DEPARTMENT OF BUSINESS AND MANAGEMENT
Master Thesis in International Economics and Industrial Dynamics

FROM GLOBALIZATION TO A NEW DISTRIBUTION OF WEALTH: FOCUS ON INEQUALITY AND TECHNOLOGICAL CHANGE

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ABSTRACT

INTRODUCTION

"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." – John Maynard Keynes, 1930.

This reflection, made almost one century ago, has taken increasing significance throughout the twentieth century; it also represents one of the key challenges of current times. This view strongly relates to the implications of technological change in all aspects of the economic scenario – above all, Keynes focused on the effects that it is destined to generate in the long-run. Today, an increasing number of scholars and economists have strongly levered on Keynes' theoretical milestones and they have tried to adapt them to the framework of the twenty-first century: in this perspective, the studies carried out by French economist Thomas Piketty are considered as the starting point for the macroeconomics of the new millennium. In his book *Capital in the Twenty-First Century*, he stated that "over a long period of time, the main force in favour of greater equality has been the diffusion of knowledge and skills". Both statements convey relevant considerations: indeed, in one sentence, Keynes – one of the most influential economists of the past century and the founder of modern macroeconomics – expresses that there is a strong relationship between technological change – originating from industrialization patterns – and changes in the structure of distribution of income. Piketty, on his side, grants significant relevance to technological change as the tool to enable economic convergence among countries.

Which patterns did economies follow in the aim of improving their position in the international scenario? Which is the final result of these paths in the current framework? The four industrial revolutions that took place in the past centuries, and which are still continuing to take place today, enabled unprecedented improvements in industrial dynamics, and they have been able to heavily re-shape the conception of international economics. Indeed, they enabled national economies to gain relevant momentum in the global scenario, hence determining the development of market integration, which is usually referred to as globalization. The industrial revolutions, as well as their resulting patterns of market integrations, have significantly influenced the international dynamics occurring among nations; furthermore, they also generated important changes within national frameworks. Which is the nature of such changes? To which extent do they relate to uneven distribution of income? In particular, with income distribution, we usually

refer to the way resources are allocated among factors of production – say, labour and capital. The way resources are distributed within these two factors of production represents a crucial aspect to analyse, since it embodies the source of inequalities within social structures.

Which is the nature of the linkages that shape the relationships among technological change, globalization and inequalities? This is the question represents the *fil rouge* of this study. Keeping the focus on changes in the technological capabilities of firms, industries and countries, the aim will be to determine the implications of such changes in an integrated economic environment. The study will revolve around three main chapters: the first chapter will aim at determining the most significant historical milestones with respect to industrialization patters and the current dynamics in the international scenario. The second chapter will revolve around the need to establish the current state of income distribution, and to relate it to globalization patterns. The third and final chapter, in turn, will intend to establish the theoretical nature of technological change, in order to make some final considerations on its relationships with globalization and inequalities.

CHAPTER 1 - INDUSTRIALIZATION PROCESSES AND GLOBALIZATION

The purpose of the first chapter will be to understand and analyse the historical progress concerning market integration and globalization pattern. Starting from recent trends in economic history, it is possible to determine that an increasing number countries to started to engage in industrialization processes. This process occurred at different points in time or with different degrees of intensity; nevertheless, almost all economies have taken a part in this mechanism of change. Starting from the eighteenth century, such processes generated the emergence of integrated markets, where exchanges were facilitated by the introduction of special tools and of *ad hoc* regulatory frameworks. In the twenty-first century, three hundred years later, economies are still experiencing technological advancements and their implications on the current degree of economic and social development are remarkable.

1. Industrialization processes

The past waves of innovation represent the historic course which have generated the current degree of globalization and market integration. The first industrial revolution is traditionally related to Watt's steam engine: it determined specialization in production, allowed economies of scale and scope and improved the degree at which trade integration occurred. The second industrial

revolution was enabled by the expansion of the railway system and of telegraph lines; it strongly influenced transformation and communication costs within companies and across countries. Lastly, the third industrial revolution enabled the emergence of the Information and Communication Technologies (the ICT); it determined further convergence in trade, enabled the emergence of new relevant players in the global market, and eventually, it generated relevant changes in the production system and determined further decreases in transportation-related costs. These main features of the past three industrial revolutions support the analysis of the current state of industrialization, by focusing in particular on the major implications of the fourth industrial revolution – also known as the Industry 4.0 – in the process of globalization of markets. The Industry 4.0. consists of the overall technological developments which derive from the digitalization of production processes as well as from the wide-spread diffusion of the Internet. The technologies which relate to this new industrial revolution allow objects to be connected among them and with people; they generate "smart" products which can gather and transfer data and knowledge.

2. Trends in globalization

Globalization was enabled by three major changes: the reduction in transportation and communication costs, and the emergence of economies of scale, scope and specialization. While the emergence of economies of scale, scope and specialization allowed a first wage of market integration, namely in the most developed economies, with the dramatic reduction of both transportation and communication costs a greater number of countries could experience economic progress and integration. In the last decades, the trade of goods and services strongly increased, in particular with respect to parts and components, which are produced in different regions of the world and then assembled in one place before being sent to key markets. Furthermore, with the emergence of globalization, both developed and developing countries strongly started to benefit from flows of investments coming from foreign countries: Foreign Direct Investments (FDIs) represent today one of the major tools for international expansion. International integration of markets enabled a greater development of international flows of both technological and managerial know-how: for instance, companies can licence their patents, intellectual property rights, brands, and more generally intangible assets. Lastly, improvements in the degree of market integration further boosted investments in strategic industries such as infrastructures: indeed, the latter significantly support transportation and the ICT technologies, which are the economic sectors at the heart of the globalization process.

The current state of globalization sees the world output shared among an increasing number of relevant players: beside the traditional industrialized economies, the last decades have enabled the emergence of late industrializers, which have soon become emerging economies. The rise of a new global economic order is determining strong implications for the world's equilibrium: the increase in GDP of emerging economies is determining significant mechanisms of convergence so to reach developed economies; despite this emerging countries face significant difficulties to increase per capita income. Indeed, because of structural lacks of social policies and infrastructures, it is harsh for developing countries to enhance the living standards and the social conditions of their important and increasing population: hence, at the current state of globalization, the increase in a developing economy's GDP is not in line with the increase of the country's GDP per capita. Despite strong convergence from a merely economic viewpoint, these new players are still strongly struggling to find the way to transfer such economic gains in the social dimension.

For a long time, countries have been mainly focusing on their domestic matters for issues concerning the regulatory framework. Indeed, the lack of supranational or international institutions did not support the creation of the setting for a global standard regarding economic development. As economies grew and expanded internationally, it became gradually necessary to intervene at a global level. Throughout the last century, indeed, several attempts were made to both regulate and support change in the international framework of globalization. The emergence of inter-governmental bodies – such as the GATT and then the WTO – created a favourable environment for trade to further develop and for new players to efficiently position themselves in the changing scenario. If until a couple a decades ago value chains were managed locally, today they are increasingly developing on an international basis, within which each country plays a well-defined role. Indeed, it is now time to see to which extent the emergence of Global Value Chains (GVCs) is giving greater impulse to the globalization process.

GVCs represent the concrete result of globalization: historical progress enabled the current degree of market integration and supported production fragmentation. Also, the establishment of an international regulatory framework for trade has strongly supported the growth of GVCs. Still, their emergence is quite a recent phenomenon: it has become a preponderant issue thanks to the economic development of emerging countries, whose role in the international scenario became relevant starting from the second half of the twentieth century. GVCs can foster the development of technology and knowledge transfers through the expansion of trade (i.e. imports) and through the ability for countries to attract foreign companies to invest in the national territory. In this perspective, Foreign Direct Investments (FDIs) are among the easiest way to developing and

emerging economies to gain relevant flows of technological innovation and knowledge development. Integration in the GVCs framework started within the manufacturing industry: production steps were fragmented and transferred among nations, depending on production costs. This process represented a mere dead end, since the technological and knowledge-related spill-overs were fairly limited. Still, it determined important benefits with respect to the industrialization processes of a relevant number of countries (i.e. China). Lately, GVCs integration started to take into account the service industry: as we saw in the previous sections, this industry is indeed the one where there is the greatest potential for both technological advancement and knowledge transfer. Countries that can position themselves along the GVCs of the service industry are very likely to get high degrees of technological and knowledge transfers.

CHAPTER 2 – GLOBALIZATION AND INEQUALITY: A NEW DISTRIBUTION OF WEALTH

In the second chapter, the analysis will revolve around the need to identify all the changing dynamics concerning distribution of income. Starting from industrialization patterns and the current state of globalization, it is crucial to understand the way these scenarios affect resource allocation in the world's equilibrium. Indeed, there are several linkages between globalization and the structure of inequalities, which are worth being analysed.

1. Income inequality: an overview

Theories revolving around distribution of income have always represented central provisions to enable the study of economic efficiency and to understand global dynamics. In 1969, Joseph Stiglitz was among the first to consider the significant relevance of shifting the focus from factors of production and extend it to the study of distribution of wealth and income among individuals. Thomas Piketty, a French economist, started to adapt classical theories on distribution of wealth to the economic and social scenario of the twenty first century. Branko Milanović, a Serbian-American economist, deeply focused on the way globalization patterns and processes of market integration affect the structure of global inequality, among countries and societies.

The way economic growth changed the structure of inequality has very robust theoretical implications. In this sense, the major contributor to the study of the relationships between development and inequality is Simon Kuznets. According to the Kuznets hypothesis, it is possible

to state that at small levels of income per capita, inequality is just as small; as the economy develops, inequality tends to increase; finally, at high levels of income per capita, the level of inequality falls back to initial degrees. In the current framework of globalization and market integration, it is crucial to understand to which extent globalization patterns have affected the structure of inequality. In the case of the United States, the level of income inequality show relevant signs of heterogeneity, since the share of income owned by the top decile did not decrease over the last century. In particular, the greatest levels of income concentration by the top decile were registered in 1928 and in 2007: in both cases, indeed, the concentration of national income almost reached 50%. The United States' history was strongly shaped by important waves of protectionism[1]: the most relevant occurred in the decades of 1930s and 1970s: these political moves seem to have affected the structure of inequalities, which improved in both decades. The only experience of reduction in equalities in the United States occurred in the period that followed the Second World War, when the top decile owned on average less than 35% of income. In the case of France, the levels of income inequality are still important; nevertheless, the share of income concentration owned by the top decile of the population strongly decreased in the last century. For over twenty years, that is from 1910 to 1935, the share of the top decile in total income was on average over 40%. It was greater than 45% at the eve of the First World War: this period, also known as the Belle Époque, represented the time of greatest concentration of resources for the last century in France. Once the global conflict saw its end, the level of national income owned by the top decile was around 30%. In the remaining of the century, the top decile was never able to completely re-establish the levels of income concentration prior to the world conflicts: in one century, the share of national income owned by the top decile decreased by 15 percentage points. Moreover, emerging countries could represent a third cluster of analysis: even though income inequalities seem to have been reduced in the last century, the dynamics concerning income concentration and countries inequality in emerging countries are not that far from the results we described in LMEs and CMEs.

2. Focus on income inequality in the age of globalization

Based on Hall and Soskice's theory on Varieties of Capitalism, which clusters countries in Liberal Market Economies and Coordinated Market Economies, it is possible to determine that differences in income distribution could be related to their structural divergences. The political

[1] Cavallini, Laura, *Protectionism in America: an Overview*, online version only, available at http://themarketmogul.com/protectionism-america-overview/, 2017.

and economic tradition of liberal countries have strongly affected their position with respect to internationalization of markets, as well as their degree of openness towards globalization patterns. In particular, according to these four countries' view on the degree of governments' interventions in the economy, it is possible to ascertain that, except for the punctual waves of protectionism we already depicted, LMEs faced processes of unregulated openness towards globalization. As a result, governments' interventions have been very limited in time: in this perspective, let us recall that the United Kingdom never accepted to become part of the Schengen Area and that Donald Trump is not particularly favourable to international agreements (e.g., NAFTA, which he intends to renegotiate massively). Hence, in these countries, fierce competition in the international scenario might have prevented the structure of inequality from decreasing. The processes of gradual openness towards internationalization of markets in CMEs proves that the level of coordination and alignment that defined this specific cluster also holds in the case of globalization. Indeed, for European countries, globalization processes took place in a rather structured and regulated way: indeed, all along the second half of the twentieth century, the degrees of openness of national economies towards global trade improved gradually and mildly. During the same period, as a matter of fact, the level of income inequality in CMEs progressively decreased. Hence, as opposed to LMEs, mild expansion of market shares in global trade might have enabled an enduring decrease in inequalities.

The role of emerging countries[2] has become significantly relevant in the last decades. In 2000, the share of global wealth owned by emerging countries was 40%; in ten years, non-OECD countries increased their share accounted for over 50% of the world's GDP. In other words, in 2010, the world's output was perfectly shared among western traditionally industrialized countries and emerging economies. The strong economic development of emerging countries in the last decades raises the question of how the wealth produced in these countries is distribution throughout society. In particular, globalization patterns enabled emerging countries to become significant attractors of flows of Foreign Direct Investments (FDIs) and to grasp relevant positions in the framework of Global Value Chains (GVCs). Emerging economies have been playing relevant and diverse roles in GVCs: during the 2000s, they became major exporters of intermediate and final manufactured goods (China, South Korea, and Mexico) and primary products (Brazil, Russia, and South Africa). Nevertheless, it seems that the emergence of GVCs and their development in emerging countries did not support these countries in the reduction of inequality;

[2] OECD, *Perspectives on Global Development 2017: International Migration in a Shifting World*, 2016, OECD Publishing, Paris.

conversely, they might have contributed to the increase in the level of income inequality. Consequently, recent globalization patterns – high levels of growth, relevant increases in the share of the world's FDI inflows, increased relevance in the framework of GVCs – in emerging countries prevented them from developing relevant reductions in the structure of inequality.

CHAPTER 3 - THE IMPLICATIONS OF TECHNOLOGICAL CHANGE IN INEQUALITY AND GLOBALIZATION: THE KNOWLEDGE-BASED ECONOMY

In the third chapter, the focus will shift towards the identification a new economic phenomenon, known as the knowledge-based economy, considered as the final outcome of technological change; starting from there, the analysis will tackle the implications of this new reality with respect to the structure of inequality among countries and with respect to international market integration. The analyses of this chapter will determine the establishment of a new stage in the evolution of economic principles: the shift towards the knowledge-based economy will represent the cornerstone of this chapter.

1. The drivers of technological change

In recent times, the relevance of technological change gained significance within national productive systems and supported the creation of international markets for trade of goods and services. Technological change is at the heart of the determinants of globalization: thanks to the emergence of the ICT and to the drop in communication costs companies could actually expose themselves in the international scenario; it also strongly supported the process of openness of a new set of countries towards global trade dynamics.

Technological change is featured by three main biases. Recent trends in the level of technological change determined the need for an increasing number of highly skilled workforce in a significant number of industrial activities and a consequent reduction of the demand for unskilled labour force. In time, increases in productivity determined by skilled workers put the educated workforce in a more efficient; hence, the role of skilled workers in production systems has become increasingly relevant. The resulting increasing demand has determined greater levels of pay. Consequently, the weight of the wage of skilled workers on the total amount of wages becomes more relevant, hence determining a skill premium. This phenomena is at the heart of the notion of skill-biased technical change.

Capital-biased technological change depicts the effects of technological advances in the distribution of resources between the owners of capital and the labour force, starting from the new millennium. Indeed, for any given increase in the productivity of capital (induced by improvement in technological processes), the use of the latter will become more efficient, as well as more profitable for those who own it. Conversely, the productivity of labour remains unchanged; however, wages relative to the cost of capital experience a decrease, and so do wages in real terms, determining a disadvantage for the labour force.

Brynjolfsson and McAfee[3] have further expanded the discussion around biases deriving from technical change: in particular, they have determined that all previous trends are destined to further affect the distribution of income in the future, and particular with respect to those who will mostly benefit from increasing shares of income. Their theory on superstar-biased technological change presents that increasing portions of the value produced by companies will be distributed to a very limited number of people. In this way, the concentration of the outcomes of productions will further increase, shifting away from those who are highly educated to those who are considered "superstars" – who are strongly capable of levering on their special talents to develop new approaches to business-related procedures.

The different approaches to the definition in the biases of technological change – especially skill-biased technical change – can be explained by the way the nature of technology is outlined: indeed, the "pure technological approach", as defined by Acemoglu[4], presents technology as the one feature determining changing levels in the bias. The view of technology as exogenous – determined by external forces – gives greater impulse to the enhancement in the need for skilled workers: because of their greater level of education, the latter are more capable of managing the outcomes of technological advances. As a result, the need for skilled workers – say, the demand coming from the industry – will be great in times of increased technological change. Eventually, these dynamics will further increase the level of skill bias deriving from technological enhancement. Conversely, the case of endogenous technical change represents perhaps a more delicate situation, which main features we still tried to outline: aside from the considerations we made on the demand-pulled incentives and on the implications of the market size, we were able to

[3] Brynjolfsson, Erik, and McAfee, Andrew, *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*, 2014, W. W. Norton & Company.
[4] Acemoglu, Daron, *Technical Change, Inequality, and the labour market*, 2002, Journal of Economic Literature.

determine that endogenous technical change imply that new technologies experience a skill bias when the labour force experiences an increase in the level of skills.

The OECD has long analysed the concept of a knowledge-based economy, and today the organization still represents of the major contributors to the cause: it defined it as "the trends in advanced economies towards greater dependence on knowledge, information and high skill levels, and the increasing need for ready access to all of these by the business and public sectors"[5].

From our modest standpoint, our aim is to intend the concept of knowledge-based economy as the ultimate concretization of technological change. It is possible to define knowledge-based capital as the stock of capital which is neither physical nor financial, and which embodies significant levels of technology-related features. There are three main categories[6] of capital-based technologies: first, computerised information gathers the sum of pieces of software and databases. Second, innovative property embodies all the outcomes of innovation which convey business relevance – say, copyrights, trademarks and R&D practices. Third, economic competencies revolve around corporate practices to improve competitiveness: it includes organizational design, skills developed within firms, as well as the networks the latter are able to develop and the brand equity as it perceived by consumers.

In order to invest in knowledge-based capital, it is important to understand that they present several differences compared to investments in physical items. First, the knowledge-based capital lacks visibility: without physical manifestation, it becomes harsh to assess the feasibility and profitability of investments. Second, the use of knowledge-based capital is non-rival, meaning that one's use does not determine scarcity or decrease in the availability of the productive factor. Third, the property of knowledge-based capital is particularly complicated to determine: owners do not have full control over the transfer of the capital and hence returns on investments might be underestimated. Last, this capital strongly relies on innovation patterns, which are often uncertain and risky: relying on insightfulness and experimentation, before investing in knowledge-based capital, one must consider unexpected sunk cost and that eventually the results of innovation might not bring any incremental value.

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[5] OECD, *The Measurement of Scientific and Technological Activities: Guidelines for Collecting and Interpreting Innovation Data: Oslo Manual, Third Edition" prepared by the Working Party of National Experts on Scientific and Technology Indicators*, 2005, OECD, Paris.

[6] Corrado, Carol, Hulten, Charles, and Sichel, Daniel, *Measuring Capital and Technology. An Expanded Framework*, 2005, the National Bureau of Economic Research.

2. Technological change and the emergence of the knowledge-based economy: focus on inequalities and globalization

The knowledge-based economy and growth in productivity

In terms of economic efficiency, firms that seek increases in their levels of productivity are typically the ones that most lever on technological advances. Multifactor Productivity (MFP) gathers all the attempts that firms and economies make to improve their competitive position in the market. By focusing on the efficiency of capital, it represents a tool to understand the degree of innovation that firms introduce in their productive processes. Hence, MFP enables us to state that the knowledge-based economy, through its effects coming from increases in MFP, might represent a way for economies to converge in the long-term towards a new equilibrium.

Trends in innovation

The absolute levels of intensity of innovation (which is related to both technological change and hence to the knowledge-based economy) strongly differ among countries; moreover, innovation processes are usually concentrated in the major economic leaders of the world. The cluster of countries presenting the greatest levels of R&D relative to GDP is the same which presents the greatest amount of patents per capital: great levels of productivity enabled the emergence of patterns towards innovation, which are perhaps not sustainable in economies which performance is not as remarkable. This trend determines a vicious circle where economic leaders and industrialized countries continue to concentrate the sources of innovation, in spite of developing countries. Hence, the degree of innovation that takes place within countries, which supports patterns towards greater levels of technological change, is strongly related to the levels of long-term performance of economies.

Cross-country divergences in investments in knowledge-based capital

Investments in knowledge-based capital strongly vary across countries: in this perspective, the resources devoted to the improvement of the knowledge-based economy are substantial in early industrializers such as the United States, Canada and the United Kingdom, but they are also relevant in countries like Japan and Sweden. Cross-country differences in the degree of investment in knowledge-based capital are related to the way companies use the innovations deriving from technological change: in this case, the existing differences in the relevance in the global scenario

are further accentuated by both different levels of investments in knowledge-based capital and in the use they make of it in their key industries.

The knowledge-based economy and differences in resource allocation

The ability of firms to channel resources towards the most innovative and productive industries is divergent depending on the country: firms which are capable of developing productivity increases tend to detain a greater portion of the manufacturing workforce. Moreover, traditional economic leaders tend to foster a business environment that enables more productive and innovative firms to flourish: in the long-run, they tend to become larger than firms which are less productive. Moreover, there is a positive covariance between the levels of productivity and the structure of employment. In this perspective, it is important to understand that the current allocation of the labour force in the leading economies supports the productivity of workers. Hence, in a relevant number of countries, distribution of income is becoming increasingly concentrated in firms which tend to invest greater amounts of resources in innovation and in patterns towards increases in productivity.

Towards efficient resource allocation

It is important to keep in mind that the structural frameworks of countries can affect significantly the way the transfer of productive factors can occur. Indeed, while one would believe that resources are most efficiently transferred in the most liberal economies, empirical evidence presents diverging results. While we determined that there is a positive correlation between knowledge-based capital contribution to labour productivity growth and the efficiency of labour allocation across firms, the composition of this correlation shows that LMEs represent the countries which mostly levers on knowledge-based capital to improve its labour productivity; however, these countries present small degrees of efficiency in the way the labour force is allocated across firms. The knowledge-based economy fosters better resource allocation in Coordinated Market Economies: indeed, these markets strongly rely on Governmental intervention in key matters, and the efficiency of labour allocation must certainly represent one. If labour is efficiently allocated in the most productive industries, it is likely that the workforce will be resilient to technological change. Hence, the knowledge-based economy affects to a lesser extent the structure of inequalities of CMEs than LMEs.

The knowledge-based economy and the improvement of GVCs

In order to be competitive in the international environment, national economies ought to rely heavily not only on their competitive advantage; they should be able to identify the greatest amount of key industries through which they can offer high levels of value-added. Value-added, indeed, represents the way firms are capable of increasing the price or the value of a good they sell or a service they provide, starting from the amount of resources they need to employ in productive activities. If, in the past, emerging countries represented mere subcontractors for multinational firms to lever on – because of their reduced costs – today, thanks to the development of the knowledge-based economy and to the emergence of GVCs, they have become key players in the international scenario. Indeed, technological change has strongly supported the shift of these economies from simple executors to solid economic players: in particular, it is worth reminding that technological advances deriving from the fourth industrial revolution enabled the creation of high-technologies industries which today strongly affect emerging countries' competitive advantage. Hence, countries that have been able to lever on the knowledge-based economy to improve their level of value added, have become key players in the GVCs scenario in relevant and profitable industries.

Challenges deriving from the knowledge-based economy

The current world equilibrium is a lot different than it used to be in the twentieth century. Indeed, today, the amount of countries that are actively performing operations in the international scenario has strongly increased: this phenomenon was due to the emergence of GVCs and supported by technological change. Indeed, the way integration in international markets enables the success of industries has also strongly varied. An increasing number of emerging economies rely their competitive advantage on the development of the high-technology industries; nevertheless, while they represent key players in many industries, the share of income they earn from the process does not reflect the actual contribution of these countries. Hence, the emergence of the knowledge-based economy – which creates new industries and supports the development of patterns of market integration, through namely GVCs – lacks a thorough consideration of the distribution of value creation among economic players. In this perspective, there are several policy implications related to the knowledge-based economy that countries need to take into careful consideration.

Levering on technological change to support the development of GVCs

For countries – both developed of emerging economies – being integrated in the globalized world represents a significant asset: in this perspective, it is crucial for policy makers to take into careful consideration the subject, if they intend to pursue a long-term vision of economic development. An effective national policy should create the right business environment that enables firms to feel supported in the action of taking risks by investing in knowledge-based capital. In this perspective, public policies should include regulatory tools to improve the ease of doing business: if even a restricted number firms were able to increase their stock of knowledge-based capital, the spill-overs generated by these firms could spread throughout the business environment, hence generating a virtuous circle which national economies as a whole could benefit from. In order to enable the development of a long-term competitive advantage in the international framework, public policies should focus on creating a business environment that supports investments in knowledge-based assets.

Determining the right incentives to develop the knowledge-based economy

Which are the right kinds of incentives that emerging economies should establish in order to support the process of market integration in the knowledge-based economy? In order for policy-makers to provide the right incentives to foster investments in knowledge-based capital, it is important to grant the tools to enable free trade and investments policies that promote the improvement of GVCs in the framework of the knowledge-based economy. In this perspective, it is crucial to ascertain that some emerging countries have already recognized this need and they are providing the right kinds of incentives. Investments in the knowledge-based economy are fundamental to carry out effective attempts of joining the internationally integrated business scenario; moreover, they can further support the development of the domestic business environment, which represents a key feature to support in a long-term political vision of gaining momentum in the globalized world.

CONCLUSION

Which is the nature of the linkages that shape the relationships among technological change, globalization and inequalities? This is the question that guided us throughout this study. Keeping the focus on changes in the technological capabilities of firms, industries and countries, we tried to determine the implications of such changes in an integrated economic environment. Indeed, starting from a statement made by John Maynard Keynes in the early 1930s, our aim was to determine the effects of industrialization patterns on the international dynamics of market integration and on the structures of income distribution.

To deeply analyse this issue, the study revolved around three main chapters: the first chapter aimed at determining the most significant historical milestones with respect to industrialization patters and the current dynamics in the international scenario. The second chapter revolved around the need to establish the current state of income distribution, and to relate it to globalization patterns. The third and final chapter, in turn, intended to establish the theoretical nature of technological change, in order to make some final considerations on its relationships with globalization and inequalities.

Our urge was to find concrete and tangible connections among the issues of globalization, technological change and inequalities. In this perspective, our aim was to give great impulse to the attempts of convergence and divergence with respect to different clusters of countries. Now that we ascertained that it is technological change that re-shaped the structures of inequalities and gave greater impulse to patterns of globalization, we can finally state that our analysis is complete. Still, there is one issue we would like to lever on to provide our reader one last input: we determined that international organizations have played a crucial role in the identification of the knowledge-based economy as the turning point for recent changes in market integration and change in the structure of inequalities. Still, their concrete actions still lack: indeed, they might represent the actual and specific tool to enable substantial convergence patterns in the globalized scenario.

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INTRODUCTION

"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." – John Maynard Keynes, 1930.

This reflection, made almost one century ago, has taken increasing significance throughout the twentieth century; it also represents one of the key challenges of current times. Moreover, this view strongly relates to the implications of technological change in all aspects of the economic scenario – above all, Keynes focused on the effects that it is destined to generate in the long-run. Today, an increasing number of scholars and economists have strongly levered on Keynes' theoretical milestones and they have tried to adapt them to the framework of the twenty-first century: in this perspective, the studies carried out by French economist Thomas Piketty are considered as the starting point for the macroeconomics of the new millennium. In his book *Capital in the Twenty-First Century*, he stated that "over a long period of time, the main force in favour of greater equality has been the diffusion of knowledge and skills". Both statements convey relevant considerations: indeed, in one sentence, Keynes – one of the most influential economists of the past century and the founder of modern macroeconomics – expresses that there is a strong relationship between technological change – originating from industrialization patterns – and changes in the structure of distribution of income. Piketty, on his side, grants significant relevance to technological change as the tool to enable economic convergence among countries.

Starting from these remarks, it is crucial to introduce the concept of industrialization as the sum of technological enhances that have been taking place in a great share of the world's countries, starting from the late eighteenth century up to the new millennium. Which patterns did economies follow in the aim of improving their position in the international scenario? Which is the final result of these paths in the current framework? The four industrial revolutions that took place in the past centuries, and which are still continuing to take place today, enabled unprecedented improvements in industrial dynamics, and they have been able to heavily re-shape the conception of international economics. Indeed, they enabled national economies to gain relevant momentum in the global scenario, hence determining the development of market integration, which is usually referred to as globalization. Globalization has been enabled by the results of the past industrial revolutions,

which in particular generated the decrease in transportation costs, the quasi-elimination of communication costs, and the emergence of the Information and Communication Technology as a tool to improve market efficiency. Hence, with the help of the processes that occurred during the four industrial revolutions, it is possible to understand all recent trends in globalization and its current state of art.

The industrial revolutions, as well as their resulting patterns of market integrations, have significantly influenced the international dynamics occurring among nations; furthermore, they also generated important changes within national frameworks. Which is the nature of such changes? To which extent do they relate to uneven distribution of income? Indeed, both aspects deserve thorough consideration. In particular, with income distribution, we usually refer to the way resources are allocated among factors of production – say, labour and capital. For the purpose of this study, it is also important to highlight that the way resources are distributed within these two factors of production represents a crucial aspect to analyse, since it embodies the source of inequalities within social structures. Moreover, with increasing openness of economies towards internationalization of markets, the need to analyse the structures of inequality among countries has started to gain momentum in economic literature: indeed, the way resources are allocated at the global scale can strongly affect development patterns.

The historical perspective is fundamental to carry out a precise and thorough analysis: having a temporary timeline of industrialization patterns, of globalization processes and of the evolution of the structure of inequality is crucial to understand the current perspective. Which is today's concretization of technological change? How does it relate to globalization patterns and to changes in distribution of income? These questions are not trivial, since they embody the need to identify changing dynamics in international relations; moreover, they determine the emergence of new ranges of challenges that need to be taken into careful consideration. Indeed, the analysis of the current state of art with respect to technological change, globalization and inequalities, can help have a better understanding of new possibilities and threats deriving from an integrated global and industrialized scenario. Based on these considerations, this study aims at tackling the subject by breaking it down into three approaches.

The purpose of the first chapter will be to understand and analyse the historical progress concerning market integration and globalization pattern. Starting from recent trends in economic

history, it is possible to determine that an increasing number countries to started to engage in industrialization processes. This process occurred at different points in time or with different degrees of intensity; nevertheless, almost all economies have taken a part in this mechanism of change. Starting from the eighteenth century, such processes generated the emergence of integrated markets, where exchanges were facilitated by the introduction of special tools and of *ad hoc* regulatory frameworks. In the twenty-first century, three hundred years later, economies are still experiencing technological advancements and their implications on the current degree of economic and social development are remarkable.

Indeed, the first chapter of this study aims at identifying the past waves of innovation in a historical perspective, in order to understand how they have been succeeding to one another and which implications they have generated with respect to the current degree of globalization and market integration. In this perspective, the past three industrial revolutions will be briefly overviewed, so as to present the historical milestones that shaped industrialization processes. The first industrial revolution is traditionally related to Watt's steam engine, and it determined specialization in production, allowed economies of scale and scope and improved the degree at which trade integration occurred. The second industrial revolution was enabled by the expansion of the railway system and of telegraph lines; it strongly influenced transformation and communication costs within companies and across countries. Lastly, the third industrial revolution enabled the emergence of the Information and Communication Technologies (the ICT); it determined further convergence in trade, enabled the emergence of new relevant players in the global market, and eventually, it generated relevant changes in the production system and determined further decreases in transportation-related costs. These main features of the past three industrial revolutions will support the analysis of the current state of industrialization, by focusing in particular on the major implications of the fourth industrial revolution – also known as the Industry 4.0 – in the process of globalization of markets. The Industry 4.0. consists of the overall technological developments which derive from the digitalization of production processes as well as from the wide-spread diffusion of the Internet. The technologies which relate to this new industrial revolution allow objects to be connected among them and with people; they generate "smart" products which can gather and transfer data and knowledge.

Then, the analysis carried out in the first chapter will revolve around recent trends in globalization, by examining recent dynamics in trade integration and in the generation of the world’s output. To do so, it is important to evaluate the world economic development that

determines the current state of globalization, and to understand the regulatory framework of international trade. Indeed, in a period of great advances for the emerging countries, it is important to analyse the drivers of this new wave of market integration. Moreover, given their increasing relevance in the international economic scenario, the study will revolve around the role of emerging countries in the current dynamics of market integration. Lastly, the attention will move towards the phenomenon of Global Value Chains (GVCs): with the unprecedented degree of coordination and specialization of countries, it is believed to be one of the major results of the globalization process. GVCs have been strongly enabled by globalization, and in particular, by the reduction of transportation costs and the elimination of communication costs. Indeed, technological transformation strongly supported this emerging trend, enabling countries to specialize parts of their economy in the production of specific components or in the delivery of specific tasks, rather than to focus on the entire product or service. The aim of this section will be to analyse the features of this new phenomenon, and see how its scale and scope have changed the international scenario of production. Then, it will be crucial to investigate the new perspectives that GVCs offer to developing and emerging countries with respect to trade integration, while taking into consideration the risks that countries and companies could face in the phenomenon of GVCs.

In the second chapter, the analysis will revolve around the need to identify all the changing dynamics concerning distribution of income, both from a national standpoint and in an international perspective. Starting from industrialization patterns and the current state of globalization, it is crucial to understand the way these scenarios affect resource allocation in the world's equilibrium. Indeed, there are several linkages between globalization and the structure of inequalities, which are worth being analysed.

In this perspective, it is crucial to present the theoretical origins of growth and inequality. Theories revolving around distribution of income have always represented central provisions to enable the study of economic efficiency and to understand global dynamics. In 1969, Joseph Stiglitz was among the first to consider the significant relevance of shifting the focus from factors of production and extend it to the study of distribution of wealth and income among individuals. Starting from his analyses, Stiglitz gave great impulse to the development of new studies on the way wealth distribution affect the production function, social structures, labour skills, and inequality as a whole. Moreover, Thomas Piketty, a French economist, started to adapt classical

theories on distribution of wealth to the economic and social scenario of the twenty first century: indeed, it is believed that his findings are destined to have relevant implications in the way income inequalities are going to be studied in the next decades. Then, Branko Milanović, a Serbian-American economist, deeply focused on the way globalization patterns and processes of market integration affect the structure of global inequality, among countries and societies.

The three authors presented above enable the study to have theoretical grounding; according to their theories, it is possible to understand today's structure of income inequality, as well as its evolution in the past century. Indeed, in the current framework of globalization and market integration, it is crucial to understand to which extent industrialization processes and globalization patterns have affected the structure of inequality; also, it is worth examining which outcome they are likely to generate in the future. In order to do so, the aim of this chapter will be to focus on the analysis of the theoretical implications that have been rising in the framework of the current century. It will take into consideration the theoretical principles of the relationship between industrialization patterns and distribution of income and empirical evidence on past and current states of inequality within and among nations.

The linkages among the current structure of inequality and the recent trends in internationalization of markets and in globalization are worth being thoroughly depicted: in this framework, the study will revolve around the issue of the different dynamics that have been shaping the international scenario, and their implications with respect to a new distribution of income. In this perspective, empirical evidence related to distribution of income will represent the starting point to carry out a comparison among Europe, the United States and emerging countries with respect to distribution of income.

In the third chapter, the focus will shift towards the identification a new economic phenomenon, known as the knowledge-based economy, considered as the final outcome of technological change; starting from there, the analysis will tackle the implications of this new reality with respect to the structure of inequality among countries and with respect to international market integration. Indeed, the key issues of this chapter revolve around the need to establish the implications of technological change for the internationally-integrated economic environment; moreover, it will be interesting to understand to which extent the knowledge-based economy is re-shaping the labour market, namely focusing on the consequences it might generate on inequalities.

These analyses will determine the establishment of a new stage in the evolution of economic principles: the shift towards the knowledge-based economy will represent the cornerstone of this chapter.

In recent times, the relevance of technological change in the business environment strongly increased: not only did it gain significance within national productive systems, it also supported the creation of international markets for trade of goods and services. Indeed, technological change is at the heart of the determinants of globalization: thanks to the emergence of the ICT and to the drop in communication costs – both enabled by technological change – companies could actually expose themselves in the international scenario. Not only did it enable corporations to become international players, technological change also strongly supported the process of openness of a new set of countries towards global trade dynamics. The analysis for this last chapter will revolve around the need to define the nature of technological change, as well as the determinants that are responsible for the re-definition of the international economic environment and of the labour market. The analysis will focus on the determinants of technological change, in particular with respect to the biases it is subject to: skill-biased change, capital-biased change and superstar-biased change. Then, the focus will shift towards the nature of technology and on the drivers that represent its major features: in this perspective, the attention will be on determining the way technology can be conceived as exogenous and, conversely, the features that define technology as endogenous.

The final outcome of technological change lies in the identification of new economic phenomenon, known as the knowledge-based economy. The latter envisages increasing investment flows in knowledge-based capital, intended as the sum of the assets that do not embody any physical component: computer-based information, innovative tools for the protection of Intellectual Property Rights (IPRs), as well as innovative habits concerning economic activities. The purpose of this section will be to understand the dynamics related to the effects of this new economic phenomenon with respect to the structure of inequality, in order to determine whether, in the era of the knowledge-based economy, resources are allocated efficiently. Then, the study will give emphasis to the relationship between the knowledge-based economy and the most recent patterns in globalization: to do so, the analysis will focus on the improvements in GVCs related to technological change, and the need to take into consideration several challenges will be evaluated. Lastly, the study will try to determine the policy implications that revolve around globalization and the knowledge-based economy.

All in all, the concept of technological change represents the *fil rouge* for all the analyses that will be carried out, and it will guide the reader throughout this study: thanks to its deep understanding, several precise considerations will be made on the implications of the knowledge-based economy on inequalities and on international dynamics regarding globalization and market integration.

CHAPTER 1 – INDUSTRIALIZATION PROCESSES AND GLOBALIZATION

Recent trends in economic history saw the emerging tendency of countries to engage in industrialization processes. At different points in time or with different degrees of intensity, all economies have taken a part in this mechanism of change. Gradually, such processes generated the emergence of integrated markets, where exchanges were facilitated by the introduction of special tools and of *ad hoc* regulatory frameworks. This historical radically new period of industrialization process started during the eighteenth century; almost three centuries later, we are still experiencing technological advancements that are shaping the current degree of economic and social development.

The aim of the first chapter of this study is to identify to which extent the past waves of innovation have been succeeding to one another and which implications they have fostered with respect to the current degree of globalization and market integration. In order to do so, we will first analyse the historical milestones that shaped industrialization processes: in particular, we will briefly overview the three past industrial revolution. Their main features will help us examine the current state of industrialization: we will determine the major implications of the fourth industrial revolution – the Industry 4.0 – in the process of globalization of markets.

In the second section of the chapter, the focus will be on recent trends of globalization: first, we will examine recent trends in trade integration and in the development of the world's output. To do so, we will evaluate the world economic development that determines the current state of globalization; then we will study the regulatory framework of international trade. Lastly, the analysis will move towards the phenomenon of Global Value Chains, whose determinants – which we will examine in depth – support the emergence of a new state of globalization of markets.

1. Industrialization processes

1.1. Industrial revolutions: an overview

Introduction

The historical phases that have allowed today's magnitude of markets integration (globalization) are to be found in the astonishing processes determined by the industrial revolutions. To different extents, such revolutions changed production processes and shaped the economy, the politics, and the society as a whole, across countries as well as within them. They have represented processes of economic evolution that led to the transition from an agricultural and artisan model to one of great industrial modernity, defined by the wide-spread use of machines which could only work thanks to mechanical power and new sources of energy (fossil fuels above all). From a political standpoint, they have generated new challenges, which comprehend the need for an educated and skilled workforce, well-managed and efficient cities and safe infrastructures. Consequently, new establishments were put in place and they were more or less able to deal with the modern environment. Lastly, with respect to society, they have determined the emergence of new social classes with changing skills, jobs, needs and expectations; also, they have enabled the shift of living areas from the country-side to urban regions.

Which have been the main features of the past industrial revolutions? Why have they represented such relevant milestones of recent history? To which extent did they influence and shape trade integration among countries? In this first section, the study will focus on the most relevant characteristics of the three industrial revolutions that took place through the last three centuries. In particular, we will see how the first industrial revolution, namely related to Watt's steam engine, determined specialization in production, allowed economies of scale and scope and improved the degree at which trade integration occurred. Then, the focus will be on the second industrial revolution, enabled by the expansion of the railway system and of telegraph lines; we will see how such changes influenced transformation and communication costs within companies and across countries. Lastly, it will be crucial to pay attention to the third industrial revolution, and in particular to see how the Information and Communication Technologies (the ICT) determined further convergence in trade, enabled the emergence of new relevant players in the global market, eventually determined relevant changes in the production system and generated further decreases in transportation-related costs.

1.1.a. The first industrial revolution

The first industrial revolution[7] determines the emergence of unprecedented technological change in all aspects of life and in all stages of production. Indeed, since the beginning of the eighteenth century and for most of the nineteenth century, in a relevant number of countries located in Western Europe, societies have been experiencing the shift from economies based on agriculture and artisanship to economies characterized by industrial activity. In fact, the weight of agriculture in the overall structure of the economies started to diminish as countries and economies first entered and then developed industrial mechanisms. In addition, as industrialized processes grew in many economies, the productivity of the agriculture strongly increased: this implied that less workers were needed in that industry and consequently they could shift towards new kinds of jobs. In fact, the change in the period started in the beginning of the eighteenth century and continued for most of the nineteenth century.

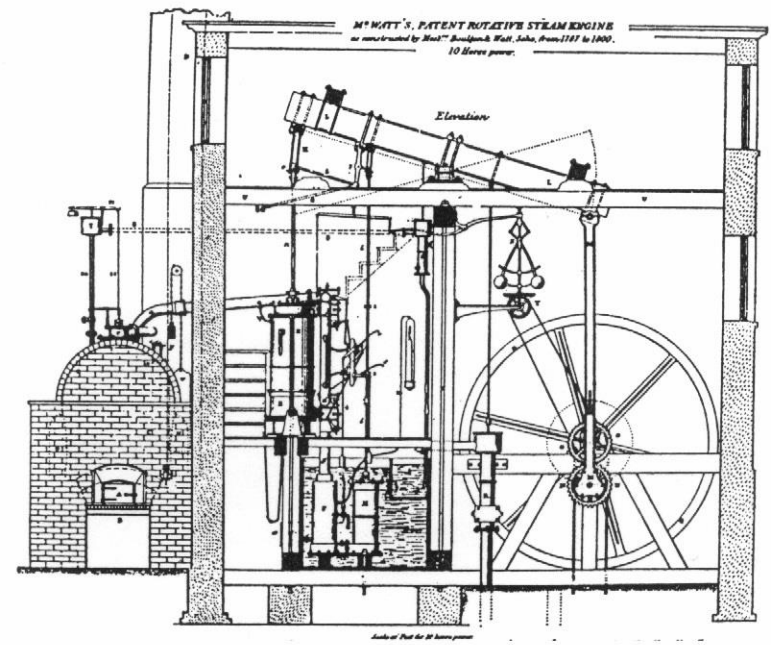
The most relevant feature that characterized this period was that the concentration of productive factors (both labour and capital) shifted towards a secondary industry, which included new sectors such as construction, infrastructure, mining, metallurgy and manufacturing. Furthermore, this period of transformation saw the emergence of other specific features. First, there was an increase in the use of machineries powered by mechanical energy; second, in order to allow these new machines to work properly, this period saw the establishment of new sources of energy, the most relevant example being the one of fossil fuels. Third, and last, materials that could not be found in nature started to be largely used and found a significant role in the production processes. The most illustrative application of these features is the replacement of traditional sources of energy, such as charcoal, in favour of coal and of the emerging of steam engines, which could provide sources of energy and power in all these new kinds of productive activities. Let us now analyse which new kinds of productive activities saw the emergence with the first industrial revolution.

The mining industry

The first productive activity that characterized the first industrial revolution is the mining industry. This industry represented a crucial productive activity at the time, since the demand for extraction of natural resources increased strongly. The success of this industry was ensured by the introduction of steam power and the development of many clever tools to make the mining activity

[7] Rondo Cameron, Larry Neal, *A Concise Economic History of the World*, 2003, Oxford University Press.

and the extraction of mineral materials increasingly efficient. Many inventors brought about significant ameliorations to the extraction process: at the very end of the seventeenth century, Thomas Savery patented the steam pump, which was enhanced, a decade later, by Thomas Newcomen, who invented the first atmospheric steam pump. Due to its significant expenses and to its strong inefficiencies, such as its large consumption of fuel, new solutions were needed: in this perspective, James Watt was asked to increase the efficiency of Newcomen's invention and patented the steam engine.



Watt's double-acting rotative engine, showing the cylinder with condenser below, the parallel motion and the sun-and-planet motion.
(Original in John Farey, *A Treatise on the Steam Engine*, London, 1827; also reproduced as fig. 14 of H. W. Dickinson, *A Short History of the Steam Engine*, Cambridge University Press, 1939, p. 81)

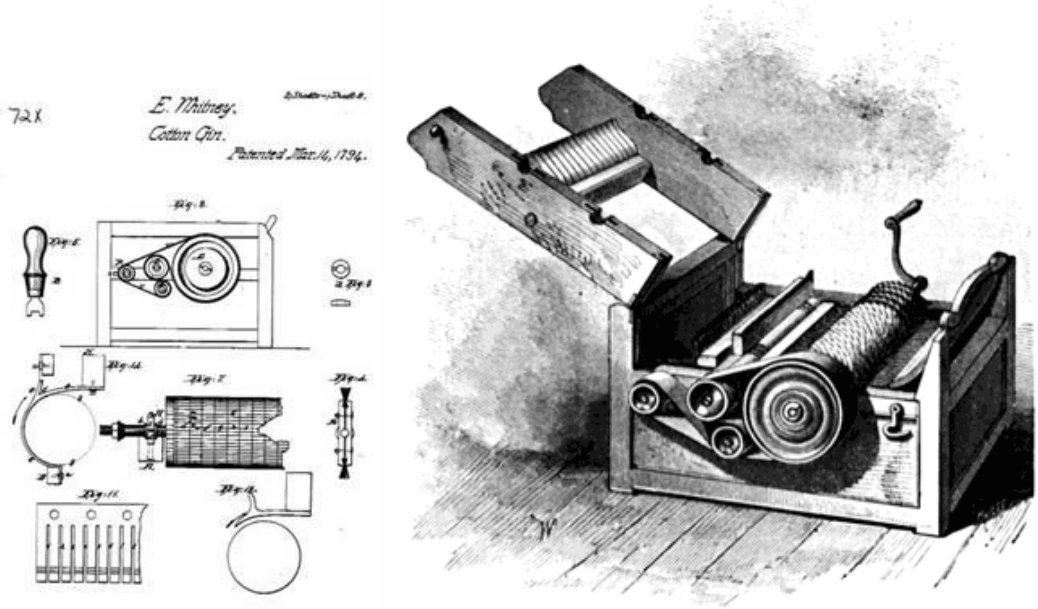
Reproduction of Watt's double-acting rotative engine[8]

The textile industry

The second industry which benefited from the first industrial revolution is the textile industry. Although it was still present in the pre-industrial stage of history, it became preponderant in the eighteenth century thanks to technological advances. Just as it happened for the mining industry, thanks to technological change, many inventions were carried out in order to increase productivity and efficiency of production processes. In this perspective, it is worth mentioning the

[8] Source: Dickinson, H. W., *A Short History of the Steam Engine*, 1939, Cambridge University Press.

flying shuttle by John Kay and the spinning Jenny invented by James Hargreaves: both machineries strongly increased productivity of labour but, at the same time, they also presented some inefficiencies. To have concrete answers to their increased needs, British businesspeople and workers had to wait for an American to come up with a relevant invention: in 1793 Eli Whitney patented a mechanical engine which could separate cotton seeds from their fibres. Until Whitney's invention, this work was done by slaves and represented a very significant cost for American cotton growers. This machine was called the "cotton gin".



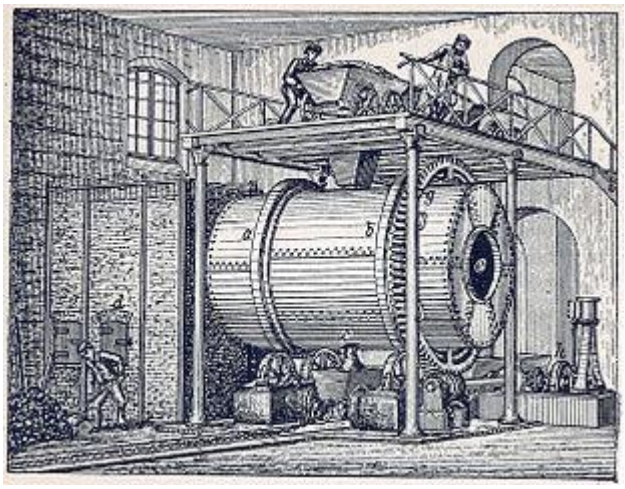
Representation of Eli Whitney's cotton gin[9]

The chemical industry

The third industry that saw a great expansion thanks to the first industrial revolution is the chemical industry. Theoretical advances, enabled by great chemists such as Antoine Lavoisier, supported the practical application of technical advances. Let us take the example of alkalis: chemists could produce them by burning natural vegetable materials. From a productive point of view, this process resulted to be excessively inefficient, since the supply natural materials is by definition inelastic; to solve this issue, new chemicals were needed. In 1791, Nicholas Leblanc started to produce alkalis with sodium chloride, which could be found far more easily than the

[9] Source: http://www.sussexvt.k12.de.us/science/The%20History%20of%20the%20World%201500-1899/Eli%20Whitney%20Invents%20the%20Cotton%20Gin.htm

natural vegetable materials that were needed before. This process achieved resounding success and it was used in a wide range of productions, including glass, paint and soap.

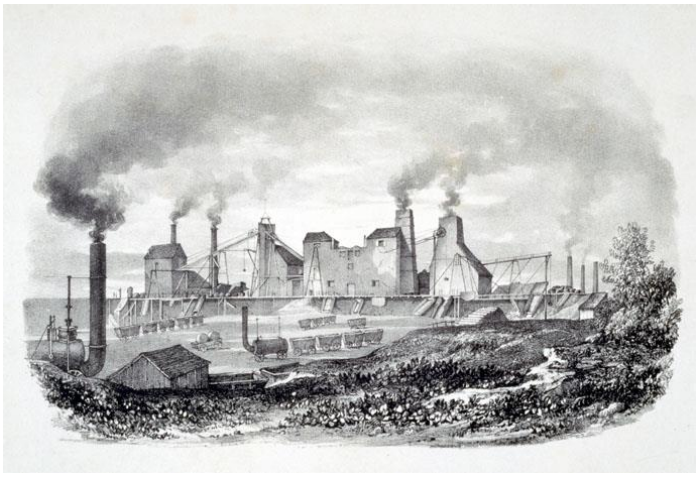


Representation of the "Leblanc process" for the production of sodium chloride[10]

The coal industry

The fourth industry whose expansion was supported by technological advances of the first industrial revolution is the coal industry. By definition, this industry very labour-intensive, but it was also a very profitable activity: at that time, coal was a crucial input, and it was needed in a very wide variety of industries and activities. Indeed, its profitability further increased thanks to technological change: in fact, the first railways enabled mines to go much deeper under the ground and thus increase miners' capacity to extract the mineral. Furthermore, the same railway systems were used to collect the mines to the river, in particular the Tyne in England, where coal was easily transported all over the country.

[10] Source: Wikipedia



Representation of a coal mine in Sunderland, owned by Hetton Colliery, who also owned one of the world's first private steam railways[11]

In the last paragraph, we mentioned the importance of the railway in a relevant share of the new productive activities. Indeed, the steam railway represents the best way to end the analysis of the first industrial revolution, since it is the most direct evolution of Watt's steam engine, i.e. the key that enabled the revolutionary process. The first working locomotive was built in 1801 by Richard Trevithick; ever since, many improvements were made until, in 1813, George Stephenson (an autodidact) built a successful steam railway and, in 1830, he was able to connect Liverpool and Manchester.

Conclusive remarks

The system of changes and features we have just mentioned give historical significance to the period that experienced the introduction of mechanical advances, such as mechanized machines in the textile and manufacturing industries, in a new range of production processes. Also, this period would have probably not been defined a revolution if James Watt had not invented the steam engine, which allowed the replacement of traditional sources of energy with one of low cost and abundantly available. Last, the first industrial revolution was strongly influenced by the success of a new organization of inputs to ensure production: the concept of the organization of production within the factory was established at that time.

[11] Source: http://www.bbc.co.uk/schools/primaryhistory/victorian_britain/children_in_coal_mines/

1.1.b. The second industrial revolution

In the previous section, we saw that the first industrial revolution generated unprecedented change thanks to the emergence of new technologies and new tools. In particular, thanks to the steam engine, many new industries could develop and prosper. Among the many, we took into consideration the mining, textile, chemical and coal industries, which are particularly illustrative for the degree of technological and technical advance. In this section, we intend to continue our analysis in the historical timeline of industrial revolutions, by focusing the second industrial revolution.

The second industrial revolution[12] started in the middle of the nineteenth century and it was enabled by new tools and technologies such as steel, electricity, the spread of the railroad and petroleum. It is also worth mentioning that it is during the second industrial revolution that rose the main theoretical studies on organizational structure (e.g. Taylorism and Fordism). Unlike the first industrial revolution, during which new discoveries occurred on trial and error basis and were often carried out by autodidacts (i.e. George Stephenson), the second industrial revolution was shaped by scientific and engineering-based technological change. Indeed, this new procedure enabled both the amelioration of existing technologies, namely the ones brought about during the first industrial revolution, and at the same time it helped to establish some brand new industries which gained significance relevance in a great number of western countries. Let us now analyse, with respect to the second industrial revolution, which new industries were enabled by new discoveries and the application of new technologies throughout the production process.

The steel industry

Just like the steam engine represents the most illustrative feature of the first industrial revolution, steel strongly contributed to this new phase of industrialization. Indeed, steel started to play a very significant role in industrial production and this is because this material gradually became less expensive and more efficient to produce; consequently, these two relevant features increasingly translated to those who used steel as an input for production. As its wide usage and popularity grew, steel production generated important economies of scale and scope, which to a greater extent determined a decrease in the labour intensity of the industry: as a consequence, steel productivity also strongly increased in the framework of the second industrial revolution.

[12] Vale, Richmond, *Second Industrial Revolution: the Technological Revolution*, 2016, available at richmondvale.com

The majors innovations occurred under the supervision of Sir Henry Bessemer. His main finding, the Bessemer process[13], is widely known as the method that allowed the mass-production of steel. This process, which aimed at removing impure materials from pig iron, involve that air bursts would be injected inside the molten iron; the injected oxygen, together with high temperatures and the high percentage of carbon (naturally included in the pig iron), would then react with the impurities which could then easily be separated by pure steel right from the furnace. Indeed, the Bessemer process represented the first method to obtain steel in one single phase.

Bessemer furnace, Kelham Island Museum, Sheffield, England[14]

Many innovations followed one another as producers and entrepreneurs were starting to understand the important implications of steel in the production processes. Progressively, thanks to process innovations, which answered to diverging starting conditions of the natural materials (for instance, in continental Europe iron contained a greater portion of phosphorus than the iron which could be found in Great Britain), steel production experienced success in different countries, such the United States, Germany and Belgium. Later in time, the Siemens-Martin process completed the Bessemer process, and steel could gain greater applications in the industrial framework.

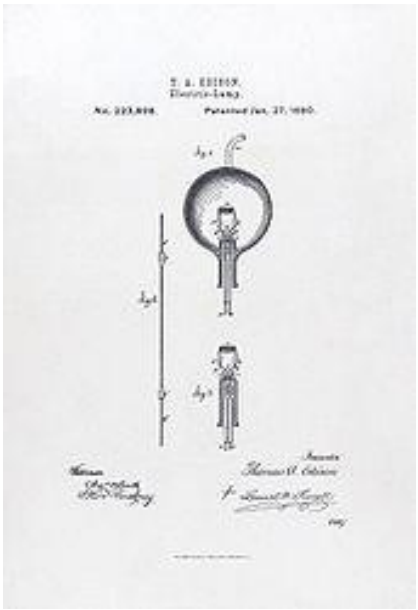
The introduction of steel in industrial processes came at very affordable costs. In this perspective, it became an attractive material for many business applications: steel started to be

[13] *Cfr* https://www.britannica.com/technology/Bessemer-process
[14] Source: https://www.britannica.com/technology/Bessemer-process

used to build bridges and railroads; furthermore, the first skyscrapers were build using steel. Lastly, much of the military equipment used during the First World War was produced with this material: tanks and naval vessels are just the most illustrative examples of the warmongering potential of steel.

The electricity industry

During the second industrial revolution, electricity[15] progressively substituted steam-powered machines, which had played a prominent role in the productive activities for all the first industrial revolution. In 1831, Michael Faraday discovered that a magnet, if placed near a coil of wire and moved, could cause electrical current. Within a year, this phenomenal discovery was put into industrial practice: the first electrical generator was presented in Paris in 1832. By the 1850s, the first concrete industrial uses of electrical energy were developed and, later on, thanks to further improvements and discoveries, electrical power had a large-scale potential: in this perspective, it is worth mentioning Joseph Swan's incandescent lamp, which led the way to the unprecedented potential for light and electricity, and to Thomas Edison's improvements in electric light.



U.S. Patent #223898, Thomas Edison's incandescent lamp[16]

It is widely known that the electricity industry generated unconceived benefits to entire countries and societies: indeed, the very first modern power station was located in Deptfort and

[15] *Cfr* http://www.saburchill.com/history/chapters/IR/055.html
[16] Source: http://americanhistory.si.edu/lighting/history/patents/ed_inc.htm

could supply electricity to central London and progressively to the entire area of the city. Furthermore, it gave an incredible boost to companies and production systems: in fact, mass production, whose first stage was enabled by steam power, saw an incredible improvement during the second industrial revolution and finally resulted in the development of assembly lines. Overall, with electric lighting developing in the production systems, workers could experience remarkable improvements in a wide range of aspects, starting with their working conditions, but also including the increase in productive of productive factors and the decrease in the pollution degree which characterized factories at that time.

The petroleum industry

One of the most innovative materials that were introduced during the second industrial revolution is petroleum[17]. During the second half of the nineteenth century, in fact, both production and refinery of petroleum were developed. The first attempts to give concrete application to this new industry occurred in Great Britain: in fact, in Scotland, starting from 1850, the chemist James Young began to set up the first oil refineries for commercial use. Still, the great success of this new natural resource took place in the United States: indeed, the first modern oil dwell is located in Pennsylvania, traditional industrial State in the west coast of the United States. This was the first dwell built with the only purpose of extracting oil.

Picture of the Drake well in Pennsylvania, Drake Well Museum[18]

[17] Halfan Cartsens, *The Birth of the Modern Oil Industry*, 2009, Geoscience and Technology explained
[18] Source: http://www.geoexpro.com/articles/2009/03/the-birth-of-the-modern-oil-industry

Edwin Drake, the owner of this dwell, also commercialised the first product deriving from petroleum: kerosene found incredible applications in many industries. In this perspective, it is worth noting that kerosene fostered the development of both modern lamps and heaters. Soon, indeed, the demand for oil and especially kerosene outrun supply: this natural material became fundamental in all stages of life and in all phases of production processes.

The telecommunication industry

The last industry that rose from the technological changes of the second industrial revolution is the telecommunication industry. In this industry, the innovative process started, once again, in Great Britain, but as time went by, many process and radical innovations were developed in many different countries. In fact, the first electric telegraph was built in London by William Fothergill Cooke and Charles Wheatstone in 1837[19].

A Cooke and Wheatstone electric Telegraph from 1837, (London Science Museum)[20].

This innovative idea of being able to communicate and transmit messages through the telegraph was further improved in the United States by Samuel Morse: he was able to invent the Morse code, a coding system that could be transmitted over the telegraph lines. Thanks to these new tools, in just two decades, were established the first lines that connected Great Britain to Europe (1851) and Great Britain to the United States (1858).

[19] *Cfr* http://ethw.org/Cooke_and_Wheatstone%27s_Electric_Telegraph
[20] Source: http://ethw.org/Cooke_and_Wheatstone%27s_Electric_Telegraph

The telegraph determined a historical milestone for communication; still, new instruments soon replaced this technology. In this perspective, in the United States, the first telephone[21] was patented in 1876 by Alexander Graham Bell. In Germany, Heinrich Hertz was the first to theorize the existence of electromagnetic waves, which were later known as the radio waves. Between Italy and Great Britain, Guglielmo Marconi improved the studies conducted by Hertz and proved that communication could also occur without the use of physical cables, so that signals could be sent wireless: in 1897 he sent the first wireless communication across the Atlantic ocean. This is how Marconi was able to market the first radio in the end of the nineteenth century (1898).

To conclude, it is important to highlight that the telecommunication industry is the one industry that led the way to the third industrial revolution: because of its technological implications, it enabled the process of great advances that led to the Information and Communication Technologies, which stands behind the revolution of the late twentieth century.

Conclusive remarks

The second industrial revolution started the process of integration of markets which determined globalization, which will be discussed in the next paragraphs. The role played by Britain in the world's economic order started to become progressively less relevant, and new players started to earn preponderant positions: in particular, during the second industrial revolution, the United States of America and Germany climbed the hierarchy to become the world's economic leaders. Part of the success of the United States can be explained by the fact that, in those days, this country was experiencing a very important degree of liberalization of markets, more technically called *laissez-faire.*

1.1.c. The third industrial revolution

The two world wars that characterized the first half of the twentieth century determined that the concentration of expenses and resources took place in significantly strategic industries (above all, the metallurgic and military industries). Their disastrous aftermaths, still, gave great boost to a relevant number of countries that had be damaged by the fierce of war: this boost generated important levels of growth in many western countries and it allowed the development

[21] *Cfr* http://www.saburchill.com/history/chapters/IR/059.html

of a significant number of new industries. The result of this new wave of disruption is the third industrial revolution[22].

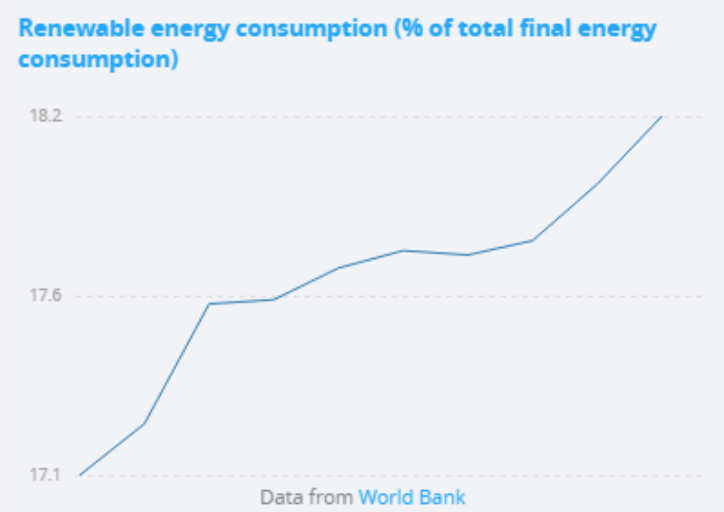
Starting from the second half of the twentieth century, moreover, the unprecedented degree of integration of markets started to pose many new challenges. Among the many, three new claims are strictly connected to the phenomenon of globalization. First, globalization posed the question of sustainability: it was no longer sustainable and affordable to continue to exploit the combination of natural resources that had been at the heart of the first and the second industrial revolutions. World leaders, theorists and business influencers rose the question of the increasing need to develop alternative and renewable sources of energy. Second, market integration determined an unprecedented degree of specialization of markets and economies: such process could only occur thanks to the emergence of the Information and Communication Technologies (the ICT). Lastly, one major feature of the third industrial revolution is appearance of the service industry: in this perspective, it is interesting to see to which extent this industry was able to develop and gain a preponderant position in the world economy in less than a century.

The first pillar: renewable energies

The first and the second industrial revolutions saw the participation of a relatively limited number of countries, which owned the quantity of natural resources needed to carry on economic and productive progress. Still, with the third industrial revolution, enabled by globalization of economies, a much greater number of players joined the process. If Great Britain, Germany, and the United States owned a significant part of the required natural resources, Japan, a new major player, was not as lucky. Also, the scientific community started to analyse the effects of the economic development deriving from the two first industrial revolutions. Their findings were concerning: it was very hard to conceive that the same pace of exploitation of natural resources and pollutions of the earth could be kept so to ensure uncontrolled development.

[22] Rifkin, Jeremy, *Leading the Way to the Third Industrial Revolution: A New Energy Agenda for the European Union in the 21st Century - The Next Phase of European Integration*, 2008, available at http://www.mss.gov.si/fileadmin/mss.gov.si/pageuploads/Predsedovanje_EU/Tematska_konferenca/Paper_Industrial_revolution_Rifkin.pdf

Renewable energy consumption[23]



In this perspective, new kinds of sources of energy were strongly needed: on the one hand, they would enable new players to face economic growth; on the other hand, they would solve the problem of over-exploitation of limited natural resources. With the third industrial revolution, indeed, new technological processes allowed the emergence of sources of energy that could re-generate on a human timescale. Renewable energies[24] include a wide variety of sources including solar, wind, hydro, geothermal, and biomass. By slowly replacing the use of traditional sources of energy, these new resources could lower new players' dependence on imported fossil fuels; also, through renewable energy, countries could play an important role in the changing process and turn their energy production into a more sustainable business. Although such renewable energies are still playing a marginal role in the energy industry, they represented a breaking point with respect to traditional fossil fuels. Thus, they strongly characterize the third industrial revolution.

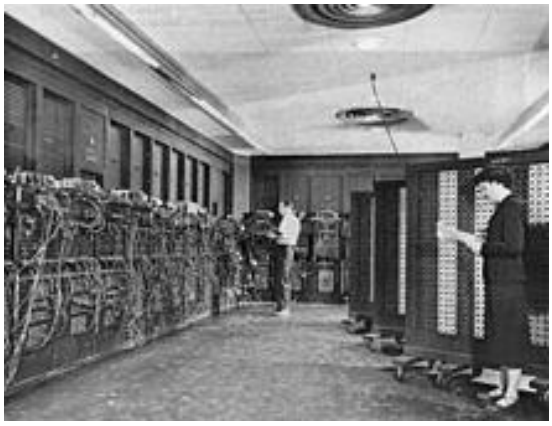
The second pillar: the Information and Communication Technologies

The second strong feature of the third industrial revolution is the ICT. In the second half of the twentieth century, new economic players were rising, and they were making businesses with one another and with the traditional players: in order to ensure the success of this process, distances among them needed to become easier to overcome. Also, market integration determined an unprecedented degree of specialization of markets and economies: the most illustrative example of this process is the emergence of Global Value Chain, which will be discussed in the next

[23] Source: World Bank Data Base
[24] *Cfr* https://ec.europa.eu/energy/en/topics/renewable-energy

paragraphs. In this perspective, the role played by the ICT was to dramatically reduce communication costs and ensure coordination among players.

From a historical perspective, the Second World War strongly influenced the development of the industry: Alan Turing findings, indeed, not only helped the allied forces to win the war, they also strongly affected the development of computational science and artificial intelligence. Moreover, military purposes strongly boosted innovation in the industry: for instance, both the first electronic programmable computer built in the United States, the ENIAC, and first commercial computer, the ERA 1101, were first used by the US military forces.



The ENIAC, first electronic programmable computer built in the US, 1946[25].

Computational science[26] experienced unprecedented progress in the following decades; still, widespread popularity did not occur until the 1970s, decade that saw the foundation of the two major computer companies: Microsoft was founded in 1975 and Apple was born in 1976. Together with the hardware, this period experienced the development of sophisticated software: in 1980, the first hard disk drive was created, while the MS-DOS (Microsoft Disk Operating System) was introduced in 1981. Still, the most significant innovation of the ICT industry was released in 1990: it is the World Wide Internet that truly enabled the dramatic reduction of communication costs. For instance, the ICT strongly supported new business theories. Let us take the example Toyotism: just in time production and lean inventories could not have been developed without sophisticated systems of computer and data management.

[25] Souce: http://ds-wordpress.haverford.edu/bitbybit/bit-by-bit-contents/chapter-four/4-8-project-px-and-the-eniac/
[26] *Cfr* https://www.ictlounge.com/html/timeline_of_ict.htm

To conclude, it is worth noting that the third industrial revolution is also known as the "Information Age"[27]: ever since their invention, computers continued to gain efficiency and they enabled the coordination of markets. Furthermore, they supported the emergence of new industries: the most illustrative example is the service industry, which will be discussed in the next paragraph.

The third pillar: the emergence of the service industry

The tertiary sector, most commonly referred to as the service industry, has experienced great expansion during the third industrial revolution: in fact, thanks to the latter, it gradually became the most significant industry in the world output (58.59% in 1995[28]). This sector includes a wide range of services, from the ICT (which we have discussed in the previous paragraph) to the public administration; still, in the perspective of the third industrial revolution, the most relevant element to consider is the transportation industry. As we will analyse further in this study, globalization was allowed by two major features: the reduction in communication costs (covered by the ICT), and the reduction in transportation costs. Indeed, during the third industrial revolution, all sorts of transportation means and routes expanded: the networks of infrastructures improved, the airplane transport was developed, and the naval transportation was rendered more efficient. All these improvements strongly affected international trade.

Singapore harbour evolution: 1953[29] versus 2017[30]

The third industrial revolution enabled the emergence of new players, which strongly rely on the tertiary sector. Let us take the example of India: this country owns a significant English-speaking labour force but, before technological advances could benefit the country, it had always

[27] Russell, Andrew L, Telecommunications Standards in the Second and Third Industrial Revolutions, 2006, available at http://arussell.org/papers/2006Vol5Prt1_13.pdf
[28] Source: World Bank
[29] Source: https://www.flickr.com/photos/mghan/galleries/72157624496977696/
[30] Source: http://www.mpa.gov.sg/web/portal/home/port-of-singapore

been excluded by the processes of market integration. Nonetheless, thanks to the third industrial revolution, the country could exploit its competitive advantage by becoming integrated with the rest of the world. India is today one of the leading economies in the service sector.

Conclusive remarks

In this section we analysed to which extent the third industrial revolution determined the actual degree of market integration which has been enabling globalization. After two revolutions whose aims were to come up with radical innovations, astonishing discoveries, and amazing inventions, the third industrial revolution strongly focused on process innovation. What could only be considered small advances contributed to the creation of a new world order and had direct implications in the traditional sectors of the economy. Today, it would be impossible to conceive a world without the totality of technological advances that took place in the last decades: in fact, these technological changes have determined a new industrial revolution, the fourth industrial revolution, also called the Industry 4.0.

Conclusion

In this first section, we have analysed the major features and implications of the three industrial revolutions that characterized the past three centuries. In the first industrial revolution people experienced the introduction of mechanical advances, such as mechanized machines in the textile and manufacturing industries, in a new range of production processes. These new tools were powered by the steam engine, the most significant innovation of the times, which allowed the replacement of traditional sources of energy with one of low cost and abundantly available. Also, the first industrial revolution was strongly influenced by the success of a new organization of inputs to support production: the concept of the organization of production was another relevant finding of the time.

The second industrial revolution started the process of integration of markets which determined globalization: indeed, new players started to earn preponderant positions in the creation of a new economic order. In particular, during the second industrial revolution, the United States of America and Germany climbed the hierarchy to become the world's economic leaders. This could happen because they owned a relevant share of natural resources and the patents of the new

inventions; also, policy decisions (i.e. *laissez-faire*) strongly favoured the affirmation of these new players.

The third industrial revolution further fostered the actual degree of market integration. By focusing on process innovation, this revolution enabled small advances to contribute to the creation of a new world order and had direct implications in the traditional sectors of the economy. Furthermore, these technological advances are opening new unprecedented scenarios. What was considered as pure science-fiction is indeed becoming possible and affordable to achieve. Indeed, the third industrial revolution has generated the fourth industrial revolution, also called the Industry 4.0.

1.2. Industry 4.0

Introduction

In the first section of the chapter, we have tried to understand the importance of the past three industrial revolutions through their main features and the most significant implications in the process of integration of markets. We have analysed how the three past industrial revolutions increasingly determined different world orders, with different players and new leaders; the latter could only be achieved with radical inventions or process innovations. Finally, we determined that the steam engine, the use of natural resources in the production processes, the railway and the telegraph lines, as well as the ICT and the emergence of the tertiary sector enabled the rise of globalization.

Where are we today with industrial revolutions? Which technologies are indeed responsible for changing the current degree of integrations of markets? In the most recent years, new technologies are re-shaping industries, markets and economies as a whole in such a way that experts in the industrial environment have started to talk about a fourth industrial revolution, or, as it is called, Industry 4.0. Industry 4.0. consists of the overall technological developments which derive from the digitalization of production processes as well as from the wide-spread diffusion of the Internet[31]. The technologies which relate to this new industrial revolution allow objects to be connected among them and with people; they generate "smart" products which can gather and

[31] Paolazzi, Luca, and Traù, Fabrizio, *Scenari industriali n. 6. Novembre 2015: Produzione e commercio: come cambia la globalizzazione. La manifattura italiana riparte da buone basi,* 2015, Confindustria.

transfer data and knowledge. The consequences of this new industrial revolution are somehow different than the ones deriving from the past revolutions: the manufacturing industry is becoming progressively integrated in the digital industry; consequently, firms can start to manage unprecedented margins and strongly increase the efficiency of their productive processes. In this way, entrepreneurs and managers are able to make better decisions based on a greater stock of information. Thanks to these new technologies, new business models, companies, products and goods are being developed: hence, our purpose in this section is to understand to which extent digitalization of the economy and new technologies are defining the features that have just been mentioned; also, it is necessary to understand the range of opportunities and risks that arise from this fourth industrial revolution.

1.2.a. Definition

The term "Industry 4.0" illustrates the sum of new technologies, productive factors and systems of organization of labour that are deeply re-shaping the way goods are produced and services are delivered, as well as organizations and consumers relate among and across them[32]. Such changes affect both directly and indirectly the way markets, industries and economies are organised. Industry 4.0 is expected to bring forward digitalization of production processes in all industries, especially in the manufacturing sector[33]. The radical innovations that determined this new industrial revolution are strongly related to technological progress and easier access to new technologies.

The first feature of Industry 4.0 is the increasing amount of data gathering and availability, together with stronger computational capability and greater connectivity. The applications of such innovations can be found not only in the ITC industry: indeed, they can have great incidence in many different industries, from manufacturing (i.e. better-organized lean management) to the most traditional economic activities (i.e. mineral extraction). In both cases, greater analytical capacity can strongly enhance the way products are made and services are delivered. Consequently, advanced analytical capacity can generate increasing margins or it can allow producers of goods

[32] Magone, Annalisa, Mazali, Tiziana, 2016, *Industria 4.0: Uomini e machine nella fabbrica digitale*, Guerini e associati.
[33] Baur, Cornelius, Wee, Dominik, *Manufacturing's next act*, 2015, McKinsey&Company.

or deliverers of services to ask for a price premium: in both scenarios, profits strongly increase for companies adopting new technologies that define this new industrial revolution.

The second feature is defined by the development of new tools for data analytics: in this perspective, tools such as big data are key developments for the implementation of digitalization of companies and industries. One major tangible application of this new business development is to be found in the emergence of the *Customer Relationship Management* (CRM). CRM can be defines as the general processes that companies develop to manage their interactions with customers. Today, such processes have gained substantial weight and they are still getting increasing relevance within companies' dynamics: what a couple of decades ago could only be described as *post-sale assistance* has become today the sum of elaborated processes which includes the analysis of sales, the forecast of trends and the study of customers' behaviour. The general aim of this process being to enhance the overall customers' experience, it would not be possible to accomplish such levels of interactions and synergies without the current degree of technological process that today's industries are experiencing.

The third component that ensured Industry 4.0 is the development of interaction between people and machines: more powerful connectivity, the creation of technological hubs and the integration of markets are allowing greater synergy between labour and capital. This feature can have strong implications within companies for internal division of labour: new technologies can indeed re-distribute the allocation of tasks that could once only be performed by physical individuals and which can today be delivered by automated machines. For example, storage in warehouses, particularly demanding work, was once managed by teams of logistical employees; today, new machines are set up to deliver the exact same task. In this perspective, in order to avoid duplication of tasks, employees are meant to re-build their tasks to be able to control and manage the machines. Furthermore, labour-machine interaction can also strongly reduce coordination times: indeed, thanks to technological change, people and machines can communicate remotely and information can circulate freely at an unprecedented pace.

Lastly, Industry 4.0 is strongly characterized by the development of "physical" advances deriving from the digital world: in this perspective, the most relevant innovations are 3-D printing, whose implications are still to be entirely considered, and robotics, which is indeed strongly re-defining today's industry. On one side, 3-D printing is already generating important shifts because of its numerous applications in many industries (from manufacturing to biomedicine) and it is showing signs of great potential for future developments. On the other side, machines are

constantly improving with respect to robotics to the point that they are indeed becoming *smart machines*. In the long run, robotics is expected to re-think the way products are made.

To become part of this new wave of industrial and technological progress is not to be taken for granted: indeed, there are some components that companies and production procedures should follow to be fully integrated in the process of technological change[34]. In particular, beside having developed the capability for machines and objects to be fully integrated and connected with people, thus being able to transfer pieces of information, and beside giving production processes means to store, analyse and contextualise these pieces of information, firms must follow specific paths. Indeed, to be considered part of the fourth industrial revolution firms and production systems should enable employees to have the support of smart technologies, which can back them up throughout the entire decision-making process, help deliver the best output, and provide them with help with specific tasks. Considering decision-making, moreover, new technologies developing in the framework of this new industrial revolution very often determine the independence of machines with respect to those who command them: in this perspective, they can generate autonomous solutions to production-related issues which are more or less complex and more or less determinant for the company's results.

All the features that we have just described have contributed to technological change and are still developing the implications of the industrial revolution that we are currently living. In order to seize the full picture, it is necessary to understand to which extent such tools and technologies are influencing the current state of art.

1.2.b. Industry 4.0's state of art

In the previous section, we have tried to outline the main and most relevant features through which new technologies are generating a new industrial revolution. In particular, we have established that new tools and inventions should ensure firms with increasing amount of data gathering and availability, stronger computational capability and greater connectivity. Then, we determined that new tools for data analytics (i.e. big data) are fundamental in the revolutionary process and that without increased interaction between people and machines no technological change would be possible. Last, we tried to understand the importance of developments in the field

[34] Marr, Bernard, *What Everyone Must Know About Industry 4.0*, 2016, Forbes.

of physical advances deriving from the digital environment. It is indeed time to in which way all these technological advances are influencing and shaping today's economies and industries[35].

In this section, we analyse to which extent greater flows of information, available at all times increase productivity of firms and production processes; related to this issue, it is also very important to understand the wide categories of risks related to such increases in productivity. Second, we try to figure out whether new technologies and technological change are generating less asymmetrical information; in this perspective, it is also crucial to analyse new business models deriving from such changes. Third, our aim is to come up with new clusters of goods which result from the changing process: in particular, we will see to which extent new products differ from the old ones in conception and for their usages. Lastly, it is crucial to evaluate both opportunities and risks coming from this wave of disruptiveness.

New opportunities

In recent years, the idea of a new industrial revolution is the result of the sum of technological advances that have characterized the first years of the new millennium: in particular, firms and people have experienced the development of the usage of the Internet and the emergence of digitalization throughout the entire production process. The third industrial revolution, which enabled the beginning of the digital era, saw computers as new fundamental tool to exploit in firms for productive matters: in this way, costs for data analytics, gathering and storage were dramatically reduced. In these times, though, computers were usually managed by humans: indeed, they are the ones who transmit orders and commands to machines for them to execute. Consequently, the main feature of this historical phase is the presence of some sort of vertical hierarchy, which sees humans at the top and machines at the bottom of the pyramid; also, the separations between physical and virtual world, and between manufacturing and the service industry were clearly defined.

Today, indeed, we are living an era where the connection among all the objects and humans is possible. The reasons of this new disruptive wave are to be found in the greater availability of technological factors and in the consequential cost reduction of the usage of such factors. In particular, technological sensors and smart actuators are becoming smaller and less costly for firms to afford, not only because they are less expensive, but also because they consume less energy

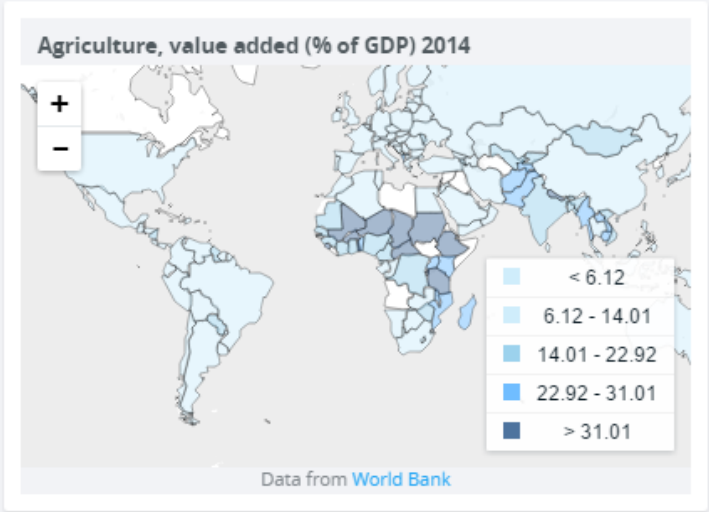
[35] Paolazzi, Luca, and Traù, Fabrizio, *Scenari industriali n. 6. Novembre 2015: Produzione e commercio: come cambia la globalizzazione. La manifattura italiana riparte da buone basi*, 2015, Confindustria.

power. Second, internet connections are also relatively cheap and ubiquitous: thanks to them, new forms of organization of labour (i.e. smart working, telework,…) are enabled and they shape the organizational structure of firms. Last, the Internet is gaining great relevance for its availability of a potentially unlimited number of addresses where people and firms can thus gain relevance.

Technological advances that determine this new innovative wave are enabling tools and objects to generate information; all these flows of information can be found in great quantities and they are always available. In this way, indeed, both the speed at which decisions are taken within the production process and the quality of the results of such decisions increase dramatically: firms can strongly benefit from the outcomes of information changes deriving from the fourth industrial revolution. As a matter of fact, the development of these new capabilities ought not to be seen as a mere consequence of modern times: new tools such as big data and data analytics – which are able to attribute meaningful features to the huge information flows we have just described – enable the artificial intelligence to really support specific decisions.

Technological advances deriving from the Industry 4.0 allow firms to better manage scarce resources: indeed, this is possible thanks to the great information flows, which support the way decisions are made. As a result, decisions are taken with a stronger knowledge-base and are thus much more accurate than they used to be. Let us take an example: throughout economic history, we have experienced the shift from the agriculture-based to the industry-based economy. Since returns and profits were much lower in the first scenario, labour and capital slowly but inexorably made their way in the world of technical changes and advances. As a result, starting from the eighteenth century, the share of agriculture in the economy dramatically fell until it became almost negligible in the most advanced and industrialized economies.

Agriculture, value added (% of GDP), 2014[36]



Nevertheless, today, we are experiencing an inverting trend: more than ever, new technologies are affecting the agricultural industry in ways that were unconceivable until a few decades ago. New technologies are becoming the tool through which the agricultural industry is able to feed the increasing population: in fact, new tools such as sensors can easily monitor the performance of fields (e.g., the humidity of land, the weather conditions, the risk of possible intrusions,…) and transmit data to remotely-located control centres. Also, they enable farmers to analyse the condition of lands and understand where to use fertilizers and pesticides: in this way, producers are able to make the best decision and efficiently use (dangerous) resources at the same time. In this way, new technologies can increasingly help to limit the negative spill-overs deriving from the industrialization of the agricultural processes.

A relevant number of firms have been living a period of popularity thanks to the application of new technologies to create new products or to deliver new categories of services. Among the many, BTicino[37] is developing strong relevance in the Italian market with respect to the industry of the Internet of Things (IoT). In particular, thanks to its great knowledge regarding home equipment, the company was able to shift the offer range to align it with the changing needs of its Italian customer base: in this perspective, it is developing products in the direction of both "building automation" and "home automation". Consequently, consumers can manage remotely the features of a very wide variety of objects that are related to their homes: examples of such objects are lights, domestic appliances, windows, and thermoregulation. In this way, objects that once had very little or no value become today strongly relevant within this connected framework.

[36] Source: World Bank Data Base
[37] *Cfr* http://www.domotica.it/bticino/

Indeed, the IoT is not only a matter of consumption of households, it is believed to have great implications in production processes. Firms' outcome is determined by the way raw materials are transformed throughout the production cycle: in order to ensure the success of this process, machines ought to be perfectly harmonized with one another and with the workers that control and monitor them. Indeed, today *ex-post* interventions on machines' malfunctions or breakdowns, which risk to jeopardize the entire production process, can be easily avoided thanks to the introduction of sensors which are able to constantly check on the good functioning of tools and machines within the production process. Furthermore, these sensors enable firms to fix broken inputs remotely: in this perspective, as these new procedures develop, it might actually become unnecessary for workers to physically go and take concrete measures to ensure efficient maintenance. The ability for companies to gather data on the functioning of machines and to have live conversations with machine operators can allow them to establish what is called "just in time training", namely enabling technicians to successfully fix broken or malfunctioning items thanks to procedures they had no or very little skills for. If the company is unable to establish this new procedure, specialized technicians will be sent to the production facility with full comprehension of the issue and with the repairing procedure; also, they might be able to immediately substitute the missing or broken item, thus enabling the company to recover production in little time. All in all, this ongoing dialogue between machines and people allows the digitalization of processes to fulfil the requirements of skilled technicians; in this way, the skills of specialized technicians are optimally allocated throughout the production process since machines can easily and efficiently take care of the bureaucratic procedures.

The most influential implication of the IoT on production processes represents the fact that it enables machines to both communicate with the product that they are producing and with the environment surrounding them. Indeed, companies produce goods that gather information and data about themselves, and such goods are able to efficiently communicate with the machines producing and manufacturing them: in this perspective, new business possibilities arise for companies, including customization of goods, post-sale assistance, and customer relationship management.

Industry 4.0 put into practice: the phenomenon of Fast Fashion

Let us take the example of an industry whose features have been steady for decades but whose principles are being shaken but technological change. Today, fashion is living one of the greatest transformation of all times: such changes are due to the emergence of new players, that

are re-defining the industry thanks to their new vision and the support of technology throughout the entire value chain. In particular, these new players made the fashion industry revolve around speed: they have invented "fast fashion". Fast fashion is a relatively new trend in the fashion industry that, in a fairly short amount of time, has disrupted and revolutionized the overall industry. In fact, fast fashion represents the answer to a constantly growing demand-driven market structure. By constantly renewing product offering in the stores, fast fashion represents one of the main ways of surviving and growing in a particularly mature industry. This is thus only possible if both the entire supply chain and value proposition are reviewed and shaped according to some very innovative features: fast fashion companies offer a product that is relatively little expensive and thus is accessible to the masses. What companies mainly focus on is bringing to the market products that are trendy at that precise moment. As a result, fast fashion can be considered as the practical application of the concept of "see now, buy now".

Fast fashion has brought disruptive changes to the traditional fashion industry. It has in fact shaped a new way of thinking the conception and motion of fashion items. It has brought strategic production close to markets; it has promoted coordination and efficiency not only of resources but also of the ties and connections among the steps of the supply chain. These innovations are only possible thanks to the use of specific technology. This has given an important boost to constant innovation in an industry with fairly steady features. All this to the benefits of consumers who in fact were used to seeing new collection and fashion items imposed to them by fashion companies. These companies had months earlier invested huge amounts of capital in conception, design, production and promotion of new items, and such items had to be sold in one way or another (meaning either at full price or discounted at a certain moment). This, plus very strong advertising campaigns had the result on customers' perception of goods being 'pushed' at them rather than feeling as part of the process. Today, the production is demand-driven, with companies such as Inditex having only 15% of pre-commissions of items, whereas the same proportion is equal to 60% in the traditional fashion industry. Operating in a very globalized environment, the old concept of seasonal collection is also disappearing: companies which are willing to stand out in this industry must be very reactive to globalized needs with remaining regional differences. This is where fast fashion companies with lean and agile structures are able to overtake traditional companies.

The fast fashion industry is strongly characterized by those European firms that have forged the industry and are thus first comers, and non-European firms, which are struggling to keep the

pace of growth of their rivals. The largest fast fashion retailer is Spain-based company Inditex. Its portfolio of corporations include companies such as Pull & Bear and Bershka, but its shining star is without any doubt Zara.

Zara represents the first example of fast fashion: thanks to the innovative vision of the industry by its founder, it was able not only to shape but also to refine this new industry. It was indeed the first company to offer affordable prices for goods that had a very important component of attention towards consumers' needs. In fact, the founder's mantra was to offer goods that would immediately and constantly respond to the latest feedbacks of the market: this was defined as a 'user-generated approach' to fast fashion. The strategy that has been used since the early days was not to come out with some new radical innovations, but to rather carefully look at the trends during fashion shows and from there build the general trend of the brand. What the brand has also always been keen on is coming up with process innovation, with the support of new technologies. The company was able to define a new use of inventory, much leaner and thus much more economically viable; it was also able to organize its suppliers in order to being close to key markets for those fastness-related products (regardless of cost savings) and to lever on cost control by using suppliers from the far East for less trendy items. This is accompanied by a great effort in reducing the time necessary to come up with new goods: it takes Zara only four weeks to go from the moment when a need is identified to the moment it is satisfied; this is why the brands is able to produce almost one thousand different products every year. This would not be possible if the company did not master the links that connect production to distribution: Zara has the whole production collected in the headquarters and then has it shipped to the different stores through two deliveries per week. This model allows the company to have much less uncertainty when it comes to forecasting consumers' needs in the long run (though the company still works on designing a new look for the brand every 18 months) and is implemented by a very well-developed system of data collection. In addition to widespread processes of data analytics, Zara is also very keen on the development of smart machines: in fact, the company has developed fully automated factories in Spain where automatons work non-stop with raw materials to deliver semi-finished pieces of clothes.

Fast fashion deeply relies on a newly-conceived supply chain which strongly relies on new technologies: there are new features in all kinds of operations, from a new use of technology to an innovative management of marketing. So far, we have seen that what is crucial to fast fashion is the fastness necessary to respond to constantly changing tastes and needs. To be able to do so, they must conceive reactive and dynamic supply chains: the logistics part is in fact one of the main keys

to ensure the speed at which the numerous players operate. In addition to fastness, these supply chains must constantly keep an eye on the demand: they must be reactive to any sudden change in consumers' needs. For instance, Zara's lean supply chain ensures the brand to be responsive to small changes in the weather: when the fall is warm, coats and jackets will not sell well; on the opposite, there will still be the need for light clothes and dresses. Thanks to the use of peculiar technologies enabled by the fourth industrial revolution (such as complex and elaborate algorithms, big data and data analytics), the entire supply chain is coordinated to quickly adapt to such changes.

Increasing risks

So far, we have analysed to which extent greater flows of information, available at all times increase productivity of firms and production processes. Once the wide range of a new generation of opportunities are established, it is also very important to understand the overall categories of risks associated to relevant increases in productivity.

New technologies determine important changes in protection issues and in the privacy framework. Regarding the consumption side of business changes, with privacy issues deriving from the Industry 4.0, we usually refer to the set of new features that new goods have and that allow companies producing them to monitor at all time customers' consumption behaviour and geographical location. In this perspective, a new trade-off arises for consumers: whether they can access customized and advances tools will depend on their willingness to give up some of their privacy.

On the other side, namely on internal organizational structure, increasing risks regard industrial relations among workers and machines: in fact, machines are indeed able to identify the worker it is dealing with. In this way, machines can easily adapt to different needs, qualifications, timings, speeds, and productivity levels, thus reducing adjustment times and thus increasing productivity for the company and safety for workers. Still, this process has relevant consequences on workers' privacy: for instance, it might increase the degree of organizational control over workers coming from the management, thus stimulating discontent of workers' trade unions.

A relevant share of features related to the Industry 4.0 reflect that the borderline that divides manufacturing from services is becoming increasingly blurred: in fact, in "cyber-physical" systems it is very harsh to separate the virtual part from the actual physical one within all production processes. This represents indeed the main change if we compare the Industry 4.0 with the previous

industrial revolutions, and in particular with the third, in which digitalization started to play an important role but in which the separation line was very clear. This blurred line implies increasing risks related to cyber-security, since possible attacks might jeopardize the overall functioning of goods but most importantly the benefits of technological features consumers benefit from. Also, manufacturers and firms might benefit from the increasing lack of separation between the physical and the virtual worlds: this is the case for the latest scandal coming from Volkswagen, which used technologies deriving from the Industry 4.0 to manipulate emission spill-overs of their products.

New business models and new products

In the last paragraphs, we saw that the current flows of information, available live and at all time, enable firms and companies to reach greater levels of efficiency. Aside from this relevant benefit, new technologies enable the development of new business models, since new available flows of information dramatically reduce or even eliminate asymmetries in the distribution of information. This new process is ensured by the possibility of both producer and user to acquire information about their counterpart in the goods they have produced or purchased. This allows the greatest possible degree of cooperation between the producer and the user. Let us take the example of Xerox's business model: the company, leader in the copying and printing industry, developed a model based on the elimination of information asymmetry which focuses on user-experience rather than on the transfer of property. In fact, the company remains the owner of the machines, which are given to users in exchange of a fixed lease price, and a variable price based on the number of copies the user makes. In this perspective, the company, which remains the owner of the good, is in charge of all repairing and substitution activities and receives information flows directly from the machine, while the end user can benefit from a greater consumer experience.

Other examples can be found in many different industries: for instance, the absence of information asymmetry can help implement new business models which relate to supply contracts. Let us take the example of beer producers: the contract they stipulate with their clients usually includes beer dispensing machines and beer kegs. Restaurants, bars, and pubs, by contract, are able to provide their customers with beer by using the supplier's dispensing machine. Still, the supplier cannot be certain that their contractors will only use the beer they supply them; if this were not the case, the contractor would not respect the supply contract. New technologies can help solve this uncertainty by reducing information asymmetry: today, the producer is able indeed to connect to the Internet the dispensing machines he provided his clients. In this way, they can easily monitor the consumption of beer at their contractor's activities and check whether real consumption

actually matches the purchase of beer by their clients. Today, such a business model does not necessarily seem profitable and efficient; still, these new technologies might become key assets for future developments.

New business models, enabled by new technologies, are changing the way individuals and businesspeople perceive the allocation of property of goods and the way the relationships between supplier and user of goods and services are established. From a merely business administration point of view, these new business models can have strong implications over companies capitalizations and over the natures of value and supply chains. With respect to business models, market capitalization and supply chains, new technologies and the Industry 4.0 are playing a crucial role in this wave of change. Let us take a few examples of today's most popular, successful and profitable firms and let us see to which extent new technologies helped support their business model and how they might eventually reshape the entire industry these companies refer to.

Uber, US-based company, is living today an unprecedented degree of popularity (as news report, both in a positive and in a negative way). The company's business model is entirely internet-based, although the service they provide is totally physical (Uber drivers, indeed, physically transport individuals from one spot to another); the company is valued around 68 billion dollars[38] and what is most surprising is that Uber supplies transportation but owns zero vehicles. On a similar path, Facebook, US-based company, has a market capitalization of 416.64 billion dollars[39]; its core activity is to allow people who have access to an internet connection to create a profile on the platform so to keep in touch with their friends and share with them flows of information. It is today's world's most popular social media but it does not create any information content. US-based platform for short-term rents Airbnb could be 2017's most valuable IPO: it is currently valued at 30 billion dollars[40] and might soon be listed on the stock market. Its business model enables landlords to upload their apartments and houses on the platforms in order to allow travellers to find affordable accommodations all over the world; still, the company is not a real estate firm and does not own any of the accommodations it provides. Lastly, China-based company Alibaba, one of today's most valuable retailer, focuses on e-commerce, connecting merchants and

[38] Chen, Liyan, *At $68 Billion Valuation, Uber Will Be Bigger Than GM, Ford, And Honda*, 2015, Forbes Magazine.
[39] Data of April 20 2017, Source: Yahoo! Finance.
[40] Morris, David Z, *Airbnb Valued at $30 Billion in $850 Million Capital Raise*, 2016, Fortune Magazine.

retailers to their customers and end-users. Its current market capitalization is 282.40 billion dollar[41], but the company does not own or manage any inventory.

Lastly, it is interesting to understand whether these new technologies can effectively change and re-shape the ability of companies to properly manage and monitor their competitive advantage. In this environment characterized by strong horizontal connections, it is very likely that, eventually, firms will have expose themselves is a more preponderant way, and that they will have to share a greater portion of their knowledge. Both these activities might erode the company's competitive advantage and undermine the company's market share. Still, we also saw that, thanks to constantly diminishing information asymmetry, companies are able to have greater control over their supply chain and thus earn greater vertical control.

Conclusive remarks

In the last paragraphs, we have analysed how technological change is affecting production processes, which new kinds of business models it is creating and how the separation line between products and services is getting increasingly blurred. With respect to this last aspect, it is now important to understand the nature of new goods and services that arise from technological change.

The most relevant feature of this new range of goods lies in their ability to perform new sets of activities which were thought impossible to be in the recent past. Let us think for example about self-driving cars: although there are many social issues that still need to be considered, it is very likely and the remaining technological barriers will be overcome and this new product will eventually re-shape the automotive industry. In this perspective, institutional bodies are showing some signs of comprehension and acknowledgement of this changing movement: in the framework of celebrations for 60th anniversary of the Treaty of Rome, the European Commission[42] launched an initiative to promote the digitalization of all Member States of the European Union. Among the various propositions, the European Commission is strongly betting on connected and automated mobility.

[41] Data of April 20 2017, Source: Yahoo! Finance.
[42] *Cfr* https://ec.europa.eu/digital-single-market/en/digital-day

Conclusion

The fourth industrial revolution is aiming at redefining the economy and its industries: indeed, it is bringing forward new perspective of productivity increases, while implementing new business models that are currently generating either brand new products or products with relevant process innovations. The macroeconomic implications of these changes ought to have important consequences that have not entirely been entirely covered yet. Production processes that are increasingly efficient could generate positive variations in the productivity of labour, could reduce prices and might eventually determine a negative impact on employment. Furthermore, the emergence of new business models might boost companies' internationalization strategies, supported by those technologies which can easily help them monitor and manage all the steps of the value and supply chains: this possibility, on the other hand, might generate a positive impact on occupation and further boost aggregate demand. Thus, the most controversial issues are related to the direction that employment will take in this wave of change: it is quite assorted that, in the short future, there will be increasing need for skilled workers; still, it is uncertain whether this positive effect will be able to balance the negative implications that workers will have to deal with in the future. It is also likely that repetitive activities will be managed by machines, and that there will be greater safety on the workplace; nonetheless, this wave of social change led technological transformation is determined to have relevant consequences.

Other challenges need to be tackled: the most relevant, because of its significant risks, is the security of all digitalized items: starting from the simple Internet connection to the most sophisticated processes related to the IoT, all these technologies are significantly and increasingly sensible to external attacks. Furthermore, Government, international and supranational organizations, as well as local authorities are strongly responsible for the choices they make with respect to economic policies: indeed, in order for the technological changes of the Industry 4.0 to successfully work, infrastructures, technological hubs, training systems need to be implemented. All in all, the debate revolving around technological change and new models of industry is determined to be inflamed in the short future, since this new industrial revolution is strongly believed to inexorably change and re-shape the components of the economy, as well as societies' demand, income, development and well-being. Is the Industry 4.0 determined to become a radical revolution? Besides this crucial aspect, in the near future it will be fundamental to understand whether real opportunities are meant to be greater than the deriving risks, and to which extent the Industry 4.0 is going to influence the actual degree of market integration.

2. Trends in globalization

2.1. Recent trends in trade integration and world output development

Introduction

Globalization of markets was enabled by the transformation processes that derived from the three industrial revolutions; also, it is receiving further impulse by the new wave of technological progress determined by the Industry 4.0. With globalization, we usually refer to the process of integration of markets a very wide variety of fields: indeed, today finance is globalized, the capital market is globalized, as well as the service industry, just to cite some major illustrative examples.

Globalization was enabled by three major changes: the reduction in transportation and communication costs, and the emergence of economies of scale, scope and specialization. While the emergence of economies of scale, scope and specialization allowed a first wage of market integration, namely in the most developed economies, with the dramatic reduction of both transportation and communication costs a greater number of countries could experience economic progress and integration. In this perspective, in the last decades, the trade of goods and services strongly increased, in particular with respect to parts and components, which are produced in different regions of the world and then assembled in one place before being sent to key markets. Furthermore, with the emergence of globalization, both developed and developing countries strongly started to benefit from flows of investments coming from foreign countries: Foreign Direct Investments (FDIs) represent today one of the major tools for international expansion. Moreover, international integration of markets enabled a greater development of international flows of both technological and managerial know-how: for instance, companies can licence their patents, intellectual property rights, brands, and more generally intangible assets. Lastly, improvements in the degree of market integration further boosted investments in strategic industries such as infrastructures: indeed, the latter significantly support transportation and the ICT technologies, which are the economic sectors at the heart of the globalization process.

What are the current trends for globalization? This section[43] is aiming at understanding the current degree of transformation of development enabled by globalization. Indeed, in a period of great advances for the emerging countries, it is important to understand the drivers of this new

[43] World Trade Organization, *World Trade Report 2014 Trade and development: recent trends and the role of the WTO*, 2014, WTO.

wave of market integration. In the first part of this section, we will briefly analyse the main recent trends in development and trade. Secondly, we will focus on the increasing relevance, in the international framework of the economy, of developing countries. Lastly, we will raise the attention of the phenomenon of Global Value Chains: with their unprecedented degree of coordination and specialization of countries, it is believed to be one of the major results of the globalization process.

2.1.a. Recent trends in global development of world output

The feature that mostly changed the economic world order is the emergence of new economic players. The rise of the developing countries in the global dynamics finds its foundation in different changes that occurred in the last decades. Indeed, throughout the twentieth century, many countries experienced an unprecedented degree of openness with respect to their economic and commercial policies: this new perspective generated the variety of international and supranational agreements we know today (let us think for example about the European Union, the North American Free Trade Agreement, and the Mercosur). This fertile ground gave great impulse to emerging economies to find a competitive role within the global system.

Still, the precarious conditions of today's international framework foster new challenges for both developed and developing countries. Further advances in the integration of markets strongly depend on the actual capabilities for countries to maintain the current degree of openness of the economy. Indeed, from a historical viewpoint, developed countries have expanded and they have defined development paths; still, today's developing economies are strongly re-shaping the distribution of world output, as well as trade and development systems.

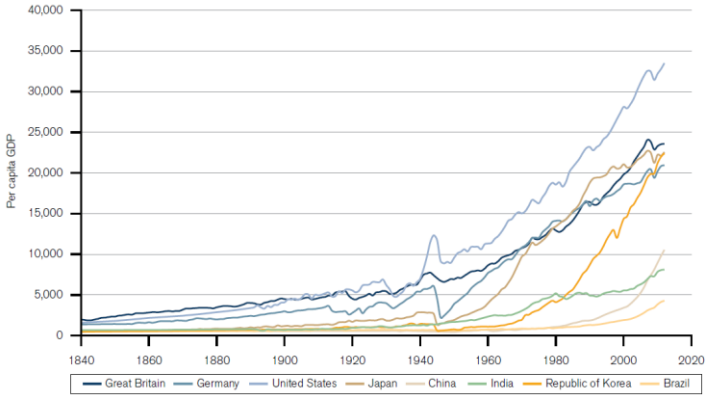
In the previous sections of this study, we examined the wide range of technological changes that generated the three industrial revolutions; furthermore, we determined that these innovative waves were behind the emergence of paths of market integration. To better understand the features of the globalized world framework, it is now time to analyse the most recent trends in trade and development patterns.

World economic development

The industrialization processes that characterized recent history strongly shaped economic development and countries' growth; these processes are still heavily influencing the course of market integration. Indeed, despite the initial geographical restriction and the slowness at which progresses were made, international movements of economic development gradually spread by both geographical expansion and flow intensity.

As we analysed in the previous sections, the first attempts to enable market integration occurred during the second half of the nineteenth century, namely during the first and second industrial revolutions. During this period of significant industrialization, a restricted number of countries started to diverge from the rest of the world, in particular with respect of output and GDP. This process started in the first half of the nineteenth century, it is still continuing today and it is very likely to be maintained in the future.

Per capita GDP for selected economies, 1840-2012[44]



The second great period of market integration happened in the second half of the twentieth century: during this time, as we can see in the figure above, new players (above all, Japan and the Republic of Korea) started to develop at a very intense pace; soon, they became major players in the trade and development processes. Soon, they were able to reach a level of development that was very close to the "early-industrializers" level of output; eventually, they were able to overcome it.

The last decades of the twentieth century enabled a wave of convergence: "late-industrializers" could eventually emerge in the international framework: countries like China and

[44] Source: WTO data estimates based on Maddison Project and IMF.

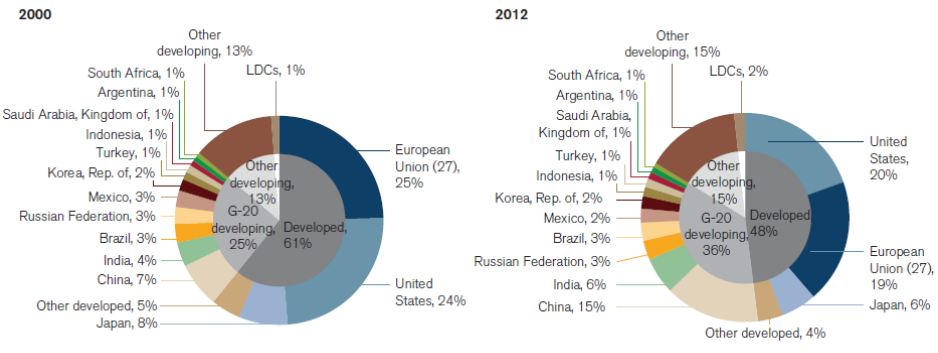
Brazil are slowly catching up to the rest of the industrialized economies. What is mostly worth noting is that, despite early-industrializers, the economic and social development of these countries took place at an unprecedented pace: the concept is clearly asserted by Martin Wolf, who said that "never before have so many people – or so large a portion of the world's people – enjoyed such large rises in their standard of living". Eventually, projections for future years show that it is very likely that such countries might reach a similar level of development as their most significant competitors.

This process has been strongly influenced by economies' desire to grow and develop in a framework of international integration: indeed, many countries found as a key tool for development their ability to position themselves in an efficient way in the process of globalization. As this new global economic order expanded, it became necessary to create a regulatory framework to both contain and support further growth and development: great advances in this sense occurred during the twentieth century.

The current state of globalization

The current state of globalization sees the world output shared among an increasing number of relevant players: beside the traditional industrialized economies, the last decades have enabled the emergence of late industrializers, which have soon become emerging economies. The figure below shows us to which extent developing economies are being able to gain increasing shares of GDP. If we consider the first twelve years of the twenty-first century, we can easily state that these countries experienced an increase in the share of the world's output of 13 percentage points, starting from a share of 39 percent in 2000 to one of 52 percent in 2012[45].

Shares of selected economies in world GDP at purchasing power parity, 2000-2012[46].

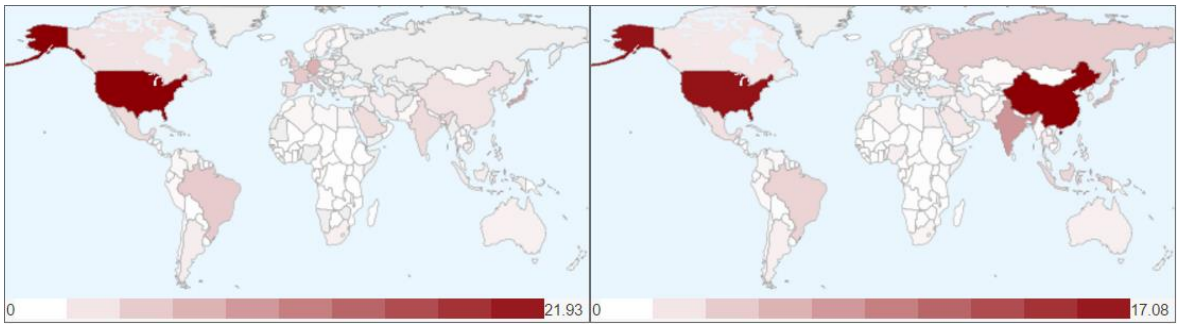


Source: IMF World Economic Outlook database, October 2013.

[45] Data from the World Trade Report, 2014.
[46] Source: IMF World Economic Outlook database, 2013.

The countries that are currently driving this convergence process are typically the G-20 developing countries: this group of countries, established in the framework of the WTO in 2003, includes nations from South and Central America, South-East Asia, Africa, as well as China, India and Turkey. It accounts for 26.3 percent of the living area around the world and for 58 percent of the world population (4.26 billion people)[47]. Their specific increase in the share of world output is strongly connected to their rising relevance in the international trading system. In particular, the G-20 developing countries' share of exports increased by 11 percentage points during the same period, moving to 36 percent in 2012 from 25 percent in 2000. If we look more in depth, the roles played by China and India themselves are sufficient to explain the increasing relevance of this group in the world's economic order. The first was able to double its share in the world GDP, moving from 7 percent to 15 percent, while the latter's share increased by 2 percentage points, rising from 4 percent to 6 percent.

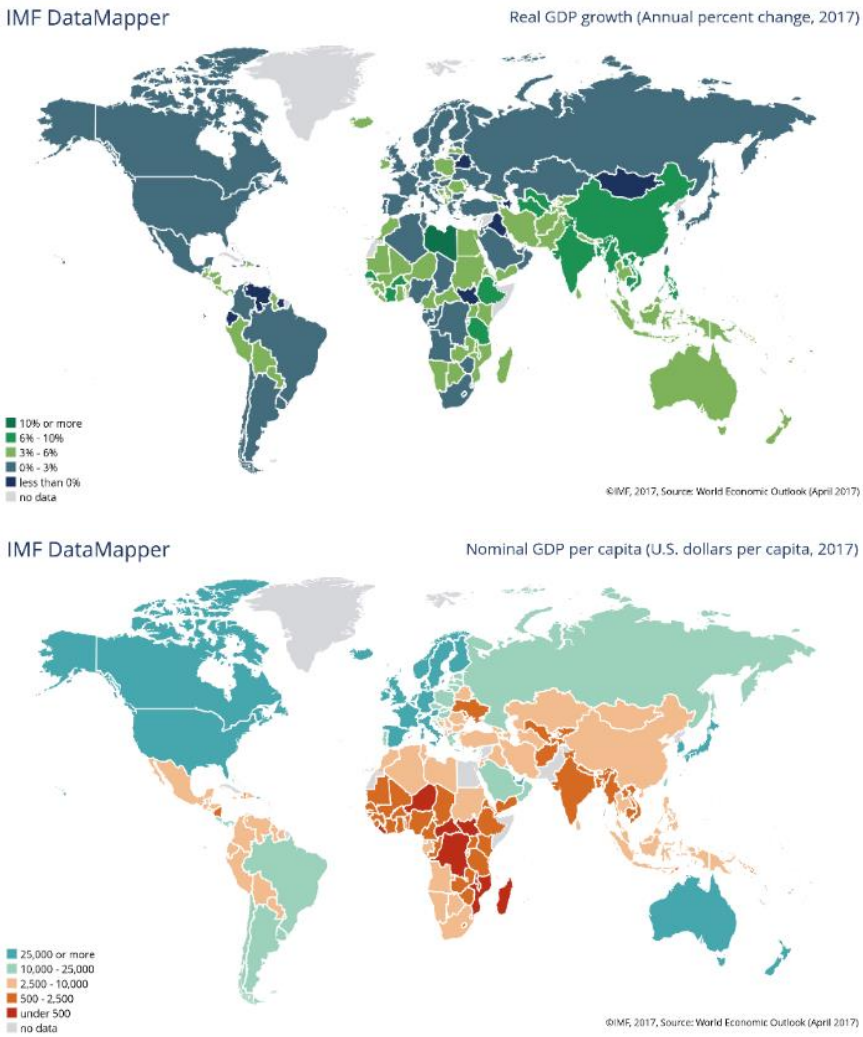
Comparison of GDP shares in the world map, 1980 and 2015[48]



The emergence of a new global economic order has strong implications for the world's equilibrium. Indeed, the increase in GDP of emerging economies is determining significant mechanisms of convergence so to reach developed economies; despite a relevant increase in GDP – as the maps and graphs below show – emerging countries face significant difficulties to increase per capita income. Indeed, because of structural lacks of social policies and infrastructures, it is harsh for developing countries to enhance the living standards and the social conditions of their important and increasing population. Indeed, economic growth is a necessary condition for development but it is not sufficient to enable concrete advancement processes. At the current state of globalization, indeed, the increase in a developing economy's GDP is not in line with the increase of the country's GDP per capita.

[47] Data available at https://www.worlddata.info/alliances/g20-developing-nations.php.
[48] Figures source: http://www.economywatch.com/economic-statistics/economic-indicators/GDP_Share_of_World_Total_PPP/; data source: the IMF

Real GDP growth and nominal GDP per capita, 2017[49]

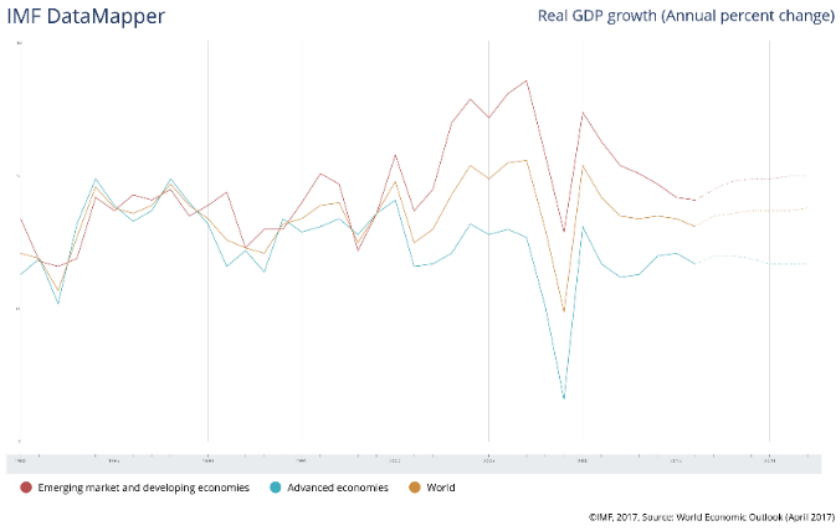


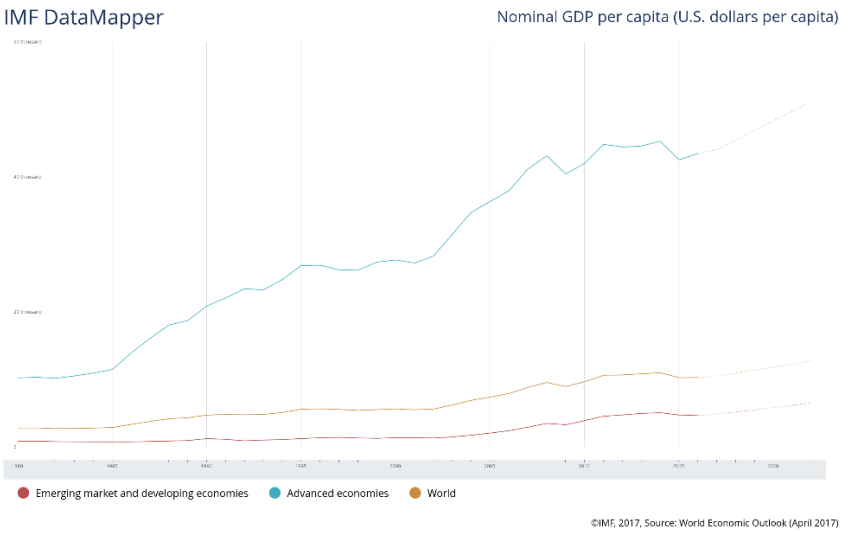
The two maps above show us the heterogeneous paths in economic growth and the social dimension. The first map shows real GDP growth for the year 2017; the countries coloured in green are the ones with the greatest percentage growth. This increase is asymmetrical to what is shown in the second map, that is the nominal GDP per capita, where the pink-to-orange coloured countries are the ones with the lowest level of income per capita. Indeed, the countries with the greatest level of growth are also the ones who are the least able to transfer and distribute economic development on to their population. Overall, gains from globalization of markets are not uniformly distributed throughout the countries' societies. This lack of homogeneity is perfectly transposed in the next two graphs, one showing real GDP growth over the last decades and the other revealing nominal GDP per capita growth. While the first graph suggests homogeneous reactions to cyclical changes of the world's economic dynamics, for both developed and developing economies, the

[49] Source: IMF Data mapper

latter presents diverging patterns for developed and developing countries. Indeed, while the first's nominal GDP per capita has been gradually increasing over the last decades and is expected to continue to grow at the same pace for the future, for the same period the trend has been of very limited and slow growth for emerging economies.

Real GDP growth and nominal GDP per capita[50]





Conclusive remarks

In this section, we tried to understand the current degree of the world's economic development, as well as to pinpoint the actual state of globalization. The main finding of these analyses is that the world economic order that shaped the twentieth century and fostered economic

[50] Source: IMF Data mapper

development at a global scale has been put under a lot of pressure by the emergence of new strong players. Despite strong convergence from a merely economic viewpoint, these new players are still strongly struggling to find the way to transfer such economic gains in the social dimension. Still, their unprecedented degree of openness towards market integration that occurred throughout the late decades of the twentieth century and is continuing in the first years of the twenty-first century were strongly encouraged by the development of an international regulatory framework for international trade.

2.1.b. Development of the regulatory framework for international trade

For a long time, countries have been mainly focusing on their domestic matters for issues concerning the regulatory framework. Indeed, the lack of supranational or international institutions did not support the creation of the setting for a global standard regarding economic development. Still, as economies grew and expanded internationally, it became gradually necessary to intervene at a global level: progressively, indeed, the international framework started to experience numerous attempts to both regulate and support trade and development.

First attempts to create the international regulatory framework

During the nineteenth century, national governments strongly relied on economists and theorists[51]. The most prominent names were Adam Smith and David Ricardo; their views and theories on economic issues were behind a great number of national policies. In this perspective, it is important to remember that the first attempt to regulate free trade occurred in Great Britain in 1846: indeed, with the Corn Laws, the government introduced high tariffs on foreign corn, so protect domestic production and increase the government's revenues. Despite this punctual attempt to protect domestic stakes, for great part of the nineteenth century Great Britain represented the major advocate of free trade: indeed, it was one of the time's most influential economy and trader and this is why it supported, mostly alone, the necessity to act towards trade liberalization. At the time, the country's aspiration represented one single drop in an ocean of countries that were little or no industrialized, and whose economy could not bear the weight of international expansion. Furthermore, as time went by, some countries did become industrial competitors, but exogenous shocks could not help the changing process. In this perspective, the most illustrative restraint to

[51] Hill, Charles W., *International Business: Competing in the Global Marketplace*, 2015, McGraw Hill education.

internationalization of markets was the Great Depression of the 1930s: the first economic and financial crisis of modern times generated a great wave of protectionism, when countries that had started to open their economies to international markets went back to protecting their domestic interests. In this case, it is worth noting the Smoot-Hawley Act, designed by the US Congress, whose aim was to direct domestic demand towards domestic products using significant "beggar-your-neighbour" trade barriers (i.e. tariffs), but whose consequences were disastrous for many economies.

The GATT experience

The times to recover from the Great Depression were long and further depressed by the Second World War. These tremendous experiences, still, had positive effects on the conception of international trade. Indeed, at the end of the war, Great Britain's dominant position as the world's leading economy was outcome by the US, which gradually gained world economic leadership. Through their initiative, indeed, the world development started to be supported and regulated: the General Agreement on Tariffs and Trade (GATT) was established in 1947. The main aim of this agreement was to give great impulse to market liberalization: in order to reach this goal, the main action to undertake was to eliminate all kinds of barriers to free trade (tariffs, subsidies and import quotas). Gradually, both industrialized and developing worlds joined the agreement. The success of the GATT lied in the fact that its process was gradual: indeed, the main initiatives revolved around so-called "Rounds", thanks to which progresses were made time after time.

The initial success of the GATT could only endure for a few decades. Once again, exogenous variables strongly modified the international context the agreement was exposed to: in particular, a new period of crisis during the 1970s and 1980s started to question all the recent advances concerning free trade. Indeed, behind these increasing uncertainties stood the major leading economies: both the US and Great Britain were experiencing conservative governments, for which free trade was not among the main priorities. Furthermore, the world economic equilibrium was put under a lot of pressure because of the emergence of new significant economic powers: this was the case of Japan, whose innovative industries – both from production and organization points of view[52] – were strongly competing with the traditional economies and whose economy had become the second at the global level, after the American one. To give greater

[52] It was the case for just in time production, lean management and organizational theories such as Toyotism.

impulse to integration of markets and to overcome the wave of mistrust towards trade agreements, the GATT had to evolve towards the World Trade Organization (WTO).

The evolution towards the WTO

To fight the climate of protectionism and increasing pressures towards international integration of markets, the eighth Round of the GATT, held in Uruguay in 1986, aimed at further reducing trade barriers and at adapting the negotiation matters to the current state of world trade. Indeed, global exchanges were shifting from manufactured goods and commodities – which had been until then the cornerstone of advances in market integration – towards the tertiary sector. In this perspective, it was important to start to consider the protection of intellectual property rights, whose features could be easily transferred without proper compensation; it was necessary to come up with a proper framework for regulation that could enable these tools to circulate among markets. The negotiations around the Uruguay Round went on for almost a decade: in 1993 an agreement was reached, which was enforced two years later, in 1995.

In the new wave of commercial exchanges that was re-shaping the world's economic order, countries experienced the need for regulatory tools to adapt. In 1995, the WTO, under the Marrakesh Agreement, replaced the GATT: the Agreement was signed in 1994 by 123 countries and it envisaged the creation of two independent bodies. The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) and the General Agreement on Trade in Services (GATS). The first aimed at harmonizing the standards related to the protection of Intellectual Property Rights, as well as trying to establish international guidelines so to obtain a common international regulation; the latter, on the other side, gave greater significance to free trade of services.

Major implications for the emerging world economic order

Let us now understand to which extent the WTO is affecting trade of Intellectual Property Rights (IPRs). The TRIPS regulation, which emerged during the Uruguay Round, required Member States to grant and ensure the implementation of patents for twenty years and of copyrights for fifty years. The most significant aim of such decision was to acknowledge the relevance of IPRs for a fair expansion and development of trade under the international framework. In this perspective, the protection of patents, trademarks, know-how, copyrights was carried forward by regulatory tools whose aim was to enable their trade and exchange. This process allowed IPRs – which were already encouraging economic development – to gradually start gaining relevance as mechanisms to foster innovative processes. The effectiveness and necessity

to adopt new tools in this area were straightforward: on the one hand, developed countries – which usually owned strong innovative capacity – needed protection to maintain their first-mover position and their competitive advantage. On the other side, developing countries could strongly benefit from innovative products and processes, so they could lever on IPRs to develop their position within the global economic order.

Conclusive remarks

The recent evolution of the economic development order sees the emergence of new economies, whose relevance and weight in the international scenario have been strongly evolving, to the extent of becoming significant players. To regulate and support this rising equilibrium –that sees emerging countries putting a lot of pressure on developed economies – recent inter-governmental agreements have been enabling new regulatory tools to thrive innovation. Consequently, the development of tools to protect IPRs at an international level became preponderant in the world trading system; furthermore, they are representing the founding element that enabled the emergence of the knowledge-based economy.

Conclusion

This second section of the study aimed at understanding the most recent trends in trade integration and the recent developments of the world output. First, our intent was to grasp the recent patterns of the world economic development: to do so, we looked at the changing variables that are indeed defining the current degree of market integration; also, we highlighted the most relevant variables of the present state of globalization. In particular, we granted unprecedented relevance to the ongoing process of market integration for emerging countries. Indeed, their increasing weight in the world economic dynamics has been putting under great pressure traditional players such as the early industrialized countries. Still, we saw that these new players have not found yet a proper way to transfer the economic gains deriving from globalization.

Then, we analysed to which extent the development of an international regulatory framework for international trade encouraged the process of market integration. Throughout the last century, indeed, several attempts were made to both regulate and support change in the international framework of globalization. In particular, we explained the reasons of the recent trend to convey increasing attention to international exchanges of services and IPRs.

Indeed, the emergence of inter-governmental bodies created a favourable environment for trade to further develop and for new players to efficiently position themselves in the changing scenario. Such players have been able to bring forward new valuable dynamics and they are expanding them throughout the international framework: they are indeed enabling the emergence of a new organization of production at a world scale. If until a couple a decades ago value chains were managed locally, today they are increasingly developing on an international basis, within which each country plays a well-defined role. Indeed, it is now time to see to which extent the emergence of Global Value Chains is giving greater impulse to the globalization process.

2.2. Global Value Chains

Introduction

The patterns of integration of markets and globalization of the last decades enabled the emergence of global dynamics for the production of goods and the delivery of services. New players have become increasingly relevant in the international scenario and they have brought forward their need to specialize production so to obtain and maintain a competitive advantage in the globalization process. As a result, production has become more and more fragmented and its stages have been gradually broken up and transferred to the country where they could be performed the most efficiently.

This process of fragmentation of production is not new: indeed, the literature envisaged division of labour since the nineteenth century – see Taylorism – and throughout modern time countries, as well as companies, have been strongly levering on this element to become competitive in the international market. As integration of markets and international trade increased, new perspectives rose: indeed, countries and firms gradually started to understand that production could be performed in different countries, spread throughout the globe; such new perspectives brought with them high degrees of innovation regarding organization of labour and of production.

Which direction is production taking with respect to these changing dynamics? These new perspectives gradually led to the rise of Global Value Chains (GVCs), which have been strongly enabled by globalization, and in particular, by the reduction of transportation costs and the elimination of communication costs, respectively facilitated by the first and the second wave of

globalization. Indeed, technological transformation strongly supported this emerging trend, enabling countries to specialize parts of their economy in the production of specific components or in the delivery of specific tasks, rather than to focus on the entire product or service. In this section, our aim is to analyse the features of this new phenomenon, and see how its scale and scope have changed the international scenario of production. Then, we will try to investigate the new perspectives that GVCs offer to developing and emerging countries with respect to trade integration, while taking into consideration the risks that countries and companies could face in the phenomenon of GVCs.

2.2.a. The nature of GVCs

GVCs represent the concrete result of the globalization process: as we saw in the previous sections, historical progress enabled the current degree of market integration and supported production fragmentation. Also, the establishment of an international regulatory framework for trade has strongly supported the growth of GVCs. Still, their emergence is quite a recent phenomenon: indeed, it has become a preponderant issue thanks to the economic development of emerging countries, whose role in the international scenario became relevant starting from the second half of the twentieth century.

The main features of GVCs

In June 2012, G20 leaders highlighted "… the relevance of regional and global value chains to world trade, recognising their role in fostering economic growth, employment and development and emphasizing the need to enhance the participation of developing countries in such value chains." [53] Indeed, this note sums up the economic features of GVCs: in particular, such features can be illustrated by agglomeration and dispersion forces.

Agglomeration forces bring together the economic geography of countries and economies: indeed, they are able to convey a relevant degree spatial concentration in the international framework. The most relevant determinants of agglomerations forces are their significant spill-over effects: the creation of productive or technological hubs can enhance innovation patterns and they can strongly benefit the local communities. Let us think for instance about the fact that

[53] OECD, WTO, UNCTAD, *Implications Of Global Value Chains For Trade, Investment, Development And Jobs*, 2013, available at http://www.oecd.org/trade/G20-Global-Value-Chains-2013.pdf

agglomeration forces can convey fast diffusion of ideas: their spill-over effects can be represented by the easy access for both firms and individuals to these new innovative flows. Furthermore, agglomeration forces reduce the need for coordination: an agglomerated economic geography can indeed enable strong networks and efficient systems of transfer of resources and information. Lastly, agglomeration in the economic geography is enabled by intermediate trade costs: indeed, with high costs, companies will prefer to be close to their key markets, build more production plants and thus disperse production; on the other side, with low trade costs, companies will not have preferences on where to locate production, which will thus be very dispersed.

On the opposite side, the economic geography of trade raises the question of dispersion forces. Such forces are mainly driven by differentials the costs of production: in particular, for many western economies, the most relevant cost in the production process is labour. In this perspective, wage differentials represent the major variable for firms to take into account when they decide to internationalize their value chain. Moreover, with their emergence, developing economies founded their comparative advantage on determined skills and competences; companies can strongly benefit from the use of such capabilities and this might represent a crucial advantage to create GVCs mechanisms. Let us take the example of the Indian competitive advantage in the service sector: this country strongly relies on low-cost labour force (first dispersion force) which is strongly skilled with respect to this specific industry (second dispersion force).

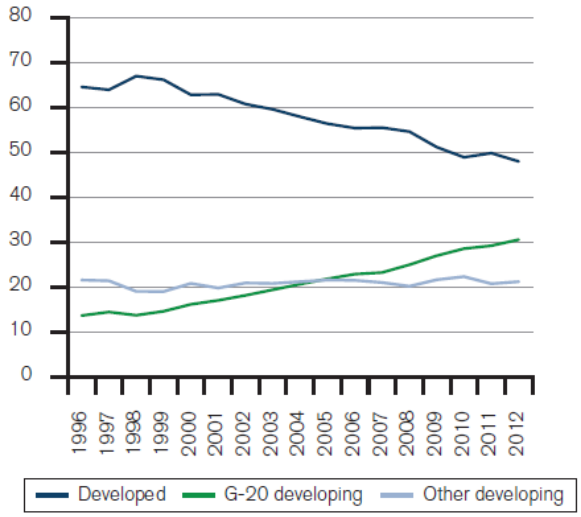
The current state of GVCs

The recent patterns of international trade have strongly supported the growing need for production processes to be interconnected across firms and countries. As we saw in the previous sections, the dramatic reduction of both transportation and communication costs have enabled the fragmentation of production: gradually, the focus of international trade shifted from finished products to parts of components, produced at the lowest costs in the most specialized countries. Consequently, today, more than one quarter of imports are parts and components of goods.

If we analyse the composition of this trade, we can see one of the major implications of GVCs on globalization and trade integration. Indeed, in fourteen years, the share of import of parts and components of developed economies has decreased by almost 20 percentage points, moving from 66 percent in 1996 to 48 percent in 2012. On the opposite, the share of imports of the G-20 developing group almost doubled in the same period: it was 14 percent in 1996 and increased up

to 31 percent in 2012. The main implication of this change in the world equilibrium is that emerging economies have become strong and active players in the productive framework, and today, indeed, they are not only mere sub-contractors of developed economies.

Share in imports of parts and components by country group, 1996-2012[54]

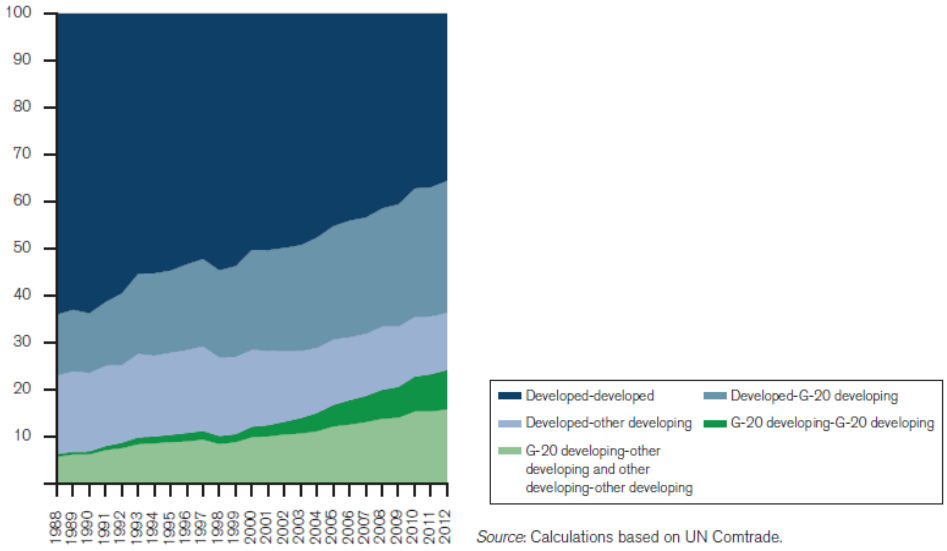


Source: UN Comtrade, WTO Secretariat.

This idea that through GVCs emerging economies can gain a relevant position in the international scenario is further confirmed by the fact that GVCs are enabling increasing processes of trade among emerging countries. Indeed, trade among developing countries experienced unprecedented growth in the last decades: it was around 6 percent in 1988 and it increased to almost 25 percent in 2013. As the figure below shows us, this phenomenon made up to a relevant decrease in the trade among developed economies, which was preponderant at the beginning of the period, but whose relevant lost intensity over time.

[54] Source: UN Comtrade, WTO Secretariat

Share of imports in parts and components, 1988-2012[55]



Source: Calculations based on UN Comtrade.

Conclusive remarks

Before moving forward with our analysis, it is worth spending a few words on the role played by the service industry in the process of GVCs. By definition, services are less subject to fragmentation, and thus they can more hardly be traded among countries. Still, with the degree of technological change we are experiencing, we saw how today's products embed significant degrees of service features: such features are transferred and traded with the product and, thus, they take part in the GVCs.

2.2.b. GVCs' support to development

In economic history, industrialization processes occurred on specific industries and within national borders: the most illustrative example of this phenomenon was the way the automotive industry was developed in Japan. In this case, the major companies built their supply chain within the factories' boundaries, so to have direct and constant contacts with the suppliers. However, today, economies are developing without this necessity: they can indeed specialize in specific tasks that place them in a relevant position in the international framework, rather than on industries or products.

[55] Source: UN Comtrade

Technology enhancement and knowledge transfer

The participation of economies in the process of GVCs strongly affects technology enhancement and knowledge transfer: indeed, the ability for countries to be strong players in the international framework enables them to conquer significant sources of potential development. As a matter of fact, it is empirically proved that countries that manage to be efficiently integrated within the framework of GVCs can benefit more from technology intensification and knowledge transfer[56].

GVCs can foster the development of technology and knowledge transfers through the expansion of trade (i.e. imports) and through the ability for countries to attract foreign companies to invest in the national territory. In this perspective, Foreign Direct Investments (FDIs) are among the easiest way to developing and emerging economies to gain relevant flows of technological innovation and knowledge development. Moreover, the degree of quality of the transfer embedded in either imports of FDIs is greater when it comes from industrialized and developed countries, where usually the technological and knowledge-based content is more significant[57].

Lastly, it is important to note that GVCs are following a similar path to the one experienced during industrialization processes: it has been experiencing structural transformation. Indeed, the industries that enable the expansion of GVCs are not the ones that started the transformation process. Integration in the GVCs framework started within the manufacturing industry: production steps were fragmented and transferred among nations, depending on production costs. This process represented a mere dead end, since the technological and knowledge-related spill-overs were fairly limited. Still, it determined important benefits with respect to the industrialization processes of a relevant number of countries (i.e. China). Lately, GVCs integration started to take into account the service industry: as we saw in the previous sections, this industry is indeed the one where there is the greatest potential for both technological advancement and knowledge transfer. Countries that can position themselves along the GVCs of the service industry are very likely to get high degrees of technological and knowledge transfers.

The allocation of earnings from GVCs

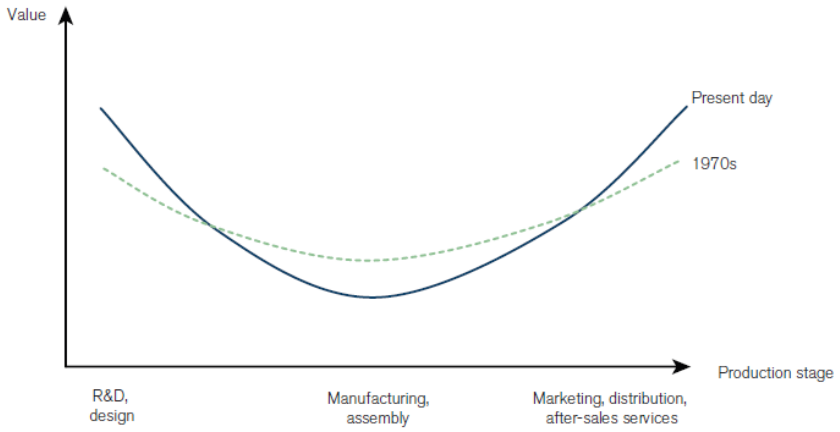
Developing economies are becoming increasingly strong players in the international framework, and they are getting a relevant role in the process of GVCs. As we saw in the previous

[56] Piermartini and Rubicova (2014).
[57] Keller (2000).

sections, their weight both in world output share and in the trade integration is increasing in the last years, and this process is means to continue in the same direction. Still, it is worth mentioning that the distribution of gains deriving from the GVCs are still not granting high benefits to such economies.

Let us take the example of the apparel industry: as we saw in the case of Fast Fashion, big multinational companies strongly rely on GVCs, and research[58] shows that 95 percent of the labour employed in this industry works in factories located in developing countries. Still, only around 10 percent of the gains deriving from this industry are transferred to these countries. This empirical example finds a general application in the "smile curve": the activities that can be part of the GVCs process along the value chain are usually R&D, design, manufacturing, assembly, marketing, distribution, and after-sales services. If we observe the geographical distribution of these activities, we can easily state that the ones that generate the greatest value are the ones that are performed in developed countries, i.e. the ones where the multinational companies have their headquarters.

The "smile curve"



Source: Dedrick and Kraemer (1998).

Moreover, the curve shows us that the divergence of the value of each production stage has become more pronounced with time. Consequently, emerging and developing countries struggle to capture the real value of their output. This lack of fair distribution of the gains of GVCs processes represents another strong obstacle that emerging economies have to face while dealing with to social development.

[58] International Labour Office (2005).

Conclusive remarks

GVCs represent a relevant tool for both developed and developing countries to improve their position in the international scenario. Indeed, the former can reaffirm their dominant position by performing the most value-generating activities; the latter can find relevant ways to approach world trade and thus gain increase shares of the world output. Still, GVCs represent an alarming source of increasing inequalities: indeed, they perfectly illustrate the general rule for the recent trends in distribution of wealth. If on one side GVCs contributed to the emergence of a relevant number of new economic players, on the other side they can easily lead an unfair distribution of resources.

Conclusion

The rise of GVCs is a recent phenomenon, which is destined to re-shape the world economic order. Indeed, it is granting international relevance to the economic development of emerging countries. This emerging trend has been strongly supported by technological transformation, which has enabled countries to specialize parts of their economy in the production of specific components or in the delivery of specific tasks, rather than to focus on the entire product or service.

In this section, we saw that the main features that enabled GVCs are agglomeration and dispersion forces: indeed, because of their peculiar traits, they are the reason of the new geography of the world's economy. We moved to the analysis of the major implications of GVCs on globalization and trade integration: in this perspective, emerging economies have become strong and active players in the production framework, enabling them to become other than mere sub-contractors of developed economies. Second, we focused on the way GVCs are currently supporting the different economies' development: since today emerging countries can specialize in specific tasks rather than on industries or products, it was worth to understand in which ways technological change is enhanced and knowledge is transferred throughout the chains. Also, it was important to consider to which extent GVCs are influencing the current distribution of wealth among all countries.

To conclude, GVCs have become the way for both developed and developing countries to improve their position in the international scenario. Furthermore, the current degree of integration

of markets is greatest of all times: coordination among countries occurs at an unprecedented degree. Still, this exceptional degree of market integration comes at a price: GVCs represent an alarming source of increasing inequalities in the issue of distribution of wealth. It is now time to move on to the second chapter of this study, which analyses the relationship between globalization and inequalities.

The historical milestones we have analysed in this chapter, namely the new processes determined by the industrial revolutions, have allowed today's magnitude of markets integration. To different extents, such revolutions changed production processes and shaped the economy, the politics, and the society as a whole, across countries and within them. At different points in time or with different degrees of intensity, all economies have taken a part in this mechanism of change. Gradually, such processes generated the emergence of integrated markets, where exchanges were facilitated by the introduction of special tools and of *ad hoc* regulatory frameworks. These changes generated new challenges from both political and standpoints; they saw the emerging tendency of countries to engage in trade and international exchanges.

The aim of the first chapter of this study was to identify to which extent the past waves of innovation have been succeeding to one another and which implications they have fostered with respect to the current degree of globalization and market integration. In order to do so, we first analysed the historical milestones that shaped industrialization processes: in particular, we briefly overviewed the three past industrial revolution. Their main features helped us examine the current state of industrialization: we determined the major implications of the fourth industrial revolution – the Industry 4.0 – in the process of globalization of markets.

In the second section of the chapter, the focus was on recent trends of globalization: first, we examined recent trends in trade integration and in the development of the world's output. To do so, we evaluated the world economic development that determines the current state of globalization; then we studied the regulatory framework of international trade. Lastly, the analysis moved towards the phenomenon of GVCs, whose determinants – which we examined in depth – support the emergence of a new state of globalization of markets.

The natural conclusion of this chapter is the rise of GVCs: indeed, they represent the result of over three centuries of industrialization processes, of integration of markets and of trade. Despite understandable enthusiasm around this phenomenon, we also tried to depict some critical aspects that are affecting the economic world order and the dynamics that revolve around trade. In fact, while GVCs contributed to the emergence of a relevant number of new economic players, their implementation on a global scale can easily lead an unfair distribution of resources. This issue will be the founding topic of the next chapter.

CHAPTER 2 – GLOBALIZATION AND INEQUALITY: A NEW DISTRIBUTION OF WEALTH.

In the first chapter of this study, we highlighted the different processes that led to the current degree of globalization. Indeed, we saw to which extent the wide range of technical advances that shaped recent economic history affected the economic orders of countries and how these dynamics affected the international scenario. In particular, we focused on the current state of industrialization processes, defined as Industry 4.0: starting from the analysis of this new phenomenon, we analysed today's implications of further industrialization on business-related issues. Then, we moved to the analysis of a recent phenomenon which has re-shaped the global scenario, and which is meant to have great implications in the near future: indeed, with GVCs, we tried to highlight the emerging features of this new process of convergence in trade and production.

How do these scenarios affect the way resources are allocated in the world's equilibrium? Indeed, the aim of this second chapter is to understand the linkages between globalization and the structure of inequalities, and analyse whether such linkages vary according to the features of single economies. To do so, we will recall the theoretical origins behind economic growth and inequality, focusing in particular on Simon Kuznets' studies and on the major reviews to his environmental curve.

Then, we will deeply concentrate on empirical evidence related to distribution of resources. In this perspective, we will analyse the evolution of distribution of resources and income inequality over the past century: the basis of our analysis will be the comparison among Europe, the United States and emerging countries with respect to distribution of income. In this way, we will be able to evaluate the linkages among the current structure of inequality and the recent trends in internationalization of markets and in globalization: in this framework, our study will revolve around the different dynamics that have been shaping the international scenario, and their implications with respect to a new distribution of income.

1. Income inequality: an overview

1.1. Economic growth and inequality: theoretical origins

Introduction

Theories revolving around distribution of income have always represented central provisions to enable the study of economic efficiency and to understand global dynamics. In 1969, Joseph Stiglitz[59] was among the first to consider the significant relevance of shifting the focus from factors of production and extend it to the study of distribution of wealth and income among individuals. Starting from his analyses, Stiglitz gave great impulse to the development of new studies on the issue of the way wealth distribution affect the production function, social structures, labour skills, and inequality as a whole. Less than fifty years after Stiglitz innovative studies, Thomas Piketty[60], a French economist, started to adapt classical theories on distribution of wealth on the economic and social scenario of the twenty first century: indeed, it is believed that his findings are destined to have relevant implications in the way income inequalities are going to be studied in the next decades. Moreover, Branko Milanović[61], a Serbian-American economist, deeply focused on the way globalization patterns and processes of market integration affect the structure of global inequality, among countries and societies.

What is today's structure of income inequality? How has it changed in the recent past? Indeed, in the current framework of globalization and market integration, it is crucial to understand to which extent industrialization processes and globalization patterns have affected the structure of inequality; also, it is worth examining which outcome they are likely to generate in the future. In order to do so, in the first section of this chapter, our aim will be to analyse and study the theoretical implications that have been rising in the framework of the current century: in particular, after covering the theoretical principles of the relationship between industrialization patterns and distribution of income, we will focus on empirical evidence regarding both past and current states of inequality within and among nations. Then, the analysis will shift towards Piketty's assumptions over income inequality. In this perspective, building our analysis on his work *Le Capital au XXI^e^*

[59] Stiglitz, Joseph. E., *Distribution Of Income And Wealth Among Individuals*, Econometrica, 1969.
[60] Piketty, Thomas, *Le Capital au XXI^e^ Siècle*, Seuil, 2013.
[61] Milanović, Branko, *Global Inequality: A New Approach For The Age Of Globalization*, Harvard University Press, 2016

Siècle, we will deeply cover the issues of the evolution of distribution of resources and income inequality over the past century, the transformation of the top 1% wealthiest part of the population, and the comparison among Europe, the United States and emerging countries with respect to distribution of income. Then, we will try to evaluate the linkages among the current structure of inequality and the recent trends in internationalization of markets and in globalization: in this framework, our study will revolve around the issue of the different dynamics that have been shaping the international scenario, and their implications with respect to a new distribution of income.

1.1.a. Recent studies on economic growth and inequality

For a long time in history, data collection and management were not among the main priorities of nations and states. Consequently, it was particularly harsh to keep track of economic, social, demographic and environmental dynamics and changes. Indeed, the first reliable statistical data in the economic field date from a couple of decades ago; still, starting from this basis, mathematicians and economists have been able to give historical and statistical significance to the increasing amount of data evidence.

Why did states, governments, and individuals start to feel the need to monitor the dynamics and the changing process of the inequality structure? What is the current state of inequality among countries and within them? In the perspective of measuring the levels of inequality among people and countries, the need started to be conceived by public institutions because the implications in the social sphere were starting to become unneglectable. Consequently, reliable and accountable methods to measure changing patterns in distribution of income. In this way, indeed, public institutions found concrete ways to understand and measure the wide range of drivers that led trends related to inequality; moreover, by using such measures and tools, public bodies were able to examine and understand the dynamics revolving around the effects of public policies on the structure of inequality. In order to carry out these new studies and analyses, the focus of economists shifted towards the notions of income and wealth: indeed, these two variables soon became the key tools to interpret changing dynamics. To understand the impacts of globalization on inequality, it is necessary to take a close look at the way such inequalities are structured within countries and among them.

Environmental Kuznets curve

Before starting the analysis of income inequality in the last decade, let us take a step back and see how economic growth influenced and shaped the structure of inequality among individuals. Indeed, throughout the first chapter of this study, we analysed to which extent technical advances affected globalization patterns and the different degrees of trade integration; following this perspective, it is worth mentioning that technological enhancement also strongly influenced the construction of different societies and the relations among them.

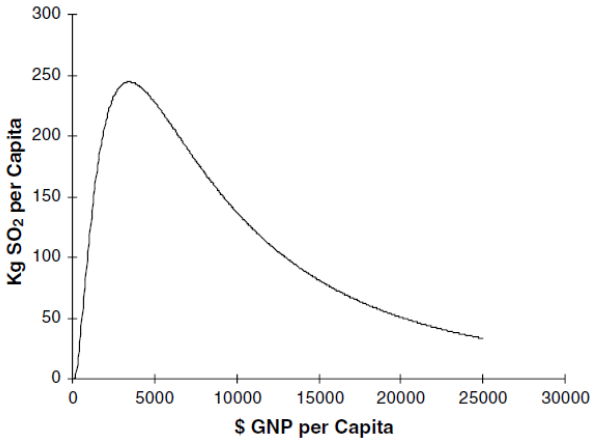
The way economic growth changed the structure of inequality has very robust theoretical implications. In this sense, the major contributor to the study of the relationships between development and inequality is Simon Kuznets. His studies in this field started in the 1920s, when, drawing from Schumpeter's theories on the effects of technological change on the business cycles, and from Pareto's studies on the way the distribution of income occurs among households, Kuznets developed the existence of a relationship between the variables that define environmental deterioration and income per capita. Let us take a close look at these two sets of economic indicators: the former are strongly related to the degree of industrialization of nations, which in turn determines economic growth and development; the latter, on the other side, expresses the way the wealth of nations is redistributed among individuals.

According to Kuznets' studies, therefore, the two sets of variables perfectly illustrate the way economic growth determine the structures of inequality. In particular, in the first chapter, we covered all the different phases of industrialization of economies and countries: we analysed to which extent both early and late industrializers developed their key markets. In this perspective, it is worth noting that, at different stages in time and with different degrees, all countries following industrialization processes experienced increasing levels of pollution. Meanwhile, as industrialization paths increased in their intensity, wide ranges of new opportunities emerged in the business environment; these important favourable circumstances enabled significant improvements in countries' wealth. Consequently, increasing national income strongly affected individuals' income, which also strongly increased during the first wave of industrialization.

These analyses are reasonably straightforward; most surprising outcomes arise from the consequences of further industrialization patterns undertaken by countries and economies. In particular, beyond specific levels of wealth – namely, income per capita – evidence shows that the degree of environmental degradation and pollution tends to decrease. If we put together the first

stage of increasing pollution with this stage of reduction of environmental damage, and we relate it to the increase of income per capita, the result represents an inverted U-shaped curve, which has the name of Kuznets curve.

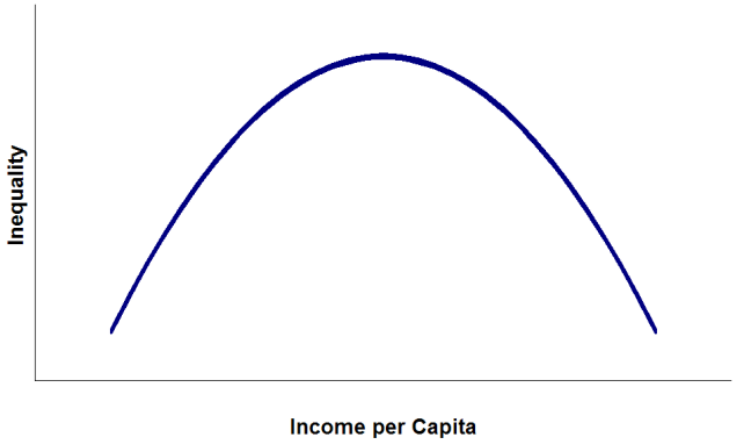
Environmental Kuznets curve for world development[62]



Hypothetical Kuznets curve

In this perspective, according to the Kuznets hypothesis, it is possible to state that at small levels of income per capita, inequality is just as small; as the economy develops (according to our study, this occurs through industrialization processes which can be associated to changing degrees of environmental degradation), inequality tends to increase; finally, at high levels of income per capita, the level of inequality falls back to initial degrees.

Hypothetical Kuznets curve[63]



[62] Source: Stern, David I., *The Rise and Fall of the Environmental Kuznets Curve*, 2004, Elsevier.
[63] Source: Wikipedia.

Conclusive remarks

Kuznets attempts to link economic growth to changes in the structure of inequality represent an important milestone in the study of distribution of income. Indeed, his studies determined a significant increase in the attention dedicated to the issue; following Kuznets' impressive findings, still, a relevant number of authors were able to highlight several weaknesses in his analysis. In the next session, indeed, we will try to determine the major critics to Kuznets' studies on economic growth and inequality.

1.1.b. Critics to Kuznets studies

With his studies, Kuznets gave strong impulse to the foundation of analysis of income inequality and technological change: starting from the study of this relationship, a significant number of economists focused on the implications that industrialization patterns generate on the degree of equality concerning distribution of wealth. In particular, it is worth mentioning that, although his studies and his main findings occurred throughout the twentieth century, strong relevance to his analyses was granted in the last years of the century: among the main contributors to the emergence of Kuznets' success stands the World Bank, which in its World Development Report, in 1992, reported that "the view that greater economic activity inevitably hurts the environment is based on static assumptions about technology, tastes and environmental investments"[64]. Following this relevant attention to the issue, a significant number of economists started to further implement Kuznets' findings. In particular, David Stern[65] analysed the outcomes of additional studies around the issue of industrialization processes and income inequality: in this perspective, he conceived the emergence of three alternative scenarios.

The new toxics

First, the revisions analysed by Stern concern the implications of environmental pollution: in this perspective, it is important to understand that the nature of pollutants have been changing throughout the centuries and with respect to economic and production activities. Let us think for example about the extensive use of coal and charcoal: these two natural resources were at the heart

[64] World Bank, *World Development Report 1992 : Development And The Environment. World Development Report; World Development Indicators*, 1993, Washington, DC : World Bank Group.
[65] Stern, David I., *The Rise and Fall of the Environmental Kuznets Curve*, 2004, Elsevier.

of industrialization patterns during the nineteenth century in many countries; their exploitation was remarkably intense and consequently their impact on the degree of pollution dramatically increased. Hence, technical advancement was strongly related to the use of such resources. As technological change pursued its development, however, some of these natural resources experienced a loss of relevance and thus their exploitation decreased. In this perspective, to substitute these means, which became obsolete, new resources were needed; instead of looking for less environment-damaging solutions, the impact of new resources on the environment as a whole never started to decrease. Consequently, the relationship between environmental damage and inequality in income changed in time: the typical inverted U-shape of the Kuznets curve became much less pronounced with respect to what Stern called the "new toxics", meaning that, for significant increases in income per capita, environmental degradation is not reduced the way Kuznets theorized.

The race to the bottom

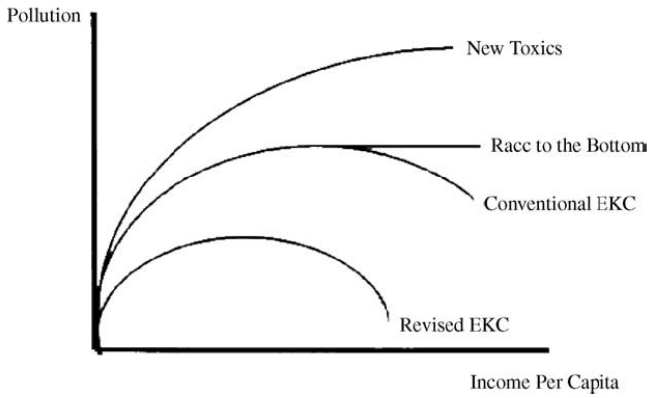
Stern tried to understand to which extent geographically-related dynamics of globalization and industrialization shaped environmental damage and distribution of income. Indeed, he noted that, throughout recent history, pollution and environmental degradation followed the direction of industrial dynamics: in particular, he highlighted that as early industrializers continued their paths towards economic activities which consumed smaller amounts of natural resources, late industrializers started to experience increasing degrees of industrial activities, with relevant consequences on the environment. Thus, the level of polluting emissions did not experience any decrease: it simply shifted location. Consequently, these mechanisms balanced one another, and, as this "race to the bottom" – as Stern called it – of outsource of environment-damaging economic activities started in time, the level environmental damage remained stable with respect to increases in income per capita.

The revised Environmental Kuznets curve

Lastly, Stern tried to revise the classic Kuznets curve by taking into account the implications of time with regard to technological change; despite this so-called "revised curve" still presents the typical inverted U-shaped form, its components are significantly different from the ones theorized by Kuznets. Indeed, in this changing perspective, technological advancement fast affected the increases in income per capita and the levels of environmental damage; nevertheless, such increases were not as sharp as they were depicted by Kuznets starting analysis

and did not endure for more significant increases in the levels of income per capita. Hence, the implications of this "revised curve" proved to be less significant from both the impact of industrialization and the degree of inequality in distribution of income. The figure below tries to sum up all the considerations above; moreover, it puts together the different interpretations revolving around Kuznets considerations on income inequality and the degree of industrialization.

Alternative views of the Environmental Kuznets Curve[66]



Conclusive remarks

The analyses of the revised EKC we have just tried to understand are the result of severe and robust criticisms towards the traditional studies of Kuznets. Despite the undeniable relevance of these reviews, his theoretical implications are undeniable for those who approach the issue of the relationships between the structure of income inequality and technological advancements. Indeed, this theory represents a true milestone which allows us to further analyse the different structures of inequality: in the remaining of this section, in fact, we will focus on the implications for such designs within national borders and among countries.

Conclusion

In the first section of this chapter, the focus was on the theoretical origins of the relationship between economic growth and inequality. In this perspective, we strongly relied on Kuznets, whose studies determined the emergence of a relevant and peculiar linkage between the two variables. Indeed, we recalled that the constraints that define environmental deterioration and

[66] Source: Stern, David I., *The Rise and Fall of the Environmental Kuznets Curve*, 2004, Elsevier.

income per capita are strongly related on the one side to the degree of industrialization of nations – which in turn determines economic growth and development –and on the way the wealth of nations is redistributed among individuals on the other side. Then, we noted the major critics to the principal results of the studies carried out by Kuznets. In particular, we depicted three significant detailed analysis of the classic environmental curve: in this perspective, all critics reviewed the original study made by Kuznets gave further emphasis to the theoretical relevance of the relationship between economic growth and the structure of inequalities.

Recent studies on inequality within countries and among them strongly rely on empirical data: throughout this first paragraphs, our aim was to enable our study to have objective and theoretical foundations to the analysis of such empirical statistics. Indeed, several authors recently covered the issue of income inequality in a changing scenario: in particular, Branko Milanović focused on the approach to inequality in a global perspective; moreover, Thomas Piketty strongly emphasised the dynamic structures of inequality within countries and in determined clusters of economies. Our aim, for the remaining of this section, is to thoroughly depict these changing dynamics in an international framework.

1.2. The structure of inequality within countries

Introduction

In the last paragraphs, we tried to give a theoretical basis to the analysis of the relationship between technological advancement and distribution of income. To do so, we studied Kuznets' attempt to relate the two components in the typical inverted U-shaped form; also, we gave great emphasis to the criticisms and reviews of his models in the more recent decades, which, however, generally contributed to the development of a significant number of studies around the issue of the relationship between technological change and inequality. Throughout the years, these relevant analyses have been leading towards greater quality in the findings: in particular, it is indeed possible to thoroughly examine both past and current states of inequality. In this section, we will focus on the way the structure of inequality has been changing and evolving in the last century.

According to Kuznets' findings, richer economies ought to be the ones with the smallest amount of inequality levels: indeed, as we saw in the previous section, at small levels of income per capita, that is when a country is not developed economy-wise, the degree of inequality is also

significantly small. As soon as the above-mentioned country undertakes the process of industrialization, the economy develops in the same way; consequently, the overall levels of inequality are usually likely to increase. Eventually, as economic development usually translates into higher levels of income per capita, evidence shows that the level of inequality decreases, up to the point of going back to initial degrees. As a result, in this perspective, the richest and most developed economies should be the most equal ones: from a historical point of view, indeed, this statement can be confirmed, since, until the late 1980s, many countries experienced a very significant decrease in inequality; still, starting from the early 1990s, it is much harsher to consider as true the theoretical and economic principles stated by Kuznets. Indeed, throughout the last couple of decades, a significant number of developed and wealthy countries suffered from increasing levels of inequality in their societies; as we just mentioned, this phenomenon first started in the 1990s and endured in the new millennium, despite or encouraged by the global financial and economic crisis all countries all suffered from, to different extents.

So far, we gave strong emphasis to the theoretical implications deriving from the relationship between globalization and the emergence of greater or smaller levels of inequality. The reason behind this choice was that we support the relevance of theoretical findings in order to create an objective – although criticized, as we thoroughly ascertained – basis to our analysis. Indeed, our aim is now to take into account the structure of inequality for a certain number of countries; to do so, we chose to use the variable of national income, and see how it is distributed among society. In this perspective, we believe that national income is the most objective tool to understand national dynamics of concentration of resources; also, it allows us to compare and contrast such dynamics across countries. Indeed, national income does not take into account the tax level, which strongly diverges from country to country; hence, by using this variable, it is possible to us to have an objective level of comparison. How did the structure of inequality change in the past century? What are the reasons of such changes? In order to give concrete explanations to these questions, it is now time to analyse the historical trends in income inequality.

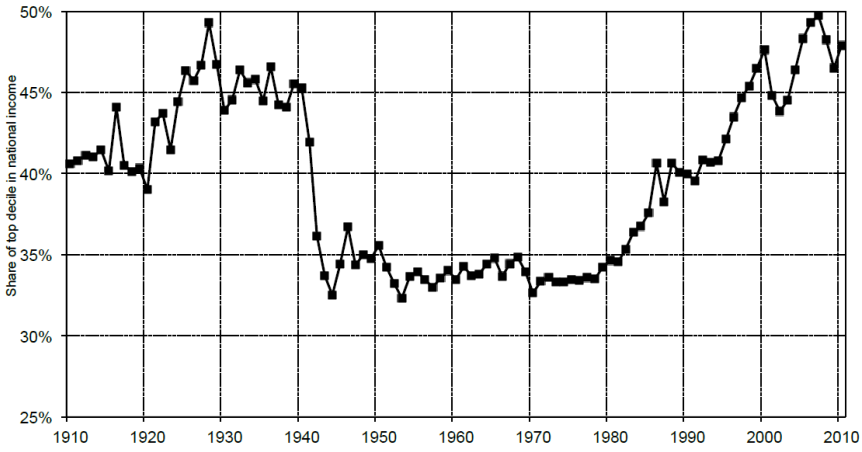
1.2.a. The structure of inequality in the United States

The historical dynamics that we tried to understand in the previous paragraph can be further clarified by a concrete example. Let us think of the one country whose economic impulse has always been envied by the rest of the world: the United States is commonly thought to one of the

countries whose principles find their roots in the support to one's capability to reach better living conditions. Still, historically-wise, the situation has long been different: for most of the first half of the twentieth century, in fact, the top decide of the population, considering national income, owned typically over 40% of resources. This rate dropped dramatically at the beginning of the 1940s, reaching a level around 33% in the middle of the decade. This share of national income remained mostly stable throughout the following thirty years, until it started to increase in the early 1980s; it reached levels prior to the decrease of the 1940s at the turn of the millennium, and the punctual drops were never specular to the one experienced in the first half of the century.

Income inequality in the United States

Income inequality in the United States, 1910-2010[67]



If we look closely at the timeline above, we realize that there are some historical contingencies that might have determined the sudden variations in the trend line. In particular, we could try to find some historical explanations to either sudden increases or decreases. What past events determined such a high level of inequality? If we try to combine empirical variations of income distribution with historical milestones in economic and political history, it is possible for us to draw a few conclusions, which strongly take into consideration the impact of globalization and the process of market integration in either the reduction or the increase of income inequality in the case of the United States.

First, the greatest levels of income concentration by the top decile were registered in 1928 and in 2007: in both cases, indeed, the concentration of national income almost reached 50%, meaning that half of the income of the country was owned by one person on ten. Historically

[67] Source: Piketty, Thomas, *Le Capital au XXIe Siècle*, Éditions du Seuil, 2013.

speaking, these two years represent the eves of the two most dramatic financial, economic and social crises that the country ever experienced. Hence, starting from this evidence, we could conclude that serious crises are always anticipated by high levels of income inequality.

Second, the long period of reduced inequality corresponds to a significant wave of economic and social development that shaped the United States as well as many industrialized countries, such as American and European nations, as well as Japan. This long period was shaped by favourable exogenous conditions, such as political stability (following the dramatic and striking events of the two world wars), the beginning of concrete actions towards market integration and expansion of free trade, etc.; such conditions enabled the emergence of significant degrees of economic growth in the above-mentioned countries, together with on-going industrialization processes, the generation of new and innovative of both business areas and management studies. Hence, for this period, it is possible to establish a strong linkage between the low degree of income inequality in the United States and the country's level of economic development.

Indeed, in this perspective, it is worth reminding Piketty's view on this matter: in this book Capital in the Twenty-First Century, his view is quite critical, since he depicts this period economic development as a catch up period, strongly shaped by the recovery deriving from the two world wars. As a matter of fact, his statistical analyses depict that the United States' economic growth for the period of thirty years going from 1945 to 1975 as a rather normal growth, while it was greater for those country that were severely hit by the conflict, for which infrastructural damages had to be recovered and significant amounts of economic resources were invested during that period.

Lastly, the line in the graph above presents some similarities for the periods characterized by significant increases in the barriers to free trade. In particular, indeed, the United States' history was strongly shaped by important waves of protectionism[68]: the most relevant occurred in the decades of 1930s and 1970s. In the first scenario, it is worth reminding the consequences of the Smoot-Hawley Tariff Act of 1930, which represents one of the most significant examples of protectionist act not only of American history, but probably of global trade; indeed, this act determined the increase in duties on imported goods up to 50%. Despite the international conditions were strongly different in the 1970s, and as a matter of fact no similar measures were taken in this second case, the international environment was shaped by strong political tensions,

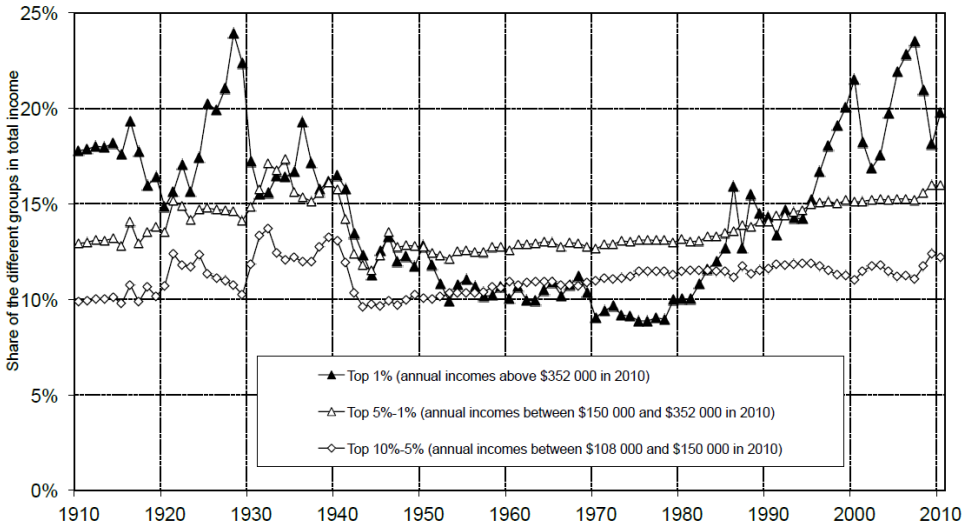
[68] Cavallini, Laura, *Protectionism in America: an Overview*, online version only, 2017, available at http://themarketmogul.com/protectionism-america-overview/.

determined by increasing political uncertainty in strategic geographic regions such as the Middle East, where the Unites States owned significant stakes, and by the emergence of conservative leaders such as Ronald Reagan in the United States and Margaret Thatcher in the United Kingdom. What is most striking, according to the graph above, is that during the period of the 1930s the level of income concentration in the top decile was significantly great, around 45%; moreover, it was during the 1970s that national income in the top decile in the United States started to increase dramatically, until it reached the levels prior to the Great depression. Consequently, it is possible to state that protectionist waves strongly contributed to the increase in concentration of resources.

The decomposition of the top decile in the United States

The graph below serves as an example in order to go into further details and understand what happens within the top decile with respect to national income. The main evidence deriving from this graph lies in the fact that the trend line with the most volatile behaviour is the one representing the top percentile, the one that gathers all individuals with annual incomes above $352.000 in 2010. Indeed, starting from the graph it is possible to state that the top percentile was the category that both owned the greatest share of national income, when inequality were strong; it was also the one that most suffered in times of inequality reduction. On the contrary, we can observe that the situation for the top 1%-5% and the top 5%-10% is more stable in time: the two trend lines of the graph behave the same way and have smaller increases and drops, compared to the top percentile.

Decomposition of the top decile, United States, 1910-2010[69]



[69] Source: Piketty, Thomas, *Le Capital au XXIe Siècle*, Éditions du Seuil, 2013.

Conclusive remarks

In this section, we analysed the trends in income distribution for the top decile of the United States; the reason behind the choice of this specific country lied in the fact that, aside from being a global economic leader, this country is strongly heterogeneous. In fact, if we were to make clusters, the United States most certainly fall into Hall and Soskice's Liberal Market Economies (LMEs)[70]: according to their theory on varieties of capitalism, indeed, five features determine LMEs. First, the way country manage with institutional relations, meaning how companies deal with their stakeholders: in this perspective, for LMEs, within companies workers and employers are little organized and wage negotiations take place at the company level. Second, the way vocational training and the organization of education are conceived varies whether countries belong to the LMEs: if they do, labour's skills are general, in order for workers to easily shift from company to company. Third, corporate governance within LMEs strongly relies on public information and on financial markets to gather financial resources. Fourth, the network of inter-firm relations is significantly competitive for LMEs, in which there are strong lacks of coordination within industries. Lastly, in LMEs the relations between the management employees are usually hostile, and in most cases strategic decisions are taken by the former. Consequently, taken into account all these features, the United States represented a significant example to make strong statements on the distribution of income: according to this first analysis, we can indeed state that the level of inequality in the United States did not decrease in the past century, and it remains significantly great. Now, indeed, it is time to take into consideration a country which owns different approach to the five features we have now depicted.

1.2.b. The structure of inequality in France

France has developed a historically different approach concerning the features that shape Hall and Soskice's varieties of capitalism. In fact, although it is not the most relevant example of Coordinated Market Economies (CMEs), it is possible to find some strong connections with the theoretical principles of varieties of capitalism. Indeed, regarding industrial relations, it is important to remember France's historical tradition in trade union representation and in collective bargaining. Also, with respect to vocational training and education, skills of workers in France are usually specific to the industry and often to the company employees work to. Third, concerning

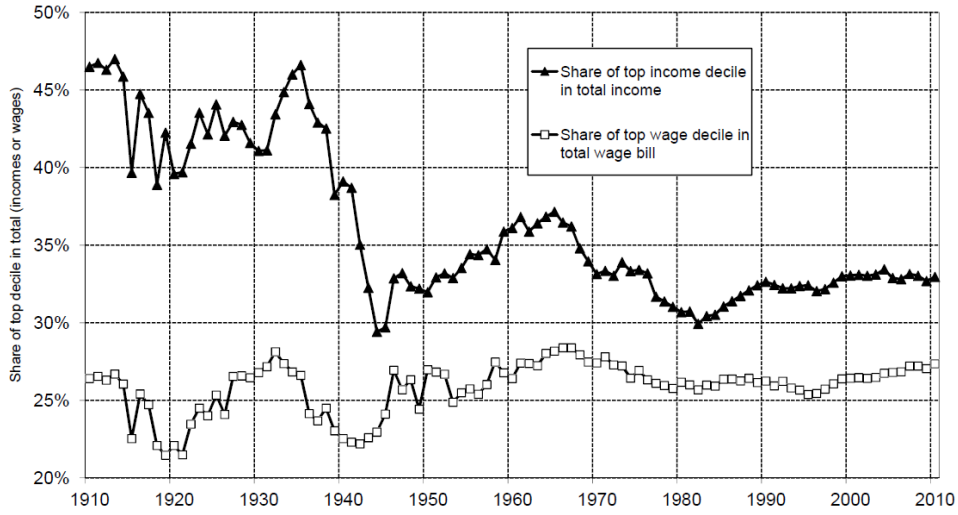
[70] Hall, Peter A., and Soskice, David, *An Introduction to Varieties of Capitalism*, Oxford University Press, 2001.

corporate governance, French firms tend to rely less on capital market and on short term financial goals; on the opposite, they typically find more interest in have long term visions. Fourth, the industrial network in France allows the emergence of strong inter-firm relations, according to different industries and different markets. Lastly, there are usually strong bounds between management and employees, with whom strategic and important decisions are taken.

Following these principles, it is clear that there are some diverging trends in the way the industrial structure was created and in the way it has developed in time. Indeed, thanks to the studies carried out by Piketty, it is possible to us to analyse the structure of income inequality in France, and compare it with the case of the United States.

Income inequality in France

Income inequality in France, 1910-2010[71]



Starting from the graph above, our aim in this section is to understand the reasons behind the behaviour of the share of the top decide in total national income. At a first attempt of analysis, it is possible to ascertain that there are fewer variations, compared to the previous case: indeed, the distribution of income was strongly concentrated at the beginning of the century, until it suffered from exogenous changes in both national and international frameworks, which we will try to analyse. After the shock, actually, the level of income concentration was never restored; on the opposite, it was subject to further drops, until it became stable in more recent times.

For over twenty years, that is from 1910 to 1935, the share of the top decile in total income was on average over 40%. It was greater than 45% at the eve of the First World War: this period,

[71] Source: Piketty, Thomas, *Le Capital au XXIe Siècle*, Éditions du Seuil, 2013.

also known as the Belle Époque, represented the time of greatest concentration of resources for the last century in France. Despite a significant drop of over five percentage points in five years (from 1915 to 1920), the graph shows us that on the one hand the level of inequality remained significantly high for the inter-wars period; on the other hand, it was able to recover completely from the drop that occurred during the First World War. Indeed, at the beginning of the 1930s, the level of income concentration strongly increased, reaching a level of 37% in the middle of the decade.

In the eve of the Second World War, the top decile started to experience a severe drop in its level of national income concentration: despite a negligible rise at the turn of the decade, the share of top decile of national income decreased by over 15 percentage points in only ten years. The reasons of this dramatic drop are known and can be found in the general reluctance towards economic development that the Second World War determined; moreover, France played a major role in the conflict from the point of view of military efforts, and its territory represent one of the main battlefields in both war and peace processes.

Once the global conflict saw its end, the level of national income owned by the top decile was around 30%; after a long period of decrease, determined by the reasons we just tried to explain, the top decile started, once again, to earn increasing shares in the process of distribution of income. In this perspective, the period known as the *Trente Glorieuses* – the period of favoured economic and social development – enabled the top decile to slightly improve its share of ownership of national income. Still, in the remaining of the century, the top decile was never able to completely re-establish the levels of income concentration prior to the world conflicts. Indeed, in one century, the share of national income owned by the top decile decreased by 15 percentage points. This data is considerably relevant: according to Piketty, in fact, this reduction translated in the fact that the top decile of the population experienced a drop of a third of ownership of produced wealth; on the opposite side, this share of produced wealth was split among the remaining 90% of the population.

So far, we thoroughly analysed the trends deriving from the last century of concentration of national income by the top decile of the population. The main evidence lies in the fact that the latter experienced a first period a relevant concentration of resources, which level was lost during the world conflicts and never restored in the following decades. Indeed, it would be interesting to understand the major explanations behind such trends. Also, with regard to the final objective of this study, it would be crucial to ascertain the linkages that connect the reduction of inequality in France with the processes of globalization and market integration.

The emergence of France in the international framework

Several exogenous elements and changes in the international environment prevented the top decile to restore its ownership of national resources. In particular, changes in the business framework, in the economic, social and political scenarios strongly affected the country and consequently its wealthiest share of the population. Starting from the second half of the twentieth century, France undertook a strong process of openness towards international trade and hence increased its market integration: in this perspective, the country strongly developed its industries and sought concrete ways to become a leading economy in the international scenario.

The need for France to find its relevance in the global framework was also experienced by a significant number of European countries: several reasons historically explain this increasing necessity. First, the dramatic aftermaths of the Second World War and the need for the continent to live and prosper in peace created the awareness to find tools that could prevent the continent to experience another world war. Moreover, European economies started to take into consideration the increasing relevance of the United States as a global leader, and the latter's increasing tensions with the USSR. To deal with this changing international environment, an increasing number of countries undertook the process of European integration, which gradually led to the transfer of a certain number of sovereign competences to the new supranational body. This issue results crucial if we link it with the topic of the structure of inequality: indeed, European integration prevented Member States to establish and undertake excessive policies with respect to market integration, such as the protectionist ones launched by Reagan's presidency in the United States. Moreover, Member of the European integration process owned smaller sovereignty with respect to economic policies: in this way, favourable conditions to increase the concentration of national income resulted significantly greater to pursue.

Conclusive remarks

The changes in the international framework we just analysed represent the main reasons for the decrease in income inequality in France. Indeed, evidence shows that France's top decile, today, owns a smaller share of national income compared to the US; still, this does not mean that it is an equal society, since the share of concentration of national income of the top decile was well beyond 30% in 2010. The reason behind the choice to analyse a country like France, behind the fact that it represents a CME, according to Hall and Soskice's theory on variety of capitalism, is that this country strongly contributed to the creation of international and supranational bodies,

whose goal was to regulate and support the processes of globalization and market integration. We believe that, given the direction of this study, it was necessary to look at the behaviour of inequality of income within an internationally integrated market economy.

France's levels of income inequality are still relevant; nevertheless, the share of income concentration owned by the top decile of the population strongly decreased in the last century. Taking into consideration the reasons of this decrease, would it be possible to state that the integration of a national state into a supranational organization – which determined stronger openness to globalization and international trade – fosters the process of reduction in income inequality? In order to find concrete and objective answers to this issue, it is now time to compare the structure of inequality among countries.

Conclusion

In this section, we tried to give practical grounds to the theoretical implications deriving from the relationship between globalization and the emergence of greater or smaller levels of inequality. Indeed, our aim was to take into account the structure of inequality for a certain number of countries; to do so, we chose to use the variable of national income, and see how it is distributed among society. We gave solid answers to the queries related to the structure of inequality change in the past century. Moreover, we tried to analyse the reasons of such changes. To do so, we analysed historical trends in income inequality for the United States and France.

In the first case, we analysed the level of income inequality for a country whose determinant features show relevant signs of heterogeneity: indeed, we were able to state that the level of inequality in the United States did not decrease in the past century, and it has remained significantly great. In the second case, we could determine that France's levels of income inequality are still important; nevertheless, we could ascertain that the share of income concentration owned by the top decile of the population strongly decreased in the last century.

For the purpose of this study, we strongly believe that comparisons among singular countries are not sufficient to give significant grounds to our findings: indeed, in the context of integration of markets and in an increasing significance in globalization patterns, we assume that it is fundamental to take into consideration the linkages of income inequality among countries, which we will try to cluster according to specific theoretical notions.

1.3. The structure of inequality among countries

Introduction

In the last section of the chapter, we analysed the historical trends in distribution of income within countries. To do so, we took into consideration two countries which present different historical milestones, different approaches to the openness to international markets, as well as two countries with different varieties of capitalism. After reviewing their respective structure of inequality for the past century, it was possible for us to conclude that the level of income inequality did not decrease in the US, while it strongly decreased in France.

The analysis of the structure of inequality within these two countries allows us to understand the importance of the study of historical trends in national dynamics. Nevertheless, it is very hard not to take into consideration the implications that the international scenario bears in national historical dynamics: indeed, we meticulously analysed effects of changes in the international framework as causes of either increases or drops in levels of inequality. This attention to the global scenario is not new: indeed, it represents the lead way used in this study; in this perspective, we strongly believe that beyond the analysis of national dynamics, it is fundamental to focus on the levels of inequality among countries.

1.3.a. The structure of income inequality among Liberal Market Economies

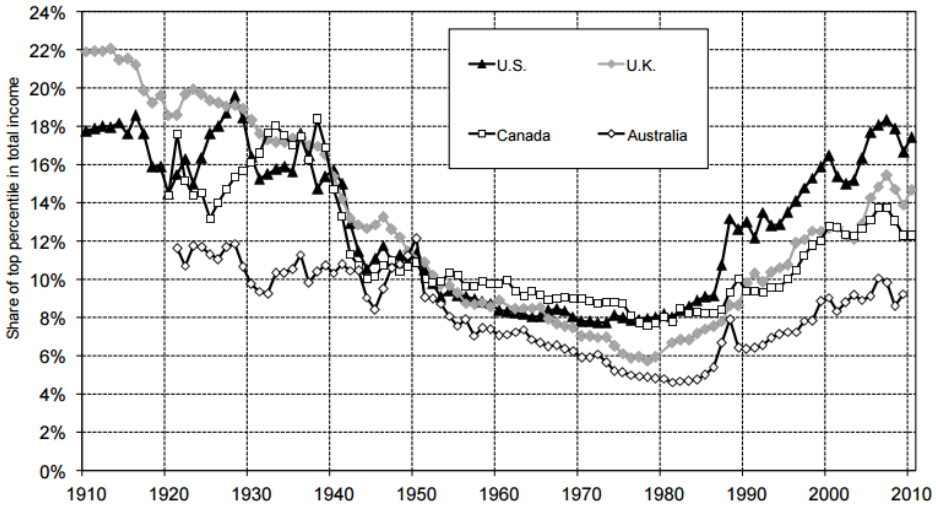
In the previous sections of this chapter, we briefly focused on Hall and Soskice's theory on varieties of capitalism. The authors strongly rely on the distinction between Liberal Market Economies (LMEs) and Coordinated Market Economies (CMEs), which main features we analysed in the previous paragraphs. Varieties of capitalism can support our study on the structure of inequality among countries: indeed, through the clusters the authors made, it is possible for us to make clear distinctions on the choice of countries we decide to analyse.

Following the theory on varieties of capitalism, LMEs are typically constituted by Anglo-Saxon countries. In addition of sharing the five traditional features at the basis of the theory, it is possible to ascertain that there are relevant similarities in the way income inequalities are structured. Indeed, the aim of this section is to understand to which extents countries belonging to

the LMEs have been experiencing changing trends in distribution of income, in order to compare and contrast them.

Income inequality in Liberal Market Economies

Income inequality in Anglo-Saxon countries, 1910-2010[72]



The graph above presents the structure of income inequality for the United States, the United Kingdom, Canada and Australia. In particular, the graph shows us the share of top percentile in total national income for the four countries. In the previous paragraphs, we deeply analysed the distribution of income in the top decile of the United States; moreover, we briefly described the composition of this top decile, by further clustering the top incomes in 1%, 1% to 5%, and 5% to 10%. This analysis enabled us to state that the top percentile is the part of the American population whose behaviour was the most volatile, all along the twentieth century: indeed, it was the share of the population which owned almost 20% of national income in 1928, and it owned over 18% of national income in 2007, that it before the financial and economic crisis that first hit the country and then affected the whole world. Moreover, this part of the population strongly suffered from reduction in income distribution: in particular, its share of national income was cut by half in forty years, that is from the late 1920s to the early 1970s; still, the levels of income concentration prior to the crisis of 1929 and the Second World War were soon recovered.

It is interesting to compare the behaviour of income distribution with countries whose major features are significantly close to the ones shaping the United States. In this book *Le Capital au XXIe Siècle*, Piketty focuses his analysis on the last four decades; despite the relevant findings

[72] Source: Piketty, Thomas, *Le Capital au XXIe Siècle*, Éditions du Seuil, 2013.

for this period, we believe that it is just as important to depict the historical changes for the whole period. Indeed, at the beginning of the twentieth century, the country whose top percentile owned the greatest share of national income was the United Kingdom, with a share of 22%, compared with a share of 18% for the top percentile of the US.

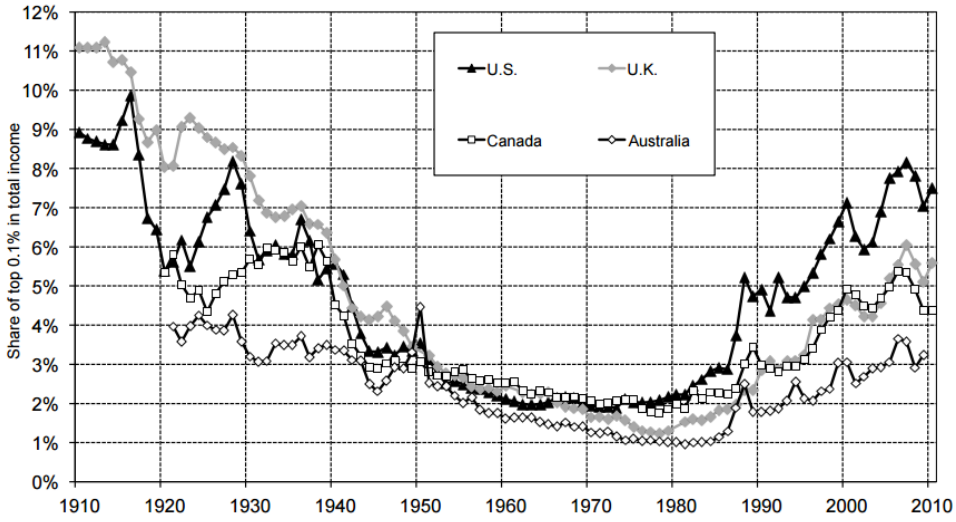
Starting from the 1920s, we have data for Canada and Australia: these countries' levels of income concentration of the top percentile were smaller than in the United States and in the United Kingdom; still, they were significantly high, at around 14% and 12%, respectively. In this perspective, it is worth noting that all along the first half of the twentieth century, the behaviour of Australia's top percentile regarding concentration of national income remained more stable than the rest of the Anglo-Saxon countries: indeed, the Australian top percentile's share of national income oscillated in the range from 8% to 12% throughout the period 1920-1950. Nevertheless, on the opposite, The United States, the United Kingdom and Canada experienced greater levels of sudden increases or decreases: in particular, it is worth noting that Canada's top percentile lost 10 percentage points in ownership of national income in six years. Indeed, it concentrated a share of national income equal to over 18% in 1939, which dramatically decreased and was around 8% in 1945. Moreover, it is interesting to note that in Canada, as well as in the United Kingdom, the level of concentration of income by the top percentile could never be restored to the level prior to the Second World War. However, as we already analysed, the top percentile of the United States managed to restore a similar degree of income concentration to the one it owned before the world conflict. How could the top percentile of the United States restore this degree of income concentration? Also, why did the top percentiles of Canada and the United Kingdom not manage to recover to the levels prior to the Second World War?

To further detail our analysis, let us start by taking into consideration the changing dynamics of income concentration by the top percentile of all four Anglo-Saxon countries from the 1970s. The choice of decade is not random, since at the turn of the decade the levels of income concentration were particularly close to one another. Indeed, the share of national income owned by the top percentile was concentrated in the range from 6% to 8% in all four Anglo-Saxon countries. During the decade, the situation remained stable for the United States, while it worsened for the Canada, United Kingdom and Australia: as a matter of fact, in 1980, the share of national income concentration of the top percentile was respectively 8%, 6% and 5%. At this punctual moment in recent history, it is possible to state that all four societies were significantly more equal than they have ever been in recent history.

Starting from the 1980s and until the first decade of the years 2000s, the level of national income owned by the top percentile of the population has strongly improved; as a result, the level of inequality increased in all four Anglo-Saxon countries. Let us see in detail to which extent the changing dynamics that shaped the last three decades affected the structure of inequality in the four countries. Throughout the most recent decades, the range of national income concentration of the top percentile strongly increased: in the United States, it reached a level of 18% in 2010, while it was over 14% in the United Kingdom, 12% in Canada and around 9% in Australia.

Distribution of income in the top 0.1% of Liberal Market Economies

The top 0.1% income share in Anglo-Saxon countries, 1910-2010[73]



The graph above serves as an additional proof of the dynamics depicted throughout our analysis: indeed, the behaviour of national income concentration by the top 0.1% is almost identical to the one of the top percentile, as we depicted in the previous paragraphs. Nevertheless, what is particularly troublesome is that, in this specific case, the diverging patterns of the structure of income inequality are greater than in the previous case: in particular, the share of top 0.1% in total national income in the United States is almost three times greater than the one in Australia (8% compared with 3%, respectively). The analysis of this graph confirms the tendency of Anglo-Saxon countries to have a rather unequal societies on one hand, and on the other, they present increasing diverging structures of income inequality among them.

[73] Source: Piketty, Thomas, *Le Capital au XXIe Siècle*, Éditions du Seuil, 2013.

Conclusive remarks

Data expressed by the graphs analysed in this section present a particular situation: in less than forty years, indeed, the level of income concentration increased in all four Anglo-Saxon countries, hence determining increased unequal societies. Moreover, the expansion of the share of income concentration owned by the top percentile of the United States doubled the one of Australia, and strongly surpassed the remaining two countries. If we further increase the level of accuracy in the analysis, we can see that the share of top 0.1% in total income in the United States is almost three times greater than the one in Australia.

At this point in our study, indeed, it is time for us to start making some strong remarks: not only did income inequality increased within countries in the most recent decades, the dynamics rising from the last decades allow us to state that the structure of income inequality suffered from a dramatic increase also across countries. Is the trend of increased inequalities among countries a peculiar feature of LMEs or is this phenomenon also spread to the other clusters? In order to answer to this question, let us now analyse the same dynamics for the major examples of CMEs.

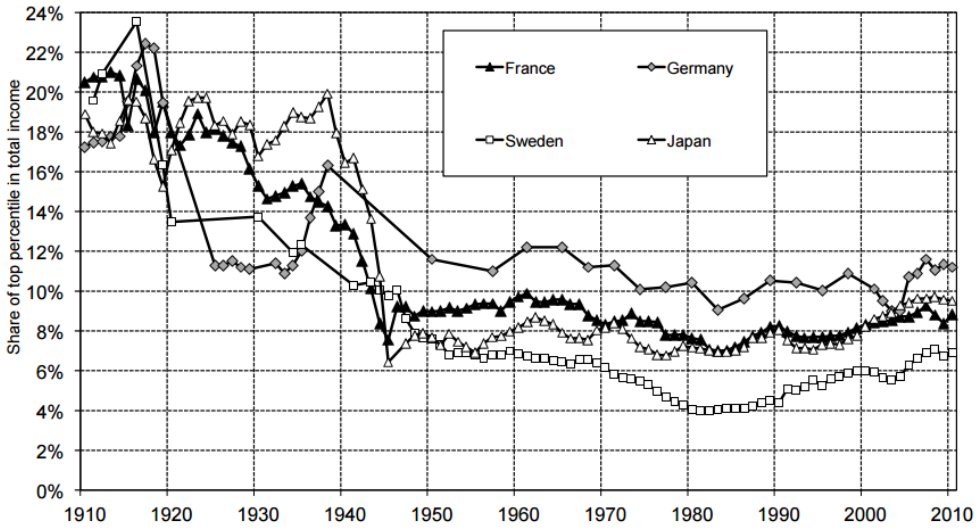
1.3.b. The structure of income inequality among Coordinated Market Economies

In the previous section, the analysis focused on the need to ascertain the changing paths of the structure of income inequality in rather similar countries. By choosing LMEs, our aim was to find a rational basis through which we could start to build a comparable analysis. Indeed, on one side, the analysis of income concentration by the percentile presented a situation of increased income inequality within countries. Moreover, on the other side, we could strongly affirm that, according to the dynamics that rose during the last decades, the structure of income inequality suffered from a dramatic increase also across countries.

The determinant features of LMEs are significantly different, if not opposite, to the ones defining CMEs: not only do they vary with respect to the five characteristics – institutional relations, vocational training and education, corporate governance, inter-firm relations, and relations with employees – they also present diverging approaches to the management of internationalization of markets and globalization. In this section, our aim is to focus on four CMEs and see to which extent the structure of inequality among these countries varied in the last century.

Income inequality in Coordinated Market Economies

Income inequality in Continental Europe and Japan, 1910-2010[74]



The graph above presents the dynamics related to the share owned by the top percentile in France, Germany, Sweden and Japan, from 1910 to 2010. Indeed, it is important to highlight that, at the beginning of the twentieth century, the level of national income owned by the top percentile was similar to the levels found in the United States and the United Kingdom. In particular, France's top percentile owned the greatest share of national income, just above 20%, followed by Sweden, where it was almost 20%, Japan (19%) and Germany (around 18%). The deviation between the France and Germany, however, is rather small: although the societies of these are strong inequalities in the societies of these four countries, the structure of inequality behaved the same way at the beginning of the period of analysis.

The following years and decades first present homogeneous increases in the share of the top percentile in national income, which reaches the level of almost 24% for Sweden. Nevertheless, starting in the late 1920s, all four countries' top percentiles experienced severe drops in their level of income concentration: this decrease was particularly dramatic for Germany, whose top percentile lost almost half of its share of national income in seven years, from 1918 to 1925. France's top percentile also experienced a significant decrease in its income concentration: in 1916, it owned almost 24% of national income, while four years later, in 1920, the share was around 14%. During this period, Sweden and Japan showed a greater capacity to react to exogenous contingencies: indeed, the variation of the top percentile's share of total income was

[74] Source: Piketty, Thomas, *Le Capital au XXIe Siècle*, Éditions du Seuil, 2013.

more limited than it was in the other two countries. Overall, it is possible for us to state that the countries' top percentile followed diverging behaviours regarding the variations of income concentration; nevertheless, it is unneglectable that the levels of inequality deriving from these dynamics were never recovered by any of the countries taken into analysis.

For over two decades – the 1920s to the early 1940s – the deviation of the behaviour of these four countries was significantly great: indeed, it is possible to ascertain that for this period of time the four countries went through different processes, that they had to face different issues and that they found different ways to deal with international challenges. In particular, it is important to remember that Germany was under a dictatorship, that the French territory was one of the main battlefields of the Second World War and that France was a major player during war, together with Japan, which was among the main losers of the conflict. The sum of these dynamics dramatically affected the structure of inequality among these countries, and their outcomes have strongly affected the distribution of income for the following decades.

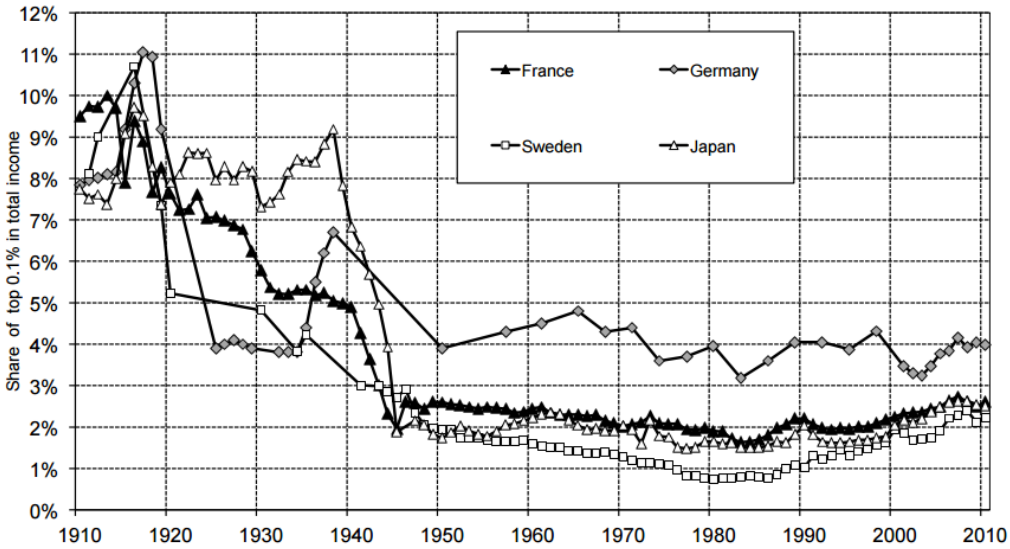
At the beginning of the 1950s, indeed, the deviation among the four countries was significantly reduced; nevertheless, the top percentiles of all countries lost a significant share of their national income. Here, it is important to highlight that the level of income concentration, thus the level of income inequality, was never restored in any of the countries taken into analysis in this section. This is a first point of contrast with the case of LMEs, where all four countries' top percentiles managed to reach similar levels of income concentration prior to the Second World War.

In this perspective, it is fundamental to analyse the behaviour of the four countries taken into account during the second half of the twentieth century. In particular, as we just depicted, the levels of income concentration prior to the world conflict were never recovered; on the contrary, starting from the 1950s, all countries' top percentiles experienced reduced variations. Indeed, throughout the second half of the century, Germany has remained the country whose top percentile detained the greatest share of national income: the share fluctuated throughout the period in a range from 9% to 12%. At the other side of the spectrum stands Sweden, whose top percentile owned a smaller share of national income compared to the one owned by Germany: it remained within the range of 4% to 7% all along the period. Lastly, it is important to highlight that France and Japan presented a similar behaviour, especially from the beginning of the 1980s: the share of national income owned by the top percentile was around 7% in 1980 and it increased to 9% at the end of the period.

To conclude, evidence shows that after a significant period of reduction of inequality, the share of concentration of resources slightly increased in the last couple of decades. Still, the degree of income inequality is much smaller in these CMEs than it is in LMEs; moreover, having reached this level of analysis, it is worth noting that differences across countries is far smaller in the case of CMEs than it was in liberal countries.

Distribution of income in the top 0.1% of Coordinated Market Economies

The top 0.1% income share in Coordinated Market Economies, 1910-2010[75]



The graph above can further detail the statements we have just made. The dynamics that we depicted in the level of income owned by the top percentile are replicated in this case to the same extent. In particular, we note that the top 0.1% experienced the same troubled fluctuations in the first half of the century, and also in this case the share of income concentration strongly decreased throughout the century. At the end of the period, it is possible to note that the levels of income concentration are not only strongly reduced, they are also similar to one another: with the exception of Germany, indeed, we note that in 2007 the share of the top 0.1% in national income is around 2.5% for France, Japan and Sweden, while it is around 4% in Germany.

Conclusive remarks

In conclusion, the trends in income concentration during the last century led to more equal societies in the CMEs we took into consideration, since the level of concentration of income by the top percentile strongly decreased over time. Indeed, compared to the structure of inequality in

[75] Source: Piketty, Thomas, *Le Capital au XXIe Siècle*, Éditions du Seuil, 2013.

LMEs, the share of the top percentile in national income dropped severely throughout the period of analysis and the latter could never manage to restore the levels of income concentration prior to the world conflicts. Moreover, according to the analysis carried out in this section, it is possible to ascertain that there has been a process of harmonization in the structure of inequality among the four countries we analysed: in this perspective, we could highlight that the degree of inequality among CMEs is significantly smaller that in LMEs.

The analysis of income inequality in CMEs proves that there are several reasons to these discrepancies with the case of LMEs. They are strongly relevant to the purpose of our study and deserve a dedicated section. Before deeply and properly analysing all the effects that generate such differences, and in order to have a significant set of data, let us take into consideration one last cluster: developing countries.

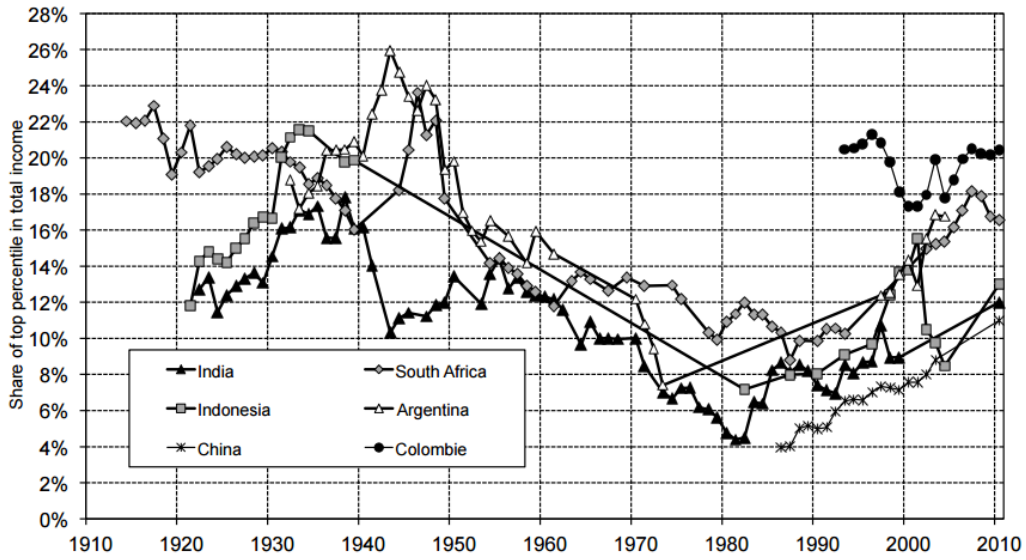
1.3.c. The structure of income inequality among emerging economies

To overview the historical trends in distribution of income, we based our analysis on Hall and Soskice's theory on varieties of capitalism: this provision helped us simplify the discussion and supported our reasoning. Indeed, with the authors' efforts to cluster countries according to their physiological features, we could expand their findings and ascertain that there are strong similarities in the way income inequality is structured within clusters. Nevertheless, it is impossible to ignore the limits of this theory, which sometimes would risk to over-simplify an intertwined scenario.

To overcome these physiological limits, let us now move aside from Hall and Soskice's principles and include into our study a new set of countries. Indeed, the international scenario has strongly changed in recent history: the features of economies shifted in time, new industries rose, and new players improved their relevance in the global framework. In this perspective, we strongly believe that there is a significant interest in analysing the way the emergence of new players could affect their internal structure of income inequality; moreover, our aim is to try and see whether similar patterns have appeared in the process.

Income inequality in emerging economies

Income inequality in emerging countries, 1910-2010[76]



Before starting, it is important to clarify that the set of data available for emerging countries – India, South Africa, Indonesia, Argentina, China and Colombia – are not as complete as the ones we used for LMEs and CMEs. Nevertheless, we believe that because of their significance, we are allowed to use them as a starting point for our analysis and for us to make some considerations.

Let us start by first taking into account the dynamics of the first half of the twentieth century. In this perspective, it is very surprising to realize that there are some emerging countries which present a level of income concentration owned by the top percentile very similar to the one presented in LMEs and CMEs. In particular, the graph shows us that during this period, South Africa's top percentile owned around 20% of national income; also, during the 1920s, the level of income concentration strongly increased in Indonesia, moving from 12% in 1921 to 22% in 1934. Argentina, on its side, presents the greatest levels of income concentration by the top percentile: it was 19% in the early 1930s and it reached 26% in 1944.

During the 1940s, the share of top percentile in national income in the different emerging countries followed diverging paths. On one side, some countries experienced an increased level of income inequality: beside Argentina, South Africa's top percentile improved its degree of concentration of national income, which reached 24% in 1946. On the other side, however, the

[76] Source: Piketty, Thomas, *Le Capital au XXIe Siècle*, Éditions du Seuil, 2013.

situation of the top percentile in India severely worsened: the level of income concentration was almost reduced by half, moving from 18% in 1939 to 10% in 1944.

Another feature that proves similarity with the changing patterns in LMEs and CMEs lies in the fact that the second half of the century enabled the harmonization in the structures of inequality of countries. In this perspective, the graph enables us to state that starting from the 1960s to the early 1980s, the structure of income inequality within emerging countries experienced a significant decrease; moreover, the shares of top percentile in total income among emerging became more similar to one another.

Despite the tendency until the 1980s for inequalities within and among emerging countries to decrease, the most recent decades enabled a significant recovery of the levels of income concentration, which, however, did not reach the levels prior to the 1940s. In particular, it is worth noting that the share of the top percentile in national income in South Africa increased by over ten percentage points from 1988 to 2006, moving from 8% to 18%. Indonesia followed a similar path, moving from almost 8% in 1983 to almost 16% in the early 2000s; however, the top percentile's concentration of income dramatically dropped in the last decade, moving back to the levels of the early 1980s. India, on its side, enabled an improvement of the income owned by its top percentile: the level of income owned by the top percentile was 4% in the early 1980s and it increased by seven percentage points in fifteen years; still this improvement occurred at the end of a long period of recurrent drops in the share of income concentration. Consequently, the levels of income concentration prior to the 1940s were never restored: in 2010, the share of the top percentile in national income was precisely 12%.

The case of China and Colombia

The graph presents incomplete data for China and Colombia: although it would be a levity from a statistical point of view to generalize the implications for these two countries, let us briefly depict the main evidences. Concerning China, it is worth noting that the level of inequality was very modest in the late 1980s: indeed, it was 4% in 1987. Starting from then, China's top percentile started to earn increasing shares on national income: the share almost tripled in less than 25 years, reaching a level of 11% in 2010. With respect to Colombia, the small set of data enables us to pinpoint one major feature regarding the level of inequality: the country seems to experience particularly great levels of inequality, since in throughout the 1990s and the 2000s the share of the top percentile in national income was in the range 17%-22%.

Conclusive remarks

To conclude, the dynamics concerning income concentration and countries inequality in emerging countries are not that far from the results we described in LMEs and CMEs, which are traditional industrialized economies. Despite a more limited set of data, we could still describe the general trends in the share of income owned by the top percentile of a significant number of countries. Concerning the countries for which we have a complete set of data, it is possible to ascertain that the level of inequalities was reduced in all countries, to different extents. Nevertheless, the structure of inequality among countries was not reduced in time; on the contrary, it remained the same as it was in the 1910s.

In this section, we tried to carry out a thorough analysis: the results we just briefly summed up leave to a certain number of queries. The nature of these queries acquire increased significance, since the role of emerging countries in the international scenario is still strongly uncertain. In this perspective, in the next future, the links and relations with industrialized economies – here represented by LMEs and CMEs – are destined to re-shape the global framework. Indeed, it is crucial to deeply understand the mechanisms that link the current structure of inequalities, which we just analysed, with the overall processes of globalization and integration of markets.

Conclusion

In the first section of this chapter, our aim was to understand the recent dynamics in the structure of inequality in the global scenario. To deeply analyse the process, we chose to use the distribution of income as the *fil rouge* of our study. Indeed, at first, we gave great emphasis to the theories revolving around distribution of income, since they have always represented central provisions to enable the study of economic efficiency. In this perspective, we believed they could support us in the process of understanding global dynamics. In this perspective, we introduced the major contributor to the cause and his main findings: indeed, with his environmental curve, Kuznets was able to give theoretical consistency to the relationship between economic growth – industrialization patterns – and the change in inequalities. After having recalled these theoretical principles, we were able to deeply concentrate our analysis on empirical evidence related to distribution of resources: in this perspective, we analysed the evolution of distribution of resources and income inequality over the past century, the transformation of the top 1% wealthiest part of the population, and we carried out a comparison among Europe, the United States and emerging

countries with respect to distribution of income. The aim of these analyses was to evaluate the linkages among the current structure of inequality and the recent trends in internationalization of markets and in globalization: in this framework, our study revolved around the different dynamics that have been shaping the international scenario, and their implications with respect to a new distribution of income.

Throughout this chapter, a relevant number of questions rose: in particular, the aim of the analysis we just conducted was to give a solid basis of empirical evidence to then try and determine the nature of the relationship between income distribution and globalization patterns. Indeed, the current state of globalization is the result of significant changes in the world's economic order, which have drastically re-shaped the international scenario: in this perspective, we ascertained that relevance of emerging countries in the global framework has been increasing, but it is still strongly uncertain. This change is meant to affect traditional industrialized economies, which in this section were represented by LMEs and CMEs. This is why, in the light of the considerations highlighted throughout this first section, the degree of relevance assumed by these queries – with its increased significance – deserves a dedicated section.

2. Focus on income inequality in the age of globalization

Introduction

In the previous section, the focus of the analysis was on the process that determined the recent dynamics in the structure of inequality in the global scenario. First, we focused on the theories revolving around distribution of income: indeed, we believed they could support us in the process of better understanding the current degree of globalization patterns. In this perspective, we introduced the major contributions enabled by Kuznets' studies: indeed, he was able to enable theoretical consistency to the relationship between economic growth – industrialization patterns – and the change in inequalities. Then, we thoroughly highlighted different sources of evidence related to distribution of resources: in this perspective, we analysed the evolution of distribution of resources and income inequality over the past century in the United States and in France. After that, we carried out a comparison among Europe, the United States and emerging countries with respect to distribution of income. All in all, we used the variable of distribution of income as the *fil rouge* of our study.

The aim of these analyses was to evaluate the linkages among the current structure of inequality and the recent trends in internationalization of markets and in globalization: in this framework, our study revolved around the different dynamics that have been shaping the international scenario, and their implications with respect to a new distribution of income. In the current international framework, how is globalization re-shaping the structure of distribution of income among countries? Is it creating rather more equal societies, or are inequalities increasing? This section will focus on the structure of income inequalities and its relations with the processed of globalization and integration of markets.

2.1. Income inequality and globalization in LMEs and CMEs

The methodology we used throughout the chapter enabled us to cluster countries according to their approach to several features – institutional relations, vocational training and education, corporate governance, inter-firm relations, and relations with employees – and we were able to determine the similarities and contrasts among them with respect to the structure of globalization.

As a result, we first built our analysis on the comparison of income inequality structures for Liberal Market Economies and Coordinated Market Economies. In this perspective, we soon realized that the countries belonging to these two clusters were economies with traditional industrialization patters: indeed, they typically were early industrializers which processes had been shaped by the industrial revolutions studied in the first paragraph. Hence, we felt the need to include a set of countries which industrialization processes and which degree of openness towards international market were not as linear as in the case of LMEs and CMEs. In this perspective, we decided to include in our analysis a set of emerging countries.

2.1.a. Globalization and inequality in LMEs

Let us focus for a moment on the way globalization patterns and the structure of inequality are linked to one another in the case of LMEs. Countries belonging to this cluster, indeed, have a political tradition based on the liberalization of the economy: above all, although we already reminded the efforts made by Ronald Reagan in the United States to increase protectionist policies, it is ascertained that the country is the most explicative example of liberal country. From this viewpoint, Canada has showed similar behaviours as the United States: in particular, the country's current Prime Minister, Justin Trudeau, is also the leader of the Canadian Liberal Party. In this perspective, the country's historical tradition has enabled the natural openness of markets towards international trade: starting as a colony, indeed, since the seventeenth century, Canada has always strongly relied on trade of goods. Mr Trudeau once stated that "we have always been dependent on trade with the world, so an anti-trade argument really doesn't get very far in Canada from the get-go"[77]. The United Kingdom has also historically proved to be favourable to liberalization of markets: we already recalled Margaret Thatcher's approach to the economy; in this perspective, it is worth reminding that her view was strongly committed to low taxation and economic deregulation. Lastly, Australia has also proved to have a strong tradition of liberal economic thought: in the country, there are strong commitments towards the importance of individual and corporate rights and the limitation of government intervention[78].

The political and economic tradition of liberal countries have strongly affected their position with respect to internationalization of markets, as well as their degree of openness towards

[77] http://www.economist.com/news/briefing/21709291-why-canada-still-ease-openness-last-liberals
[78] Lynch, Timothy J., *Australian liberalism old and new*, The Conversation UK, 2013.

globalization patterns. In particular, according to these four countries' view on the degree of governments' interventions in the economy, it is possible to ascertain that, except for the punctual waves of protectionism we already depicted, LMEs faced processes of unregulated openness towards globalization. As a result, governments' interventions have been very limited in time: in this perspective, let us recall that the United Kingdom never accepted to become part of the Schengen Area and that Donald Trump is not particularly favourable to international agreements (e.g., NAFTA, which he intends to renegotiate massively). Hence, in these countries, fierce competition in the international scenario might have prevented the structure of inequality from decreasing.

Conclusive remarks

In order to prove the solidity of the statement we just disclosed, it would be relevant to dissert whether there are consistent differences in the way other countries faced the challenges of integration of markets in the international framework; moreover, it would be interesting to analyse whether other countries relied on levers to manage and support such processes.

2.1.b. Globalization and inequality in CMEs

In the previous sections, we clearly exposed the distinctive features of LMEs and CMEs: in particular, we defined CMEs as countries which strongly rely on collaboration and on the establishment of long-term relations. Indeed, it is now time to see whether these features hold in the framework of their exposure on international markets. The analysis we carried out in the last section focus on four countries in particular: Germany, Sweden, France and Japan. If our aim is to understand their degree of cooperation in the international scenario, it is impossible to ignore that three of the four countries belong to the European Union: indeed, the membership to such a relevant supranational organization has strongly affected the degree of freedom of Member States with respect to their room for manoeuvre.

In particular, the process of European integration enabled the creation of a single market, a single external border trade policy for all Member States[79]: the founding intention of European integration was to avoid conflicts through the creation of shared markets for strategic resources.

[79] European Union's Directorate-General for Trade, *What is Europe's Trade Policy?,* Commission's Publication Office, 2009.

Indeed, in the last sixty years, EU Member States have acted as a single entity in the international scenario: bilateral negotiations gradually shifted towards the establishment of a European mediation, which outcomes were significantly more favourable for all Member States, given the increased bargaining power. In time, what had been conceived as a political move became one of the most successful attempts to manage and support the process of internationalization of markets.

Concerning Japan, its geographic location might have prevented the country from finding efficient ways to manage and give emphasis to globalization processes; on the contrary, during the second half of the twentieth century, the country became one of the major economic leaders of the world. Indeed, Japan was able to contribute to the internationalization of markets by improving its share of import and export of goods and services; moreover, and perhaps most importantly, the country was able to lever on past industrialization patterns – which best practices had been imported by early industrializers – and create new business models. In particular, practices such as lean management, just in time production and Toyotism strongly supported the process. In this case, hence, the success of Japan's role in the international scenario strongly relied on the coordinated structure of its companies' network.

Before determining the relationship between CMEs' patterns of globalization and their structure of inequality, let us made a small anticipation on the direction that is taking our study. In this perspective, the example of the Japanese takeover in the process of market integration proves that, at a certain point in time, the focus shifted away from mere mechanisms of import and export of goods and services and moved towards the transfer of aspects related to the production, distribution and use of knowledge and information[80]. In other words, we are wondering here whether we can consider Japan as the first example of "knowledge-based economy": this issue is at the heart of the final considerations of this study, this is why it will be long tackled in the next chapter.

The processes of gradual openness towards internationalization of markets in CMEs prove that the level of coordination and alignment that defined this specific cluster also holds in the case of globalization. Indeed, for European countries as well as for Japan, globalization processes took place in a rather structured and regulated way: indeed, all along the second half of the twentieth century, the degrees of openness of national economies towards global trade improved gradually and mildly. During the same period, as a matter of fact, the level of income inequality in CMEs

[80] OECD, *The Knowledge-Based Economy*, 1996, OECD Publishing, Paris.

progressively decreased. Hence, as opposed to LMEs, mild expansion of market shares in global trade might have enabled an enduring decrease in inequalities.

Conclusive remarks

The processes of openness towards international markets occurred in diverging ways for LMEs and CMEs: on one side, policy implications determined very limited public intervention in the process, while on the other side globalization patters were managed and supported by public regulatory tools and by the introduction of dedicated international and supranational organizations. Consequently, the effects of these diverging approaches to market integration determined opposite results: in the case of LMEs, fierce competition in the international scenario – with very limited public supervision – might have prevented the structure of inequality from decreasing; in the case of CMEs, mild approaches to international competition has coincided with significant decreases in the levels of inequality of incomes.

2.2. Globalization and inequality in emerging countries

In the last paragraphs, we tried to articulate objective statements on the relations that shape the structure of inequality and the patterns of globalization in LMEs and CMEs. Indeed, we are able to do so since the determinants of these clusters are particularly clear and opposed to one another; consequently, we could ascertain that the relations we were searching for were also adverse. Indeed, the analysis we carried out enabled us to state that in the framework of LMEs, fierce competition on the global scenario, without proper regulation, prevented the levels of inequality to decrease significantly. On the opposite, in the context of CMEs, globalization was strongly supported and managed by regulatory tools and by the creation of international organizations: in this perspective, a mild approach to integration in international markets supported the decrease in inequality levels experienced in CMEs.

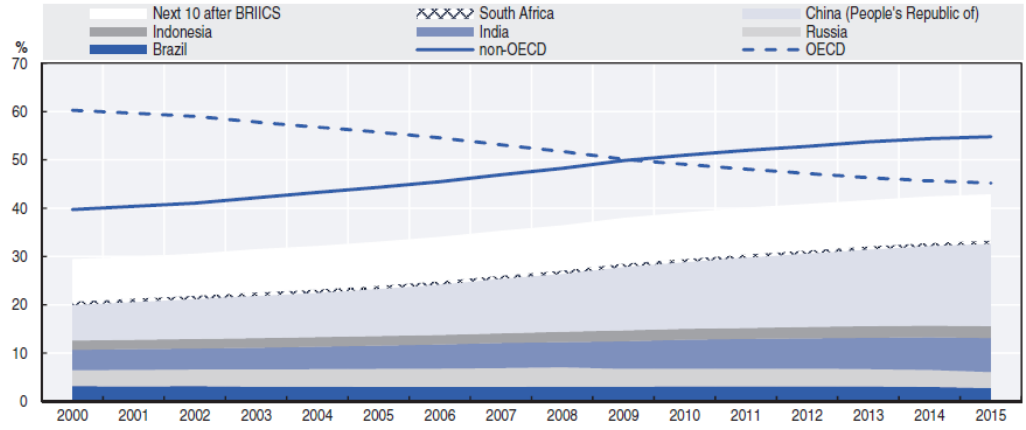
2.2.a. Levels of growth of emerging countries

The role of emerging countries[81] has become significantly relevant in the last decades. In particular, the graph below presents the distribution of global wealth among western economies

[81] OECD, *Perspectives on Global Development 2017: International Migration in a Shifting World*, 2016, OECD Publishing, Paris.

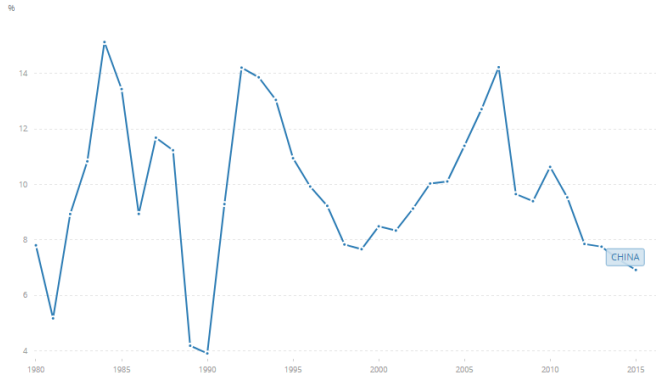
(OECD countries) and emerging economies (non-OECD countries). In 2000, the share of global wealth owned by emerging countries was 40%; in ten years, non-OECD countries increased their share accounted for over 50% of the world's GDP. In other words, in 2010, the world's output was perfectly shared among western traditionally industrialized countries and emerging economies.

Share in global GDP (in %), 2000-2015[82]



In particular, the graph above clearly presents the positive path that China experienced with respect to long-term sustained growth. The country's share in global GDP was below 10% in 2000 (around 7%), while in 2010 it was around 17%: in ten years, the country was able to capture an increase in its relevance in the international scenario equal to ten percentage points. Indeed, the level of growth registered in China during the last decades is impressive: in the last four decades, GDP growth was on average around 10% (author's estimation on World Bank data). The graph below presents a visual representation of the progression in China's GDP growth for the last decades.

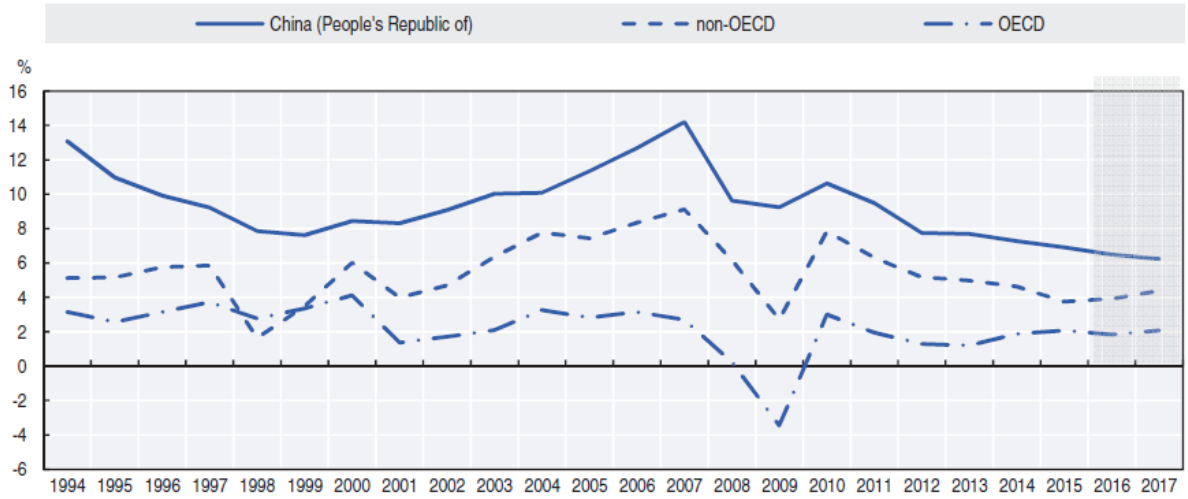
China's GDP growth, 1980-2015[83]



[82] Source: OECD, *Perspectives on Global Development 2017: International Migration in a Shifting World*, 2016, OECD Publishing, Paris.
[83] Source: World Bank national accounts data, and OECD National Accounts data files.

It is interesting to compare the impressive expansion of the Chinese economy with the rest of the world, say with western economies and the rest of developing countries. During the last two decades, the Chinese expansion determined a significant level of growth differential with respect to both categories of countries. Indeed, in 1994, GDP growth in China more than doubled the level of growth in non-OECD countries, while it was over six times greater than in advanced economies. In 2015, the growth differential between China and other economies was significantly smaller: indeed, China's level of growth was over three times greater than in OECD countries, while it was over the doubled in comparison with non-OECD countries. Despite the fact that the differential has been reduced over the years, it is impossible to neglect that the country earned a dominant position in the international scenario.

Growth differentials among China, OECD and non-OECD countries, 1994-2017[84]



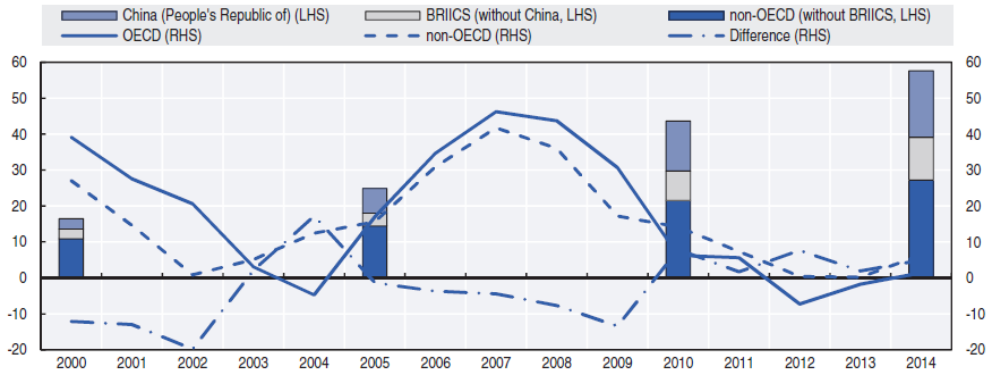
2.2.b. The capacity of emerging countries to attract Foreign Direct Investments

Previously during the chapter, we briefly focused on China: in particular, we stated that the level of inequality was very modest in the late 1980s at around 4%. Nevertheless, the country experienced an increase in inequality, which translated in a level of income concentration by the top percentile equal to 11% in 2010. Indeed, we explained that this increase in the level of inequality was due to the country's openness towards market principles, which began in 1978: such principles, among the significant number of initiatives, enabled the opening up of the country to flows of foreign investments.

[84] Source: OECD, *Perspectives on Global Development 2017: International Migration in a Shifting World*, 2016, OECD Publishing, Paris.

The strong economic development of emerging countries in the last decades, as proven by the Chinese case, raises the question of how the wealth produced in these countries is distribution throughout society. In particular, globalization patterns enabled emerging countries to become significant attractors of flows of Foreign Direct Investments (FDIs) and to grasp relevant positions in the framework of Global Value Chains (GVCs). In particular, in the last decades, emerging countries have been able to lever on inflows of FDIs to further develop and support the countries' growth.

Growth of net FDI inflows (in %, RHS) and share of world's net FDI inflows (in %, LHS), 2000-2014[85]



The graph above presents the growth of net inflows of FDI for emerging countries, as well as the share of the world's net FDI inflows. Regarding the former, the lines in the graph enable us to understand that both OECD and non-OECD countries experienced relevant levels of growth regarding the capacity of attraction of FDI inflows: in particular, in the pre-crisis period, rates regarding the flows of net FDIs were over 30% in both categories. Nevertheless, the crisis strongly affected the structure of internationalization of investments, and the level of growth of FDI inflows decreased to around 5% for non-OECD countries and to 3% for OECD countries. Concerning the latter, still, it is possible to ascertain that the share of the world's net FDI inflows strongly increased in the last decades for emerging countries. In particular, in fifteen years, the part of net FDI inflows owned by non-OECD countries moved from 17% to 58%. Consequently, emerging countries were able to lever on FDIs to develop and further support the growth patterns.

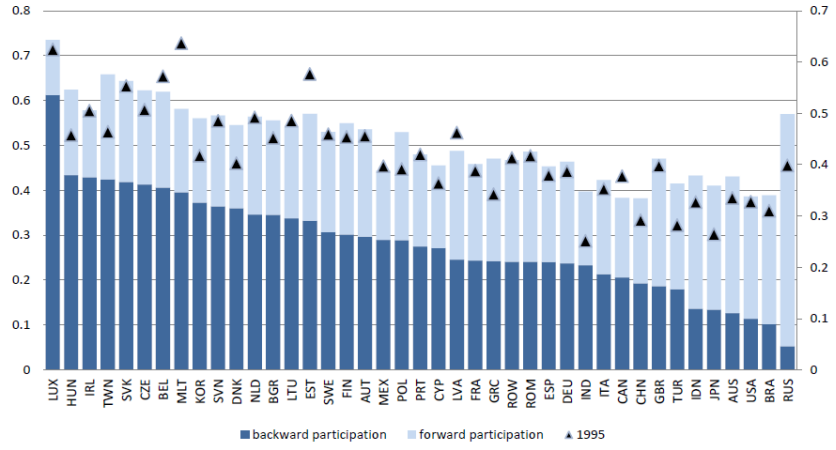
[85] Source: OECD, *Perspectives on Global Development 2017: International Migration in a Shifting World*, 2016, OECD Publishing, Paris.

2.2.c. The role of emerging countries in the framework of Global Value Chains

In the first chapter, we tried to analyse the international dynamics that enabled the emergence of GVS. In this perspective, we determined that the process saw the emergence of international division of labour, according to countries' specialization throughout the value chain. Moreover, we gave great emphasis to the role played by globalization in the enabling of the GVCs: indeed, with reduced transportation costs, limited communication costs, and the emergence of the ICT and its applications in the business environment, multinational companies could strongly lever on the internationalization of production processes throughout the value chain.

Emerging countries strongly benefited from the emergence of GVCs: indeed, thanks to their endogenous features – namely abundant raw material, plentiful and inexpensive labour capital – they were able to become relevant players in the international framework. In this perspective, emerging economies have been playing relevant and diverse roles in GVCs: during the 2000s, they became major exporters of intermediate and final manufactured goods (China, South Korea, and Mexico) and primary products (Brazil, Russia, and South Africa). The degree of participation in GVCs in major economies is presented in the graph below.

Global Value Chains participation, 2009[86]



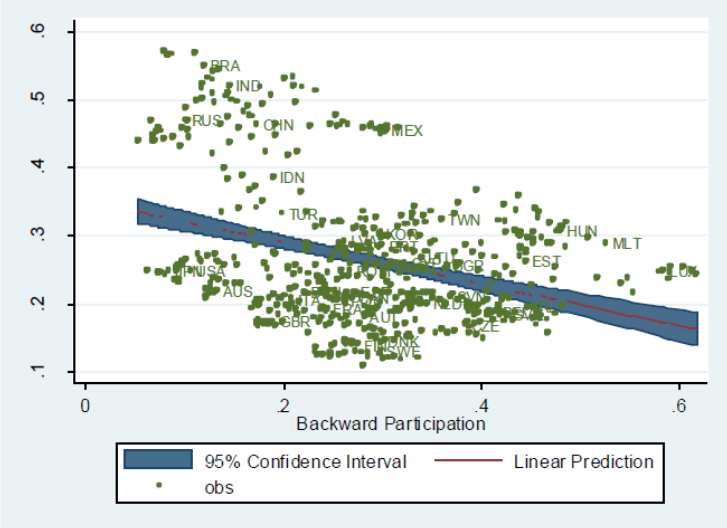
Let us take into consideration the most relevant examples of emerging countries: India and China. Since 1995, their degree of participation in the framework of GVCs have increased significantly; moreover, moving from around an index of around 0.25 to 0.35 in the first case and shifting from 0.3 to 0.35 in the second case. Consequently, we can ascertain that the weight of

[86] Lopez Gonzalez, J., P. Kowalski and P. Achard, *Trade, global value chains and wage-income inequality*, 2015, OECD Trade Policy Papers, No. 182, OECD Publishing, Paris.

GVCs in the countries' business model improved in a relevant way. Moreover, the graph enables us to make a clear distinction between backward and forward participation in GVCs: in the first case, we intend all the buying flows, while in the second the focus is on sale of inputs in international markets. In this perspective, emerging economies are significantly more exposed to forward exposure in the level of participation to GVCs (see in particular Russia and Brazil, but this is also true for India and China).

The way GVCs are structured within countries and the degree at which countries participate in GVCs can be linked to the level of inequality. Indeed, we just described that emerging countries participate in the process with relevant forward linkages. In this perspective, evidence provided by the OECD shows that countries that participate in GVCs with forward linkages (emerging countries) tend to have higher degrees of inequality.

Backward participation in GVCs and wage inequality[87]



Emerging economies are all located in the top-left side of the graph: indeed, their level of backward participation is lower than in the rest of the world, while their degree of wage inequality is significantly greater. In this perspective, it seems that the emergence of GVCs and their development in emerging countries did not support these countries in the reduction of inequality; hence, they might have contributed to the increase in the level of income inequality which we depicted in the previous sections. Consequently, we are able to state that recent globalization patterns – high levels of growth, relevant increases in the share of the world's FDI inflows,

[87] Lopez Gonzalez, J., P. Kowalski and P. Achard, *Trade, global value chains and wage-income inequality*, 2015, OECD Trade Policy Papers, No. 182, OECD Publishing, Paris.

increased relevance in the framework of GVCs – in emerging countries prevented them from developing relevant reductions in the structure of inequality.

Conclusive remarks

In emerging economies, the implications that define the relationship between globalization and the structure of inequality are considerably intertwined. Indeed, all of them contribute, to different extents, to determining changing equilibria in the international scenario. If in the previous paragraphs, we were able to easily ascertain the structure of inequality and its relation with internationalization of markets, in the case of emerging countries we needed to analyse specific economic tools before making any objective consideration. This is why we based our analysis on the concepts of world output distribution, on the ability of countries to attract FDIs and on the participation to GVCs. High levels of growth, relevant improvements in the share of the world's FDI inflows, and increased relevance in the framework of GVCs should have determined a greater distribution of wealth among societies. Still, evidence shows that inequalities have been increasing in the emerging economies: this discrepancy is strongly related to the fact that their participation in the context of GVCs occurs with forward linkages. As a result, globalization in emerging countries has not been fostering a fair redistribution of economic resources.

Conclusion

The relations that tie globalization and inequality in LMEs and in CMEs present rather straightforward results. Because of their different approaches to the openness towards international markets occurred in history, globalization determined different consequences on their structures of inequality: on one side, policy implications enabled very limited public intervention in the process, while on the other side globalization patters were managed and supported by public regulatory tools and by the introduction of dedicated international and supranational organizations. Consequently, in the case of LMEs, very limited public supervision regarding competition in the international scenario might have prevented the structure of inequality from decreasing; in the case of CMEs, the significant decreases in the levels of inequality of income that these countries experienced can be related with mild approaches to international competition.

The case of emerging countries, on the opposite, brings forward a considerably complicated relationship between globalization and the structure of inequality. Indeed, our aim for

this section was to analyse specific economic tools in order to make rational statements on the issue. Thus, we based our analysis on the concepts of world output distribution, on the ability of countries to attract FDIs and on the participation to GVCs. Despite high levels of growth, relevant improvements in the share of the world's FDI inflows, and increased relevance in the framework of GVCs, inequalities have been increasing in the emerging economies. Indeed, globalization in emerging countries has not been fostering a fair redistribution of economic resources.

In the second chapter of our study, we tried to carry out a thorough analysis on historical trends in income inequality: starting from Stiglitz's intention to extend economic studies to the analysis of distribution of wealth and income among individuals, we developed our findings based on Branko Milanović and Thomas Piketty studies. Indeed, Milanović focused on the way globalization patterns and processes of market integration affect the structure of global inequality, among countries and societies; Piketty, on his side, presented the most careful and precise analysis of the current degree of inequalities in distribution of income.

First, we recalled the theoretical implications that link the issues of economic growth and inequality: in particular, we focused on Simon Kuznets' studies, which led to his environmental curve and to his hypothetical curve. Starting from the theoretical groundings enabled by his analyses, we could also direct our attention towards the major critics to the environmental curve, which gave greater impulse to the study of the links between economic growth and changing levels of inequality.

Then, we were able to deeply concentrate our analysis on empirical evidence related to distribution of resources: in this perspective, we analysed the evolution of distribution of resources and income inequality over the past century, the transformation of the top 1% wealthiest part of the population. To do so, we carried out a comparison among Europe, the United States and emerging countries with respect to distribution of income. The aim of these analyses was to evaluate the linkages among the current structure of inequality and the recent trends in internationalization of markets and in globalization: in this framework, our study revolved around the different dynamics that have been shaping the international scenario, and their implications with respect to a new distribution of income.

The empirical analysis of past and current trends in the structure of income inequality among the relevant number of countries we took into consideration enabled our analysis to move towards wondering whether a relationship between the levels of inequality and the patterns of globalization exists. In this perspective, we were able to ascertain that in the case of LMEs, very limited public supervision regarding competition in the international scenario might have prevented the structure of inequality from decreasing. Conversely, we stated that in the case of CMEs, the significant decreases in the levels of inequality could be related with mild approaches to international competition. Moreover, we tried to determine an objective rationale behind recent approaches concerning globalization undertaken by emerging country, and see how they could be related with their level of inequality. Evidence showed while their share in global output increased,

inequalities also increased; we could ascertain that this discrepancy was strongly related to the fact that their participation in the context of GVCs occurred with forward linkages. As a result, we were able to state globalization in emerging countries did not foster a fair redistribution of economic resources.

Despite poor results in the distribution of income, the role of emerging countries has been becoming increasingly relevant in the international framework: the way they manage inequality is destined to strongly affect future patterns of globalization. Indeed, emerging countries are gradually shifting their business model from one of simple subcontractor of western economies to one of true player in innovative dynamics. It seems that technological change, through its capacity to create international markets, has given a relevant impulse to the growth of emerging countries. To which extent are these dynamics connected to technological change? Indeed, the shift towards the development of knowledge-based economy will represent the cornerstone of the next chapter.

CHAPTER 3 – THE IMPLICATIONS OF TECHNOLOGICAL CHANGE IN INEQUALITY AND GLOBALIZATION: THE KNOWLEDGE-BASED ECONOMY

In the previous chapters, we analysed the industrialization patterns that led to the emergence of today's Industry 4.0, or the fourth industrial revolution. Indeed, our aim was to determine the degree of industrialization on one side, to then examine the determinants of the current level of market integration. In this perspective, we determined the most recent trends in globalization, focusing in particular on the global development of the world's output, on the emergence of a regulatory framework for international trade, and we gave great emphasis to the emergence of Global Value Chains, in particular with respect to their nature and to the way they can support global trade.

Then, we tried to determine the evolution of inequalities in income during the last century for a relevant number of countries: indeed, by clustering countries into Liberal Market Economies, Coordinated Market Economies and emerging countries, we could compare and contrast the recent trends in distribution of income. Finally, we sought for the existence of relationships between the structure of inequality and the emergence of globalization processes: in this perspective, our aim was to ascertain whether the nature of these relationships diverged depending on the cluster of countries we analysed.

At last, we were able to determine that the role of emerging countries has been becoming increasingly relevant in the international framework and that the way they manage inequality is destined to strongly affect future patterns of globalization. Indeed, we soon realized that technological change, through its capacity to create international markets, has given a relevant impulse to the growth of emerging countries, which are strongly levering on the increased business opportunities deriving from technological change.

What are the implications of technological change for the internationally-integrated business environment? How is it re-shaping the labour market, and which consequences does it have on inequalities? Indeed, the aim of this chapter will be to determine the drivers that are defining technology and see how technological change is related to the structure of inequalities. These analyses will enable us to define a new stage in the evolution of economic principles: the shift towards the knowledge-based economy will represent the cornerstone of this chapter.

1. The drivers of technological change

1.1. Determinants and nature of technological change

Introduction

In recent times, the relevance of technological change in the business environment strongly increased: not only did it gain significance within national productive systems, it also supported the creation of international markets for trade of goods and services. Indeed, technological change is at the heart of the determinants of globalization: thanks to the emergence of the ICT and to the drop in communication costs – both enabled by technological change – companies could actually expose themselves in the international scenario. Not only did it enable corporations to become international players, technological change also strongly supported the process of openness of a new set of countries towards global trade dynamics.

What is the nature of technological change? Which determinants are responsible for the re-definition of the business industry and the labour market? Indeed, the aim of this section will be to set aside all consideration on globalization and inequality and focus the attention on technological change, in order to understand its determinant features and ascertain its relevance for the purpose of our study. To do so, we will first we will thoroughly examine the determinants of technological change, in particular with respect to the biases it is subject to: in this perspective, we will take into consideration skill-biased change, capital-biased change and superstar-biased change. Then, we will focus on the nature of technology and on the drivers that represent its major features: in this perspective, the attention will be on determining the way technology can be conceived as exogenous and, conversely, the features that define technology as endogenous.

1.1.a. The determinants of technological change

Previously in this study, we deeply focused on the implications of technological change with respect to the current degree of market integration at an international level. In this perspective, we were able to ascertain that the way the structure of international markets developed since the first industrial revolution, as well as significant progresses in the level of countries' openness in world trade are strongly related to improvements in technology.

Indeed, many authors deeply focused on the issue of technological change: among them, Daron Acemoglu[88] presented a thorough analysis on the way technical change can affect inequality and the labour market. Before making any consideration on the issue, our aim is to lever on his findings concerning technology and determine the different approaches to the definition of technology, both regarding the main features defining it, as well as the resulting nature he envisages.

The bias in technical change

To understand the logic behind the determinants of technological change, we consider as crucial the need to illustrate the series of progresses in economic theory that occurred in the recent decades concerning technology. Indeed, in this section, our aim is to present the most classic theories on the production function, and see how they evolved in time, taking into consideration the introduction of changes in technology affected the process.

In this first section, let us focus on one of the most significant models of economic growth. In his studies on growth models, Robert Solow presented growth as a result of factors accumulation: in this perspective, labour, capital and technological change were the only factors affecting the structure of growth. To sum up Solow's findings[89], by taking into consideration only labour and capital, it is possible to ascertain that levels of savings and of population growth determine the stock of capital necessary in the situation of steady state of the economy, as well as the level of income pro-capita necessary in the steady state. In this case, still, it is impossible to explain the level of growth in the long term that many countries have experienced: indeed, with the factors of labour and capital, one the steady state is reached, the output generated by the labour force ceased to increase.

To give an explanation to the long-lasting levels of growth experienced by many countries, Solow decided to introduce the concept of technological change. Regarding the contribution of technological change with respect to economic growth, Solow envisaged that improvements in technology translated into increases in the efficiency of labour: in this perspective, changes in technology enabled the improvements in the levels of output of firms. Consequently, through

[88] Acemoglu, Daron, *Technical Change, Inequality, and the labour market*, 2002, Journal of Economic Literature.
[89] Solow, Robert, *A Contribution to the Theory of Economic Growth*, 1956, The Quarterly Journal of Economics, Vol. 70, No. 1, pp. 65-94.

technological change, countries could experience medium and long-term increases in the levels of income pro-capita.

Indeed, according to Solow, the relevance of technological change with respect to increases in growth is to be found in the fact that only improvements in technology (or in the efficiency of labour, which is turn determined by technological improvements) can affect the rate of growth of the economy. In this perspective, the other parameters (labour and capital) do not affect the rate of growth in the steady state.

It is important to recall the theoretical principles determined by Solow studies: this is because, in his view, the factors we mentioned in the previous paragraph are neutral. In particular, according to his view, the level of production was merely determined by the sum of factor inputs which were transformed into outputs. With changes in technology, the production function shifted towards new levels of output. In this perspective, Solow defined technological change as an aggregate total factor productivity, which improvements were equal to increases in output, leaving marginal rates of transformations untouched for given inputs[90]. As a result, Solow's approach to the issue of growth and technological change determined changes in total factor productivity as factor-neutral.

Conversely, further studies on the issue determined a certain degree of bias in the definition of the factors that support levels of growth: indeed, several determinants, which we will analyse in the coming section, determined the need to re-think Solow's findings, in particular the ones related to neutral factors in the effects of technological change in the production function. Hence, to understand these changing dynamics, we need to introduce the concept of biased changes in technology.

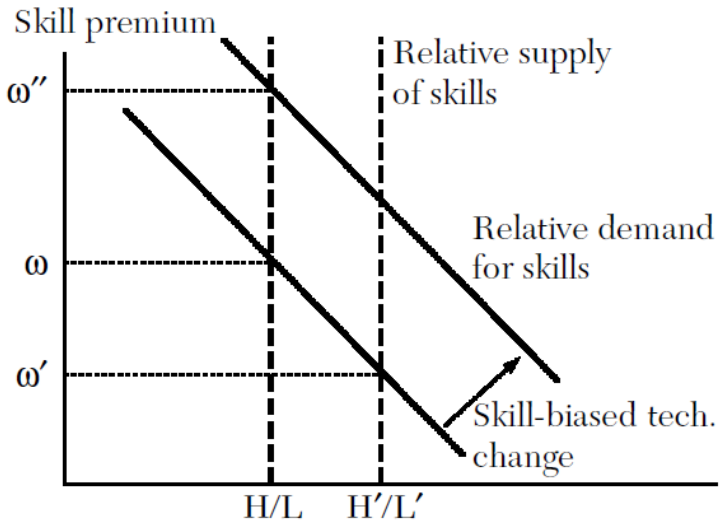
Skill-biased technological change

Recent trends in relevant improvements in the level of technological change determined the need for an increasing number of highly skilled workforce in a significant number of industrial activities. Indeed, changes in the way technology affects productive activities have determined a significant increase in the need of skilled labour, and a consequent reduction of the demand for unskilled labour force. The reason of this trend is to be found in the fact that skilled labour is able to increase its productivity throughout the production function: this is possible because its

[90] Violante, Giovanni L., *Skill-Biased Technical Change*, 2008, The New Palgrave Dictionary of Economics.

education, abilities and experience put the skilled workforce in a more efficient position than it is for the unskilled labour. As a result, the role of skilled workers in production systems becomes increasingly relevant, as well as the demand they are able to generate: in this perspective, they are able to grasps greater wages. Consequently, the weight of the wage of skilled workers on the total amount of wages becomes more relevant, hence determining a skill premium. This phenomenon is at the heart of the notion of skill-biased technical change.

Graphical representation of the skill-bias in technological change[91]



This graph serves as an exemplification of the skill premia and skill-biased technological change. In the horizontal axis stand the levels of supply of skills; in the vertical axis stands skill premium. Indeed, the downward sloping curve represents the classical curve representing the relative demand of skills while the relative supply of skills (H/L, where H represents the highly skilled portion of the labour force and L the low skilled workers) is given, and parallel to the vertical axis.

For any given increase in the relative quantity of labour supplied, the new equilibrium point determines a smaller level of skill premium, since, according to the law of demand and supply, greater availability of one good determine a reduction in the price of the good. Moreover, this graph enables us to understand that a variation in the level of wage premium must be translated in either change in the level of supply of skilled labour, either by a shift in the relative demand for skills determined by technological change. Hence, if we consider that the amount of relative supply

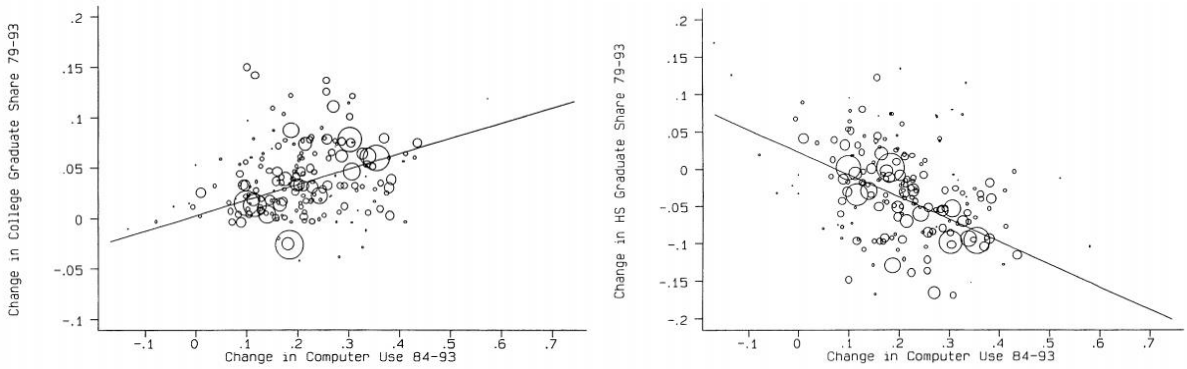
[91] Source: Acemoglu, Daron, *Technical Change, Inequality, and the labour market*, 2002, Journal of Economic Literature.

of skilled and unskilled workers (H/L) is exogenous, then it is possible for us to state that increases in wage premia have been determined by technological change[92].

Several authors tried to present empirical data to the statements we have just described. Indeed, Giovanni Violante[93] ascertained that the ratio between the wage of college graduates and the wage of high school graduates (what we called the wage premium) increased from 1.45 in to 1.7 in thirty years, that is from 1965 to 1995. At the same time, he noted that investments in equipment related to the Information and Communication Technologies (ICT), such as pieces of software as well as hardware, increased by 34 percentage points in forty years, moving from 6% in 1960 to 40% in 2000. Skilled workforces on one side and improved ICT tools have enabled, in the recent decades, a significant amelioration of the productivity of the business environment.

Studies conducted by Autor, Katz and Krueger[94] affirmed that in the United States, in the period 1940-1994, there has been an increase in the demand for highly skilled workers. In the same perspective, they ascertained that relevant improvements in the use of automated tools related to the ICT have been occurring in the industries that have experienced the greatest increases in the demand for highly educated labour. As a result, the authors were able to determine the existence of a relation between the substantial increase in the relative demand for highly skilled workers and the emergence of a skill-biased technological change.

Changes in computer use and industry workforce educational shares[95]



[92] Card, David, and DiNardo, John E., *Skill Biased Technological Change and Rising Wage Inequality: Some Problems and Puzzles*, 2002, National Bureau of Economic Research.
[93] Violante, Giovanni L., *Skill-Biased Technical Change*, 2008, The New Palgrave Dictionary of Economics.
[94] Autor, David H., Katz, Lawrence F., and Krueger, Alan B., *Computing Inequality: Have Computers Changed the Labor Market?,* 1998, The Quarterly Journal of Economics, Vol. 113, No. 4, pp. 1169-1213.
[95] Source: Autor, David H., Katz, Lawrence F., and Krueger, Alan B., *Computing Inequality: Have Computers Changed the Labor Market?,* 1998, The Quarterly Journal of Economics, Vol. 113, No. 4, pp. 1169-1213.

The graphs above present the diverging changes in computer use in different industries according to the education level. On the left hand side, the graph presents a positive relation between the change in computer use and the change in the share of college graduates. On the right hand side, conversely, increases in computer uses are associated with decreases in the share of high school graduates. Consequently, these graphs indicate that industries which have mostly levered on technological change has also moved their occupational mix towards the use of highly educated workers. Hence, focusing on the United States, they stated that the greatest degrees of within-industry growth in the demand of highly skilled labour force occurred in the industries with the highest application of technological improvements.

According to Acemoglu's studies, there has been an acceleration in skill-biased technological change starting from the 1970s. In this perspective, the author presented empirical results on the issue of skill-biased technological change: he focused on the historical evolution of skills development within the labour force. What is most striking, according to his analysis, is that while technological change occurred at constant paces during the twentieth century, evidence shows that the level of availability of skilled workers varied at different rates.

Employment shares and skill-biased technical change, 1940–1990[96]

	Employment Share			Wage Bill Share		
	Some college	College graduate	College equivalent	Some college	College graduate	College equivalent
1940	6.4	6.1	9.3	8.9	12.3	16.7
1950	9.5	7.7	12.4	11.0	11.9	17.4
1960	12.5	10.1	16.4	14.1	16.4	23.4
1970	16.4	13.4	21.5	16.5	21.5	29.7
1980	23.6	19.2	31.0	22.4	28.1	39.3
1990	30.8	24.0	39.3	28.5	36.7	51.0

	$\sigma = 1.4$						$\sigma = 2$					
	Some college		College graduate		College equivalent		Some college		College graduate		College equivalent	
	$\frac{A_h}{A_l}$	D	$\frac{A_h}{A_l}$	D	$\frac{A_h}{A_l}$	D	$\frac{A_h}{A_l}$	D	$\frac{A_h}{A_l}$	D	$\frac{A_h}{A_l}$	D
1940	0.004	0.21	0.016	0.31	0.035	0.38	0.140	0.37	0.303	.055	0.392	0.63
1950	0.006	0.24	0.011	0.28	0.030	0.37	0.146	0.38	0.219	0.47	0.313	0.56
1960	0.013	0.29	0.030	0.37	0.080	0.48	0.189	0.43	0.343	0.59	0.476	0.69
1970	0.017	0.32	0.069	0.47	0.179	0.61	0.199	0.45	0.485	0.70	0.652	0.81
1980	0.042	0.40	0.157	0.59	0.486	0.81	0.270	0.52	0.643	0.80	0.933	0.97
1990	0.090	0.50	0.470	0.81	1.777	1.18	0.357	0.60	1.064	1.03	1.673	1.29

Let us focus on the relationship between the temporary increases in the share of college graduates and on the variation of technology shifts (A_l/A_h) for the same category of workers. The decade of the 1970s represented the period with the greatest increase in the supply of college

[96] Source: Acemoglu, Daron, *Technical Change, Inequality, and the labour market*, 2002, Journal of Economic Literature.

graduates workers: indeed, the employment share of college graduates shifted from 13.4 in 1970 to 19.2 in 1980, determining hence an increase of over 43%. On the opposite, during the same decade, the technological shift registered one of its lowest increase: moving from 0.069 in 1970 to 0.157, it registered an increase of 127%, while, for instance, in the decade after it increased by almost 200%[97].

Consequently, it is possible for us to ascertain that uneven variations in the supply for skilled workers – here represented by the sudden increase in college graduates during the 1970s – might also have determined changes in the structure of inequality, in this case represented by returns to skills. Indeed, focusing on the United States' labour market, Acemoglu noted a relevant increase in the inequality among similarly educated workers.

Throughout the late decades of the twentieth century, the need to determine the relations between technological change and the increased need for skilled workers became a relevant issue in the economic and political debate. Indeed, economists and scholars started to feel the necessity to ascertain to which extent technological change was affecting the labour market and the consequent need for skilled workers. In this perspective, they started to believe that, because of technological change, the wage structure of industrialized economies was shifting towards greater levels of inequality. Hence, they were able to ascertain that technological change – by replacing the most repetitive and less skill-demanding tasks – favoured workers that are more educated and skilled. Consequently, technological change determined an increase in the demand for skills: this process represents the skill bias in technological change.

Capital-biased technical change

In the previous section, we focused our analysis on the way the concentration of resources has been shifting towards workers who own the greatest levels of skills: indeed, we determined that technological change favoured workers that are more educated and skilled, since it replaced the most repetitive and less skill-demanding tasks. Despite the significant turmoil that skill-biased technical change has generated in recent times, there are other sources of bias in the issue we are currently analysing.

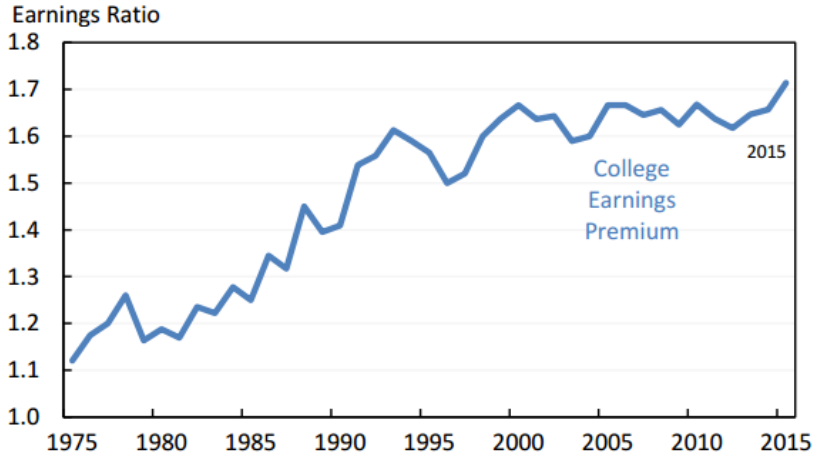
The second insight regarding biases in technical change lies in the increasing share of income that the owners of the capital are grasping at the expense of workers. Indeed, with capital-

[97] Calculations have been made by the author in the purpose of better clarifying Acemoglu's tables.

biased technological change, we move away from the analysis on increased inequality within the category of workers and we try to depict the effects of technological advances in the distribution of resources between the owners of capital and the labour force.

In recent times, scholars and economists have started to assert that it is necessary to go beyond the analyses of resource allocation within the workforce. Indeed, although during the twentieth century such analyses were at the heart of the bias in technical change, in the new millennium the study of college premia might have lost some relevance.

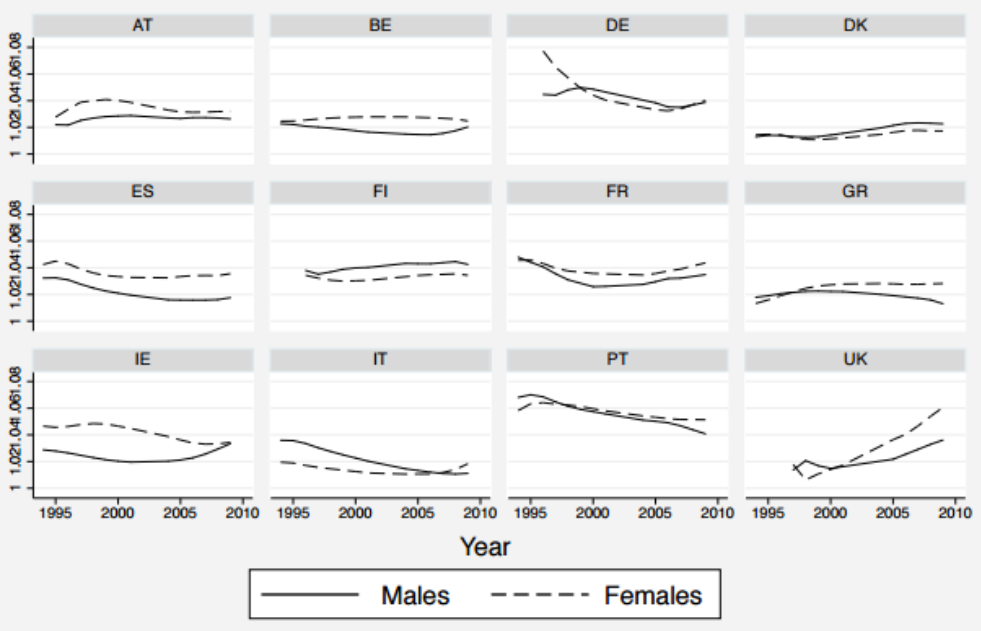
College earning premiums in the United States, 1975-2015[98]



In particular, the sustained pace experienced during the last three decades of the twentieth century did not endure in the early years of the new millennium. Having reached this point in our study, it is interesting to analyse how the skill bias has affected wage premia in the most recent years. To do so, let us also take into consideration a set of countries different from the United States, for the reasons we already ascertained.

[98] Source: Executive Office of the President of the United States, *Artificial Intelligence, Automation, and the Economy*, 2016, White House Archives, obamawhitehouse.archives.gov.

Evolution of college wage premium by country[99]



With the exception of the United Kingdom, the graph above presents similar trends for all European countries, with respect to college premia. Indeed, in the last twenty years, the trends for wage premium for college graduates has maintained a rather stable behaviour, which in some cases was even decreasing. Moreover, the graph enables us to ascertain that these trends are confirmed for both men and women: indeed, women tend to receive greater wage premia in countries such as Austria, Belgium, France, and the United Kingdom.

The results deriving from this graph could suggest that while in the past decades the demand of highly skilled workers outpaced the supply, in more recent times the market of highly educated workers might have become over-saturated. In this way, their dominant position with respect to employers and their deriving bargaining powers might have generated a reduction in the wage premia: hence, gradually, these dynamics might in turn determine a reduction in their levels of pay.

The graph we have just described remarks the divergences with the levels of wage premia related to the levels of education experienced by skilled workers in the United States, where wage dispersion has represented a relevant phenomenon in the recent decades. Indeed, once again, it is fundamental to keep in mind that the level of institutional intervention in European countries – both from a national standpoint and in a supranational perspective – prevent the labour market to

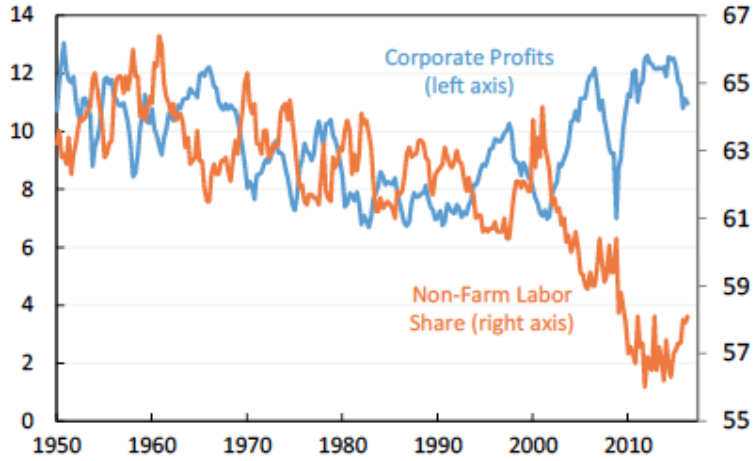
[99] Source: Crivellaro, Elena, *College Wage Premium over Time: Trends in Europe in the Last 15 Years*, 2014, Working papers, Department of Economics, Ca' Foscari University of Venice.

be excessively unregulated. In this perspective, in fact, it is possible to find a rational explanation to this discrepancies among European countries and the situation in the United States; moreover, another possible solution, although perhaps only *de facto*, would find the reason of this divergence in the fact that European industries are less highly-skilled capital intensive industries. Indeed, if we think of the Silicon Valley in California, it is harsh to find a similar counterpart in Europe; still, the level of employment of technological processes in European industries is undeniable.

The results of the study of college premia in Europe in the last twenty years and the evolution in the share of compensation owned by the workforce in the last four decades prove that the skill-biased technological change has significant limitations. This is why, we need to move towards the identification of new sources of bias.

Keeping aside these conjectures, what is certain is that in recent years the situation of skill biases in technological change has experienced a reduction of pertinence. Another explanation supporting this statement is that the relevance of the working force in the overall distribution of income has become less significant: indeed, in the last decades, the distribution of income has been shifting away from labour in favour of those who own the capital and the assets used in all production processes.

The share of compensation of the workforce and of capital owners in the United States (% GDP), 1950-2010[100]



Although there have been several fluctuations in the respective share of compensation detention, the beginning of the new millennium coincided with a true trend in divergence in the levels of resource allocation. Indeed, starting from the late 1970s, the workforce of the United

[100] Source: Executive office of the President of the United States, *Artificial Intelligence, Automation, and the Economy*, 2016, White House Archives, obamawhitehouse.archives.gov.

States' economy has experienced a drop in their income, which was reduced from around two thirds in 1975 to around one half in 2010. The causes of this reduction in income distribution lie in the fact that, as we saw earlier, labour compensation has been increasingly occurring in an uneven way; moreover, starting from the beginning of the new millennium, the distribution of income deriving from productive activities has been benefiting capital owners in spite of the labour force.

Concretely speaking, the dynamics that are pushing asset owners towards owning greater shares of income are quite straightforward. Indeed, the rationale behind these patterns is that, for any given increase in the productivity of capital (induced by improvement in technological processes), the use of the latter will become more efficient, as well as more profitable for those who own it. Conversely, the productivity of labour remains unchanged; however, wages relative to the cost of capital experience a decrease, and so do wages in real terms. Hence, workers are strongly disfavoured by the effects that technological change has on capital owners. All in all, capital-biased technical change has become considerably more relevant in the analysis of the determinants of technological change.

Superstar-biased technical change

The implications of skill-biased technical change might affect distribution of income in a more intense way in the near future. Indeed, while we determined that technological changes strongly affected the way skilled workers earn their share of income, it is now time to examine what happens to those who lever on technological advances to re-shape the way business is organized and the way productive activities are performed.

In this perspective, Brynjolfsson and McAfee[101] further expanded the discussion around biases deriving from technical change: in particular, they recalled the changes in the labour market we analysed in the previous paragraphs, namely the decrease of wages in favour of increases in productivity. Starting from there, they determined that such changing trends are destined to further affect the distribution of income in the future, and particular with respect to those who will mostly benefit from increasing shares of income. Indeed, according to their theory on superstar-biased technological change, they were able to determine that increasing portions of the value produced by companies will be distributed to a very limited number of people. In this way, the concentration

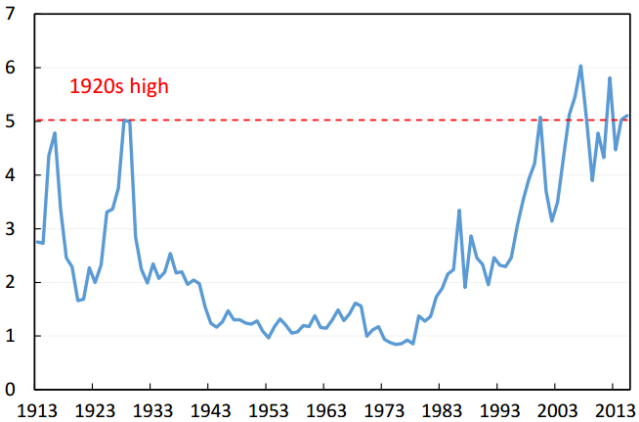
[101] Brynjolfsson, Erik, and McAfee, Andrew, *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*, 2014, W. W. Norton & Company.

of the outcomes of productions will further increase, shifting away from those who are highly educated to those who are considered "superstars". Superstars are typically those individuals who are strongly capable of levering on their special talents to develop new approaches to business-related procedures.

Superstars in the business environment are typically represented by those who were able to lever on technological change to become successful entrepreneurs: the most illustrative examples revolve around people like Sergey Brin and Larry Page, the Stanford engineers who created the algorithm of Google, Mark Zuckerberg and Jack Dorsey, founders of Facebook and Twitter respectively. Hence, superstars are usually people whose piece of software they create can be replicated a zero costs and transferred all over the world within seconds. To a lesser extent, supermanagers – as conceived by Piketty – can also represent examples of superstars: their skills and knowledge are extremely valuable in the business environment, to the point that they can lever on it to increase their share in income concentration.

There are several similarities between superstar-biased technological change and skill-biased technological change; still, their major contrast lies in the amount of people who are able to benefit for technological advances. Indeed, in the case of superstar-biased technological change, the concepts of "winner-take-most" and "winner-take-all" – defined by Brynjolfsson and McAfee – determine that changes in the ICT benefit to a greater extent those who are capable of identifying the answer through technological tools to unsatisfied needs. Consequently, the limited number of those who respond to these requirements is destined to become victors of the market, and hence, to own a great quantity of the income generated by the new industrial activity.

Share of income going to the 0.01% in the United States, 1913-2013[102]



[102] Source: Executive office of the President of the United States, *Artificial Intelligence, Automation, and the Economy*, 2016, White House Archives, obamawhitehouse.archives.gov.

Technological change is meant to drastically disrupt the way the labour market has been conceived since the eve of the first industrial revolution: indeed, what were believed to be mere temporary shifts in the structuration of the labour force are eventually translating into contingent decreases in the demand for workers. In this perspective, superstar-biased technological change has been proving that, in addition to decreasing need for human labour, the share of income that the workforce is able to gather is becoming increasingly less significant, in favour of an extremely limited number of winners – the superstars – who manage to take relevant shares of the result of productive activities.

Conclusive remarks

The implications of technological change on the labour market are starting to become key issues on the political and economic debate. Indeed, in the late decades of the twentieth century, several economists and scholars started to focus on the number of biases that derived from technological change. In particular, they focused on the increasing tendency of demand for workers shifting towards high levels of education: in this perspective, we noted that in the second half of the previous century highly skilled workers were able to detain increasing shares of income – hence receiving a wage premium related to their superior levels of education. Then, we tried to enlarge the spectrum of analysis and we realized that, in the most recent decades, the income concentration of the labour force has been decreasing, in favour of the owners of the assets used in the productive systems. In this case, we were able to determine that the bias in technological change was related to capital – hence, the capital-biased technical change. Lastly, we were able to ascertain that technological advances enabled the emergence of a small category of people – the superstars – who are particularly capable of levering of the ICT to satisfy changing needs. Consequently, their increasing power in the industry determined a "winner-takes-all" situation, where their ability to grasp relevant shares of income in becoming a key issue for the labour market to deal with.

According to the World Economic Forum[103], 65% of children who are today in elementary schools will perform jobs which do not exist yet. To conclude, technological changes are determining long-term disruptions in the way the labour market is structured, as well as for the issue of distribution of income. In fact, changes in productive processes are determining a shift to labour intensive industries to increasing capital intensive ones: hence, as time goes by, the need

[103] Future of Jobs Report, World Economic Forum, 2016.

for workers – be them skilled or unskilled – is destined to decrease significantly. Obviously, the implications of these changes for industrialized and industrializing societies need to be carefully taken into consideration: a significant number of countries may have to face the necessity to find different approaches to the way resources are allocated throughout societies. In the long run, such processes might determine new definitions in the structures of economies.

So far, we tried to define the different determinants of technological change: we did so by focusing on the diverse biases deriving from advancements in technology. Before moving on in our study, we feel the need to briefly analyse the features that define the nature of technological change.

1.1.b. The nature of technological change

In the previous sections, we determined that there are different biases that arise from technological change. In particular, we deeply focused on the skill bias, the capital bias and the superstar bias. We tried to come up with thorough analyses because we consider this issue as a fundamental aspect to understand to which extent technological change is determining the generation of a new economy.

In this perspective, the different approaches to the definition in the biases of technological change – especially skill-biased technical change – can be explained by the way the nature of technology is outlined: indeed, the "pure technological approach", as defined by Acemoglu[104], presents technology as the one feature determining changing levels in the bias. Hence, the purpose of this section is to focus on this pure technological approach which enables us to define technological change as either exogenous or endogenous.

Technology as exogenous

Starting from the beginning of the 1970s and until the end of the twentieth century, the labour force experienced an increase in the level of education that was demanded by their counterpart. In this perspective, the significant degrees of technological advances led to an increase in the skill-biased technological change. As a result, during this period, due to an increase in the

[104] Acemoglu, Daron, *Technical Change, Inequality, and the labour market*, 2002, Journal of Economic Literature.

demand for skilled workers, the labour force experienced an increase in their in their levels of wage, determining hence a skill-related wage premium, which endured until the end of the century.

As we saw in the previous sections, the trends experienced in the last decades of the twentieth century determined an increase in the ratio A_l/A_h, which in turn generated the wage premia we long described. In this perspective, we ascertained that the technological changes strongly contributed to the increasing speed in this skill bias: this occurred in particular in the second half of the century, when the improvements enabled by the ICT strongly affected the distribution of income within the labour force.

As a matter of fact, since the beginning of the 1970s onwards, the relative price of capital equipment started to decline significantly: this dynamic enabled, as we just saw, the improvement in the need for highly skilled workers. This is the heart of the conception of technological change as exogenous: indeed, the reduction in the price of capital equipment is given, it is in fact determined by other dynamics that occur within the business environment. Hence, the nature of technology in this specific case is exogenous with respect to the trends experienced in the labour market. In this perspective, technological change affects the structure of highly educated workers to a greater extent than how it contributes to the enhancement of the wage structure of the less educated. All in all, exogenous technological progresses – the ones determined by a given decline in the relative price of capital equipment – determined an acceleration in the skill bias.

Following a similar perspective, the view of technology as exogenous – say, determined by external forces – gives greater impulse to the enhancement in the need for skilled workers: because of their greater level of education, the latter are more capable of managing the outcomes of technological advances. As a result, the need for skilled workers – say, the demand coming from the industry – will be great in times of increased technological change. Eventually, these dynamics will further increase the level of skill bias deriving from technological enhancement.

If we consider technology as an exogenous variable, moreover, it is worth noting that the effects that it has on the labour force arise from an increasing need to deploy skills which can manage the benefits generated by improvements in the levels of technology. In this perspective, exogenous advances in technology can determine an increase in the productivity of the productive factors (labour and capital). Those who are able to mostly lever on these increases in productivity are those who can manage the technological improvements: hence, the major benefiters from

exogenous technological change result to be workers with the greatest levels of education. As a result, the skill bias is meant to further increase.

The practical applications that derived from the third industrial revolution can be summed up by the creation of the category of the Information and Communication Technologies (the ICT). A significant number of industries were involved in this third wage of disruption; in fact the industrial environment was affected by technological improvements as if it were an exogenous phenomenon, which it could only adapt to. Indeed, starting from the early 1970s, the third industrial revolution strongly re-shaped a several number of compartments; consequently, it had effects all over the industries, including in the way income was distributed among factors of production and within them.

The linkage between technological improvements and the increase in the skill bias during the 1970s is not casual. Indeed, the ICT that were developed during the third industrial revolution represent for many scholars a breaking point with respect to the sum of technological increments deriving from the past. Nevertheless, for other authors[105], the degree of technological change enabled by the third industrial revolution in significantly inferior to the one experienced in the first and second industrial revolutions. For the purpose of this study, and in particular for the great relevance we granted to all industrial revolutions, we decided to leave the reader the ability to discern on this specific issue.

Yet, exogenous technological change is believed to strongly benefit the highly educated workers, since it enables then to develop a comparative advantage compared to workers who own a more limited set of skills. In particular, skilled workers can deal with technical advances in a more efficient way than their counterpart: hence, in times of improvements in the level of technologies employed in productive processes, it is more likely that firms prefer to hire skilled workers over the unskilled.

The sum of the considerations we have made on exogenous technical change find groundings in the implications that the third industrial revolution generated in several productive industries. Nevertheless, it is important to keep in mind that the shift towards the fourth industrial

[105] Gordon, Robert J., *Does the "New Economy" Measure Up To the Great Inventions of the Past?*, 2000, National Bureau of Economic Research.

revolution that we are currently experiencing might generate several re-considerations of this specific issue.

Technology as endogenous

In the previous section, we tried to determine the sum of the elements that define the relationship between technological change and the development of a skill bias as exogenous or given. Conversely, it is possible to determine that recent increments in the level of technology could be the result of an increased attention to profit incentives: in this perspective, considering technological change as endogenous enables the emergence of new considerations on the skill bias.

The first feature that defines technology as endogenous is the demand pulled changes in industries. Indeed, technology improvements might represent the result of processes put into action by firms to provide value propositions that satisfy new kinds of needs. In this perspective, technological change could be seen as demand-pulled: with this statement, we mean that rapid increases in the demand of a specific good or service could determine the development of technological processes to satisfy the arising need and thus it could generate a new industry. Consequently, the new-born industry would be able to attract great levels of investments, hence enabling ulterior possibilities to reach improvements in the technology at stake. If we pursue this reasoning, endogenous technical change might also affect the structure of the skill bias, which in turn could be influenced by profit incentives and by shifting demands.

The second variable related to endogenous technological change concerns market sizes. Greater shares of potential customers increase the need to innovate the industry. To do so, it is necessary to employ new labour resources, who need to be skilled. Hence, this process determines the enhancement of skill-biased technologies. In this perspective, increased levels of the supply of educated workers might lead to the development of skill-biased technological change, since employers might lever more on the employment of highly qualifies workers. This process would, in turn, generate an increase in the demand for skills, which would eventually determine and increase in the skill premia. Hence, endogenous technological change enables us to find a linkage between increased levels of skilled workers and the supply of skills.

Lastly, it is important to highlight that the supply of skills could also be influenced by endogenous factors: indeed, a great variety of incentives might push the labour force towards investing in greater levels of education. The most relevant king of incentive, which can best help

us understand this feature related to the endogenous nature of technology, is the one concerning the wage premia for higher levels of education. As we thoroughly depicted, skill-biased technical change is strongly related to increases in the levels of pay for the most educated: high levels of returns to schooling support workers in the decision to invest in their education; greater levels of education, in turn, increase the skill bias in technological change. Finally, increased skill-biased technological change fosters return to schooling anew. This is an endogenous virtual cycle which further thrives skill-biased technical change.

Conclusive remarks

After having long discusses about the determinants of the biases in technological change, our aim was to determine whether there are diverging natures in the approaches we can use to define it; moreover, we tried to determine if the implications concerning the skill bias might also diverge. Indeed, we were able to ascertain that in the case of exogenous technological change, it has strongly affected the skill bias throughout the third industrial revolution. On the opposite, the case of endogenous technical change represents perhaps a more delicate situation, which main features we still tried to outline: aside from the considerations we made on the demand-pulled incentives and on the implications of the market size, we were able to determine that endogenous technical change imply that new technologies experience a skill bias when the labour force experiences an increase in the level of skills.

Conclusion

Throughout this first section, our aim was to dedicate some attention to the issue of technological change, both from the point of view of the determinants that define it to the different natures such process can experience. To do so, we first deeply covered the issues of the different sources of bias that arise from the concept of technological change: in this perspective, we first focused on skill-biased technical change, meaning the trend that saw the portion of the labour force which was more educated grasp an increasing share of the income generated by all production processes. Second, our attention moved towards capital-biased technical change, namely the tendency for income to move gradually towards the owners of productive assets, in spite of the labour force, because of technological change. Lastly, we ascertained to which extent technological change enabled was the emergence of superstars, who have been able, levering on

new technologies, to concentrate increasing shares of income and who hence determined the notion of superstar-biased technical change.

In the second part of this section the attention moved towards the nature of technological change: we tried to determine the different approaches used to define it; our aim was also to understand the implications concerning the skill bias. In this perspective, we were able to ascertain that exogenous technological change determined relevant increases in the skill biases throughout the third industrial revolution, starting from the 1970s in particular. In the case of endogenous technical change, conversely, we determined a more intertwined situation: to clarify the most relevant features, we made considerations on the demand-pulled incentives and on the implications of the relationship between technological change and the skill bias on the market size. Moreover, we were able to determine that endogenous technical change implied that new technologies experience a skill bias when the labour force experiences an increase in the level of skills.

The issue of inequality, although not expressively arisen, represented a relevant *fil rouge* for this section. With the degree of accuracy in the statistical data we are able to analyse today, it is impossible not to consider the changes that the labour market has had to undertake in the most recent decades: indeed, it is undeniable that the level of inequalities has strongly re-shaped the way the workforce is organized and shaped in today's globalized world. Moreover, it would be unreasonable not to consider that one of the main contributors – if it is not the main cause – of such restructuring of the labour market is represented by technological change.

1.2. Technological change and the emergence of the knowledge-based economy

Introduction

In the previous section, we tried to give great emphasis to the nature of technology and to the determinants that have been defining it. Indeed, our aim was to come up with the major implications that enabled the current degree of technological advancement we are living today, so to analyse its consequences on inequality and on the degree of market integration. In order to come up with objective assertions, we decided to cover the different sources of bias that arise from the concept of technological change: therefore, at first, we defined skill-biased technical change as the

trend of the highly educated share of the workforce grasping an increasing share of the income generated by all production processes. Then, with capital-biased technical change, we depicted the tendency for income to move gradually towards the owners of productive assets, in spite of the labour force, because of technological change. Third, we determined to which extent superstars have been able to employ new technologies to gather superior shares of income: our last focus in this perspective was towards the so-called superstar-biased technical change.

The analyses revolving around the determinants of technological change – in particular the skill bias – represent a crucial issue in the study of technological change. To further understand the resultant dynamics, we determined diverging trends in the nature of technological change. First, on the one hand, we could ascertain that exogenous technological change generated significant rises in the skill biases throughout the third industrial revolution, starting from the 1970s in particular. On the other hand, the case of endogenous technical change demanded greater analytical discernment: to clarify its most significant features, we made deliberations on the demand-pulled incentives and on the implications of the relationship between technological change and the skill bias on the market size. Lastly, we were able to determine that endogenous technical change implied that new technologies experience a skill bias when the labour force experiences an increase in the level of skills.

What has happened since the third technological revolution? Which considerations can we make on technological change in the twenty-first century? The purpose of this section will be to identify the tangible result of technological change in the twenty-first century. Thanks to the work carried out by international organizations – by the OECD in particular – we will be indeed able to give a precise definition of this phenomenon and we will depict a thorough description of this new economic process. This process will help us set the theoretical foundations before making a few last considerations of the implications of technological change in the structure of inequality and in the paths of integration of markets.

1.2.a. The identification of a new economic phenomenon

This long and thorough process provided us with sufficient elements to start making strong – and final – considerations on the way globalization has been affecting both the degree of technological change as well as the structure of inequalities. Indeed, all three elements are strongly

related to one another and they result to be intertwined in the current framework, and it is crucial for us to understand all the key elements that generate the connections among the three.

The aim of this final section will be to determine the ultimate outcome of technological change, which is the results of all four industrial revolutions, and see how it affects the structure of inequalities on one side and the degree of integration of markets – hence, globalization – on the other side.

Theoretical considerations

Which is the final outcome emerging from technological change? In the economic literature, as well as in recent industrial and business practices, a new process has been emerging and hence was identified: the knowledge-based economy is a recent trend that has started to shed light on the effects of technological change and the economic framework[106]. The term knowledge-based economy started to be developed since the early years of the 1990s: indeed, many scholars were beginning to feel that the relevance of knowledge in the industry and in productive activities was gaining increasing weight in the economic debate. In this perspective, they were experiencing the need to measure of impact of knowledge in the economy both from quantitative and qualitative viewpoints.

In 1996, the OECD gave a first definition of the knowledge-based economy: indeed, it determined that it is an economy which is "directly based on the production, distribution and use of knowledge and information"[107]. Moreover, the organization described that the trend that the knowledge-based economies follow takes paths of growth towards investments in high-technology, generates high-technology industries, employs highly skilled labour force and is able to determine significant levels of productivity gains.

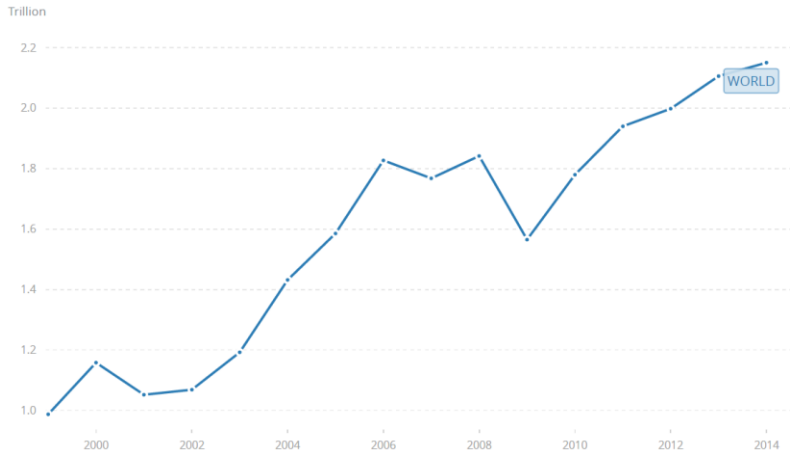
The knowledge-based economy

Through technological change, indeed, industrialized economies have become increasingly reliant on knowledge to develop new activities, to improve the current productive processes, and to remain competitive in the international scenario. The OECD has long analysed the concept of a knowledge-based economy, and today the organization still represents of the major contributors to

[106] Godin, Benoît, *The Knowledge-Based Economy: Conceptual Framework or Buzzword?*, 2003, The Journal of Economic Transfer.
[107] OECD, *The Knowledge-Based Economy*, 1996, in OECD, STI Outlook, Paris.

the cause. Since 1996, other attempts to define this new phenomenon have come from the organization: the most significant effort occurred in 2005, when it described the knowledge-based economy as "the trends in advanced economies towards greater dependence on knowledge, information and high skill levels, and the increasing need for ready access to all of these by the business and public sectors"[108].

High technology exports, 1999-2014[109]



The graph above presents the increased relevance that products and services with a great technological component have been grasping in the international scenario. Indeed, in fifteen years, the value of the exports – in the global framework – of high-tech items more than doubled, moving from 1 trillion dollars in 1999 to almost 2.2 trillion dollars in 2014.

In particular, as we already depicted, the emergence of the ICT has been a great tool to give impulse to the knowledge-based economy: the development of tangible assets that are strongly related to the ICT represented one of the major factor of trade at the international level; nevertheless, as the knowledge-based economy developed, industries for trade of intangible assets – further enabled by the last industrial revolution – became increasingly relevant in the global context. Examples of tangible assets related to the ICT are rather straightforward: one might think about computers, pieces of hardware, industrial machineries and all the wide range of related equipment.

[108] OECD, *The Measurement of Scientific and Technological Activities: Guidelines for Collecting and Interpreting Innovation Data: Oslo Manual, Third Edition" prepared by the Working Party of National Experts on Scientific and Technology Indicators*, 2005, OECD, Paris.
[109] Source: World Bank.

Conversely, the identification of intangible assets fostered by the knowledge-based economy are perhaps less obvious to determine; nevertheless, intangible assets represent today the greatest area of interest related to the knowledge-based economy. In this perspective, let us just name a few examples: pieces of software, patents, copyrights and intellectual property rights as a whole.

In the last couple of decades, the OECD strongly focused on the issue of the knowledge-based economy: indeed, its purpose was to try and determine objective and unopposable theoretical groundings to the development of the interest towards this new element of the economy: therefore, the organization defined two main concepts to enable a clear definition of the matter. With "investment in technology", it tried to give a statistical connotation to the emerging role of knowledge in the economy: this component's purpose was to gather all the expenditures in activities which goal was to improve the existing level of knowledge, as well as to support the increase and the expansion of new kinds of knowledge. The second concept related to the knowledge-based economy was the identification of a revised version of the indicator of high-technology intensity: this revision of the existing indicator enabled the development of measurements of the knowledge-based industries. The main features of such industries were their great degree of investment in the development of innovative products or services, their extensive use of already-existing technologies, and a highly educated labour force.

1.2.b. The main features of knowledge

Now that we defined the concept behind the knowledge-based economy, we are able to outline the different features that illustrate the concept of knowledge. In the purpose of our study, we consider as necessary to understand to which extent knowledge can become a resource that can be trade in markets, and on the contrary, in which cases it is perhaps harsher to lever on to increase profitability.

The first feature: "know-what"

Among the four features[110] of knowledge, there are two of them that economic players can adopt to improve their competitive position in industries and markets. In particular, with "know-

[110] Godin, Benoît, *The Knowledge-Based Economy: Conceptual Framework or Buzzword?*, 2003, The Journal of Economic Transfer.

what", we usually refer to the connotation of knowledge related to the wide range of facts it can enable to determine. In this specific case, knowledge supports the transfer of informational data, which can be classified, clarified and analysed. The "know-what" usually refers to the ability of economic bodies to master the greatest amount of information flows, which can become extremely valuable in specific business areas. Let us think for example about financial brokers: their precise knowledge of the financial industry – broken into an enormous number of bits – enables them to represent highly valued assets in any firm practicing business in the field.

The second feature: "know-why"

The second economic-related feature of knowledge is the "know-why", intended as the sum of all scientific processes that have always aimed at understanding and regulating natural principles. This is where technology plays a major role: indeed, this feature of knowledge related to technological improvements to create new kinds of products, new practices to deliver services and hence new patterns to follow to generate renewed sources of income. The "know-why" enables economic players to frame and regulate technological progress, through organizational tools and specialization patterns. This kind of knowledge is particularly valuable to firms, since it can foster potential sources of additional income: to gather the maximum amount of "know-why", hence, companies tend to invest in research and development departments, which relevant sources of expertise through the hiring of highly specialized and educated workforce, and they sometimes stipulate contracts with laboratories and universities.

The third feature: "know-how"

Third, knowledge is also strongly related to what is commonly defined as "know-how", namely the detention of skills and capacities to perform specific and determined actions. It typically represents tacit knowledge within organizations: since every single individual who is efficiently inserted within the productive framework owns a certain level of "know-how", it is considered as significantly more difficult to identify, codify and measure in the productive scenario. In particular, it is worth noting that this feature of knowledge strongly varies depending on the kind of industry it relates to, on the firm it is associated, and to some extent to the single person who owns it: indeed, it represents the sum of emotions, experiences, insights, and observations that are generated depended on the frames that are used to analyse and understand the dynamics that surround us. To overcome the difficult transfer of "know-how", and of tacit knowledge more generally, individuals and firms tend to widen their business perspective by

joining in organizations and networks that gather other representatives of their markets and industries.

The fourth feature: "know-who"

For firms to improve their level of tacit knowledge, they need to be able to determine which establishments of industrial and social relationships will mostly benefit them in the perspective of improving their competitive position in a given industry. This is where the “know-who” comes into play: indeed, to own a significant understanding of a market, or to know the right people who can help one reach great levels of bargaining power within an industry, are crucial tools to support and manage competitive advantages. From a practical standpoint, the need to develop and enhance the “know-who” finds practical applicability in the increasing trend to give strong relevance to corporate networking: this practice is seizing significant attention in organizational practices, because of its several benefits for companies and individuals.

Conclusive remarks

The understanding of these features represent a theoretical condition in the purpose of defining the effects of the knowledge-based economy in a global perspective. Indeed, the development of technological processes enabled the codification and the management of a great range of knowledge flows, which before were relegated to the field of tacit knowledge. In particular, let us think of the way firms can benefit from big data, which today more than ever are enabling the analysis of huge flows of information, which before was left unexploited. These processes are generating brand new industries and they are determining unprecedented levels of attentions towards knowledge: performing business activities on knowledge has become profitable since due to increased codification capability, knowledge is becoming progressively a commodity firms and industries can use to improve their competitiveness in a given market. To conclude, it is possible for us to ascertain that technological change has been giving great relevance to the economic component of knowledge, hence determining the emergence of the knowledge-based economy.

Conclusion

The previous paragraphs enabled us to understand this new economic phenomenon known as the knowledge-based economy. Indeed, starting from the increased interest in the matter manifested by the OECD at the end of the twentieth century, we could determine that an increasing portion of the economic literature – namely the one focusing on global patterns of economic processes – dedicated momentum to the emergence of a new kind of economy.

From our modest standpoint, our aim is to intend the concept of knowledge-based economy as the ultimate concretization of technological change. For practical matters, the continuation of our study will revolve around the concept of knowledge-based capital, connoted as the productive factor related to the knowledge-based economy. Before moving on towards the last section of this study, let us now focus for a moment on this new economic concept. Indeed, it is possible for us to define knowledge-based capital as the stock of capital which is neither physical nor financial, and which embodies significant levels of technology-related features. The economic literature[111] recognizes three main categories of capital-based technologies: first, computerised information gathers the sum of pieces of software and databases. Second, innovative property embodies all the outcomes of innovation which convey business relevance: in this perspective, we can think of copyrights, trademarks, as well as R&D practices. Third, economic competencies revolves around corporate practices to improve competitiveness: hence, it includes the organizational design, the sum of skills developed within firms, as well as the networks the latter are able to develop and the brand equity as it perceived by consumers.

In order to invest in knowledge-based capital, it is important to understand that they present several differences compared to investments in physical items. First, the knowledge-based capital lacks visibility: indeed, without physical manifestation, it becomes harsh to assess the feasibility and profitability of investments. Second, the use of knowledge-based capital is non-rival, meaning that one's use does not determine scarcity or decrease in the availability of the productive factor. Third, the property of knowledge-based capital is particularly complicated to determine: owners do not have full control over the transfer of the capital and hence returns on investments might be underestimated. Last, this specific kind of capital strongly relies on innovation patterns, which are often uncertain and risky: relying on insightfulness and experimentation, before investing in

[111] Corrado, Carol, Hulten, Charles, and Sichel, Daniel, *Measuring Capital and Technology. An Expanded Framework*, 2005, the National Bureau of Economic Research.

knowledge-based capital one must consider that there might be unexpected sunk cost and that eventually the results of innovation might not bring any incremental value.

Starting from here, our aim will now be to analyse to which extent the knowledge-based economy is determining new patterns in income distribution, and hence see its effects on inequalities. Then, the focus will shift towards globalization: in this case, we will deeply study the effects of the knowledge-based economies in the composition of the world's output.

2. Technological change and the emergence of the knowledge-based economy: focus on inequalities and globalization

2.1. The implications of the knowledge-based economy on inequalities

Introduction

The analysis of the structure of inequalities represented one of the key issues of this study. In the course of the different chapters, we were able to determine that the changing dynamics related to distribution of income have several linkages with technological progress. Moreover, through the study of the structures of inequalities in a wide range of countries, and by comparing the results among the clusters we made, we were able to ascertain that diverging trends in income distribution were strongly related to the way countries managed and supported patterns related to market integration.

How are patterns of technological change and the structure of inequality related to one another? To which extent did innovation in the business environment affect the way income is distributed within societies? In recent years, innovative patterns were strongly affected by increasing investment flows in knowledge-based capital, intended as the sum of the assets that do not embody any physical component: to clarify the matter, we can think about industries such as computer-based information, innovative tools for Intellectual Property Rights (IPRs), as well as innovative habits concerning economic activities. Lately, these new flows of investments have increasingly started to affect productivity growth in a wide range of industries: indeed, while this is true for all industrialized countries, it is important to highlight that there exists significant ways in technological change determine new patterns in distribution of income. Therefore, our aim for this section will be to understand the diverging patterns in the implications of technological changes in the way resources are distributed among firms and societies.

The purpose of this last section will be to make final considerations of the degree of technological change in the framework of market integration and in relation to the structure of inequality. For us to have concrete and practical landmarks, we have tried to identify the result of technological change in the framework of the Industry 4.0, and we came up with the definition of the knowledge-based economy. Starting from there, then, our aim will be to relate it to the current tendencies in distribution of income and to analyse how it affects globalization patterns.

In fact, with the help of the knowledge-based economy, which we identified as the final outcome of technological change patters, the purpose of this section will be to understand the dynamics related to the effects of this new economic phenomenon with respect to the structure of inequality. To do so, our aim will be first to depict the current trends in innovation and resource allocation: in this perspective, we will try to analyse how investments in knowledge-based capital, and its consequent increases in productivity growth, affect allocation of income within countries and across them; moreover, we will try and ascertain the various implications on the labour force and on employment policies. This process will enable us to determine whether, in the era of the knowledge-based economy, resources are allocated efficiently. Then, we will give emphasis to the relationship between the knowledge-based economy and the most recent patterns in globalization: to do so, we will first cover the improvements in GVCs related to technological change, and we will evaluate the need to take into consideration several challenges. Lastly, we will try to determine the policy implications that revolve around globalization and the knowledge-based economy.

2.1.a. Innovation in the current framework

Throughout the analytical process that defined this study, we have been able to determine that technological change induced firms and industries to grant greater levels of attention towards the highly educated share of the workforce. If we assume that the practical economic outcome of the fourth industrial revolution lies in the emergence of the knowledge-based economy, we can then relate this new economic phenomenon to the increased demand of highly skilled workers. Conversely, improvements in the degree of technological applicability across productive lines and value chains have started to determine a drop in the demand for medium and low skilled jobs: indeed, since technical increments have enabled machines to perform a series of repetitive activities, a great share of the less educated jobs have started to become redundant in the framework of the productive processes.

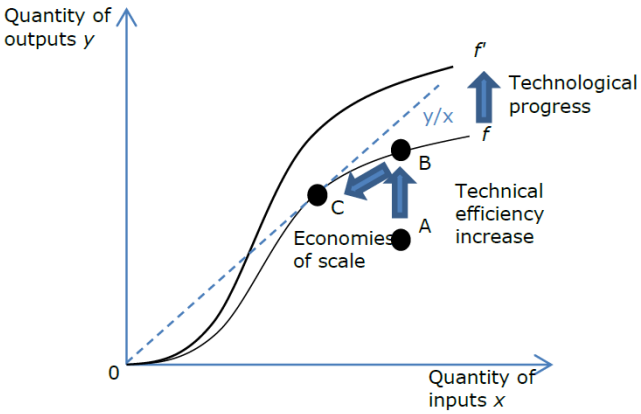
The emergence of digital technologies has determined the ability for firms to codify what was believed to be tacit knowledge until a few decades ago. Indeed, as we saw in the previous section, technological progress strongly affected the features of knowledge: what was embedded in the organizational structure of firms, what was enclosed in each individual's education and training, has recently started to be easily measured and eventually codified. This new capacity owned by firms made knowledge become an extremely valuable – and hence, tradable – good in

most industries; moreover, as time went by, it started to gain momentum in the international framework. Thus, owners of assets and of capital have started to shift the allocation of resources away from labour, in favour of investing greater shares of capital in knowledge. The aim of this section will be to understand the dynamics of these shifts and see to which extent it affected inequality.

The knowledge-based economy and growth in productivity

In terms of economic efficiency, firms which seek increases in their levels of productivity are typically the ones that most lever on technological advances. This was the case, for instance, during the first industrial revolution, when the rudimental machineries enabled unprecedented levels of economies of scale, which in turn determined increases in the efficiency of production. Today, this reasoning needs to be analysed in terms of the implications of the outcomes of the Industry 4.0 in the current framework of production processes and of the economy as a whole. To deeply understand this issue, we can use the level of multifactor productivity (MFP) to analyse the diverging increases in the expansion of the knowledge-based economies among countries. MFP growth[112] is expressed as the ratio between the change in production volumes and the corresponding change in factors that have been used to produce them over a specific period of time. An increase in MFP generates a gain in output quantity which is not originating from an increase in input use. What is most interesting in MFP is that it reveals the combined effects of many factors including new technologies, efficiency gains, economies of scale, managerial skill, and changes in the organization of production.

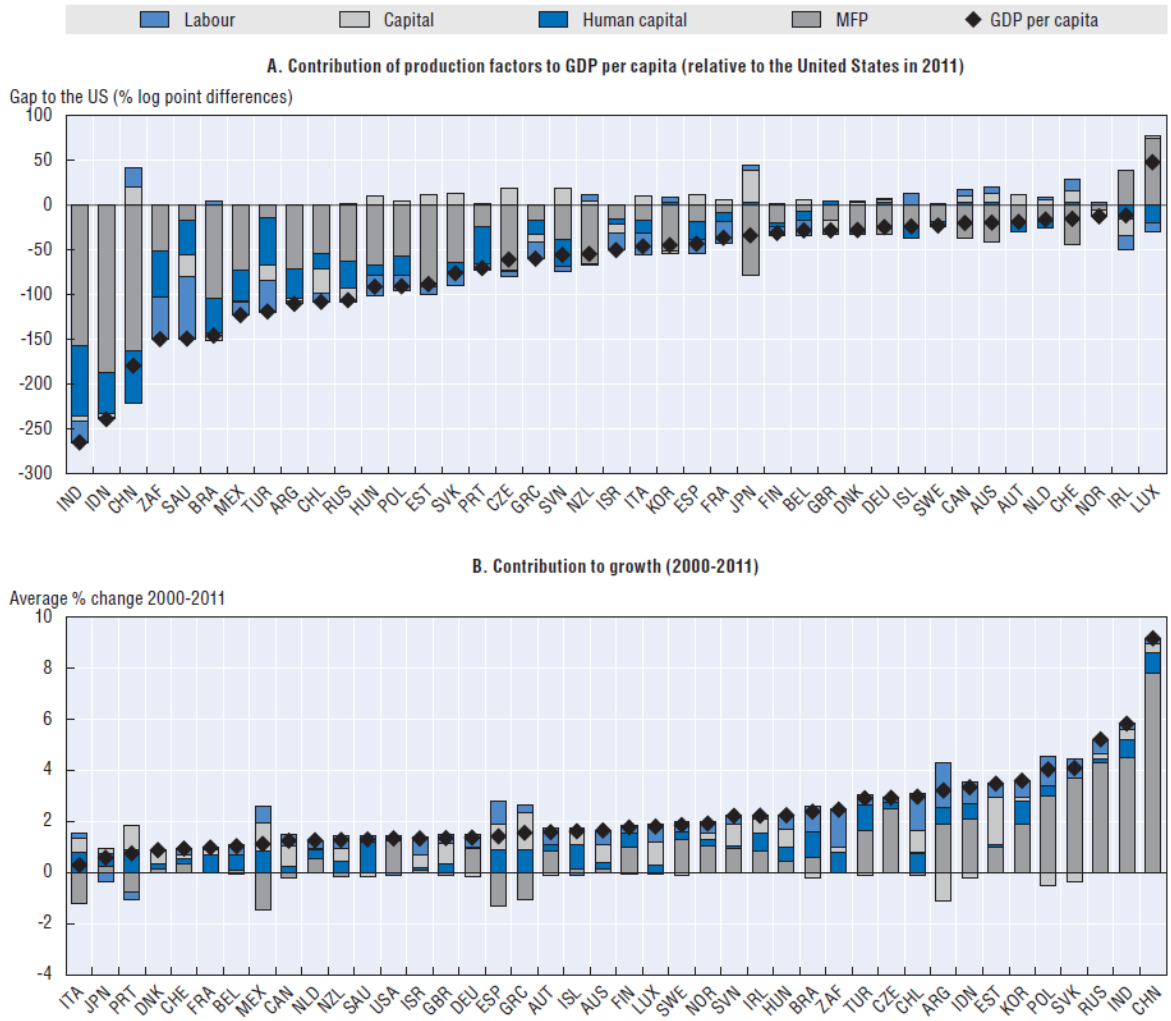
Pathways for productivity growth[113]



[112] European Commission, *Productivity in EU agriculture - slowly but steadily growing*, 2016, EU Agricultural Markets Briefs, European Commission.
[113] Source: European Commission, *Productivity in EU agriculture - slowly but steadily growing*, 2016, EU Agricultural Markets Briefs, European Commission.

The graph above serves as a theoretical illustration of the use we intend to make of MFP. Indeed, by developing new technologies and implementing them into productive processes, the production frontier shifts (from f to f' in the graph). Consequently, this translates into increases of the level of output produced, input left unchanged. Hence, technological progress improves the degree of productivity. Let us now see how this has been working in practice, by focusing on the way MFP has affected the levels of growth in several countries.

Contribution of production factors to GDP per capita (relative to the United States in 2011) and contribution to growth, 2000-2011[114]



The choice behind MFP is not trivial: it lies in the fact that this indicator gathers all the attempts that firms and economies more generally make to improve their competitive position in the market: in particular, this indicator focuses on the efficiency of inputs – both labour and capital

[114] Source: OECD, Supporting Investment in Knowledge Capital, Growth and Innovation, 2013, OECD Publishing. http://dx.doi.org/10.1787/9789264193307-en

–, the advancements in organizational design, in production procedures, and the level of interest towards research and development procedures. Moreover, by focusing on the efficiency of capital, it represents a tool to understand the degree of innovation that firms introduce in their productive processes. Hence, MFP represents the main indicator to measure changes in productivity.

The first panel of the graph above expresses the country differences with respect to the various contributors of GDP per capita, relative to the United States. The interest of this panel lies in the implications that technological change has been generating on emerging countries: indeed, the graph depicts a situation where the gap of income (source of inequality) between traditional early industrializers and emerging economies lies in the great levels of differences concerning MFP. Indeed, if we move our attention towards the second panel, which presents the way the different contributors determine different levels of growth, it is possible to ascertain that emerging economies have been able to converge towards most developed economies thanks to increases in MFP. It is particularly striking to focus on the second panel of this graph, since it gives strong relevance to the contribution of the indicator we are taking into analysis for this paragraph: indeed, for the period 2000-2011, the countries which experienced the greatest levels of growth were emerging countries such as China, India, Russia and Poland. If we concentrate on the composition of their growth, the results are straightforward: in all cases, the major contributor is represented by MFP, which in the case of China, for instance, provided a level of growth of almost 8%.

Conclusion 1

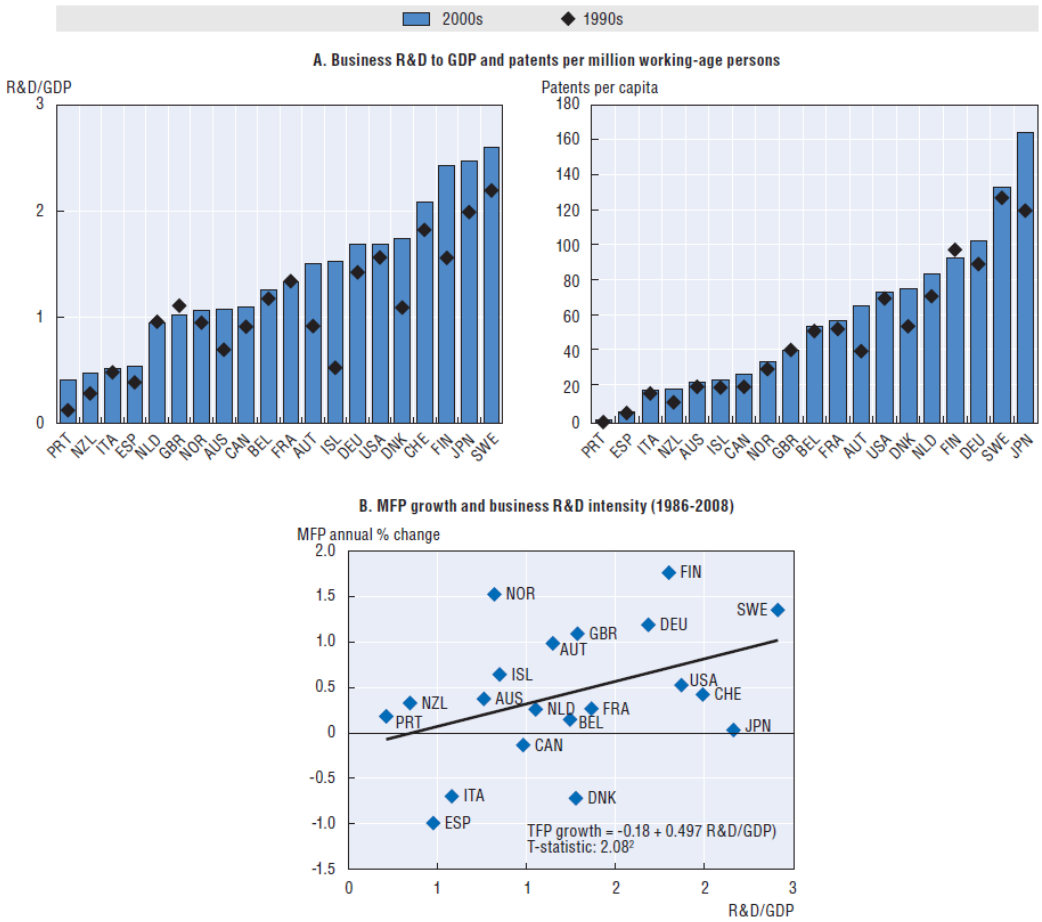
According to this first analysis, it would be possible for us to ascertain that the knowledge-based economy, through its effects coming from increases in MFP, might represent a way for economies to converge in the long-term towards a new equilibrium.

Trends in innovation

The analysis of the first set of graphs enabled us to determine that the knowledge-based economy might foster convergence patterns in the long-run. While our optimistic spirit would encourage us to blindly follow this statement, our economic mind-set cannot ignore macro trends in innovation. In this perspective, it is important to keep in mind that the absolute levels of intensity

of innovation (which is strongly related to both technological change and hence to the knowledge-based economy) strongly differ among countries; moreover, innovation processes are usually concentrated in the major economic leaders of the world.

Business R&D, patenting and MFP performance[115]



Following this perspective, the results emerging from the graphs above are not surprising. In particular, the cluster of countries presenting the greatest levels of R&D relative to GDP is the same which presents the greatest amount of patents per capita. Here, it is important to understand the reason behind this phenomenon: for the purpose of our study, indeed, we believe that great levels of productivity enabled the emergence of patterns towards innovation, which are perhaps not sustainable in economies which performance is not as remarkable.

This trend, hence, determines a vicious circle where economic leaders and industrialized countries continue to concentrate the sources of innovation, in spite of developing countries. To

[115] Source: OECD, Supporting Investment in Knowledge Capital, Growth and Innovation, 2013, OECD Publishing. http://dx.doi.org/10.1787/9789264193307-en

conclude, the latter on the one hand do not enable the investment of comparable amounts of resources to support R&D and innovation processes; on the other hand, they need to rely on the licences of patents coming from early industrializers. This consideration is supported by the third panel of the graph: indeed, it is possible to depict a positive correlation between the level of R&D over GDP and the annual percentage change in MFP.

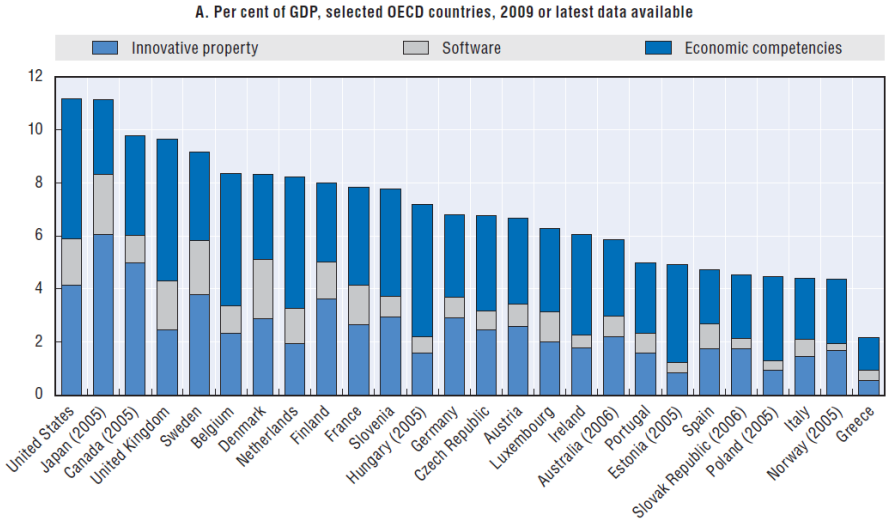
Conclusion 2

Levering on this second set of graphs, it is possible for us to determine that the degree of innovation that takes place within countries, which supports patterns towards greater levels of technological change, is strongly related to the levels of long-term performance of economies.

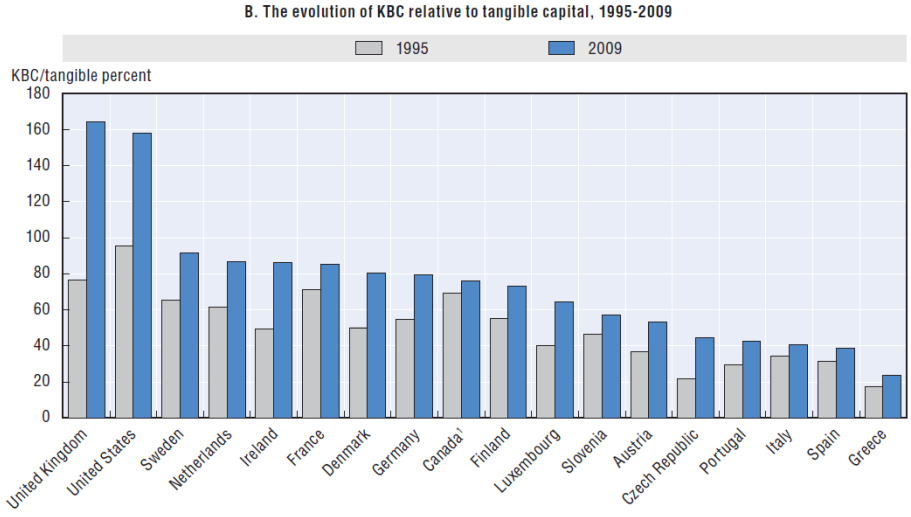
Cross-country divergences in investments in knowledge-based capital

The second set of graphs supported our analysis in a perspective of the dynamics occurring within countries. Let us now focus on the dynamics that take place across the international framework.

Investments in knowledge-based capital among selected OECD countries[116]



[116] Source: OECD, *Supporting Investment in Knowledge Capital, Growth and Innovation*, 2013, OECD Publishing. http://dx.doi.org/10.1787/9789264193307-en



Investments in knowledge-based capital strongly vary across countries: in this perspective, the resources devoted to the improvement of the knowledge-based economy are substantial in early industrializers such as the United States, Canada and the United Kingdom, but they are also relevant in countries like Japan and Sweden. In this perspective, it is important to note that, from a historical standpoint, these countries have acted as leaders in industries related to computerised information (the United States and Japan, especially concerning software) and in the field of innovative property (see the United States and the United Kingdom, with respect to the increasing levels of patents). Moreover and perhaps most importantly, it important to note the use that these countries have made of technological change: indeed, economic literature has proven us that these economic leaders have strongly levered on innovation to re-shape the way industries and companies were organized. In this perspective, let us think of all the recent trends concerning brand equity: this intangible asset has become increasingly valuable in all most profitable companies, and tools deriving from the knowledge-based economy are used to support and develop it in all specific markets.

Moreover, let us great relevance to the patterns followed by countries such as the United States and the United Kingdom, which were able to double the relevance of investments in knowledge-based capital in comparison with the degree of investments in tangible assets. Indeed, their paths are very remarkable, compared to the rest of the selected countries: indeed, no other country was able to experience the level of increase in the attention conceded to investments in intangible assets. Indeed, for these two countries, the degree of investments in knowledge-based assets represented over 150% of the one in tangible assets. The reason lying behind this trend is to be found, once again, in the use made of innovative patterns in the re-definition of the industries in the world's leading economies.

Conclusion 3

Cross-country differences in the degree of investment in knowledge-based capital are strongly related to the way companies use the innovations deriving from technological change: in this case, the existing differences in the relevance in the global scenario are further accentuated by both different levels of investments in knowledge-based capital and in the use they make of it in their key industries.

Conclusive remarks

The study of the levels of innovation in the current framework enabled us to make a few final considerations. First, we were able to determine that the knowledge-based economy, through its effects coming from increases in MFP, could represent a way for economies to converge in the long-term towards a new equilibrium. Nevertheless, we soon realized that this view was perhaps too optimistic: indeed, with a little more accuracy, we could determine that that the degree of innovation taking place within countries, which supported patterns towards greater levels of technological change, was strongly related to the levels of long-term performance of economies. Shifting our attention from internal dynamics to cross-country differences, we could ascertain that the degree of investment in knowledge-based capital was strongly related to the way companies use the innovations emerging from technological change: in this final case, we could conclude that the existing differences in the relevance in the global scenario were further accentuated by both different levels of investments in knowledge-based capital and in the use they made of it in their key industries.

2.2.b. Innovation and resource allocation

In the last section, we have tried to make some conclusions with respect to the way investments in knowledge-based capital have affected different countries. In this perspective, we were able to ascertain that while the knowledge-based economy, through its effects coming from increases in MFP, could represent a way for economies to converge in the long-term towards a new equilibrium, the degree of innovation taking place within countries was strongly related to the levels of long-term performance of economies. Moreover, we could ascertain that the degree of

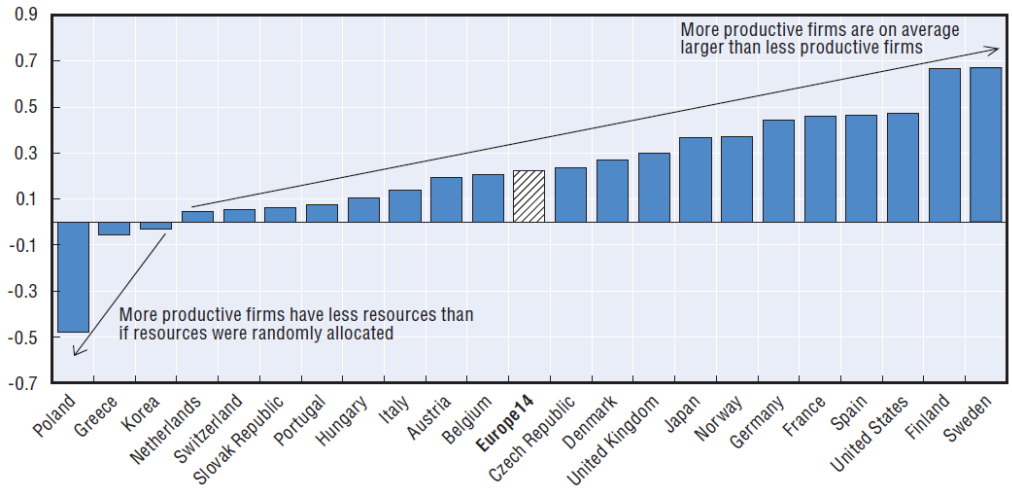
investment in knowledge-based capital was strongly related to the way companies use the innovations emerging from technological change: hence, the existing differences in the relevance in the global scenario were further accentuated by both different levels of investments in knowledge-based capital.

The natural continuation of this analysis lies in the need to understand to which extent technological change affects distribution of resources among countries and within them. To do so, let us now concentrate our attention to the way countries are capable of allocating scarce resources to the most productive industries; then, we will try to determine the relationship between investments in knowledge-based capital and efficient patterns in allocation of resources.

The knowledge-based economy and differences in resource allocation

In the previous section, we were able to determine that flows of investments in knowledge-based capital differed depending on the countries' levels of productivity and general performance. The cross-country differences we already depicted, hence, determine relevant divergences with respect to the way scarce resources are allocated to innovative industries and firms.

Covariance across firms between firm size and manufacturing labour productivity (log points) for selected OECD countries, 2005[117]



The graph above presents the difference in the ability of countries' firms to channel resources towards the most innovative and productive industries. The divergence that is presented in this graph is particularly significant: indeed, it determines that there are relevant country

[117] Source: OECD, *Supporting Investment in Knowledge Capital, Growth and Innovation*, 2013, OECD Publishing. http://dx.doi.org/10.1787/9789264193307-en

differences in the degree of the most efficient firms to grasp market shares. In particular, we are able to ascertain that firms which are capable of developing productivity increases tend to detain a greater portion of the manufacturing workforce. Moreover, we are able to determine that, once again, traditional economic leaders tend to foster a business environment that enables more productive and innovative to flourish: in the long-run, as shown by the graph, they tend to become larger than firms which are less productive.

In almost all countries taken into consideration in the graph above, it is possible to determine that there is a positive covariance between the levels of productivity and the structure of employment. In this perspective, it is important to understand that the current allocation of the labour force in the leading economies supports the productivity of workers.

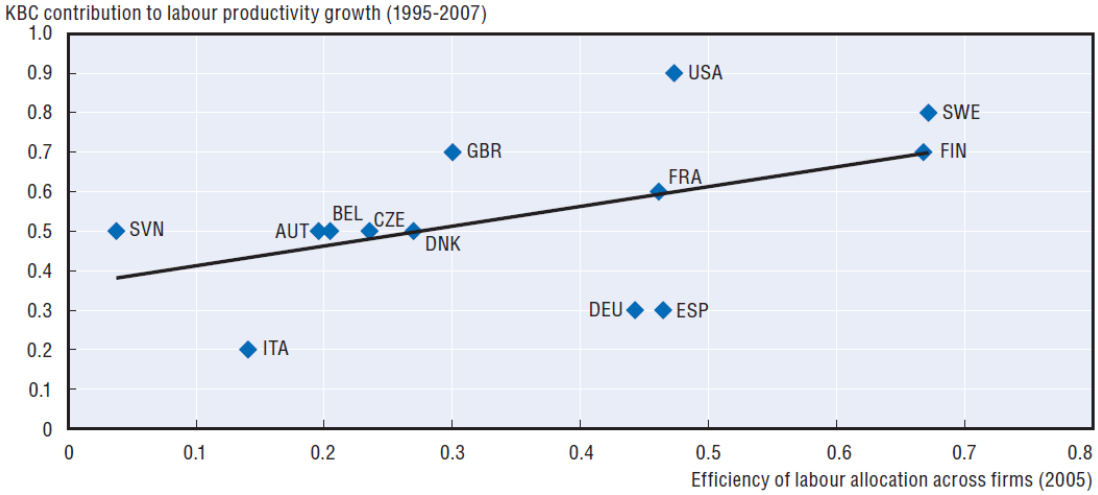
Conclusion 4

In a relevant number of countries, distribution of income is becoming increasingly concentrated in firms who tend to invest greater amounts of resources in innovation and in patterns towards increases in productivity.

Towards efficient resource allocation

So far, we have been able to ascertain that countries which are able to drive resources towards the most productive industries tend also to be the world's leading economies. In this perspective, it is important to keep in mind that the structural frameworks of countries can affect significantly the way the transfer of productive factors can occur. Indeed, while one would believe that resources are most efficiently transferred in the most liberal economies, empirical evidence presents diverging results.

Knowledge-based capital deepening and efficiency of resource allocation[118]



The outcomes of this graph, indeed, are quite surprising: while we determined that there is a positive correlation between knowledge-based capital contribution to labour productivity growth and the efficiency of labour allocation across firms, the composition of this correlation is worth being analysed.

The United States represent the country which mostly levers on knowledge-based capital to improve its labour productivity: indeed, previous analyses also tend to confirm this statement. Moreover, the United Kingdom also presents relevant levels of knowledge-based capital deepening. In the framework of our study, it is possible to relate this trend to the fact that these countries are the typical Liberal Market Economies, which, indeed, strongly support little interventions by Governments in order to let the markets act freely; it is in fact in this way that these countries believe to convey the greatest level of efficiency towards their economy. Nevertheless, these countries present small degrees of efficiency in the way the labour force is allocated across firms. Conversely, countries that present the greatest levels of efficiency of labour allocation across firms also show interesting degrees of contribution of knowledge-based capital with respect to labour productivity growth. The countries at stake can be related to the cluster of Coordinated Market Economies we deeply studied in the previous chapters.

[118] Source: OECD, *Supporting Investment in Knowledge Capital, Growth and Innovation*, 2013, OECD Publishing. http://dx.doi.org/10.1787/9789264193307-en

Conclusion 5

The knowledge-based economy fosters better resource allocation in Coordinated Market Economies: indeed, these markets strongly rely on Governmental intervention in key matters, and the efficiency of labour allocation must certainly represent one. If labour is efficiently allocated in the most productive industries, it is likely that the workforce will be resilient to technological change. Hence, the knowledge-based economy affects to a lesser extent the structure of inequalities of CMEs than LMEs.

Conclusive remarks

The aim of this section was to understand the dynamics related to the emergence of knowledge-based economy with respect to resource allocation. By considering the efficiency of the labour force allocation, indeed, we have been able to make strong statements on the matter. In particular, the analysis we carried out enabled us to understand that in a relevant number of countries, distribution of income is becoming increasingly concentrated in firms who tend to invest greater amounts of resources in innovation and in patterns towards increases in productivity. Moreover, we were able to pursue our analysis in the framework of country clusters as they were intended by Hall and Soskice in their Variety of Capitalism theory. In this perspective, we could determine that the knowledge-based economy is capable of fostering better resource allocation in CMEs, since these markets strongly rely on Governmental intervention in key issues. Therefore, we were able to ascertain that in CMEs the efficient labour allocation towards the most productive industries supports resilience with respect to technological change.

Conclusion

For the purpose of our study, the definition of the impacts of the knowledge-based economy on the current structures of inequality was a crucial aspect to consider. To do so, we always tried to keep in mind the way we carried out the analysis of the current structure of inequality in the previous chapter: in particular, it was crucial for us to understand cross-country differences, in order to keep the frame in the global scenario.

We started our analysis by taking into consideration innovation and inequality in the current framework: in this perspective, we covered the issue of the knowledge-based economy and its implications in growth productivity. We could determine that through its effects coming from increases in MFP the knowledge-based economy could represent a way for economies to converge in the long-term towards a new equilibrium. This optimistic view was soon replaced by further analyses: indeed, we could ascertain that the degree of innovation within countries, supporting patterns towards greater levels of technological change, was strongly related to the levels of long-term performance of economies. Third, our analysis enabled us to state that cross-country differences in the degree of investment in knowledge-based capital were strongly related to the way companies use the innovations deriving from technological change. Existing differences in the relevance in the global scenario were further accentuated by both different levels of investments in knowledge-based capital and in the use they made of it in their key industries.

In the second part of this section we were able to understand the relationship between resource allocation and the structure of inequality. Eventually, we could determine that while there was a positive correlation between investments in knowledge-based capital and the efficiency of labour allocation, distribution of income was becoming increasingly concentrated in firms who tend to invest greater amounts of resources in innovation and in patterns towards increases in productivity. Lastly, we could move back to our theoretical milestone – Hall and Soskice's Varieties of Capitalism – and determine that the knowledge-based economy fostered better resource allocation in Coordinated Market Economies, hence determining greater resilience capability with respect to technological change. Finally, we could conclude that the knowledge-based economy affected to a lesser extent the structure of inequalities of CMEs than LMEs.

2.2. The implications of the knowledge-based economy on globalization

Introduction

In the previous paragraphs, we tried to give strong emphasis to the emergence of a new economic phenomenon, which we identified as the final result of technological change in the twenty-first century: indeed, starting from the features of the fourth industrial revolution, we were able to ascertain that the Industry 4.0 enabled the emergence of the knowledge-based economy.

Giving great relevance to this new phenomenon, our aim was to determine its implications in the frameworks we mostly covered throughout this study.

In particular, we already deeply analysed the linkages between the knowledge-based economy and the way scarce resources are allocated: in fact, in the previous chapters, we largely covered the analysis of the structure of inequalities within countries and among them. To further detail our argumentation, we felt the need to continue this path and determine the wide range of implications of this new economic phenomenon on inequalities. We were not surprised by the different considerations we were able to make: indeed, we were able to determine that through its effects coming from increases in MFP, the knowledge-based economy could represent a way for economies to converge in the long-term towards a new equilibrium. Still, by further detailing our research, we determined that the degree of innovation within countries, supporting patterns towards greater levels of technological change, was linked significantly to the levels of long-term performance of economies. We also focused on cross-country differences, stating that divergences in the degree of investment in knowledge-based capital were strongly related to the way companies use the innovations deriving from technological change. By looking at the relationship between the knowledge-based capital and the efficiency of labour allocation, we ascertained that distribution of income was becoming increasingly concentrated in firms who tend to invest greater amounts of resources in innovation and in patterns towards increases in productivity. Finally, we stated that the knowledge-based economy fostered better resource allocation in Coordinated Market Economies, hence determining greater resilience capability with respect to technological change; we could conclude that the knowledge-based economy affected to a lesser extent the structure of inequalities of CMEs than LMEs.

Which is the counterpart of the emergence of the knowledge-based economy in the process of market integration? Would it be possible for us to replicate the analysis we carried out for inequalities in the framework of globalization? Our aim for this last section lies in the need for us to ascertain the effects of technological change in the way globalization patterns are taking place in the twenty-first century. To do so, here again, we will lever on a phenomenon which we deeply focused on during the first chapter of this study: indeed, it is possible for us to consider the emergence of Global Value Chains as the concrete manifestation of economies' attempts to join the process of market integration. Hence, through GVCs, our aim is to determine the effects of the knowledge-based economy on globalization. In this perspective, we will first concentrate on the ability of firms to capture more value by upgrading in the GVCs: in particular, we will determine

whether the knowledge-based economy is capable of driving greater value in the process. Then, we will shift towards the wide range of challenges deriving from patterns of integration into GVCs; lastly, our aim will be to make a few considerations related to the policy framework.

2.2.a. The upgrading of GVCs and future challenges

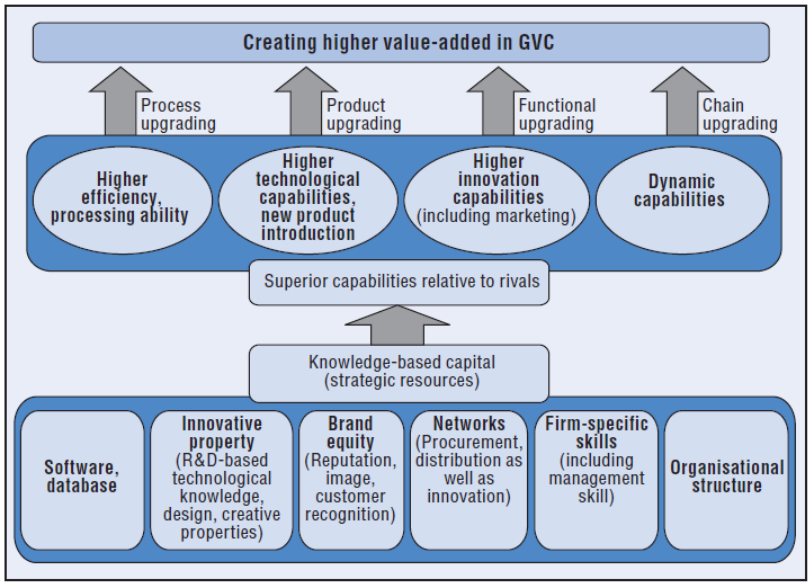
Throughout this study, we granted great attention to the emergence of GVCs in the international scenario: indeed, we tried to understand the extents to which this new economic practice shaped and supported the nature of competition and the process of integration of markets. We analysed that across the twentieth century, economies as a whole, as well as industries and firms, have started to rely heavily on the internationalization of economic activities related to the value chains; nevertheless, we also described that the way countries engaged in GVCs was determined by significant divergences in their approach to openness towards international markets.

To which extent does the knowledge-based economy affect these divergent patterns? Would it not rather enable convergence? By focusing on the integration of countries in the process of GVCs, our aim for this first section will be to evaluate the value generated by the knowledge-based economy in paths related to integration of markets and globalization. To do so, we will consider the way through which the knowledge-based economy is capable of changing countries' competitive advantage in an intertwined and challenging environment: we will try to determine whether it changes it in a positive or negative way.

The knowledge-based economy and the improvement of GVCs

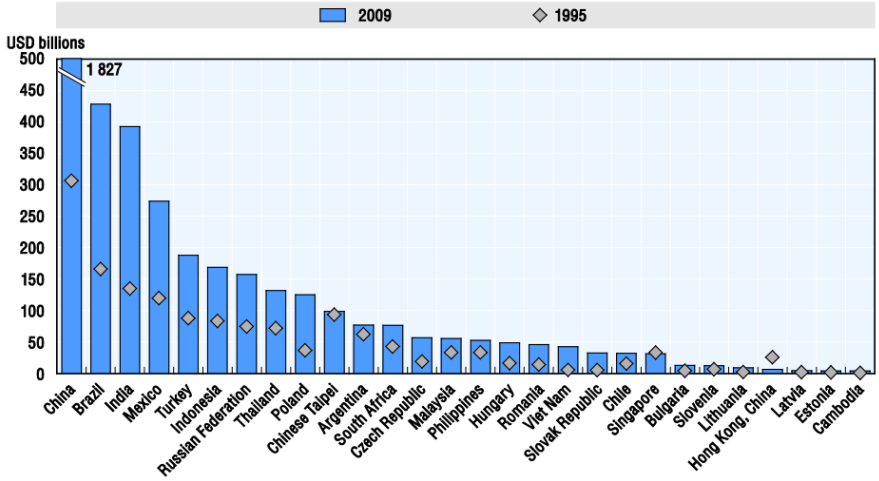
In order to be competitive in the international environment, national economies ought to rely heavily not only on their competitive advantage; they should be able to identify the greatest amount of key industries through which they can offer high levels of value-added. Value-added, indeed, represents the way firms are capable of increasing the price or the value of a good they sell or a service they provide, starting from the amount of resources they need to employ in productive activities.

A resource-based view of upgrading in GVCs[119]



Technological advancement can strongly support firms in the process of improving their ability to create value-added: indeed, in the previous sections we saw the extent to which technological change affects production lines, on the one hand, since it improves the levels of investments in knowledge-based capital. Moreover, on the other hand, it strongly affects the composition of labour, giving great momentum to highly skilled workers. Consequently, products that present remarkable features – deriving from the superior value-added – are destined to find relevant competitive positions in the international framework.

Value-added in manufacturing GVCs for selected emerging countries, 1995-2009[120]



[119] Source: OECD, *Supporting Investment in Knowledge Capital, Growth and Innovation*, 2013, OECD Publishing. http://dx.doi.org/10.1787/9789264193307-en

[120] Source: OECD/WTO Statistics on Trade in Value Added, (database), April 2013, doi: 10.1787/data-00648-en.

In this perspective, the graph above presents interesting results regarding the effects of value-added in emerging countries: the first remarkable consideration lies in the fact that all emerging economies experienced relevant increases in the levels of value-added in their manufacturing industries. Indeed, it doubled in countries such as Brazil, India and Mexico, while it became six times larger in China, for the period 1995-2009. Here, it is worth noting that emerging countries underwent processes related to GVCs in order to enable patterns of specialization: consequently, they have become key players in the manufacturing industry thanks to the significant number of firms operating in the industry and thanks to the employment of great shares of the labour force.

This argumentation is valid for an increasing number of industries: if, in the past, emerging countries represented mere subcontractors for multinational firms to lever on – because of their reduced costs – today, thanks to the development of the knowledge-based economy and to the emergence of GVCs, they have become key players in the international scenario. Indeed, technological change has strongly supported the shift of these economies from simple executors to solid economic players: in particular, it is worth reminding that technological advances deriving from the fourth industrial revolution enabled the creation of high-technologies industries which today strongly affect emerging countries' competitive advantage. To become key players in these industries, emerging countries have had to heavily invest in the education of their labour force, in order to have skilled workers who could support their shift towards the development of these new industries. These practices, in turn, gave strong impulse to their emergence in the framework of GVCs. This process, hence, has enabled them to build a solid and significant competitive advantage in the international scenario, which in turn gives them increasing degrees of bargaining power.

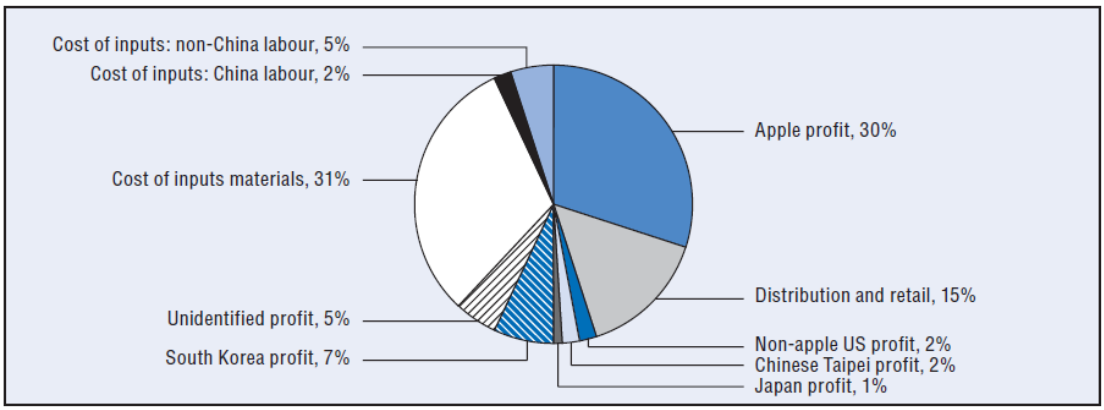
Conclusion 1

If we take into consideration emerging economies, it is possible to ascertain that countries, which have been able to lever on the knowledge-based economy to improve their level of value added, have in time become key players in the GVCs scenario in relevant and profitable industries.

Challenges deriving from the knowledge-based economy

The current world equilibrium is a lot different than it used to be in the twentieth century. Indeed, today, the amount of countries that are actively performing operations in the international scenario has strongly increased: this phenomenon was due to the emergence of GVCs and supported by technological change. Indeed, the way integration in international markets enables the success of industries has also strongly varied. Are industries deriving from the knowledge-based economy, whose success is enabled by the emergence of GVCs, supporting economic convergence?

The distribution of the unit sales value of an iPad (USD 499)[121]



As we saw in the previous section, an increasing number of emerging economies rely their competitive advantage on the development of the high-technology industries. Nevertheless, it is important to consider the final outcomes that such industries experience in the process of creation of value. In particular, as the graph above perfectly depicts, the distribution of value generated by the sale of a high-tech item occurs unevenly. The flows of income that are transferred to western early-industrialized economies represent almost half of the value created: indeed, the multinational firm, which is the owner of the good, sold owns directly 30% of the profit; moreover, since it operates in-house the greatest share of distribution activity, it also manages to earn profits from distribution and retail.

Moreover, emerging countries' economies strongly rely on the high-tech industry, which, as we saw, represents the way to emerge in the international scenario and become key players in the process of GVCs. In fact, on the other side of the spectrum, it is possible for us to ascertain

[121] Source: OECD, *Supporting Investment in Knowledge Capital, Growth and Innovation*, 2013, OECD Publishing. http://dx.doi.org/10.1787/9789264193307-en

that South Korea play a crucial role in this process, since it provides fundamental inputs such as display and memory chips; however, the country earns just 7% of profits. Following the same perspective, the role of Chinese firms in this international value chain is to provide the final assembly of the product, before it is shipped across the world in all key markets: while we could value this process as fundamental in the value chain, it is only granted around 2% of total profits.

The case presented above is only an example of how GVCs affect distribution of value creation; however, while it would be easy to make trivial statements, our aim here is not to blame western firms for earning mass profits from the use of international value chains. Indeed, in many cases, they are the one coming up with the business innovations that generate new innovative industries: it is indeed following this perspective that upstream activities of the value chain such as R&D, design, and marketing practices are heavily values – and hence rewarded – in the process of the value chain. Nevertheless, it is impossible for us not to ascertain that this uneven distribution is determined by greater integration of economies into GVCs, which in turn are supported technological change.

Conclusion 2

The emergence of the knowledge-based economy – which creates new industries and supports the development of patterns of market integration, through namely GVCs – lacks a thorough consideration of the distribution of value creation among economic players. In this perspective, there are several policy implications related to the knowledge-based economy that countries need to take into careful consideration.

Conclusive remarks

Throughout this first section, our aim was to determine the current state of art of the implications of technological change in the patterns of GVCs. Indeed, by focusing on emerging economies, we were able to describe that countries, which have been able to lever on the knowledge-based economy to improve their level of value added, have in time become key players in the GVCs scenario in relevant and profitable industries. By further analysing this issue, we

reminded that the emergence of the knowledge-based economy created new industries and supported the development of patterns of market integration, which we identified as GVCs.

Indeed, just like in the case of the relationship between technological change and inequality, we soon realised that this optimistic view was perhaps too naïve: to keep a concrete track in our study, we felt the need to determine that the knowledge-based economy presented a strong weakness in the way it fosters market integration. Indeed, we could determine that it lacked a thorough consideration of the distribution of value creation among economic players. The second conclusion gives us the input to move towards the very last section of this study. Indeed, in the current scenario of internationalization of markets, where the knowledge-based economy plays a relevant role in the creation of new industries and in the development of new economic phenomena such as GVCs, it is crucial to analyse the fact that there are several policy implications deriving from the knowledge-based economy that countries need to take into careful consideration.

2.2.b. Policy implications of the knowledge-based economy and globalization

Technological change strongly affects the way trade occurs in the international environment: indeed, through the effects it generates on GVCs, which we depicted in the previous paragraph, the knowledge-based economy can significantly influence the dynamics occurring in global trade. Indeed, by focusing on emerging economies, we were able to describe that some of these countries have been able to lever on the knowledge-based economy to improve their level of value added; hence, in time, they have become key players in the GVCs scenario in relevant and profitable industries. Further analyses enabled us to understand the relevance of weaknesses emerging from this system: indeed, we could determine that it lacked a thorough consideration of the distribution of value creation among economic players.

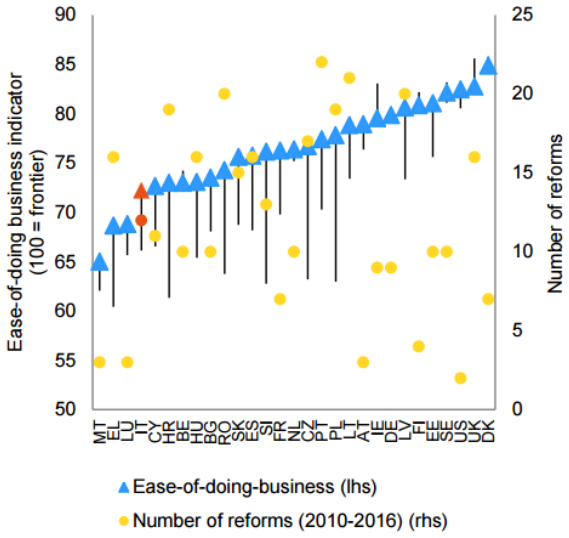
To which extent would it be possible for national Governments and for international organizations to interfere in the subject? Which policy considerations should they mostly take into account? These are crucial issues for the purpose of our study: indeed, throughout the chapters, our aim has been to understand the linkages that exist between technological change and the dynamics that occur in the international scenario, both from the standpoint of inequality as well as from the point of view of market integration. The attempt we are now making in the perspective of establishing policy considerations concerning the effects of the knowledge-based economy in the current framework of globalization could only represent the natural ending of our reasoning.

Levering on technological change to support the development of GVCs

For countries – both developed of emerging economies – being integrated in the globalized world represents a significant asset: in this perspective, it is crucial for policy makers to take into careful consideration the subject, if they intend to pursue a long-term vision of economic development. Nevertheless, simple participation in this process is not sufficient: in fact, we saw that the structural weakness of GVCs lies in the fact that mere economic operators – identifies as those who have a passive attitude in the international scenario – are forced to comply with the dynamics of market integration, without being concretely able to develop strategies in order to build and manage a competitive advantage in the business environment.

How can emerging economies determine and develop their strategy to create a competitive advantage in the international framework? Firms which are capable of levering on technological change strongly rely on the knowledge-based economy and on high-technology industries to carry out effective processes of market integration. Indeed, by following these procedures, they can invest in strategic industries and grasp first-movers advantages; as a result, they can receive significant shares of the incomes of their economic activity. In this perspective, however, it is impossible not to consider the relevant degree of uncertainty that lies in these processes: as a matter of fact, from a theoretical standpoint, investments in intangible goods are much riskier than investments in physical assets. Hence, this kind of strategy might be difficult to carry out and to support in real practice.

Ease of doing business in 2017 and the number of reforms done in 2010-2016[122]



[122] European Commission, Country Report Italy 2017, 2017. https://ec.europa.eu/info/sites/info/files/2017-european-semester-country-report-italy-en_0.pdf

According to the considerations we have just made, it would made sense to think that a good national policy should create the right business environment that enables firms to feel supported in the action of taking risks by investing in knowledge-based capital. In this perspective, public policies should include regulatory tools to improve the ease of doing business: if even a restricted number firms were able to increase their stock of knowledge-based capital, the spill-overs generated by these firms could spread throughout the business environment, hence generating a virtuous circle which national economies as a whole could benefit from. National States and Governments should, on their side, enable the creation of a favourable environment to pursue business activities: in this perspective, public interventions should focus on the improvements of skills, through their development thanks to greater investments in public education. Public policies should concentrate in the enhancements in R&D practices, both in the public and in the private environments; the support to the business environment thanks to efficient networks of infrastructures. Lastly, a concrete and effective regulatory framework for IPRs which would encourage firms to deploy resources towards innovation.

The graph above is an attempt to illustrate the benefits of the process we just described. Indeed, it presents the ease of doing business for the year 2017 and the number of reforms done in the period 2010-2016 for a selected number of countries. The purpose of this graph for our study lies in the fact that it shows that the economies which are most integrated in the international scenario (the typical leading players in GVCs) are also the ones fostering the greatest degree of ease in doing business. Conversely, countries presenting the smallest levels of ease of doing business tend to be largely peripheral in the global environment.

There is another interesting result deriving from this empirical evidence: indeed, it is important to highlight that the economies that are most attempting to reform their business environment are the typical the emerging countries (i.e. Poland, Romania, and Hungary). While the reason of this could lie in the fact that they have great amounts of inefficiencies that they need to recover from, it would be more interesting to believe that they are carrying out a long-term vision set of policies. Hence, in the long run, this policy attempt could enable the improvement in investment in knowledge-based capital, hence determining greater positions in the framework of the globalized world.

Conclusion 3

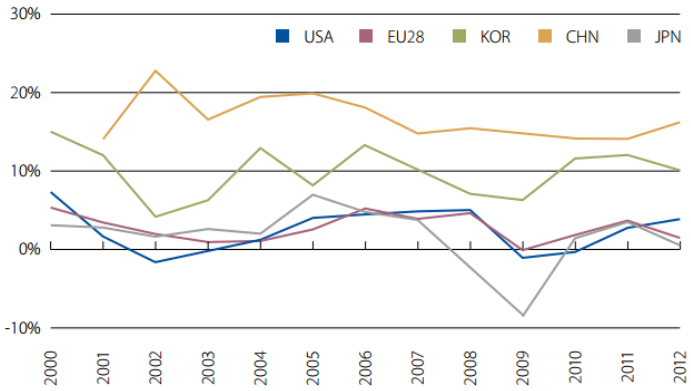
In order to enable the development of a long-term competitive advantage in the international framework, public policies should focus on creating a business environment that supports investments in knowledge-based assets.

Determining the right incentives to develop the knowledge-based economy

Throughout our study, we tried to give great emphasis to the structural differences that shape the way countries deal with governmental intervention. Indeed, by clustering developed countries into Liberal Market Economies and Coordinated Market Economies, we granted significant relevance to the fact that there are countries which are reluctant towards the public interference in the economic environment, while there are others which have always strongly relied on public intervention in crucial aspects of the business scenario. While it has happened in different ways, it is impossible to deny that both clusters of countries have succeeded in becoming strong economic players and to find relevant position in the dynamics of GVCs.

Nevertheless, for a relevant number of countries, the process towards efficient market integration is not over. The crucial issue here is to determine which are the right kinds of incentives that economies should establish in order to support the process of market integration in the knowledge-based economy. While it is not the purpose of our study to determine whether emerging countries are destined to become LMEs or CMEs, we are indeed able to make a few considerations on the way technological change and market integration ought to be supported.

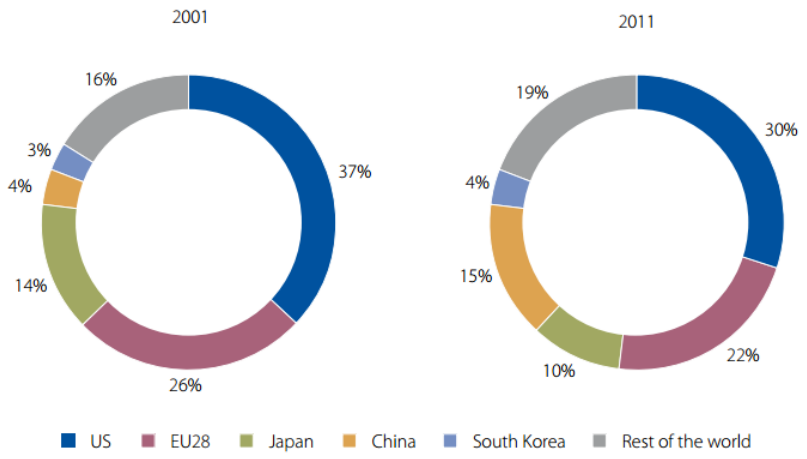
Annual growth rate of R&D expenditure (constant prices) for selected countries, 2000-2012[123]



[123] Source: European Investment Bank, *Investment and Investment Finance in Europe. Investing in Competitiveness*, 2015, Economics Department, European Investment Bank.

In order for policy-makers to provide the right incentives to foster investments in knowledge-based capital, it is important to grant the tools to enable free trade and investments policies that promote the improvement of GVCs in the framework of the knowledge-based economy. In this perspective, it is crucial to ascertain that some emerging countries have already recognized this need and they are providing the right kinds of incentives. In the attempt of giving concrete momentum to this argumentation, let us present the graph above: the results deriving from it are remarkably astonishing. In fact, it depicts a situation in which the annual growth rate of R&D expenditure has increased more in emerging countries such as China and South Korea than in the United States and the European Union. These differences have had significant effect in the medium-term, determining a change in the global distribution of R&D expenditure.

Geographical distribution of world R&D expenditure across selected countries in 2001 and 2011[124]



This second graph presents temporary evolution expenditure in R&D in selected countries. Here, again, the results are quite remarkable: indeed, traditional early industrializers such as the United States and the European Union used to own a share of R&D expenditure which accounted for almost two thirds of total investments; in 2011, however, they detained a share which was just over 50%. Conversely, emerging countries such as China and South Korea both improved their relevance in the international scenario for knowledge-based capital: indeed, the former earned 11 percentage points, moving from 4% in 2001 to 15% in 2011, while the latter was able to grasp one percentage point in the same period of time. To conclude, the analyses of these two graphs enables us to introduce a new concept, that policy makers should deeply consider: indeed, it is worth noting

[124] Source: European Investment Bank, *Investment and Investment Finance in Europe. Investing in Competitiveness*, 2015, Economics Department, European Investment Bank.

that investments in knowledge-based capital support the creation of a dynamic domestic business environment, which in turn can strongly foster the long-term positions that economies seek in the international scenario.

Conclusion 4

Investments in the knowledge-based economy are fundamental to carry out effective attempts of joining the internationally integrated business scenario; moreover, they can further support the development of the domestic business environment, which represents a key feature to support in a long-term political vision of gaining momentum in the globalized world.

Conclusive remarks

This last section supported our last attempt to make final considerations on the need to take into account the role played by the policy-maker in providing incentives to investments in knowledge-based capital. In this perspective, we focused our analysis on the need to determine effective ways for emerging countries to lever of intangible assets to join the process of market integration. Indeed, our analysis revolved around the need to find a long-term strategy to succeed in the international scenario. Hence, we ascertained that in order to enable the development of a long-term competitive advantage in the international framework, public policies should focus on creating a business environment that supports investments in knowledge-based assets. Then, we were able to determine that investments in the knowledge-based economy were fundamental to carry out effective attempts of joining the internationally integrated business scenario; moreover, they could further support the development of the domestic business environment, which represented a key feature to support in a long-term political vision of gaining momentum in the globalized world.

Conclusion

During the last decade, innovative patterns were strongly affected by increasing investment flows in knowledge-based capital, which started to affect productivity growth in a wide range of

industries. Our aim for this section was to understand the diverging patterns in the implications of technological changes in the way resources are distributed among firms and societies, as well as their effects on processes of market integration. Indeed, the purpose of this last section was to make final considerations of the degree of technological change in the framework of market integration and in relation to the structure of inequality. We identified the result of technological change in the framework of the Industry 4.0, and we came up with the definition of the knowledge-based economy. Starting from there, our aim was to relate it to the current tendencies in distribution of income and to analyse how it affects globalization patterns.

With the help of the knowledge-based economy, which we identified as the final outcome of technological change patters, the purpose of this section was to understand the dynamics related to the effects of this new economic phenomenon with respect to the structure of inequality and in relation to internationalization of markets. To do so, we first depicted the current trends in innovation and resource allocation: in this perspective, we analysed how investments in knowledge-based capital, and its consequent increases in productivity growth, affected allocation of income within countries and across them; we ascertained the various implications on the labour force and on employment policies. Then, we gave emphasis to the relationship between the knowledge-based economy and the most recent patterns in globalization: we first covered the improvements in GVCs related to technological change, and we evaluated the need to take into consideration several challenges. Lastly, we determined the policy implications that revolve around the issues of globalization and the knowledge-based economy.

To conclude, our study revolved around the need to find concrete and tangible connections among the issues of globalization, technological change and inequalities. In this perspective, our aim was to give great impulse to the attempts of convergence and divergence with respect to different clusters of countries. Now that we ascertained that it is technological change that re-shaped the structures of inequalities and gave greater impulse to patterns of globalization, we can finally state that our analysis is complete.

In the current framework of industrialization, the concrete outcome of technological change is represented by the knowledge-based economy. With the help of this new economic phenomenon, we determined the implications of technological change in inequalities and globalization. Throughout this first section, our aim was to dedicate some attention to the issue of technological change, both from the point of view of the determinants that define it to the different natures such process can experience. To do so, we first deeply covered the issues of the different sources of bias that arise from the concept of technological change; then, the attention moved towards the nature of technological change: we tried to determine the different approaches used to define it; our aim was also to understand the implications concerning the skill bias. In this perspective, we were able to ascertain the differences that emerged in the case exogenous technological change and in the case of endogenous technological change.

Then, our aim was to understand the features of the new economic phenomenon known as the knowledge-based economy. Indeed, starting from the increased interest in the matter manifested by the OECD at the end of the twentieth century, we could determine that an increasing portion of the economic literature – namely the one focusing on global patterns of economic processes – dedicated momentum to the emergence of a new kind of economy. In this perspective, we gave theoretical grounding to this new economic phenomenon and we illustrated its main features.

Third, this process supported our decision to determine the implications of the knowledge-based economy in the structure of inequalities in today's framework, by analysing innovation in the current scenario and by determining its effects on resource allocation. We could determine that while there was a positive correlation between investments in knowledge-based capital and the efficiency of labour allocation, distribution of income was becoming increasingly concentrated in firms who tend to invest greater amounts of resources in innovation and in patterns towards increases in productivity. Lastly, we could determine that the knowledge-based economy fostered better resource allocation in CMEs, hence determining greater resilience capability with respect to technological change.

Fourth, we gave emphasis to the relationship between the knowledge-based economy and the most recent patterns in globalization: we first covered the improvements in GVCs related to technological change, and we evaluated the need to take into consideration several challenges. Lastly, we determined the policy implications that revolve around the issues of globalization and the knowledge-based economy.

CONCLUSION

Which is the nature of the linkages that shape the relationships among technological change, globalization and inequalities? This is the question that guided us throughout this study. Keeping the focus on changes in the technological capabilities of firms, industries and countries, we tried to determine the implications of such changes in an integrated economic environment. Indeed, starting from a statement made by John Maynard Keynes in the early 1930s, our aim was to determine the effects of industrialization patterns on the international dynamics of market integration and on the structures of income distribution.

To deeply analyse this issue, the study revolved around three main chapters: the first chapter aimed at determining the most significant historical milestones with respect to industrialization patters and the current dynamics in the international scenario. The second chapter revolved around the need to establish the current state of income distribution, and to relate it to globalization patterns. The third and final chapter, in turn, intended to establish the theoretical nature of technological change, in order to make some final considerations on its relationships with globalization and inequalities.

The analysis that occurred in the first chapter enabled us to understand the historical milestones and the consequent new industrial processes that characterized the waves of innovation known as the industrial revolutions. In the first industrial revolution people experienced the introduction of mechanical advances, such as mechanized machines in the textile and manufacturing industries, in a new range of production processes. These new tools were powered by the steam engine, the most significant innovation of the times, which allowed the replacement of traditional sources of energy with one of low cost and abundantly available. The second industrial revolution started the process of integration of markets which determined globalization: indeed, new players started to earn preponderant positions in the creation of a new economic order. In particular, during the second industrial revolution, the United States and Germany climbed the hierarchy to become the world's economic leaders. The third industrial revolution further fostered the actual degree of market integration. By focusing on process innovation, this revolution enabled small advances to contribute to the creation of a new world order and had direct implications in

the traditional sectors of the economy. Furthermore, these technological advances are opening new unprecedented scenarios.

Then, we gave strong emphasis to the fourth industrial revolution: in this perspective, we determined that it is aiming at redefining the economy and its industries, by bringing forward new perspectives of productivity increases, while implementing new business models that are currently generating either brand new products or products with relevant process innovations. Moreover, we tried to define the main controversial issues, which are namely related to the direction that employment will take in this wave of change: it is quite assorted that, in the short future, there will be increasing need for skilled workers, as well as to the further implications that this new industrial revolution is meant to generate on processes of market integration. These queries gave us the inputs to pursue or analyses.

The first chapter also tried to define the most recent trends in trade integration and the recent developments of the world output. First, our intent was to grasp the recent patterns of the world economic development: to do so, we looked at the changing variables that are indeed defining the current degree of market integration; also, we highlighted the most relevant variables of the present state of globalization. Then, we analysed to which extent the development of an international regulatory framework for international trade encouraged the process of market integration. Throughout the last century, indeed, several attempts were made to both regulate and support change in the international framework of globalization. Indeed, the emergence of inter-governmental bodies created a favourable environment for trade to further develop and for new players to efficiently position themselves in the changing scenario. Such players have been able to bring forward new valuable dynamics and they are expanding them throughout the international framework: they are indeed enabling the emergence of a new organization of production at a world scale. If until a couple a decades ago value chains were managed locally, today they are increasingly developing on an international basis, within which each country plays a well-defined role.

The last section of the first chapter focused on the rise of GVCs as a recent phenomenon, which is destined to re-shape the world economic order. Indeed, it is granting international relevance to the economic development of emerging countries. This emerging trend has been strongly supported by technological transformation, which has enabled countries to specialize parts of their economy in the production of specific components or in the delivery of specific tasks, rather than to focus on the entire product or service. After defining the mains features of this new

phenomenon – agglomeration and dispersion forces –, the analysis moved towards the major implications of GVCs on globalization and trade integration, namely the support to emerging countries and the reconfiguration of distribution of income in the international framework. GVCs have become the way for both developed and developing countries to improve their position in the international scenario. Furthermore, the current degree of integration of markets is greatest of all times: coordination among countries occurs at an unprecedented degree. Still, this exceptional degree of market integration comes at a price: GVCs represent an alarming source of increasing inequalities in the issue of distribution of wealth.

In the second chapter of our study, we tried to carry out a thorough analysis on historical trends in income inequality: starting from Stiglitz's intention to extend economic studies to the analysis of distribution of wealth and income among individuals, we developed our findings based on Branko Milanović and Thomas Piketty studies. Indeed, Milanović focused on the way globalization patterns and processes of market integration affect the structure of global inequality, among countries and societies; Piketty, on his side, presented the most careful and precise analysis of the current degree of inequalities in distribution of income.

In the first section of this chapter, the focus was on the theoretical origins of the relationship between economic growth and inequality. In this perspective, we strongly relied on Kuznets, whose studies determined the emergence of a relevant and peculiar linkage between the two variables. Indeed, we recalled that the constraints that define environmental deterioration and income per capita are strongly related on the one side to the degree of industrialization of nations – which in turn determines economic growth and development –and on the way the wealth of nations is redistributed among individuals on the other side. Then, we noted the major critics to the principal results of the studies carried out by Kuznets. In particular, we depicted three significant detailed analysis of the classic environmental curve: in this perspective, all critics reviewed the original study made by Kuznets gave further emphasis to the theoretical relevance of the relationship between economic growth and the structure of inequalities.

Then, we tried to give practical grounds to the theoretical implications deriving from the relationship between globalization and the emergence of greater or smaller levels of inequality. Indeed, our aim was to take into account the structure of inequality for a certain number of countries; to do so, we chose to use the variable of national income, and see how it is distributed among society. We gave solid answers to the queries related to the structure of inequality change

in the past century. Moreover, we tried to analyse the reasons of such changes. To do so, we analysed historical trends in income inequality for the United States and France. In the first case, we analysed the level of income inequality for a country whose determinant features show relevant signs of heterogeneity: indeed, we were able to state that the level of inequality in the United States did not decrease in the past century, and it has remained significantly great. In the second case, we could determine that France's levels of income inequality are still important; nevertheless, we could ascertain that the share of income concentration owned by the top decile of the population strongly decreased in the last century.

Third, our aim was to carry out an analysis concerning the trends in inequality among countries: by focusing on the clusters made by Hall and Soskice, who identified countries among Liberal Market Economies and Coordinated Market Economies, we could determine that differences in income distribution could be related to their structural divergences. The processes of openness towards international markets occurred in diverging ways for LMEs and CMEs: on one side, policy implications determined very limited public intervention in the process, while on the other side globalization patters were managed and supported by public regulatory tools and by the introduction of dedicated international and supranational organizations. Consequently, the effects of these diverging approaches to market integration determined opposite results: in the case of LMEs, fierce competition in the international scenario – with very limited public supervision – might have prevented the structure of inequality from decreasing; in the case of CMEs, mild approaches to international competition has coincided with significant decreases in the levels of inequality of incomes.

Moreover, we introduced the study of emerging countries as a third cluster of analysis: in this way, we were able to ascertain that even though income inequalities seem to have been reduced in the last century, the dynamics concerning income concentration and countries inequality in emerging countries are not that far from the results we described in LMEs and CMEs. The case of emerging countries has brought forward a considerably complicated relationship between globalization and inequalities: we analysed specific economic tools in order to make rational statements on the issue. Hence, we based our analysis on the concepts of world output distribution, on the ability of countries to attract FDIs and on the participation to GVCs. Despite high levels of growth, relevant improvements in the share of the world's FDI inflows, and increased relevance in the framework of GVCs, inequalities have been increasing in the emerging economies. Indeed,

we were able to ascertain that globalization in emerging countries has not been fostering a fair redistribution of economic resources.

The third chapter of this study enabled us to determine that in the current framework of industrialization, the concrete outcome of technological change is represented by the knowledge-based economy. With the help of this new economic phenomenon, we determined the implications of technological change in inequalities and globalization. To do so, we first deeply covered the issues of the different sources of bias that arise from the concept of technological change: in this perspective, we first focused on skill-biased technical change, meaning the trend that saw the portion of the labour force which was more educated grasp an increasing share of the income generated by all production processes. Second, our attention moved towards capital-biased technical change, namely the tendency for income to move gradually towards the owners of productive assets, in spite of the labour force, because of technological change. Lastly, we ascertained to which extent technological change enabled was the emergence of superstars, who have been able, levering on new technologies, to concentrate increasing shares of income and who hence determined the notion of superstar-biased technical change.

Then, we analysed the nature of technological change: we tried to determine the different approaches used to define it; our aim was also to understand the implications concerning the skill bias. In this perspective, we were able to ascertain that exogenous technological change determined relevant increases in the skill biases throughout the third industrial revolution, starting from the 1970s in particular. In the case of endogenous technical change, conversely, we determined a more intertwined situation: to clarify the most relevant features, we made considerations on the demand-pulled incentives and on the implications of the relationship between technological change and the skill bias on the market size. Moreover, we were able to determine that endogenous technical change implied that new technologies experience a skill bias when the labour force experiences an increase in the level of skills. Then, our aim was to understand the features of the new economic phenomenon known as the knowledge-based economy. Indeed, starting from the increased interest in the matter manifested by the OECD at the end of the twentieth century, we could determine that an increasing portion of the economic literature – namely the one focusing on global patterns of economic processes – dedicated momentum to the emergence of a new kind of economy.

Third, the process carried out throughout this study enabled us to determine the implications of the knowledge-based economy in the structure of inequalities in today's framework, by analysing innovation in the current scenario and by determining its effects on resource allocation. We started our analysis by taking into consideration innovation and inequality in the current framework: in this perspective, we covered the issue of the knowledge-based economy and its implications in growth productivity. Through its effects coming from increases in MFP the knowledge-based economy could represent a way for economies to converge in the long-term towards a new equilibrium. This optimistic view was soon replaced by further analyses: indeed, the degree of innovation within countries, supporting patterns towards greater levels of technological change, was strongly related to the levels of long-term performance of economies. Third, cross-country differences in the degree of investment in knowledge-based capital were strongly related to the way companies use the innovations deriving from technological change. Existing differences in the relevance in the global scenario were further accentuated by both different levels of investments in knowledge-based capital and in the use they made of it in their key industries. Fourth, we were able to understand the relationship between resource allocation and the structure of inequality: there was a positive correlation between investments in knowledge-based capital and the efficiency of labour allocation, distribution of income was becoming increasingly concentrated in firms who tend to invest greater amounts of resources in innovation and in patterns towards increases in productivity. Lastly, we could move back to our theoretical milestone – Hall and Soskice's Varieties of Capitalism – and determine that the knowledge-based economy fostered better resource allocation in Coordinated Market Economies, hence determining greater resilience capability with respect to technological change: the knowledge-based economy affected to a lesser extent the structure of inequalities of CMEs than LMEs.

Fourth, we gave emphasis to the relationship between the knowledge-based economy and the most recent patterns in globalization: indeed, by focusing on emerging economies, we were able to describe that countries, which have been able to lever on the knowledge-based economy to improve their level of value added, have in time become key players in the GVCs scenario in relevant and profitable industries. By further analysing this issue, we reminded that the emergence of the knowledge-based economy created new industries and supported the development of patterns of market integration, which we identified as GVCs. However, we soon realised that this optimistic view was perhaps too naïve: to keep a concrete track in our study, we felt the need to determine that the knowledge-based economy presented a strong weakness in the way it fosters market integration. Hence, we could determine that it lacked a thorough consideration of the

distribution of value creation among economic players. Lastly, we determined the policy implications that revolve around the issues of globalization and the knowledge-based economy. Our last attempt was to make final considerations on the need to take into account the role played by the policy-maker in providing incentives to investments in knowledge-based capital. Hence, we ascertained that to enable the development of a long-term competitive advantage in the international framework, public policies should focus on creating a business environment that supports investments in knowledge-based assets. Then, we determined that investments in the knowledge-based economy were fundamental to carry out effective attempts of joining the internationally integrated scenario: they could further support the development of the domestic business environment, which represented a key feature to support in a long-term political vision of gaining momentum in the globalized world.

To conclude, our study revolved around the need to find concrete and tangible connections among the issues of globalization, technological change and inequalities. In this perspective, our aim was to give great impulse to the attempts of convergence and divergence with respect to different clusters of countries. Now that we ascertained that it is technological change that re-shaped the structures of inequalities and gave greater impulse to patterns of globalization, we can finally state that our analysis is complete.

Our urge was to find concrete and tangible connections among the issues of globalization, technological change and inequalities. In this perspective, our aim was to give great impulse to the attempts of convergence and divergence with respect to different clusters of countries. Now that we ascertained that it is technological change that re-shaped the structures of inequalities and gave greater impulse to patterns of globalization, we can finally state that our analysis is complete. Still, there is one issue we would like to lever on to provide our reader one last input: we determined that international organizations have played a crucial role in the identification of the knowledge-based economy as the turning point for recent changes in market integration and change in the structure of inequalities. Still, their concrete actions still lack: indeed, they might represent the actual and specific tool to enable substantial convergence patterns in the globalized scenario.

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