The Future of Work

Labour Law and Labour Market Regulation in the Digital Era

Edited by
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Summary of Contents

Table of Contents

CHAPTER 7

Technological Change, Institutions, and the Labour Market

Luigi Salvati & Pasquale Tridico

Since its inception as an autonomous science, political economy has always been interested in the way technology affects economic systems. Since the era of the classical economists, it was soon clear that technological innovations could have disruptive effects on the supply side. By changing the technical conditions of production, some innovations – also thanks to the simultaneous presence of institutional elements, think of the movement of enclosures in England at the dawn of the Industrial Revolution – made it possible to obtain increase in production that were often unthinkable before their introduction. This, in turn, favoured the increase of that *surplus*, the object of all the theories of classical economists, which was at the basis of the capital accumulation process. In turn, the accumulation of capital, certainly in a non-mechanical, but still often decisive way, favoured further innovations. However, the same classical economists, well aware of the conflicting nature of an economic system based on the sharing of the surplus between different social classes, warned, not long after the Industrial Revolution, about the negative consequences that technological progress, in particular in the form of the introduction of machines in industrial plants and in agriculture, could have had for some layers of the population, above all for the working class.

The dual nature of technological progress (as an opportunity and as a potentially destabilizing factor) has accompanied the development of social sciences and, in particular, of political economy to date. Therefore, in an era of great technological changes and innovations that advance at extremely rapid rates, it becomes paramount to study how technology influences the relationships between social classes and the methods of production.

As stated by Brynjolfsson and McAfee (2011, 2014), we are currently facing a scenario of *exponential acceleration*, especially from the 2000s onward, with the

development of the so-called digital revolution. This revolution is due especially to the progress in information and communications technology (ICT), made possible by the working of the so-called Moore's law. This famous law (Moore, 1965) notoriously states that the number of transistors in a dense integrated circuit roughly doubles about every two years: in other terms, overall processing power for computers doubles about every eighteen months (in an exponential or geometrical fashion).

However, ICT progress is not only a matter of processing power. In the last years, the expansion of the sector was mainly led by the creation of new immaterial goods, also made possible and fostered by the aforementioned increase in processing power and by the ubiquitous diffusion of portable devices, constantly connected to the internet. The exponential increase in the consumption and the production of these goods, i.e., *digital* goods, is a striking example of the effects that a change in technology can exert on the economic and social structure of societies.

Two almost unprecedented (at least on such a large-scale dimension) features characterize all these goods, like information, media, communication and social networks: non-rivalry in consumption and close-to-zero marginal costs of reproduction. In particular, user generated contents are essentially free for firms such as YouTube, Wikipedia, Facebook, Instagram and so on and so forth. Moreover, the goods 'produced' by digital firms are price-free for their users (think about free communication digital services as Skype or Whatsapp), who have experienced a surge in their utility as consumers.

These innovations can represent a great opportunity for growth and prosperity, but they may also bring with them negative effects. When new technologies are particularly profitable, they may also bring to an increase in inequalities between those who are skilled enough in the abilities that are necessary to take advantage of the new technological paradigm, on the one hand, and those who have skills that are more traditional and unskilled workers, on the other one.

In this scenario, inequalities also arise between countries; while some countries are thriving, by taking advantage of the possibilities offered by the new technologies, some seem unable to keep up with these innovations. Among the latter, Italy shows a particularly sluggish dynamics of productivity and economic growth, accompanied by an increase in income and wealth inequality.

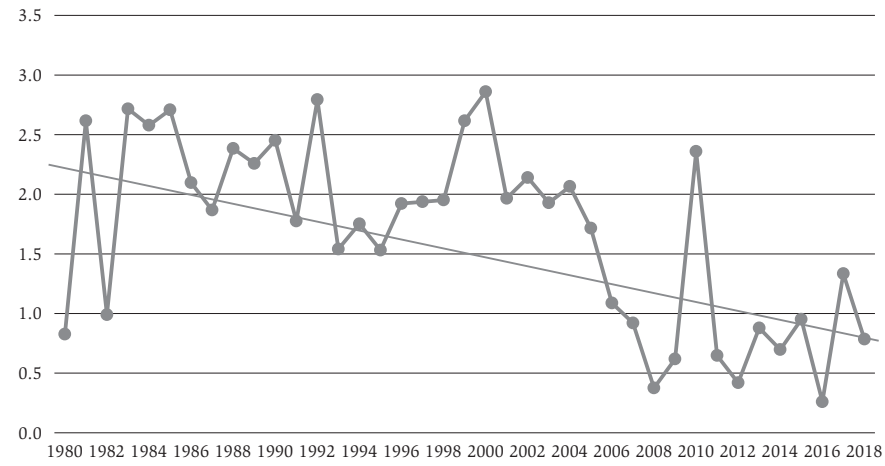
In our survey, we shall concentrate on the following issues:

(1) Do ICT have an impact on labour productivity?
(2) Do ICT destroy employment? (i.e.: does a negative impact on employment levels exist?)
(3) Do ICT change labour forces' composition? If yes, in which way?
(4) By focusing on the case of Italy, in addition to the impact on employment levels or on labour forces' composition, which effects does technology exert on wages?
(5) Which future scenarios could emerge and what kind of policy implications can we draw?

7.1 THE IMPACT OF ICT PROGRESS ON LABOUR PRODUCTIVITY: DOES TECHNOLOGICAL PROGRESS DESTROY JOBS?

The impact of ICT progress on the dynamics of labour productivity is not immediate. Data shows that in the USA productivity growth started declining since 1973. This evidence brought some scholars to question the relevance of computer-based technological progress in explaining labour productivity growth. As Solow put it in a 1987 book review:[1] 'You can see the computer age everywhere but in the productivity statistics'. This statement would later become famous as the 'Solow paradox'. A representation of the dynamics of the GDP per hour worked in G7 countries can be found in Figure 7.1.

Figure 7.1 GDP per Hour Worked in G7 Countries – Constant Prices – Annual Growth



Source: OECD. Data extracted on 15 January 2020 17:00 from OECD.Stat.

However, since the middle 1990s, a boom in labour productivity began to take place, and it was steadily increasing until the 2007-2008 economic crisis. Brynjolfsson and McAfee (2014) suggest that the paradox might be explained by the temporal lag existing between the introduction of the new technology and the subsequent productivity increases, since, for any kind of technology, slow and sometimes painful organizational adjustments are needed (e.g., the introduction of electricity at the end of the nineteenth century).

Almost all the empirical research confirms a positive effect of ICT on labour productivity, an effect which, in general, is increasing in time.

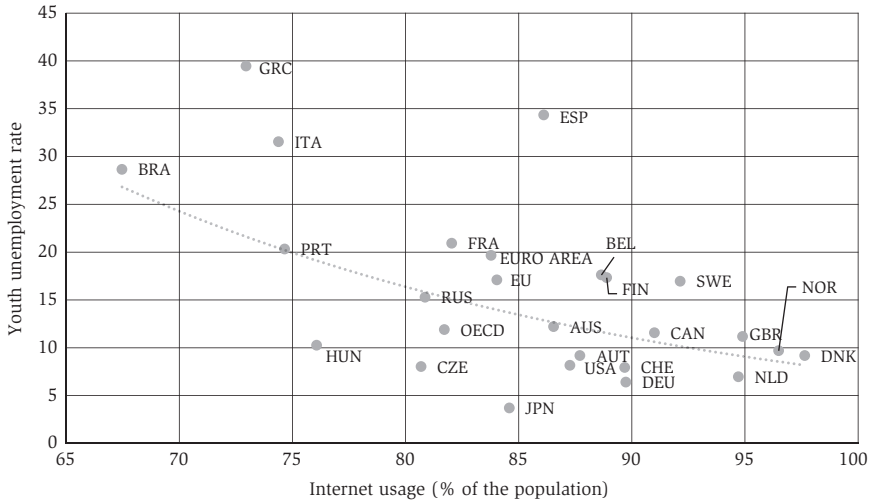
1. Robert Solow, 'We'd Better Watch Out', *New York Times Book Review*, 12 July 1987, p. 36.

Of course, as expected, differences in estimates may arise when taking into account different levels of aggregation, historical periods or geographical areas.

For example, while sectoral and aggregates analysis suggest that ICT effects on labour productivity are wider in the United States (US) than in the European Union (EU), firm-level analysis tend to exclude the presence of such differences (Van Ark et al., 2003).

In the majority of these studies, the fundamental role of complementary investments arises, suggesting that technological progress, alone, cannot explain growth. Arrangements and new strategies have to be adopted in order to profit from new technologies. For example, changes have to be made in the organizational framework. Maybe more importantly, firms have to invest in high-skilled workers and into their training. A strand of literature has developed in order to explain the effect of these arrangements, known as 'complementary investments' (Davern & Kauffman, 2000; Ravichandran et al., 2005; Pilat, 2005; Mithas et al., 2011; Ceccobelli et al., 2012). This literature also confirms the validity of the suggestions of Brynjolfsson and McAfee: new technologies are a necessary, though not sufficient condition for an increase in labour productivity.

Figure 7.2 Correlation Between Internet Usage and Youth Unemployment



Source: WB International Telecommunication Union, World Telecommunication/ICT Development Report and database (for Internet usage) and International Labour Organization, ILOSTAT database. Data retrieved in December 2019.

Figure 7.2 shows the correlation between the rate of youth unemployment and Internet usage. The Internet usage variable is 'Individuals using the Internet (% of population)'; the youth unemployment rate variable is 'Unemployment, youth total (% of total labour force ages 15-24) (modelled ILO estimate)'. Reference year: 2018 (except Australia – AUS, Brazil – BRA,

Canada – CAN, Switzerland – CHE, Japan – JAP, OECD members – OECD and US. For these countries, the reference year for the Internet usage variable is 2017 – last available year in the dataset).

Figure 7.2 shows that the diffusion of the Internet is negatively correlated with youth unemployment. It suggests that employment opportunities for the young are easier to find in countries in which the use of new technologies is widespread in the population. On the other side, new technologies may also have a downside: the so-called technological unemployment.

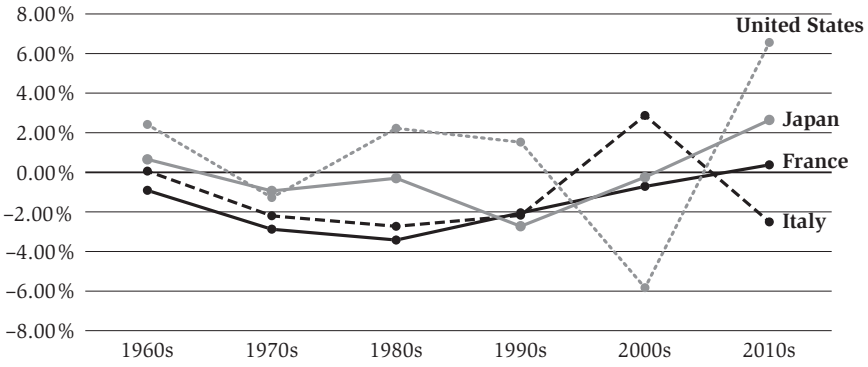
The idea of 'technological unemployment', i.e., unemployment caused by the fact that machines are used instead of workers is not new. One of the founding fathers of political economy, David Ricardo, in his *Principles* notoriously stated that, 'The opinion entertained by the labouring class, that the employment of machinery is frequently detrimental to their interests, is not founded on prejudice and error, but is conformable to the correct principles of political economy' (Ricardo, 1817).

Also, John Maynard Keynes, in his 1930 pamphlet *Economic Possibilities for our Grandchildren*, seemed to accept the fact that technological unemployment exists, although he held a very optimistic vision about the future: 'We are being afflicted with a new disease of which some readers may not yet have heard the name, but of which they will hear a great deal in the years to come – namely, *technological unemployment*. This means unemployment due to our discovery of means of economising the use of labour outrunning the pace at which we can find new uses for labour. But this is only a temporary phase of maladjustment. All this means in the long run that mankind is solving its economic problem. I would predict that the standard of life in progressive countries one hundred years hence will be between four and eight times as high as it is to-day. There would be nothing surprising in this even in the light of our present knowledge. It would not be foolish to contemplate the possibility of a far greater progress still' (Keynes, 1930, emphasis added).

More recently, Leontief argued: 'Any worker who now performs his task by following specific instructions can, in principle, be replaced by a machine. That means that the role of humans as the most important factor of production is bound to diminish – in the same way that the role of horses in agricultural production was first diminished and then eliminated by the introduction of tractors' (Leontief, 1983).

Ricardo and Keynes had no idea of, and Leontief could simply imagine, the boost in technological progress brought about by the Internet revolution. However, if Ricardo's concern is well founded and Keynes' optimism is not, such an increase in our level of technological possibilities should be seen as a reason for pessimism about the future by the workers.

Figure 7.3 Difference Between Number of Employed and Total Labour Force (Difference Between Growth Rates)

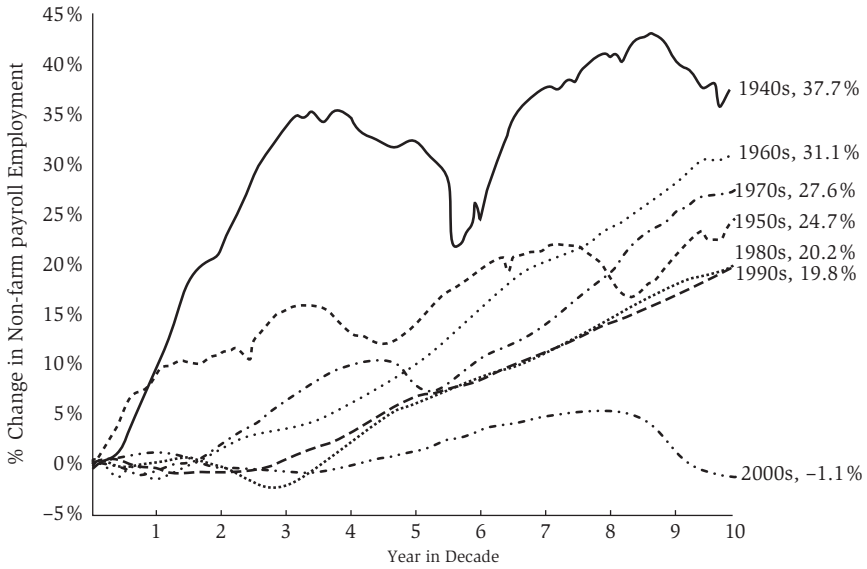


Source: Authors' elaboration on data from AMECO Database. Data retrieved on 16 January 2020.

The period 2010s represents 2010-2018. This graph depicts the dynamics of the difference between the growth rates of two aggregates: the number of employed and total labour force in the last six decades. Positive values represent a decade in which the growth in the number of employed has been greater than the increase in total labour force.

Certainly, it is early to fully evaluate the effects of technological innovations on employment dynamics (Figure 7.3 shows that in different countries and different decades, the results on whether growth in the number of employed people has kept up with the growth of the total labour force have been very heterogeneous). The observation, proposed by Brynjolfsson and McAfee, that in recent years the growth in the number of employees in the US has been lower than in the past, even in periods of sustained growth (the so-called jobless recovery), is supported by the available data (*see* Figure 7.4). Indeed, if we compare the growth in the number of people employed in the US in the decade 2000-2009 with that of each of the previous four decades, the result could appear as astonishing. Furthermore, as seen in the graph below, the growth in the number of employed workers in the first decade of the twenty-first century was well below the growth in the workforce.

Figure 7.4 US Job Growth by Decade, 1940s-2000s



Source: Copyright: Andrew McAfee. Retrieved on 30 January 2020 from https://www.slideshare.net/mobile/amcafee/mc-afee-econ-data.

Before drawing excessively pessimistic conclusions, however, it is necessary to make some clarifications. For example, it should be stressed that the decade in question was characterized by a profound economic crisis, which had a serious impact on the US: the low growth in the number of employees cannot be attributed only to the systematic introduction of new technologies and a reversal in the trend can be observed in the second decade of the century. Furthermore, as shown in Figure 7.3, other countries, although technologically advanced, have not experienced the same dynamics (*see also* Graetz and Michaels, 2018, for a 'prudent' viewpoint).

This leads us, on the one hand, to give credit to Keynes' predictions: the imbalances created by the introduction of new technologies could be temporary and theoretically governable. On the other hand, however, it suggests that we look in another direction, that of the changes in the composition of employment. If it is true, in fact, that there are no elements suggesting a generalized destruction of jobs, it is also true that some types of workers, specialized in certain tasks, could be more affected than others (and in a non-transitory way) by the introduction of technologies that make them less useful for entrepreneurs. We deal with this issue in the next section.

7.2 DOES ICT CHANGE LABOUR FORCES' COMPOSITION? IF YES, IN WHICH WAY?

What we would like to understand, at this point, is the effect of ICT progress on the dynamics of employment.

Many studies have developed about the situation in the USA: while the theory of Skill Biased Technological Change (SBTC, based on skills & educational attainment) tries to explain inequality during the 1980s, the theory of Routine Biased Technological Change (based on tasks) focuses on job polarization in the 1990s and 2000s.

In particular, an important strand of economic literature has developed, starting with the paper by Autor and Handel (2003, QJE), based on the following idea: ICT can be seen as a substitute for workers employed in routine intensive jobs (matching medium wages jobs) and as a complement for workers employed in non-routine jobs (at the top or at the bottom of the wage distribution). More precisely, the authors argue that their model implies measurable changes in the composition of job tasks, on which they focus by using data for the period 1960-1998. They claim that computerization brings about a reduction in the labour input of routine manual and cognitive tasks, while non-routine cognitive tasks labour input is increased.

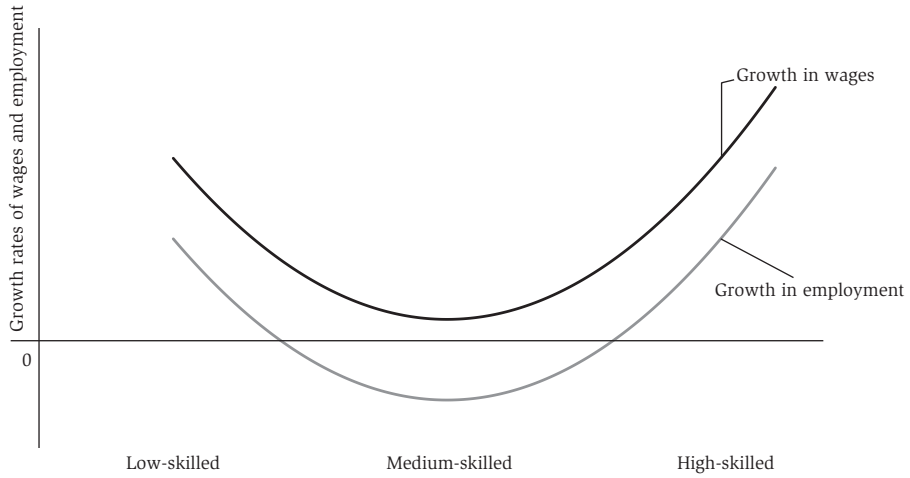
The authors also claim to be able to explain 60% of the demand shift in favour of college labour in the period 1970-1998. This means that, while the former will tend to be poorer, the latter will tend to be better paid because of their increased productivity (*see also* Autor et al., 2003; Autor et al., 2008; Autor et al., 2015; Acemoglu and Restrepo, 2017).

Boehm (2014), by conducting a study based on data regarding the US, confirms the same results. In particular, he shows that, since the late 1980s, the US labour market has been characterized by an increase in the share of low-skilled and high-skilled workers, at the expense of the share of so-called medium-skilled workers. In the same work, the author shows that real wages have remained substantially stable for workers with average wages and have increased for the extreme sides of the distribution, with lower increases for low-skilled workers and higher increases for high-skilled workers. This would suggest, in the opinion of the author, that medium-skilled workers are under strong pressure both from the point of view of job opportunities and of wage dynamics.

Jaimovich and Siu (2012) suggest that job polarization and jobless recoveries are strictly related. In their words 'First, essentially all employment loss in routine occupations occurs in economic downturns. Second, jobless recoveries in the aggregate can be accounted for by jobless recoveries in the routine occupations that are disappearing'.

We can summarize the phenomena described so far (polarization of jobs and wages) in a graph. In Figure 7.5, we see two U-shaped curves. The higher one depicts the rate of growth of wages, which we have seen to be particularly high for high-skilled workers. For low-skilled workers the wage growth rate is higher than that for medium-skilled workers, whose pays are characterized by the smallest increases. The lower curve, on the other hand, depicts the job growth rate. This rate is positive for low-skilled and high-skilled workers, while it is negative for medium-skilled workers.

Figure 7.5 The U-shaped Curves of Jobs and Wages Polarization



Source: Stylized depiction of the jobs and wages polarization suggested by the literature (*see* Autor et al., 2008; Boehm, 2014).

This graph depicts the phenomena suggested by the empirical literature on jobs and wages polarization. The higher curve represents the growth in wages for low-, medium- and high-skilled workers. The lowest values characterize medium-skilled workers, while the higher values represent the increase in wages for low-skilled workers (on the left) and high-skilled workers (on the right, with the highest growth rate). The lower curve represents the growth in employment for the same categories of workers. While low-skilled and medium-skilled workers are characterized by an increase in the number of jobs, medium-skilled workers are in the worst position, since their job opportunities are shrinking.

Many empirical studies tend to confirm this idea for the US: it can be demonstrated that among the less paid jobs there are especially non-routine manual jobs, whereas among the most paid jobs there are mainly non-routine cognitive jobs.

On the contrary, for the EU, there seems to be little evidence of wage polarization and of a polarizing effect of technology (*see* Michaels et al., 2014; Arntz, Gregory and Zierahn, 2016; Nedelkoska and Quintini, 2018; Hoftijzer and Gortazar, 2018 for studies showing no evidence; *see* Goos and Manning, 2007 and Goos et al., 2009 for the opposite conclusion). A pattern in which technology does not seem to have had a significant effect on wages and employment polarization can be observed in Italy, as we shall see in the next section.

7.3 THE EFFECT OF ICT PROGRESS ON EMPLOYMENT LEVELS, LABOUR FORCES' COMPOSITION AND WAGES: A FOCUS ON ITALY

Acemoglu and Autor (2011) have argued that Italy is among those few countries where, in addition to medium-paid jobs, also low-paid jobs are strongly declining. Anyway, Eurofound (2014) suggest that also in Italy, during the recent crisis, medium-paid jobs were the most affected.

Simonazzi and Barbieri (2016) also describe similar patterns. In addition, the authors underline that before the recent economic crisis, there was no evidence of wage polarization and, hence, of wage dynamics caused by SBTC. Moreover, Italy registered a substantially stable level of wage inequality since mid-1990s, not consistent with the existence of such a phenomenon.

This evidence could be explained by three hypotheses. The first one is that, especially before the 2000s, Italy was highly endowed with low-skilled labour and less endowed with high-skilled labour. Moreover, since the evidence on periods before the crisis show just a negligible impact of technology, not comparable to those observed in Anglo-Saxon countries, one could be tempted to look for the roots of these dynamics in the fact that Italy has been characterized by a low level of ICT investments. Finally, evidence is also compatible with the hypothesis that Italy shows very low skill-premia, that could bring to over-education and brain-drain phenomena. All these hypotheses tend to be confirmed by the available evidence.

The idea that Italy is particularly endowed with low-skilled workers seems confirmed by a recent report by the Organisation for Economic Co-operation and Development (OECD, 2017). In the paper, the fact that there is a very high concentration of low-skilled workers in the South is also underlined. Moreover, the report focuses on the fact that Italy is characterized by a relatively low percentage of tertiary educated workers (the share of 25-34 year-old people in Italy with a tertiary level education is 20%, while the OECD average is 30%), with an accordingly low number of new graduates entering the labour market.

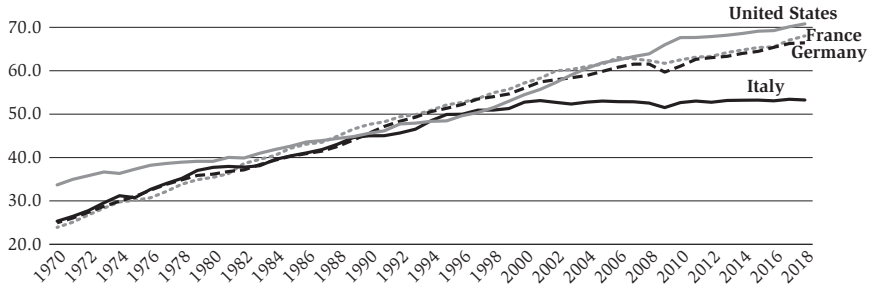
But it is not only a problem of skilled labour supply. There is also a problem of demand for certain kinds of skills. Indeed, Italy in the last decades has been characterized by the pervasive phenomenon of brain-drain and graduates' outflows (Becker et al., 2004; Morano Foadi, 2006; ISTAT, 2018), both within the country (with graduate students from the South who often find a job in the North) and from Italy to other advanced economies.

With regard to the alleged low level of ICT investments in Italy, the hypothesis seems to be confirmed by some studies. For example, Hassan and Ottaviano (2013) underline that Italy has a very low level of ICT investment compared to countries such Germany and France. A very similar pattern is described by Schivardi and Schimtz (2018), who argue that the low level of ICT investment is to be blamed as one of the main factors causing stagnant productivity and slow growth in Italy. Also, OECD data show that between 2000 and 2010, ICT investment as percentage of total investment has lagged behind in Italy with respect to almost all OECD countries in which data are available (OECD, 2020).

Finally, Naticchioni et al. (2008 and 2010) confirm the existence of a general decline in the so-called educational wage premia in Italy in the period from 1993 to 2004. In particular, educational wage premia have generally decreased over time in the private sector and have remained basically stable in the public sector. They suggest that wage inequality in this country is not easy to interpret in terms of a skillbiased technical change and that the increase in the average level of education of the workforce might have been offset by a stable trend in the demand for skills.

Nowadays Italy is trying to combine the economic development with economic policy aimed at fostering technological change: the so-called Industria 4.0, a set of policies designed to incentivise firms to make investments in the sector of the modern technologies, is a step in this direction (*see also* section 7.5). These policies also go in the direction of increasing labour productivity, whose growth has been very sluggish since the 1990s, especially vis-à-vis its three leading trade partners (*see* Figure 7.6).

Figure 7.6 GDP per Hour Worked, USD, Constant Prices, 2015 PPPs



Source: OECD. Data extracted on 15 January 2020 from OECD.Stat.

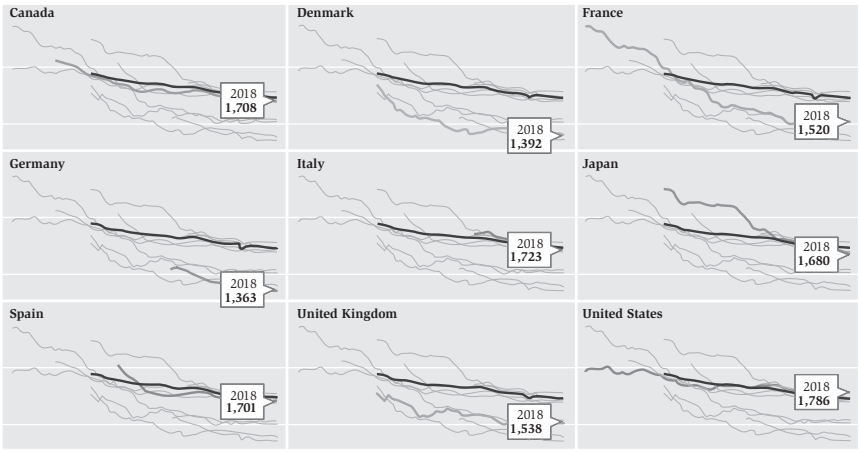
However, this is not enough. Greater efforts have to be made in the field of public education and of direct public investment, both in the ICT and in the infrastructures sector. And, of course, the issue of the extremely low level of growth of the so-called Mezzogiorno (Southern Italy) has to be tackled, through policies aimed at increasing the living standards in those regions (an example of which is *Reddito di cittadinanza*, a sort of basic income provision, but more should be done in the field of the provision of services to the citizens). Moreover, the public sector should also provide for those infrastructural interventions that are absolutely needed to make private investments in the South profitable enough.

As regards the recent policies of the Italian Government to reduce the negative effects of technological changes on workers, some interventions have already been completed: in addition to the aforementioned *Reddito di cittadinanza*, the so-called dignity decree has been introduced, with the main objective of reducing the use of fixed-term contracts both by imposing stricter limits on the use of such contracts and incentivizing permanent ones. In 2019, protections for workers in the 'gig economy' were also increased, starting with the so-called riders.

Policies to help the workers to cope with the evolution of the labour market should go in two directions: the reduction of working hours (without decreasing pay) and the introduction of a law on minimum wages.

The aim of the first set of policies is to ensure that workers can work less, without suffering cuts in wages, and have a better balance between work and private life. At the same time, this would allow for new jobs to be created to replace workers who opt for shorter working hours, including through incentives for entrepreneurs. Such a policy would be consistent with what has been the development of the labour market in recent decades. In particular, as OECD data show,[2] in the most economically advanced countries we have seen an almost continuous reduction in the number of hours worked per worker (*see* Figure 7.7).

Figure 7.7 Yearly Working Hours in Nine Selected Countries



Source: OECD (2020), hours worked (indicator). doi: 10.1787/47be1c78-en (accessed 27 January 2020).

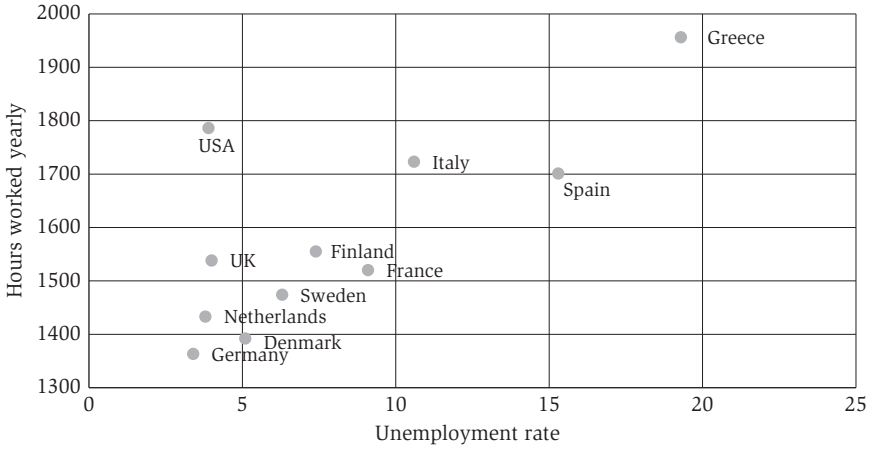
Reduction in yearly working hours in nine selected countries. The first year of the time series is 1950 for France (2,351 hours per week) and US (1,968 hours per week); 1961 for Canada (2,059 hours per week) 1970 for Denmark (1,845 hours per week), Japan (2,243 hours per week) and United Kingdom (1,779 hours per week); 1977 for Spain (2,036 hours per week); 1991 for Germany (1,554 hours per week); 1995 for Italy (1,856 hours per week). OECD average's first year is 1970 (1,945 hours per week), while the last one is 2018 (1,734 hours per week). The thick line is the OECD average.

The most striking example is given by France. In this country it has fallen from over forty-five hours per week for each worker in 1950, to around twenty-nine hours in 2018. For Italy, whose data have only been available since 1995, OECD data show a

2. Data retrieved from OECD.Stat, year 2018.

reduction from around thirty-six hours per week (1995) at thirty-three hours per week (2018). Furthermore, it is interesting to note that two of the countries where we work most in the EU (Italy and Greece, with thirty-three and thirty-eight hours per week, respectively) are also those characterized by the lower values of labour productivity (USD 53.3 and USD 36.4, respectively) and the employment rate (58.5% and 56.5%, respectively). Germany and Denmark, where we work between twenty-six and twenty-seven hours per week, on the contrary, show the highest ratio of GDP/hours worked (USD 66.4 and USD 73.4 per hour worked). Moreover, as shown in Figure 7.8, the countries with longer working hours are also the ones with the highest rates of unemployment.

Figure 7.8 Hours Worked Versus Unemployment Rate (2018)



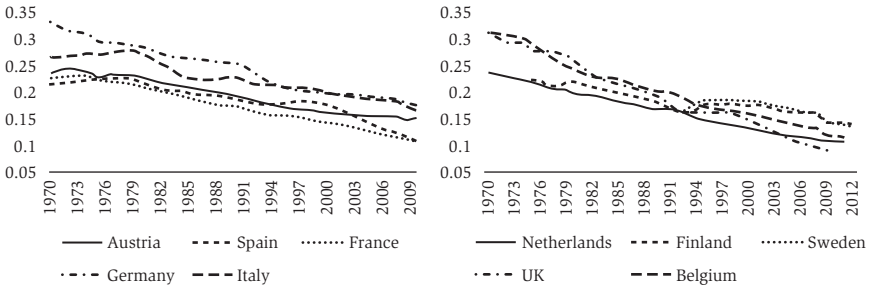
Source: Data extracted on 30 January 2020 14:11 UTC (GMT) from OECD.Stat. Unemployment rate values refer to the table 'Harmonised Unemployment Rate'; hours worked yearly refer to the table 'Average annual hours actually worked per worker'.

A law on the minimum wage, currently being examined by the Italian Senate, should aim to alleviate the suffering of the so-called working poor. Such a law should also address the issue of collective bargaining. In particular, it should aim to combat so-called pirate contracts, which allow small, unrepresentative trade unions to negotiate much lower wages than the average for a given sector.

Modern economies are going through a transition phase. In particular, what we are witnessing is a real structural change, a transition from a system in which manufacturing is the leading sector (characterized by strong investments in fixed capital) towards an economy in which services are the main economic sector (*see* the two graphs in Figure 7.9 for a depiction of the shrinking of manufacturing in many advanced economies). The services in which growth has been particularly sustained, however, are essentially characterized by a low content of capital and technology.

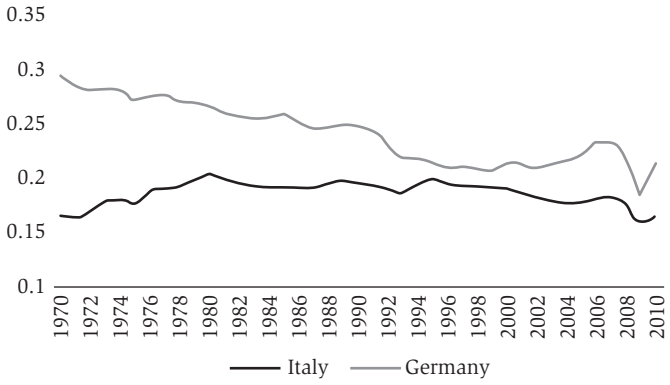
Furthermore, the greatest growth is concentrated in more mature sectors (food and accommodation, mainly). Consequently, it becomes fundamental to guide the transition towards strategic sectors – as is happening, precisely, with Industry 4.0. Paradoxically (at least if the dominant theory is taken into consideration), rigidities in the labour market can guide Italy towards productivity gains. Flexible and precarious work pushes companies to make labour-intensive investments (generally characterized by low productivity increases). Interventions such as the 'dignity decree' and the minimum wage go in the direction of creating rigidity against the use of competitiveness played on the decline in wages, pushing companies to make capital-intensive investments (Pariboni and Tridico, 2018).

Figure 7.9 Employment in the Manufacturing Sector as a Share of Total Employment



Source: OECD and EU Klems Project (*see* Pariboni and Tridico, 2018).
Employment in the manufacturing sector, share of total employment (1970-2012).

Figure 7.10 Value Added in the Manufacturing Sector as a Share of Total Value Added



Source: EU Klems Project (*see* Pariboni and Tridico, 2018).
Manufacturing sector, share of total value added (1970-2010).

7.4 FUTURE SCENARIOS AND POLICY IMPLICATIONS

In order to face the increasing challenges posed by the powerful technological change we are experiencing, new policies have to be implemented. There are mainly four kinds of policies which are usually believed to be beneficial in achieving a more equilibrated growth:

(1) industrial policies;
(2) compensation of 'losers';
(3) higher taxation on 'winners'; and
(4) working hours reduction.

First of all, an *active industrial policy* aiming at taking advantage of recent technological developments, instead of passively accepting their consequences, is needed. This is the only way to try to steer the process and to avoid being overwhelmed by it. It is easy to describe the kind of industries we are going to find more frequently in the future.

Along what lines should such an intervention plan occur? Our age has been defined that of a 'Fourth Industrial Revolution', taking advantage of innovations in the fields of hardware, software, cloud computing, internet of things (IoT), and so on. The subset of innovations which can have a huge impact on the way firms will organize their activity has been called 'Industry 4.0'. This definition includes the so-called smart manufacturing (and 'smart factories'), lights-out manufacturing (or dark factories) and 'industrial internet of things' (IIoT). As defined by Davis et al. (2012), smart manufacturing is 'the dramatically intensified and pervasive application of networked information-based technologies throughout the manufacturing and supply chain enterprise'. The term 'lights-out manufacturing' encompasses a set of manufacturing processes where factories run fully autonomously, without any human intervention (or with a very small amount of it; it is also called 'dark factories' process: if humans are not required to work in the factories, lights are not required). The IoT is a system of interrelating computers or computing devices, objects, machines and people, characterized by the possibility of transferring data packages over a network without a direct human intervention. By extension, the application of the IoT technological paradigm to industries has generated what has been called the 'IIoT'.

What is the role of the public sector in the process of adapting the economic system to such a big change in the industrial paradigm? There is a quite wide consensus on the fact that governments should try to boost the readiness of their industrial system to take advantage of the new technologies by providing the right incentives. Things such as tax benefits in many different forms are widely accepted: very high rates of depreciation applied to innovative investments; contribution for the payment of interests on loans to invest in new capital goods; tax credit measures to increase the resort to innovative R&D processes; reduction of taxes on the incomes arising from the

use of industrial patent rights, registered trademarks and new software; tax credit for training in the areas of Industry 4.0 and many other measures.

While, as we have just said, such measures are widely accepted, there is an animated international debate on the role of the public sector in fostering economic growth: should governments just focus on incentives? Or would their action be much more effective if they took direct intervention, for example by investing directly in new technologies and R&D projects? The main contribution in favour of a direct activity of governments is Mariana Mazzucato's book, *The Entrepreneurial State* (2013). She argues that in history entrepreneurial states have sparked investment in the private sector by making high-risk investments in new technologies. Moreover, she believes that the State still has a role to play in this dynamics, not only by encouraging or actively engaging in investments, but also by promoting a more inclusive process of economic growth, an objective that the private sector alone would not actively pursue. Atzeni and Carboni (2008) also argued that a strong intervention by the public sector in favour of ICT investments could be particularly effective both in boosting growth in Italy and in reducing the South-North growth and productivity divide.

In our opinion, Mazzucato has a point in underlining the importance of an inclusive growth and of the role of the State. All the innovations we have listed are potential threats to the levels of employment in the future. A growth which is guided only by the pursuit of higher rates of profit and by the reduction of workers is by definition non-inclusive. An active role of governments in trying to channel the innovation process in the direction of higher levels of employment and higher wages is of primary importance.

Industrial policies should also follow the direction of the so-called *green economy*. Faced with the continuous increase in the emission of greenhouse gases, governments are required to take action in order to reduce such emissions and try to slower the process of global warming. Moreover, more efficient and rational waste disposal and recycling techniques are necessary to thwart the rise of plastic pollution, which is threatening especially the oceans. These policies should also be implemented to solve the problem of the increasing scarcity of natural resources, and they should be accompanied by a transition to factories that make use, predominantly or exclusively, of renewable energies (such as hydroelectric, solar, tidal, wave and wind energy).

Of course, all of these policies are costly for the firms. As a consequence, a mix of subsidies, taxes and infrastructural interventions should be taken into consideration by the policymakers. At a cost for governments, too: especially in context, such as the EU, in which binding constraints limit the spending capacity of the public sector. And, on the background, the debate on whether the government should intervene directly or indirectly goes on. In addition, there is the problem of international competition with economic systems in which governments are less concerned about sustainability. Even in this case, a mix of coordinated policies has to be implemented, through international treaties, economic aid to developing economies and sanctions or disincentives for those countries unwilling to pursue a greener way of production.

At the same time, a greener economy should not bring with it a reduction in employment. In many cases, there seems to be a trade-off between environmental sustainability and employment. Firms are often in the position of placing governments

and workers in front of a dilemma: are they ready to give up some employment in exchange for less pollution and more sustainability? These are the cases in which governments should take strong and resolute interventions in order to ensure both employment and respect for the environment.

What kind of employment should we pursue? In the last decades, policy-makers have pushed for a higher level of flexibility in the labour market. These policies, as suggested by the economists of the so-called Washington Consensus, should have generated higher employment and growth, by reducing the frictions in the labour market, and higher labour productivity, through incentives for workers. Actually, this did not happen and is not happening. Available data show that a higher labour market flexibility has not brought to higher growth, employment or productivity. As a matter of fact, these policies could have generated the opposite effect (Brancaccio et al., 2018; Vergeer and Kleinknecht, 2010 and 2014; Storm and Naastepad, 2007; on the Italian case: Jona-Lasinio and Vallanti, 2013; Fana et al., 2015).

There are many reasons behind the fact that deregulated labour markets, and, in particular, higher flexibility, tend to generate a downward pressure on labour productivity (*see* Pariboni and Tridico, 2019, for a review of the literature). Firms and workers will consider investments in training and education less profitable. Firms are unwilling to invest in the training of employees that will soon work for a competitor or in other sectors. At the same time, workers that are not sure of the fact that they will be keeping their job for a long time, would risk to see their effort in learning frustrated because of frequent changes in their job or sector (Salop, 1979; Shapiro and Stiglitz, 1984). Lucidi and Kleinknecht (2010) suggest that there are many channels through which a higher labour flexibility can hinder productivity growth. First, higher levels of flexibility bring to lower investment in capital-intensive techniques, as in the Schumpeterian Sylos-Labini approach (*see also* Dosi et al., 2017 and 2018). Moreover, as we have already said, short-term contracts are conducive to under-investment in training and to a more conflictual working environment. Finally, since short-term contracts generate a downward pressure on wages, this will probably bring to a reduction in aggregate demand (in particular in the so-called wage-led economies; *see* Rowthorn, 1981 and Bhaduri and Marglin, 1990). This, in turn, will damage labour productivity through the channel of the Kaldor-Verdoorn law (Verdoorn 1949; Kaldor 1978).

Another strand of policies is based on the compensation of *'losers'*. What do we mean by 'losers'? With this word we describe workers who are worse off because of technological progress (routine labourers with an obsolete skill endowment), especially among adults and elderly people.

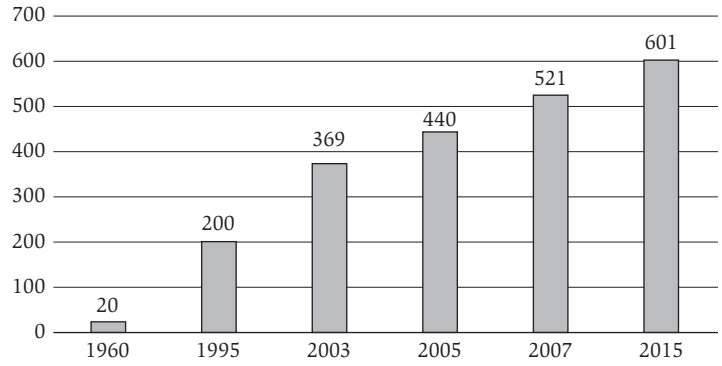
A possible policy consists in the re-training of senior workers' skills. There is animated debate on the utility of such a policy of re-training. Heckman (2000), by arguing that re-training returns are decreasing in age and that, for this reason, they would be strongly inefficient, suggests a provocative alternative: it would be better – he says – to use economic resources to improve children skills instead of training old workers.

However, working is also a matter of human dignity and social cohesion, not only an economic investment and a conclusion like the one just drawn is too simplistic. If it is true that senior workers tend to show lower re-training returns, it does not mean that

those workers should just be laid-off or left to their fate of being unproductive workers waiting for retirement.

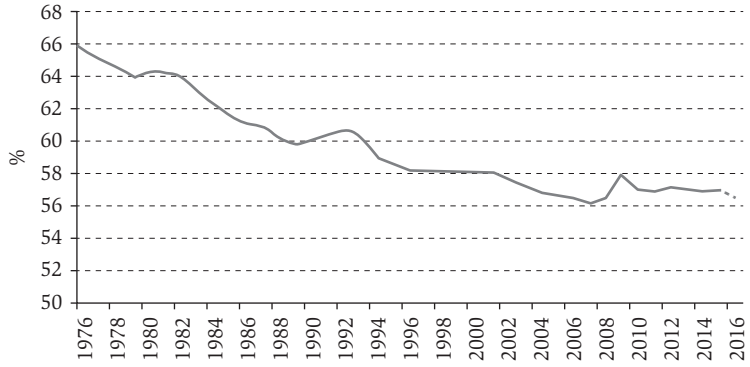
Unemployment benefits and early retirements would be more suitable, thus allowing to focus the educational resources on the new generations, that show high relative returns in education.

Figure 7.11 Ratio Between Manager Compensation and Employee Mean Wages: Rich Countries



Source: ILO.

Figure 7.12 Labour Share in the G7 Economies: 1970s-2016



Source: AMECO Database.

Let us focus on the taxation of the 'winners' of the ICT revolution. As the Figures 7.11 and 7.12 show, in the last decades wealthy people have been increasing their wealth and compensations, while the middle class is in contraction and low-paid labourers are in expansion. As a consequence, overall inequality is growing, especially

in advanced economies, and the labour share is falling. This is also a consequence of the so-called phenomenon of the 'decoupling' of productivity from labour earnings. As stated in a recent Economic Outlook (OECD, 2018) by the OECD, 'several OECD countries have been grappling not only with slow productivity growth but have also experienced a slowdown in real average wage growth relative to productivity growth, which has been reflected in a falling share of wages in GDP'.

Higher taxes for top incomes could contribute to the reduction of inequalities and could prevent social cohesion issues. Diamond and Saez (2011) and Piketty (2014) argue that optimal top income taxation could fairly exceed 70%. Note that in many countries income taxes until the 1970s were much higher than now, often above 50%. The reduction of taxation for higher incomes has influenced, along with the changes in the economic paradigm and in the labour market, the increase of inequality in advanced economies.

These data, coupled with the evidence showing that higher wages are often associated with higher growth rates (Hein and Vogel, 2007 and 2009; Onaran and Galanis, 2012; Lavoie and Stockhammer 2013) and that the increase in income inequality, alongside with financialization (Hein and Mundt, 2013), was one of the main factors to be blamed for the Great Recession (van Treeck and Sturn, 2012), show that, although it is not necessary to resort to the high levels of taxation cited above, a moderate redistribution of the tax burden could be both fair from an ethical and political point of view and conducive to growth. However, as we have seen for the efforts in environment-friendly policies, redistributive policies in a country could be offset by capital outflows and beggar-thy-neighbour strategies by other countries, willing to attract investments through favourable tax policies (fiscal competition) and deregulated labour markets.

Finally, let us focus on the reduction of working hours. While a higher flexibility in the labour market can be detrimental to productivity, some authors (Pencavel, 2014; Glaveski, 2018; Bassanini and Caroli, 2015; Messenger et al., 2007; Cette and Taddéi, 1993) have argued that shorter workweeks and workdays are a key to higher productivity. In addition, many leading firms (e.g., Microsoft Japan) have experimented four-day workweek without decreasing pay. As a result, firms report a boost in productivity, a higher level of satisfaction of their workers and higher efficiency. Other firms (such as Kellogg's, the US cereal manufacturer) operated six-hour working-day policies, with good results as well. Nowadays, even some national governments are willing to explore the possibilities offered by such arrangements of the workweek: it is not unlikely that this will be a relevant feature of the evolution of work in the future.

As we have seen in section 7.3, it seems that a reduction in working time (with unchanged wages) constitutes an adequate policy in face of the changes in the labour market of the last decades. It is necessary (and possible) to ensure that workers enjoy a greater balance between work and leisure. Such a policy could be implemented through the tax exemption of a part of the salary paid to the worker in the form of corporate welfare instruments.

The idea behind the policy is based on the fact that a reduction in working hours would result in a less than proportional loss in terms of product, since it would affect the least productive part of the working week (or day). Nevertheless, it would still be

necessary to replace the hours previously worked by workers already hired with hours worked by newly hired workers. It could therefore be argued that such a policy could also lead to an increase in employment.

7.5 CONCLUDING REMARKS

In recent decades, computer technology has developed at an unprecedented pace. These developments can undoubtedly bring with them opportunities for growth and greater prosperity, but, at least in the short run, they can also generate negative consequences for some categories of workers. However, it is still too early to talk about generalized negative consequences on workers. Perhaps due to the lack of so-called complementary investments, it seems that the technological revolution has not yet affected all sectors and all countries in a uniform way. Yet, a particular category of workers, the so-called medium-skilled workers, seems to be the most penalized by new technologies.

In this scenario, Italy still seems substantially far from full participation in the new production methods made possible by the revolution in the ICT field. This is due to the low endowment of high-skilled labour compared to other countries, a low level of investment in ICT and a low level of skill-rewards. On the one hand, this delay has so far prevented the occurrence of job and wage polarization phenomena; on the other, however, it risks making the country fall behind in the modernization process. The Italian Government is implementing a mix of policies aimed, on the one hand, at favouring the adaptation process to Industry 4.0 and, on the other, at supporting those who could be penalized by these developments. Policies just implemented, such as minimum income (*Reddito di cittadinanza*), or reduction of labour flexibility such as the ones introduced by the 'Decreto dignità' go in the direction to push firms in human capital investment rather than exploit labour cost and flexibility as levers for competitiveness and to protect low-skilled workers. The current debate on minimum wage and working hours' reduction goes also in this direction.

As for the policy suggestions deriving from these considerations, they should go in three directions:

(1) industrial policies aimed at adapting productive systems to the innovations of Industry 4.0 including working hours reduction;
(2) support for the so-called losers of the ICT revolution;
(3) redistribution in favour of the most disadvantaged sections of the population.

As far as industrial policies are concerned, a debate is underway on the nature of these policies. Some authors believe that industrial policies should consist only of incentives, while others argue that the state should play an active role as an investor. Instead, there is an almost unanimous agreement that industrial policies must have the aim of accompanying economies on the 'green transition' path, which is now inevitable. Support for workers in difficulty should take the form of financial support for the unemployed and training for those whose skills are made obsolete by technological

developments. A moderate redistribution of the tax burden – coordinated between the various countries to avoid phenomena of the 'beggar thy neigbour' type – would have the aim of supporting the policies mentioned above and of promoting a redistribution which, in countries characterized by wage-led regimes, would lead to an increase in growth rates. Finally, a gradual reduction in working hours (with unchanged wages) in particular in some selected productive segments (both from labour-intensive sectors and labour-saving sectors for opposite reasons), combined with work-family conciliation and forms of smart working, would be positive both for the workers' well-being, for productivity and employment.

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