century. As a branch of computer science, AI enables robots to simulate human intelligence and do activities that previously needed human understanding. Advances in mechanization in the late nineteenth and early twentieth centuries automated much of the physical labour performed by humans. Advances in information technology in the mid- to late twentieth century automated much of the standardized data processing that used to be performed by humans. However, each of these past episodes of automation left large areas of work that could only be performed by humans. Some propose that advances in AI are merely the latest wave in this long process of automation, and may in fact generate less economic growth than past technological advances (Gordon 2016). Others, by contrast, emphasize that AI critically differs from past inventions: as artificial intelligence draws closer and closer to human general intelligence, much of human labour runs the risk of becoming obsolete and being replaced by AI in all domains. In this view, progress in artificial intelligence is not only a continuation but the culmination of technological progress; it could lead to a course of history that is markedly different from the implications of previous waves of innovation, and may even represent what James Barrat (2013) has termed "Our Final Invention." No matter what the long- run implications of AI are, it is clear that it has the potential to disrupt labour markets in a major way, even in the short and medium run, affecting workers across many professions and skill levels (Acemoglu, Daron. 1998). Concerns about automation, mechanisation, and man-machine substitution goes back to the industrial revolution, and perhaps far further. The present AI issue fits neatly into that long-term trend. Concerns include fears that AI would accelerate the automation of jobs, causingmass technological unemployment, and that its economic benefits would accrue to only a few,driving up inequality (Frey and Osborne, 2017; Korinek and Stiglitz, 2017). The COVID-19pandemic is expected to give a further impetus to the digitization and automation of theglobal economy (Bloom and Prettner, 2020; Schrage, 2020).On the one hand, AI and automation AI is expected to boost economic growth by increasing productivity, innovation, and efficiency across various industries. According to different estimates, AI could add an average of 1.7% to 1.2% of additional GDP growth per year until 2030, resulting in 16% higher cumulative GDP compared with today (Mckinsey& Company Report). The industries that will benefit the most from AI are Information and Communication, Manufacturing and Financial Services. On the other hand, it poses various macro-economic problems such as increasing the unemployment, slowing wage growth due to low productivity, widening inequality among labour and world economies and hence it will also slow down the economic growth in long run. Besides it, there are three sustainable goals which is interconnected with this problem and may face negative impact. (i)The first sustainable development goal is "No Poverty", (ii) the eighth sustainable development goal is "Decent Work and Economic Growth" and (iii)The tenth sustainable development goal is "Reduced Inequalities" much related to these macro-economic problems. Growing labour force while the number of jobs is decreasing and slower economic growth is the main reason for widening inequalities and the main threat to economic, social, and political stability.

Within this chapter, a dual-sided examination unfolds, delving into diverse viewpoints along with corroborating empirical findings. The exploration commences with an exploration of the traditional interchange between capital and labor, highlighting the dynamic of

machine-labour substitution. By incorporating various models that meld these paradigms, a nuanced analysis emerges, accommodating both labour-amplifying and labour-eroding outcomes. These outcomes pivot on the underlying assumptions governing the elasticity of substitution between labour and capital in overall production.Yet, the discourse transcends the conventional realm of employment displacement effects. It expands its purview to encompass a holistic vantage point, one that encompasses the productivity ramifications AI infuses into economic growth. Moreover, the chapter scrutinizes a spectrum of scholarly works elucidating AI's repercussions on the distribution of income. This involves evaluating the influence on income distribution, shedding light on its intricate fabric. Conclusively, the discourse navigates toward theories and empirical corroboration. These substantiate the notion that the impact of AI and automation on labour markets, economic expansion, and inequality differs markedly from the repercussions of preceding technological strides.

II. THE TRADITIONAL VIEWS ON AI & AUTOMATION

Each decade brings forth distinct critical debates, yet the global economy consistently grapples with enduring macroeconomic challenges that culminate in the same outcome: unemployment. Beyond its macroeconomic implications, unemployment bears significant social and economic repercussions, intertwining with political matters and remaining a focal point due to its paramount importance. In the aftermath of the Great Depression, unemployment became an essential indicator of societal well-being, with research underscoring its significance.In 2015, Autor expounded on the intricate interplay between humans and machines, encapsulating the dynamics of substitution and complementarity succinctly: "Overlooking the broader impact of automation on the demand for labor by fixating solely on lost jobs disregards a pivotal economic mechanism—one where automation enhances the value of tasks that are distinctively fulfilled by workers." The advent of AI and Automation ushers in dual effects. On one hand, there's the complementary effect, while on the other, the substitution effect comes into play. The fortunes of workers hinge on their tasks' compatibility with automation; those supplying tasks that align with automation stand to gain, whereas those predominantly engaged in tasks susceptible to substitution do not.Parallel to Baumol's hypothesis in 1967 about the "cost disease," sectors at the technological vanguard might elevate employment as productivity surges. However, this surge might not extend to sectors where human proficiency vis-à-vis robots remains unmatched. Additionally, the theory of demand-side dynamics emerges as a pivotal player, as the encroachment of technology on human roles through automation and AI erodes the aggregate demand for labour—potentially leading to the feared "robocalypse" scenario.

Karabarbounis and Neiman (2014) uncovered evidence that challenges the complementarity hypothesis. They demonstrated how the proportion of labour's contribution to value-added has dwindled since the 1980s, attributing this shift to a relative decline in the cost of capital goods, primarily triggered by ICT technology. This dynamic incentivizes companies to substitute human labour with machinery. However, this did not deter Brynjolfsson & McAfee (2011, 2014) from engaging in discussions both in favour of and against the complementarity hypothesis. Automation, by augmenting the demand for capital and the rental rate, fosters capital accumulation. Thus, there can be phases of rapid automation wherein the labour share diminishes and capital accumulation hastens, even if the elasticity of substitution between labour and capital is less than one.Consequently, this suggests that capital accumulation might not be the root cause behind the decline in the

labour share (as argued by Piketty, 2014). Instead, it could be a reaction to automation, serving to mitigate its adverse impact on the labour share (when the elasticity of substitution is less than one). The age-old concept of "Technological Unemployment," first proposed by J. M. Keynes, enters the scene. Keynes highlighted the "discovery of means of economising the use of labour," leading to productivity-driven job reduction (Keynes, 1930). Similarly, Simon (1965) projected that "machines will be capable, within twenty years, of doing any work a man can do" in his seminal work "The Shape of Automation for Men and Management" (Simon, 1965). These ideas thrust technological unemployment into the spotlight among macroeconomists, experiencing a resurgence in the second decade of the 21st century.

The United Nations Development Program (UNDP) underscored the widening inequality among nations, attributing it to technological change. Notably, the UNDP report emphasized that this change affected the functional distribution of income, intensifying primary income inequality through elevated returns to capital and productivity (UNDP, 2013). Notably, automation has led to job displacement across various sectors, including the health industry, as evidenced by Iscan (2021). Even in fields like radiology, AI is introducing novel tools for analysing image data, potentially boosting productivity. However, this advancement has sparked debates about the future job landscape for radiologists. Similar scenarios emerge for professions such as physiotherapists, where AI-assisted rehabilitation could transform job markets. Numerous analogous instances abound.These developments possess the potential to curtail wage growth and decrease the labour share in income, ultimately leading to diminished prosperity. It's crucial to acknowledge that these studies are rooted in empirical data spanning several decades, pre-dating the AI alarm. Consequently, they comprehensively explore the overarching impact of "technological progress" on labour markets. While some studies offer assurances about the positive influence of computers on employment, they often omit specific considerations related to the effects of AI.

III. THE IMPACT OF AI AND AUTOMATION ON UNEMPLOYMENT/LABOUR MARKET

Frank et al. (2019) classifies current literature on the labour market implications of AI into two broad categories: a doomsayer's perspective and an optimist's perspective. Doomsayers believe that labour substitution by AI will harm employment. Frey and Osborne (2013) estimate that 47% of total US employment is at risk of losing jobs to automation over the next decade. Their research reveals that a substantial share of employment in service occupations – where most US job growth has occurred over the past decades – are highly susceptible to computerisation. Bowles (2014) uses Frey and Osborne's (2013) framework to estimate that 54% of EU jobs are at risk of computerisation. Acemoglu and Restrepo (2017) provide a historical example of excessive automation negatively affecting the labour market due to weak productivity and reinstatement effects, finding that areas in the US most exposed to industrial automation in the 1990s and 2000s experienced large and robust negative effects on employment and wages.

1. **Job Displacement:** Automation and AI technologies can replace certain human tasks and jobs, leading to job displacement. Jobs that involve repetitive and routine tasks are most vulnerable. This can result in unemployment or underemployment for some segments of the workforce, particularly those lacking the skills required to adapt to new job demands.

2. **Job Creation and Transformation:** While some jobs may be lost due to automation, new job opportunities can also emerge in industries related to AI development, data analysis, robotics, and more. However, these new jobs often demand higher skill levels, which can lead to a mismatch between the skills of the displaced workers and the requirements of the new roles.

3. **Income Inequality:** AI and automation can contribute to income inequality. Highly skilled workers with expertise in AI-related fields may benefit from increased demand for their skills, leading to higher wages and income concentration among a small group. On the other hand, lower-skilled workers may face stagnant wages or job losses, exacerbating income inequality.

4. **Global Economic Shifts:** The impact of AI and automation on employment and inequality can vary widely between different countries and regions. Developed economies with a strong focus on technology and innovation may experience more significant shifts in employment patterns compared to developing economies that rely on labour-intensive industries.

5. **Upskilling and Reskilling:** To address the challenges of job displacement, investments in upskilling and reskilling programs become crucial. Governments, businesses, and educational institutions must work together to ensure the workforce is equipped with the necessary skills to adapt to the changing job market.

IV. IMPACT OF AI ON INCOME DISTRIBUTION/INEQUALITY

Although these technologies hold the potential to significantly boost productivity and spur economic expansion, they also introduce challenges that can worsen existing disparities across various societal segments. The prevailing sentiment in much of the literature is that AI's impact on income equality is likely negative. For example, in a dynamic general equilibrium framework featuring robots as a distinct form of capital that complements traditional capital, Berg et al. (2017) employ simulations to gauge diverse degrees of automation progress on income distribution. Regardless of the scenario, all paths result in heightened inequality, with the most adverse outcome emerging when robots solely replace low-skilled labour.A pivotal contributor to technology-induced income inequality is the rise in inequality within labour income. Emerging evidence underscores the significance of labour market polarization in driving this phenomenon. This polarization occurs because tasks that AI struggles to perform tend to cluster at opposite ends of the skill spectrum, while AI tends to supplant humans in tasks categorized as 'mid-skill' (Autor et al., 2003). Acemoglu and Autor (2011) as well as Autor and Salomons (2017) present compelling indications based on the US context, illustrating how job polarization translates into wage disparities and even divergent working conditions. This underscores the urgency of enacting appropriate policy measures to mitigate the income inequality stemming from the proliferation of AI.Below are some key factors contributing to the impact of AI and automation on income distribution and inequality.

1. **Job Displacement and Polarization**: One of the most immediate effects of AI and automation is the displacement of certain job categories. Routine and repetitive tasks are increasingly being automated, leading to job losses for workers in these fields. This can

disproportionately affect low-skilled workers who may find it challenging to transition into new roles or industries. As a result, income distribution may skew towards those with the necessary skills to thrive in the rapidly changing job market, while leaving others behind.

Furthermore, AI and automation tend to polarize the labour market. While some workers benefit from higher wages and increased demand for specialized skills, others experience stagnant or declining wages due to the reduced demand for their labour. This polarization can lead to a widening income gap between high-income earners and low-income workers.

2. **Skill-Biased Technological Change:** AI and automation tend to complement and augment the skills of certain workers while substituting for others. This phenomenon, known as skill-biased technological change, rewards individuals with skills that align with the new technology and its applications. Consequently, workers with high levels of education, technical expertise, and problem-solving abilities often see their incomes rise, while those lacking such skills may face wage stagnation or declines.

3. **Concentration of AI-Related Profits:** AI and automation are often associated with tech companies and industries at the forefront of these innovations. As these industries experience significant growth, the profits generated are often concentrated among a small number of high-tech firms and their shareholders. This concentration of wealth and capital can contribute to income inequality, as the benefits of AI and automation may not be evenly distributed across the broader population.

4. **The Gig Economy and Precarious Work:** AI and automation have also facilitated the growth of the gig economy, where workers engage in short-term, on-demand work. While this offers flexibility for some individuals, it can also lead to increased job insecurity and reduced access to traditional employee benefits. The gig economy may further widen income disparities, as gig workers often lack the stability and protections associated with regular employment.

5. **Access to Education and Training**: The adoption of AI and automation places a premium on education and training. Workers with access to quality education and opportunities for upskilling and reskilling are better positioned to thrive in the changing job market. However, individuals without such access may find it challenging to participate in the workforce or obtain well-paying jobs, further contributing to income inequality.

V. HOW AI IMPACT ON ECONOMIC GROWTH

Similar to the historical evidence of technological innovation pointing towards stable unemployment rates, the renowned "Kaldor Facts" that pertain to long-term economic growth also suggest stability in growth rates and the proportion of capital within total income. Nonetheless, recent research challenges this notion. A case in point is the work of Karabarbounis and Neiman (2014), who demonstrate a decline in the share of labour in value-added since the 1980s. They attribute this trend to a relative drop in the cost of capital goods, primarily spurred by ICT technology. As a result, businesses have been incentivized to

substitute human labour with machines. This study marked an initial signal that a departure from the historical pattern might be underway, even though it was not directly tied to AI. This leads us to contemplate whether AI could accentuate this departure. Could AI potentially induce a structural transformation in economic growth rates, leading to an escalation in the capital share of income at the expense of wages?

1. **Job Displacement:** One of the significant concerns is that the widespread adoption of AI and automation may lead to the displacement of certain jobs. While new jobs and industries might be created as a result of these technologies, there could be a transitional period during which some workers face unemployment or underemployment. This can have short-term negative effects on economic growth, as displaced workers may take time to retrain and transition into new roles.

2. **Income Inequality:** AI and automation can contribute to income inequality if the benefits are not evenly distributed across the population. Those who possess the skills required to work with or develop AI technologies may see their incomes rise significantly, while others in lower-skilled roles may not experience the same level of wage growth. Widening income inequality can lead to reduced consumer spending and overall economic growth.

3. **Skill Gap and Education Challenges:** The increasing reliance on AI and automation demands a workforce with the skills to operate and maintain these technologies. If there is a lack of skilled workers, it can hinder the adoption and utilization of AI, impacting productivity and growth.

4. **Resource Reallocation:** Automation can lead to the reallocation of resources, which may cause disruptions in certain industries. For example, if manufacturing becomes highly automated, there may be a shift of resources away from labour-intensive manufacturing sectors, potentially affecting regions or countries that heavily rely on these industries.

5. **Ethical and Regulatory Concerns:** The deployment of AI and automation raises ethical concerns around data privacy, security, and potential biases in algorithms. In response, governments and regulatory bodies may impose stricter regulations on these technologies, leading to higher compliance costs for businesses and potential restrictions on certain AI applications, which could impact innovation and growth.

It's important to remember that the overall impact of AI and automation on the economy will depend on various factors, including how policymakers, businesses, and societies respond to these technological advancements. Investment in education and training, implementing appropriate policies, and fostering an environment that encourages innovation, the negative effects of AI and automation can be mitigated, and the potential for economic growth can be harnessed.

VI. POSITIVE ASPECTS OF AI

During the 2023 World Economic Forum, Mihir Shukla, a tech entrepreneur, emphasized that while many discuss the impending arrival of AI, it's already deeply embedded in our lives. The integration of artificial intelligence (AI) into everyday tasks has

seen a rapid surge in the past decade. An exemplar of this is ChatGPT, developed by Open AI, which has amassed over a billion users for tasks like coding and writing. The swiftness and extent of AI's adoption can be succinctly captured: ChatGPT reached 100 million users in a mere 60 days, a milestone that took Instagram two years to achieve.

A recent report from Stanford University revealed that AI patent applications grew by a staggering 30 times between 2015 and 2021 (HAI 2023), underscoring the remarkable strides made in AI development. AI-driven technologies now excel at an array of functions, from data retrieval and logistical coordination to financial services, intricate document translation, business report writing, legal brief preparation, and even disease diagnosis. Their capacity to learn and enhance through machine learning underpins their potential to elevate the effectiveness and precision of these tasks.

AI's role as a catalyst for productivity and growth is widely acknowledged. Its adeptness at processing and analysing vast data volumes positions it to augment business operations' efficiency. McKinsey Global Institute forecasts that roughly 70% of companies will adopt at least one form of AI technology by 2030, with less than half of large enterprises embracing the full spectrum of AI capabilities. Price Waterhouse Coopers predicts a potential 14% increase in global GDP by 2030 due to AI (PwC 2017).Inquiries into AI's impact on the job market have gained traction. Acemoglu and Restrepo (2018) furnish a theoretical framework to grasp new technologies' influence on employment. They categorize the impact of new technologies into three broad effects: displacement, productivity enhancement, and reinstatement (new technologies can create new tasks in service sectors, boosting labour demand where humans hold a comparative advantage). Lawrence et al. (2017) argues that the substantial positive spill over effects of AI automation (reinstatement) counterbalance direct substitution's adverse effects, resembling Schumpeterian "creative destruction." This perspective makes a negative impact on employment less likely, suggesting that automation could transform rather than eliminate work.Contrary to certain studies suggesting significant negative outcomes, Arntz et al. (2016) project that only 9% of jobs in the UK face automation vulnerability in the next decade. They propose that rather than job substitution, job transformation is more probable, with 35% of jobs anticipated to undergo substantial changes in the next two decades.

VII. CONCLUSION

The current body of knowledge concerning the impact of AI proliferation on employment and wages remains inconclusive. Should machines merely substitute human labour, there could be negative ramifications; however, if they work in tandem with humans to enhance overall productivity, positive outcomes are possible. This positive scenario could elevate labour productivity, leading to reduced output costs, fostering demand growth both within and across sectors. This might trigger a workforce reallocation among sectors due to resultant wage changes arising from heightened productivity.Apprehensions exist that AI could supplant human jobs. Despite the difficulties during transitions, historical precedent demonstrates that prior waves of innovation replacing human roles with machines ultimately yielded more employment opportunities and increased earnings. The notion of AI-driven technological progress exacerbating employment inequality is a concern, and some empirical studies appear to validate this worry. Strategies that encourage innovators to distribute their surplus or that shift taxation from human labour to capital have the potential to

counterbalance the potentially unequal effects of automation. However, such policy shifts alter the incentive structure underpinning individual decision-making. The efficacy of policies in mitigating automation's distortionary impact on income equality hinges on empirical observation.The literature examining the enduring repercussions of automation and AI on global economies underscores the transformative nature of these technologies. While they hold promise for elevating productivity and economic advancement, they also present challenges linked to job displacement, unequal income distribution, and the dynamics of labour markets. Constructing effective policy frameworks that foster a balanced approach to adopting technology while addressing societal concerns is critical for maximizing automation and AI's potential for sustainable economic growth. Ongoing research is indispensable for gaining a deeper grasp of how these technologies will shape the global economy in the times ahead.

REFERENCES

[1] Carl Benedikt Frey and Michael A. Osborne. "The Future of Employment: How Susceptible Are Jobs to Computerization?" Technological Forecasting and Social Change, Volume 114, January 2017, Pages 254-280. DOI: 10.1016/j.techfore.2016.08.019

[2] Arntz, Melanie, Gregory Maassen, and Terry Gregory. "AI and the Future of Work: Evidence from Expert Discussions." Institute for Labour Market Policy Evaluation (IFAU), 2020. Available at: https://www.ifau.se/globalassets/pdf/se/2020/wp2020-01-ai-and-the-future-of-work-evidence-from-expert-discussions.pdf

[3] Daron Acemoglu and Pascual Restrepo. "The Impact of Artificial Intelligence on Economic Growth." NBER Working Paper No. 25077, September 2018. DOI: 10.3386/w25077

[4] Daron Acemoglu and Pascual Restrepo. "Automation and New Tasks: How Technology Displaces and Reinstates Labor." Journal of Economic Perspectives, Volume 33, Number 2, Spring 2019, Pages 3-30. DOI: 10.1257/jep.33.2.3

[5] Daron Acemoglu and Pascual Restrepo. "The Impact of Robots on Wages." NBER Working Paper No. 24119, December 2017. DOI: 10.3386/w24119

[6] Ajay Agrawal, Joshua Gans, and Avi Goldfarb. "Artificial Intelligence, Automation, and Income Inequality." NBER Working Paper No. 24107, December 2017. DOI: 10.3386/w24107

[7] World Economic Forum (WEF). "The Future of Jobs Report 2020." Available at: https://www.weforum.org/reports/the-future-of-jobs-report-2020

[8] International Labour Organization (ILO). "World Employment and Social Outlook: Trends 2021." Available at: https://www.ilo.org/global/research/global-reports/weso/2021/lang--en/index.htm

[9] Organisation for Economic Co-operation and Development (OECD). "The Future of Work: OECD Employment Outlook 2019." Available at: https://www.oecd-ilibrary.org/employment/oecd-employment-outlook-2019_9ee00155-en

[10] United Nations Conference on Trade and Development (UNCTAD). "Technology and Innovation Report 2021." Available at: https://unctad.org/system/files/official-document/tir2021_en.pdf

[11] Acemoglu, Daron, and David Autor. 2011. "Skills, Tasks and Technologies: Implications for Employment and Earnings." In *Handbook of Labor Economics*, 4:1043–1171. NBER Working Paper Series. Elsevier.

[12] Acemoglu, Daron, and Pascual Restrepo. 2016. "The Race Between Machine and Man: Implications of Technology for Growth, Factor Shares and Employment." 22252.

[13] 2018c. "Automation and New Tasks: The Implications of the Task Content of Technology for Labor Demand", MIT mimeo November 2018, forthcoming in the Journal of Economic Perspectives.

[14] Aghion, Philippe, Antonin Bergeaud, Richard Blundell, and Rachel Griffith. 2017. "Innovation, Firms and Wage Inequality."

[15] Aghion, Philippe, Antonin Bergeaud, Richard Blundell, Rachel Griffith, and AMSE-BdFLabor Market. 2017. "The Innovation Premium to Low Skill Jobs."

[16] Aghion, Philippe, Benjamin F Jones, and C Jones. 2017. "Artificial Intelligence and Economic Growth." *National Bureau of Economic Research*, no. w23928.

[17] Agrawal, Ajay K, Joshua S Gans, and Avi Goldfarb. 2018a. "ECONOMIC POLICY FOR ARTIFICIAL INTELLIGENCE."

[18] Arntz, Melanie, Terry Gregory, and Ulrich Zierahn. 2016. "The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis." *OECD Social, Employment and Migration Working Papers* 2 (189): 47–54.

[19] Aum, Sangmin, Sang Yoon Lee, and Yongseok Shin. 2018. "Computerizing Industries and Routinizing Jobs : Explaining Trends in Aggregate Productivity." w24357. *NBER Working Paper*. NBER Working Paper.

[20] Autor, D. H., F. Levy, and R. J. Murnane. 2003. "The Skill Content of Recent Technological Change: An Empirical Exploration." *The Quarterly Journal of Economics*.

[21] Autor, David H. 2015. "Why Are There Still So Many Jobs? The History and Future of Workplace Automation." *Journal of Economic Perspectives* 29 (3): 3–30.

[22] Autor, David H., and Michael J. Handel. 2013. "Putting Tasks to the Test: Human Capital, Job Tasks, and Wages." *Journal of Labor Economics*.

[23] Autor, David, and Anna Salomons. 2017. "Robocalypse Now–Does Productivity Growth Threaten Employment?" *ECB Forum on Central Banking* 02142 (June 2017): 1–74.

[24] Baumol, William J. 1967. "Macroeconomics of Unbalanced Growth: The Anatomy of Urban Crisis." *The American Economic Review* 57 (3): 415–26.

[25] Berg, Andrew, Ed Buffie, and Felipe Zanna. 2017. "Should We Fear the Robot Revolution?" 2017. https://knowledge.insead.edu/blog/insead-blog/should-we-fear-the-robot-revolution-8011.

[26] "Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation." Report, McKinsey & Company. https:// www.mckinsey.com/ mgi/ overview/ 2017-in-review/ automation- and- the- future- of- work/ jobs- lost- jobs- gained- workforce- transitions- in-a- time- of-automation.