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The role of technological change in income inequality in the United States

Master's Thesis

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Declaration:

Herewith I declare that I have written the Master's Thesis on my own and I have cited all sources.

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Student's Signature

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List of Abbreviations

C	**Citizenship rights**
CB	**Benefits or support provided by the family, kin or the local community**
CBO	**Congressional Budget Office**
CPU	**Central processing unit**
D	**Discretionary, means-tested transfers from the state**
EB	**Enterprise benefits**
EITC	**Earned income tax credit**
FT	**Family transfers**
GDP	**Gross Domestic Product**
IB	**Insurance-type benefits**
IMF	**International Monetary Fund**
IS	**Insurance-based income transfers from the state**
MFP	**Multifactor Productivity**
NAFTA	**North American Free Trade Agreement**
NWB	**Non-wage benefits provided by firms to their workers**
OCED	**Organisation for Economic Co-operation and Development**
PB	**Private income benefits, gained through investment**
SB	**State benefits**
SI	**Social income**
UK	**United Kingdom**
USA	**United States of America**
W	**Money wage**
WB	**World Bank**
Wb	**Base or fixed wage**
Wf	**Flexible part of the wage**
WTID	**World Top Incomes Database**
WTO	**World Trade Orgaisation**

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Introduction

Since the Great Recession of 2008, the public discourse on capitalism and the functioning of the welfare state has shifted, as many developed countries being severely hit, were facing the drawbacks of the system that by large relied on the interplay of the market forces. One of the leading market economies in the world, the USA has been a particularly good example of the shift in national thinking, as it was incarnated in the rise of the Occupy Wall Street Movement. A contribution of this organised effort that gained major global support, is the framing of the *99 % and the 1 %* phrase that has raised awareness about the crisis of income inequality (The Atlantic, 2015). The importance of this issue is evident, as the language of Occupy Wall Street is adopted by the presidential candidates in the USA; firstly in 2012 by president Obama and currently by Bernie Sanders, who is defending a more socially oriented agenda.

Simultaneously the world is facing a rapid development and spread of new technologies that many scholars refer to as *the Fourth Industrial Revolution* (Brynjolfsson and McAfee, 2014). This new age of inventions and artificial intelligence could either give our civilisation the potential to flourish or to self-destruct.

Faced with these two enigmas that are gaining evermore public attention and inspired by some of my mentors that I have met during the *2015 European Forum Alpbach*, I have decided to incorporate both inequality and technological change into this master`s thesis. The goal of my work is to raise attention to the current and future causes that together with the technological change are contributing to income inequality. My research covers the time scope from the 1970s until present day in the USA. Put in more academical phrasing, this is defined as follows:

The aim of this thesis is to examine the main drivers behind income inequality in the USA since the 1970s, out of which a particular emphasis is put on technological change. Furthermore it attempts to depict the distributional implications of technological progress across different income groups in the USA.

In order to fulfil its aim, this thesis is divided in three individual chapters and various subchapters that strive to come up with answers to the following ***research questions:***

1. *How is income inequality defined and measured and what are its main causes?*
2. *How has the technological momentum and globalisation affect the income inequality in the USA since the 1970s; and how is income distributed in the current American socio-economic system?*
3. *Which US jobs are the most endangered by the technological advancement?*

The primary focus of the first chapter is to outline the terms technology and technological change. After acquiring some general idea, the study of these two terms is complemented by interpretations of the role of technology on economic growth by three mainstream schools of economic thought. The depiction of these theories starts chronologically with the *neoclassical (exogenous) growth theory*, which attributes economic and productivity growth to the rate of technological advancement (Mankiw, 2010). As this theory does not explain how technological change affects the economic output, it is further expanded by the *endogenous growth theory* that goes a step further into determining the drivers of the technological progress. Since these two theories have encountered criticism for the lack of empirical evidence, *Schumpeter`s theory of creative destruction* views technological innovation as a key to the economic progress, that is also setting the pace of the business cycles (Schumpeter, 2008). The third subchapter studies the correlation between technological change and productivity, including the indicators used for measuring economic growth and productivity.

The second chapter starts with a discussion about the place of inequality as an academic concept alongside the studies of poverty and wealth. It goes on with an assessment of the five most commonly used measurements of income inequality. Some of these are applied in the quantification of the U.S. income inequality in the third chapter. The following subchapter is devoted on the examination of the two main triggers of income inequality (technological change and globalisation) and on the channels through which they are manifesting in unequal income distribution.

The third chapter is of a central importance in the analysis of income inequality, since is based on historical data sets that follow its evolution in the USA. It starts with a century-long empirical evidence on the distribution of income among the top 10 % of the U.S. households. These figures are accompanied by some historical facts such as: financial crisis, wars, policy and technological shifts that may have additionally influenced the share of income among the population. In order to more precisely account for the various income inequality contributors,

the third chapter is divided into two subchapters, of which the first one deals with the primary (market mediated) causes of income inequality – technological change and globalisation.

Although these two are deeply intertwined, the impact of technological change is attested through wage and productivity analysis. A deeper insight is attained by decomposing the wages of workers according to the income percentile to which they belong. Lastly it observes trends in productivity and compensation and tries to explain the reasons for those tendencies. In the second chapter of this thesis is argued that besides technological change, globalisation (international trade and offshoring) is one of the two principle causes of inequality (Krugman and Obstfeld, 2011). In addition, the next section gives both theoretical and analytical support for the ways in which international trade and offshoring (globalisation) mould the level of the wages and employment in the USA.

The second subchapter is dedicated on the secondary causes of income inequality that have either political or economic background. Together with the primary causes they are shaping the state of the U.S. income inequality (Stiglitz, 2012). The political (tax and transfer policies, antitrust laws, declining unionisation) and economic forces (rent-seeking behaviour and short term profit orientation of firms) are analysed in sections 3.2.1 and 3.2.2 respectively.

The last subchapter lays the basis for future developments of the technology`s impact on inequality, taking into account the Moore`s law and the recent advancements made in this filed. Based on evaluation of the skills that will be needed to complement these super technologies, it portrays the state of the U.S. job-market in near future. Moreover, it gives an estimate of the type of jobs that will be in demand and their corresponding compensation.

The methodology used in this thesis includes the classical procedures of literature study, induction, deduction, description, comparison and lastly analysis and synthesis. The first two parts of the research are based on economic theory combining mainstream and critical approaches on technological change, productivity, economic growth, inequality and globalisation. Furthermore it employs methods to quantify these economic measures, as well as to detect their detriments. To serve that purpose, the description relies on definitions and scientific papers by the international economic institutions such as The World Bank, The International Monetary Fund, OECD, and The International Labour Organisation which is further contrasted by the thoughts of the contemporary economists such as, Stiglitz, McAfee, Brynjolfsson, Krugman and other prominent figures in the field. This part also includes the

textbook version of dealing with the above metrics, which is still the most widely spread way of quantifying the impact of the productivity growth on employment and income inequality.

The analytical part (third chapter) follows the findings from the theoretical part, applying them specifically to the USA. Firstly, it portrays the impact of technology and globalisation on inequality from the last 40 years onwards. In addition it attempts to lay down the characteristics of the American socio-economic system. Based on the available statistical data gained from the works of Piketty and Saez, Atkinson, Acemoglu, Autor and Katz as well as some state statistical offices such as the U.S. Bureau of Labour, Congressional Budget Office etc. it employs income inequality measurements, in order to map out the inequalities and the discrepancies between the U.S. population. Lastly, based on estimates by (Fray and Osborne and Levy and Murnane), it presents which American jobs and skill sets would be the most susceptible to automation, and what social layers would be the most affected by these circumstances.

This research builds up on interdisciplinary study ranging from the areas of international trade, economic theory, statistics, and economic history to writings by authors dealing with robotics and technology, technological think – tanks, research institutes and policy papers. It features secondary data coming from variety of sources, including books, academic journals, various qualitative and quantitative reports and rankings, databases and papers of the international organisations, US based institutions (US Department of Labor, Economic Report of the President, Federal Reserve Bank) academic debates and conferences, other on-line media.

1. The impact of technology on productivity and economic growth

1.1 Defining technology and technological change

The word ***technology*** has been used in different contexts through the ages. During the 19th century it referred to the arts, particularly to those which were mechanical (Crabb, 1823). Its current meaning originates from the German word *Technik*, whose usage was widely spread due to Thorstein Veblen`s analysis of modern industrial societies, thereby linking its meaning with the idea of engines, industry and progress (Schatzberg, 2006).

In the contemporary phraseology this word denotes to a certain type of knowledge that facilitates the production of either larger amounts of outputs, or higher quality outputs whilst retaining the same amount of inputs (Rosenberg, 1982). OECD similarly defines technology as *the state of knowledge concerning ways of converting resources into outputs* (Schreyer, 2001: 25). A more extensive definition is offered by Vlčková, who outlines technology as the integration of ideas and information about the products that could be created, as well as the processes that could be utilised in their production. It also accounts for the capital and labour needed for the output and furthermore it deals with the division of labour (tasks separation within and without the company). Lastly, it is concerned with wider institutional structures to which the economic activity is embedded (Vlčková, 2013).

Regarding economic theory, technology is also defined by the standard neo-classical model, which considers technology as a function describing how factor inputs can be transformed into output. It further defines technological change as a shift in the production function (Violante, 2008). In this model there is a single output production function that represents the maximum quantity of output gained from a certain combination of capital and labour. Thereby technology is the production function, graphically represented by isoquants. In this simplified model the technological progress is represented by the upward shift of the isoquants. When the input prices are added to this graphical representation, then the technological improvement causes a downwards shift of the cost function (Korres, 2008)

Technological change can be distinguished into either endogenous and exogenous or embodied and disembodied. The embodied equals to the *hardware*, consisting of capital goods (Korres, 2008). Technological change here is the factor contributing to the improvements of the quality or design of the capital goods or to the intermediate inputs (OECD, 2001).

The disembodied on the other hand, is independent on the factors of production and causes a shift of the production frontier, as the technology progresses over time (OECD, 2001). Consistently, this type of technology is attributed with the term *software* or *know-how*, which is embodied in the knowledge and the skills needed for production, adaptation, innovation and maintenance of the capital goods (Korres, 2008).The endogenous technological change is provoked by shifts in the input factors, while the exogenous is a result of factors, outside the firm or the economy in question (more in section 1.2.1) (Zhang, 2012).

The formulation *technological progress* (represented by the shift of the production function) is used as a synonym for technological/technical change. When technological change occurs, it usually affects the factors with different intensity, otherwise is it dealt with a neutral technological change (Korres, 2008). Concerning the former type of technological change, it could be either *capital intensive* (the technological shift is exclusively affecting the productivity of the capital) or *labour intensive* (the change enhances the productivity of labour) (Hořejší, 2012).

When it comes to labour intensive technological change, it can be further classified into *skill-biased technological change.* Violante defines it as: *a shift in the production technology that favours skilled (e.g., more educated, more able, more experienced) labour over unskilled labour by increasing its relative productivity and, therefore, its relative demand* (Violante, 2008: 2).

He then defends the notion that new information technologies are backing the employment of the skilled labour, particularly in their adoption phase. The inclination for a certain type of skills are determined by the endogenous factors embedded in the individual incentives of the producers. For instance these could be moulded by: the relative prices, institutions and the size of the markets (Violante, 2008).

Another characterisation is offered by Hicks, who differentiates between: capital-biased and labour-biased technological change. In each case one factor is favoured over the other. They are manifested in the relative responses of the marginal products of capital and labour. In other words, if the change in technology does affect the ratio of capital's marginal product to labour's marginal product for a certain capital-to-labour ratio, then it is dealt with capital or labour biased technological change (Hicks, 1973). The Nobel – prize-winning economist Paul Krugman refers to the capital biased technological change as *a kind of change that makes the society richer, but workers poorer* (Krugman, 2012). He explains his claim in a simplified

example assuming perfect competition, and two possible ways of producing the output (a labour-intensive and a capital-intensive method), which are represented in terms of unit inputs. The production in the economy would use a mix of the two techniques to achieve a certain output. In conditions of perfect competition the real wage rate (w) and the cost of capital (r) (measured in relation to the output) have to be such, that the cost of producing one unit of output would be 1, regardless which technique is used, so that finally w=r=1. Workers (labour) and machines (capital) are both paid their marginal product. But, if the technology improves (the productivity of capital-intensive method rises, while the labour intensive stays the same), then there is a cut to the unit inputs of the capital-intensive technique. Concerning capital-biased technological change, what will happen in the economy is that the wages will fall relative to the cost of capital, and consequently this will also trigger a fall of real wages in absolute terms (Krugman, 2012). This is how Krugman summarizes his notion of capital-biased technological change and its effect on wages. To sum up, the capital-biased technological change brings up a greater level of efficiency to the production process, by outperforming the marginal product of labour. Although the improvement of the production capabilities could be perceived as a positive societal change, it could lead to diminishing wages, and even to labour layoffs. The implications of this kind of technological progress will be further discussed in the second chapter.

1.2 Theories of economic growth. The role of technology in economic growth

There are three main streams of economic thoughts that deal with the role of technology in economic growth.

1.2.1 Neoclassical theory

The most important representative of the neoclassical theory of economic growth is the Solow`s model, which shows the impact of savings, population growth and technology on the economy`s output and its growth overtime. For the causes of this thesis, closer attention will be paid only on technology`s effect on productivity and economic advancement. Capital, labour and technology are taken as the three key determinants of the economy`s production of goods and services. Characteristic for this model is that it does not explain how the technological

progress affects the economic output, but rather how it interplays with the other factors throughout the process of economic growth. (Mankiw, 2010)

Solow believes that capital accumulation and increase in the labour force, lead to greater economic performance, but their positive effect on the economy`s growth is limited, since after a point they show a diminishing rate of returns[1]. According to Solow as soon as the potential of capital and labour based growth is depleted, and the economy reaches a linear state, the economic growth rate can be increased only by technological improvements and innovation. Technology can help achieve a higher productivity and increase the society`s production capacities over time. For the purpose of incorporating the technological change into the production function, besides capital (K) and labour (L) Solow adds a new variable, efficiency of labour (E). The classical production function[2] is now modified to Y= F (K, L×E). Efficiency of labour is expressed through society`s capability to make use of new knowledge and to utilise the improved methods of production, that increase the productivity of each unit of labour needed for the production of certain goods and services. The effective number of workers is measured by L×E, whereas solely L represents the number of workers, but L×E also includes the technology and skills with which the average worker is equipped. As stated by the latest production function, the total output (Y) is depended on the inputs of capital and efficiency of labour. The model assumes that the efficiency of labour grows at some constant rate (g). Considering a growth in the labour`s efficiency, the output will increase as if the labour force of the economy has increased. In these circumstances it is dealt *with labour augmenting technological change* and (g) is the rate of the labour-augmenting technological progress. Overall, since the labour force is growing at a rate (n) and the efficiency of each unit of labour grows at rate (g), the effective number of workers will be increasing at a rate (n+g). This has the same effect on the economic growth as the increase in the number of population (Mankiw, 2010).

If capital per effective worker (k) is added to this analysis, according to Solow`s modelling, the technological progress that increases the effective number of workers will have a diminishing effect on (k). Once the steady state[3] is reached, the capital per effective worker (k) is constant and so is the output per effective worker (y). As for the rest of the variables (output

[1] **Diminishing returns,** also called **law of diminishing returns**, is an economic law stating that if one input in the production of a commodity is increased while all other inputs are held fixed, a point will eventually be reached at which additions of the input yield progressively smaller, or diminishing, increases in output (Encyclopaedia Britannica, 2016).
[2] **Classical production function equation**: Y = f (K,L), defines the total output as a function of the two factors capital (K) and labour (L).
[3] **The steady state** refers to the long-run equilibrium of the economy (Mankiw, 2010).

per actual worker (Y/L) and economy`s total output (Y)) it is claimed that they are both growing in the steady state. The output per actual worker (Y/L = y×E) is growing at rate (g), because y is constant at the steady state, which implies that Y/L must be growing at the same rate as E, which is also (g). Correspondingly, the total output Y = y × (E×L) in terms of the steady state grows at a rate of n + g, since y is constant and E is growing at rate g and L is growing at rate n (Mankiw, 2010).

Based on empirical studies conducted in the USA (Mankiw, 2010), the Solow model can successfully predict the development of factor prices. The experiment has revealed that the technological changes affects the factor prices, as discussed above, while in the steady state, the real wages grow at the same rate as the technological progress, but the real rental price of capital is constant over time.

However, this theory has some limitations. One of them is the assumption that a convergence between poorer and richer countries will happen, as a result of the capital inflow from the rich towards the poor, which will make the latter grow at a faster pace and eventually will reach the same level of development. This claim was rejected by studies conducted on this topic (Mankiw 2010), since different countries have different steady states, determined by their saving rates, population growth rates and accumulation of human capital. They appear to be converting at their own steady states, whereas little evidence was found for intercountry convergence. In other words the differences in labour productivity, are the factors that makes them divergent, rather than the different rate of capital accumulation or any increase in labour, which is why technology is accounted as an exogenous force, independent from the two factors of production - this is also known as *the Solow`s residual*. [4]

The criticism of this model focuses mostly on its failure to explain how and why technological progress happens, which accounts for the most important catalyst behind productivity, and consequently behind economic growth as well. This shortcoming of the Solow`s model steered the proliferation of the endogenous growth theory that takes another sight into technological change and knowledge accumulation.

[4] **Solow`s residual** stands for residual growth that cannot be explained by the rate of change in the services of the labour, capital and intermediate outputs, and is often interpreted as the contribution to economic growth made by factors such as technical and organisational innovation (OECD, 2001).

1.2.2 Endogenous growth theory

In the late 1980`s a new stream of theories started developing, which strived to explain the economic growth as a consequence of the technological change that operates endogenously. Contrary to what was advocated by the theory of exogenous growth, the endogenous growth theory tries to explain the technological progress as a transformation that is triggered by internal influences. It holds that the main contributors to the economic growth are: investment in human capital, knowledge and innovation (Romer, 1994). The field of endogenous growth is based on complex models which are going beyond the aim of this thesis. For that reason, this subchapter will offer a basic outline and implications of the theory.

When compared to Solow`s model, the production function in the basic endogenous model is slightly altered: $Y=A\times K$, where the output (Y) determined by the capital stock (K) and (A), the constant that expresses the amount of output produced for each unit of capital. In this model, unlike the Solow`s model there are no diminishing returns to capital. Part of the investment (s) is saved and it part of the capital will depreciate (δ). That implies that the change in the capital stock (ΔK) equals to what is left when the capital depreciation is subtracted from the investment $\Delta K=sY-\delta K$. Since here the capital does not have diminishing returns, the economic growth depends on the savings and investment, which can lead to a continuous growth. This is derived from the alterations of the equation to $\Delta Y/Y= \Delta K/K= sA-\delta$, where the growth rate of the output ($\Delta Y/Y$) is infinite as long as $sA>\delta$. The difference with the Solow`s model comes from the assumption that there the capital has diminishing returns, so that at some point the economy reaches the steady state when the growth can be achieved only by the technological progress (Mankiw, 2010).

The advocates of the endogenous growth theory defend the assumption of constant capital returns by claiming that the capital also incorporates knowledge. The general and prevailing assumption is that there are increasing returns to knowledge. This is based on the evidence from the last century, when the increased scientific and technological advancement set off the economic growth in the countries that were the leaders in these fields (Nafziger, 2006). However, this is only a simplified version of this model that clearly points out to the crucial difference with the Solow`s model.

The expanded version of the basic one-sector model, besides firms as the traditional subject of production adds another sector, which in this case is producing knowledge and it is represented by the research universities. Same as in the Solow`s model the capital accumulation is given

by (s), which is the part of the output that goes to savings and investment. In addition to that, the growth of stock in knowledge is determined by the fraction of labour in universities (u), which is considered to be growing at a constant level. The constant increase of (u), affects the efficiency of labour that also grows at a constant rate g (u) (Mankiw, 2010). This model is significant because it shows which variables are determining in maintaining a continuous technological and consequently economic progress, whereby the growth in the stock of knowledge is central to this theory.

Moreover it is determined to unravel the growth discrepancies across countries, by looking at the choices of the private and public in terms of investment in knowledge capital[5] and the capabilities to draw form it (Romer, 1994).

This theory also supports the notion of economic convergence, whereas the speed of convergence of the developing countries to the developed ones is given by the rate of diffusion of knowledge. The engine of growth according to Romer is innovation or technical change that acts as knowledge generator enhancing capital and labour productivity. In comparison with the neoclassical theory, for endogenous growth theorists, the state`s policies (subsidizing R&D) also have a major impact to the countries' technological progress (Nafziger, 2006).

Although knowledge is considered to be a public good (freely available), much of the process of research and development (furthermore only R&D) is done in in private firms whose primal incentive is profit. As stated by (Grossman and Helpman, 1989:24), the profit seeking incentive by large explains the technological progress. The profit aspect of R&D comes from the advantage of being the first on the market with the most innovative product, which could gain the firms a temporary monopoly (Mankiw, 2010). This creates a kind of innovative chain, when other firms build upon the knowledge of the previous top innovative firms. These spillovers of R&D, depending on the firms` research efforts can bring either positive or negative impact (externalities)[6] to the other firms in the economy. The spillovers are often considered a source of productivity growth, creating a pool of knowledge, available even to firms from different sectors. Empirical studies have shown that the R&D externalities could help eliminate the fate of diminishing returns and secure sustained growth (Grillches, 1992). According to the

[5] **Knowledge capital** - an intangible asset that comprises the information and skills of a company's employees, their experience with business processes, group work and on-the-job learning. Knowledge capital is not like the physical factors of production - land, labour and capital - in that it is based on skills that employees share with each other in order to improve efficiencies, rather than on physical items (Investopedia, 2016).

[6] The externalities, according to its effect on the societal progress are divided into two groups: positive (standing on shoulders) and negative (stepping on toes) (Mankiw, 2010:242).

calculations conducted across different sectors (Grillches: 1992), the average return of R&D to the public is estimated to 40 % p.a. This number is significantly larger than the return to physical capital which is approx. 8% p.a. (Mankiw, 2010).

Although this theory gives some insight on the driving forces of the long term economic growth, it has failed to gain the support of the many important names in economics. The main reason for this is the lack of empirical evidence, since econometric models have not been able to reduce the technological innovations and the economic growth to measured inputs (Nafziger, 2006).

Paul Krugman`s criticism of the endogenous growth theory sustains in the fact that is dealing with empirically unprovable variables, that do not explain the conditional convergence among countries: *too much of it involved making assumptions about how unmeasurable things affected other unmeasurable things* (Krugman, 2013). In his critique he turns the attention to the importance of business cycles in the analysis of the technological progress.

1.2.3 Schumpeterian growth. Theory of creative destruction

In his book *Capitalism, Socialism and Democracy* (1942), the Austrian economist Joseph A. Schumpeter argues that technological innovation is in the heart of the economic progress. His *theory of creative destruction* supports the notion that in order for the capitalistic system to move forward entrepreneurs should come up with new ideas of more effective ways of production or to introduce new organisational and managerial processes that would replace the old ones and make them obsolete (Schumpeter, 2008). When the innovator enters the market it gains a temporary monopoly position that could also earn them monopoly power and profits. This profit-seeking behaviour is also beneficial for the consumers that get a wider range of products to choose from. In spite of that, the incumbent producers may not be able to catch up with the new inventions and loose the capability to compete and to sustain its market share (Mankiw, 2010). In the conditions of perfect competition, full employment, no savings nor technological change (as the model assumes) profitability is not always a given, but it depends on the capability of the firms to keep one step ahead of competitors, who could easily build up on/imitate the invention. Within this theory innovation, savings and imitation explain growth, as much as their decline and flow determine the pace of business cycles (Nafziger, 2006). According to Schumpeter, innovations are the drivers of the changes in investment and of the business fluctuations. As he puts it*: business cycles are almost exclusively the result of*

innovations in the industrial and commercial organisation. Innovations are such changes of the combination of the factors of production as cannot be effected by infinitesimal steps or variations on the margin. Innovation consists primarily in changes in methods of production and transportation, or changes in industrial organisation, or in production of a new article, or opening of a new market or of new sources of material (Economics Discussions, 2015).

Schumpeter`s assumption that technological change creates both winners and losers, is supported by historical evidence. In the peak of the Industrial revolution in 19th century England, many labour-economising machine technologies started to be widely used in the textile industry. These machines could produce more, while using less low-paid, unskilled labour. While the massive spread of the automated production helped reduce the price and it offered broader selection to the customers, it appeared destructive for the skilled knitters. Their discontent culminated into organised riots, where their protest against the new technology was manifested into the destruction of these machines. The members of the riots were called *Luddites.* This term is also used nowadays to refer to today`s opponents of the technological advance (Mankiw, 2010: 243).

Schumpeter`s view of innovation as a vehicle of the economic progress, through the process of creative destruction has served the stream of endogenous growth theory to come up with models explaining the technological advancement (Agion and Howitt, 1992).

All of these three theories argue that the technological progress is the core of the economic growth and it stands as a generator of the business cycles. Even though they see differently upon the role of the technological change in the economic progress, they account it as the central factor that creates and sustains the economic momentum.

1.3 Relationship between technological change and productivity

The endogenous growth theory also frames different views on the correlation between technological change and productivity growth. That this correlation exists, it is argued in many studies (i.e. Abramowitz, 1956). Their interconnectedness is noticeable by the interchangeable use of these terms and their particularly close definitions. Krugman defines productivity as: *a ratio between the output volume and the volume of inputs that measures how efficiently production inputs, such as labour and capital, are being used in an economy to produce a given level of output* (Krugman, 1994).

There are different methods of measuring productivity that are used to estimate the economies' productive capacities and its utilisation, to forecast the business cycles and the economic growth (Krugman, 1994). One of the most conventional measures that is used to quantify productivity is the Gross Domestic Product (GDP), or more precisely GDP (per hours worked).

Although widely spread, in times of emerging digitalisation of services and goods (to more limited extent) and their free sharing through the modern means of communication, the GDP has posed certain challenges in measuring the economic outputs. Its outcomes might be somewhat biased, the research done for the purpose of this paper, will be mostly reliant on GDP as a central indicator of the economic growth. GDP per capita is narrowed down to output per unit of labour input (or labour productivity), hours worked (intensity), the percentage of the working age population actually working (participation rate) and the proportion of the working-age population to the total population (Bjork, 1999: 2). Theory points out to many drivers of the real economic growth, but the effective combination of labour and capital unites brings increases in productivity that is the main source of growth. In a historic glance back, ever since the Industrial revolution the technological progress has accounted for 80 % of the US growth per capita (Krugman, 1997: 172). The overall importance of productivity lays in the fact that it lowers the costs of the outputs and increases the competitiveness.

Although productivity can be measured separately for each factor (e.g. labour productivity), there is a more comprehensive way of quantifying it, called *multifactor productivity* (furthermore only MFP). MFP relates the output to a combined set of inputs, reflecting the collective effects of various factors which despite of the traditional ones (labour and capital) also include new technologies, economies of scale, managerial skill, and changes in the organization of production (U.S. Bureau of Labor Statistics, 2016).

MFP is considered the most frequently observed indicator of the pace of the technological change. As indicated in an OECD study, in spite of that, *MFP is not necessarily technology, nor does technological change exclusively translate into MFP growth* (OECD, 2001: 115). As it was presented in the first subchapter there are two types of technological change – embodied and disembodied, as the diffusion of the technical change is depended on this distinction. The diffusion of the embodied technological change is closely related to the market transactions: in order for an investment into improved capital or intermediate good to happen, its marginal contribution to revenue must be at least equal to its user cost (which is itself dependent on the market price of the capital good). On the other hand, this process differs in the disembodied

technological change, because it is not necessarily dependent on marketing transactions: the stream of information is free and its use by one person does not exclude its use by other people (OECD, 2001). The methodology used to calculate the MFP sustains in: the weighted average of: the rate of change of output, the weighted average of the rate of growth of labour input, the rate of growth of capital input, intermediate inputs, and technical change. Both capital and labour inputs are heterogeneous and have a variable quality, however MFP can reflect the effects of embodied technical change, in the same ways as it reflects the contributions of each factor of production. What MFP fails to capture is the technical change so that it does not manifest the effect of the embodiment, although it can successfully display the disembodied technological change. Some of the embodiment effects of the technological change together with the changes in the skill aspect of the labour input are contained in the MFP residual (OECD, 2001).

In the empirical studies, the MFP growth is similarly not always a product of the technological progress. Non-technology factors such as: economies of scale, changes in efficiency, measurement errors, adjustment costs and cyclical effects can also cause a growth of the MFP.

Overall, the MFP indicator has a tendency of understating the role of productivity in the stimulation of the economic growth, which is mostly due to the fact that in this model capital is considered an exogenous input to the production. Contrary to that in a dynamic context this is no longer the case, as here the technological change allows for more output per capita to be produced that further leads to extra savings and increased investment that raise the capital to labour ratio. The MFP accurately measures the change in the production possibilities, it does not include the induced effects of technology on the economic growth. (Rymes, 1971).

Due to these imperfections in productivity measuring, sometimes it is difficult to contain all the implications of the technological progress in productivity growth. The technological change is accelerating, but in many cases that has not led to productivity growth as well (OECD, 2001). The empirical data of OECD indicates that many of these countries have gone through a productivity slowdown. In the economic literature there are some additional explanations for the productivity slump. According to Korres these may be: *substantial changes in the industrial composition of output, employment, capital accumulation and resource utilisation.* The drop could also happen *if that technological opportunities have declined, or else new technologies have been developed but their application to production has been less successful* (Korres, 2008: 109).

He also speaks of further alternative explanations that enter this category such as:

- *the capital factor; for instance, investment may have been insufficient to sustain the level of productivity growth;*
- *the technology factor; for instance, a decline in innovation might have affected productivity growth;*
- *the increased price of raw materials and energy; government regulations and demand policies that affect the productivity level;*
- *skills and experience of the labour force may have deteriorated or workers may not work as hard as they used to;*
- *products and services produced by the economy may have become more diverse;*
- *productivity levels may differ greatly across industries* (Korres, 2008:147).

Moreover he argues that technological change manifests itself in the long-term economic growth, and it is a less reliable indicator of the medium-term variations of the GDP and productivity.

In his paper *Recombinant Growth,* Martin Weitzman holds similar views on the shorter-term effects of technology on growth. He argues that there are limits to growth and they may lie not in the ability of humanity to generate abundance of new ideas, but rather in the ability to process them in usable forms. (Weitzman, 1998: 359). Here he suggests that although technological change may be rapid, people need to be able to digest the changes, and also take the time to implement them in the working places and into the organisational structures of the companies.

2. Defining income inequality

2.1 Definition and measurement of income inequality

The term inequality can be used in different contexts, beginning with some broader reflections to the countries` distributional policies to the narrower view used to compare the incomes within a certain system. Inequality in academia often goes hand in hand with the study of poverty and welfare. In spite of that, inequality is a wider concept from poverty because it takes into account the total distribution of individuals and households and not only the restricted distribution below the poverty line (Litchfield, 1999). These are important distinctions, as the incomes on the upper scale are as significant of indicator as the ones on the bottom. Compared to the concept of welfare, inequality is narrower since it is independent of the mean of the distribution and is concerned only with its dispersion. What they have in common is that they manage to seize the whole distribution of a given indicator (Litchfield, 1999).

The primary focus of this paper is on wage discrepancies, and for that purpose will present analysis of earned incomes. Earnings integrate more factors: marginal productivity, returns to investment in education, gaining skills, migration activities, access to opportunities etc. (Ehrenberg and Smith, 2012).

The World Bank Group points out to four most commonly used measurements of inequality. They differ in computational methods, difficulty of comprehension and tackle a different dimension of income inequality.

1) ***Gini coefficient***: perhaps the most popular indicator of inequality. The coefficient can gain values from 0 to 1. Zero indicates complete equality and one complete inequality - meaning that all the income belongs to one person and the rest have none. Graphically is represented by the Lorenz curve and the line of perfect equality (Figure 1). The Gini coefficient is the area between them. It becomes smaller when the income of the rich is redistributed to the middle class and the poor. It can be used to portray inequality on the level of both households and individuals (Ehrenberg and Smith, 2012).

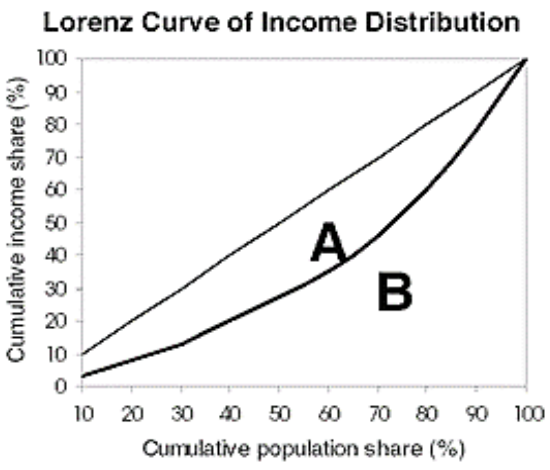


Figure 1: Lorenz Curve of Income Distribution. Source: (World Bank, 2015)

The vertical axis represents the cumulative income share versus the horizontal (distribution to the population.)
The computation of the Gini coefficient is simple. It is calculated as the area A divided by the sum of areas A and B. In the case of total equality, the Lorenz curve and the line of total equality would merge and the Gini coefficient would be 0. When the surfaces of A and B would start to equalize, than this means that few individuals receive most of the earnings, leading to perfect inequality and Gini coefficient of 1 (World Bank, 2015).

Some controversies may arise during the interpretation of this measure. It is an indicator of absolute rather than relative wealth, and in this context it may point out to a larger value (as seemingly the poverty has risen) even in cases when the absolute poverty decreases (Federal Reserve Bank of St. Louis, 2010). Its value also depends on various societal structural changes particularly of population growth, migration, family regrouping (divorces, split households). In addition the Gini coefficient is not capable of detecting where in the distribution inequality takes part, which results into two very different distributions of income having the same Gini index (Bellu and Liberati, 2006). These authors claim that the opposite also holds: similar economies (in terms of incomes and Gini coefficient values) can have different income distributions. Derived from that it should be taken with reserve, particularly in cross country comparisons, as it can be misleading.

This index ignores the wealth, thereby not accounting for the use of household income, so that it makes an appearance of inequality in different age groups (older people have a higher wealth accumulation than younger). This means that a certain country can have a low Gini income index, showing a greater income equality, while at the same time having a high Gini wealth coefficient, suggesting extreme inequality in the given society (Domej and Klein, 2000). These discrepancies should be included in the interpretation of Gini coefficient.

The Gini coefficient is also dependent on the size of the sample. When using this inequality measurement it is important to be consistent about the definition of a

household. If it includes both data from individual and household incomes, then it will display biased inequality information (Deninger and Squire, 1996).

Another disadvantage of this indicator is that it is not additive across groups, i.e. the total Gini of a society is not equal to the sum of the Gini for its sub-groups (World Bank, 2015). Since this thesis is focused on the inequality in the USA, the Gini coefficient of the US economy as a whole will not be identical to the weighted average of the individual inequalities measured for each of the US states. Nonetheless, that is achievable by the Theil index.

2) ***Theil-index:*** it is not used as often as the Gini coefficient, but it complements it by being additive across different subgroups, though it is difficult to achieve a comprehensive interpretation by measuring solely with the Theil – index (World Bank, 2015). Simply put, it is a measurement of the income distribution discrepancies across groups and between individuals belonging in one group (Conceição and Ferreira, 2000). This index finds its suitable application in data on wages, earnings and employment across different industries, capable of capturing the evolution of income inequality through time (Conceição and Galbraith, 1998). Its characteristics are such that provide an overview of the evolution of inequalities within industries. The calculations are also simple, needing only basic data of employment and wages earnings by sector. The Theil index attains values from zero to one. If it shows the minimum value of 0, then all groups have the same share of income, and if one person has all the income than the TT is 1(Conceição and Ferreira, 2000). Overall it measures the distance from the actual state of income inequality in a country to the perfect equality.

3) ***Decile dispersion ratio:*** belongs among the most interpretable metrics of inequality, since it expresses how many times the income of the rich is larger than the one of the poor. It`s precise calculation according to the WB goes as follows: *the ratio of the average consumption or income of the richest 10 percent of the population divided by the average income of the bottom 10 percent* (World Bank, 2015). Moreover this ratio can be calculated for different percentiles (e.g. the division between the richest 5 percent of the population –the 95^{th} percentile and the poorest 5 percent – 5^{th} percentile).

4) ***Share of income/consumption of the poorest x%:*** this measure is the most appropriate when the bottom earners are the central concern of the research. Its advantage over the

Gini coefficient and the Theil – index is that, opposite to them this indicator does not vary with the changes in the distribution policies (World Bank, 2015).

2.2 Agents of income inequality

The following subchapter will discuss the causes of income inequality and how these lay the basis for nations` growing insecurity. In the field of economics there are two main sources – technology and globalisation, which catalyse larger income inequalities. They manifest themselves through growing unemployment, diminishing wages hence generally greater social insecurity. Thus it is of central importance that the term *income* is well defined and later contextualised in the realm of the triggers of income inequality.

One of the leading labour economists, and co-founder of the *Basic Income Earth Network* (BIEN), Guy Standing offers a broader understanding of income. In his analysis, besides *income* he includes *security* as a complementary aspect of one`s earnings. This more inclusive disaggregation of income is framed in the content of the term *social income* (furthermore only SI). Its definition is universal for basically any society, as there are five basic sources of income which together compose the individual`s SI (Standing, 2001). In addition the SI is presented as follows:

(1) SI= W+CB+EB+SB+PB[7]

This identity can be further dissolved into:

(2) SI = (Wb + Wf) + (FT + LT) + (NWB + IB) + (C + IS + D) + PB[8]

[7] ***(SI)*** *is the individual's total social income, (**W**) is the money wage or income received from work, (**CB**) is the value of benefits or support provided by the family, kin or the local community, (**EB**) is the amount of benefits provided by the enterprise in which the person might be working, (**SB**) is the value of state benefits provided, in terms of insurance benefits or other transfers, including subsidies paid to workers or through firms to them, and (**PB**) is private income benefits, gained through investment, including private social protection* (Standing, 2001:12).

[8] (***Wb***) *is the base or fixed wage, (**Wf**) is the flexible part of the wage (bonuses, etc.), (**FT**) are family transfers,(**LT**) are local community transfers, including any income from charity, non-governmental organisations, etc.,(**NWB**) are non-wage benefits provided by firms to their workers, (**IB**) are contingency, insurance-type benefits provided by firms to their workers, (**C**) are universal state benefits (citizenship rights),(**IS**) are insurance-based income transfers from the state in case of contingency needs, and (**D**) are discretionary, means-tested transfers from the state* (Standing, 2001:12).

This deconstruction of income helps to understand that there are factors additional to globalisation and technology that are affecting one`s wellbeing. The social dimension of this identity also brings the role of state into the inequality puzzle, as it can significantly influence most of its components. The size of the welfare state is crucial in determining the level of state transfers to the individual. The labour regulations that mould the labour market and the type of working relations that are allowed within also figure here. A broader explanation of the state`s role in income inequality will be presented in the third chapter, where the focus will be put strictly on the US social system and its labour regulations.

According to (Standing, 2001) the prevailing trend for the past decades is that for many groups there has been a shift from non-wage and non-monetary forms of income to monetary wages. Since globalisation and liberalisation shaped the structure of the social income to be mostly reliant on one component, it could be concluded that the core indicator of the income inequality in the USA is expressed in the population`s wages. In addition to the diminishing state benefits and wage reliance, an increase in unemployment could significantly impact the level of income inequality.

2.2.1 The impact of *globalisation* on income inequality

International trade as one of the main drivers of globalisation is responsible for the tendency of the prices of the factors of production (e.g. capital and labour) to strive towards a single price. In most of the advanced countries including the USA the median wage has stagnated (Brynjolfsson and McAfee, 2014). In contrast, in the developing countries they are rising. This convergence of the factor prices is primarily a result of the free trade in commodities (in conditions of diminishing transportation and transaction cost), according to Samuelson`s initial *factor price equalisation* theory (Samuelson, 1948).
Krugman and Obstfeld claim that this theory is based on simplified assumptions that are untrue in the real world:

1) ***Both countries produce both goods*** (e.g. cloth and food) – price equalisation occurs only if the involved countries are similar in their relative factor endowments. This implies that the factor prices do not have to be in equilibrium in countries with different ratios of capital to labour or of skilled to unskilled labour.

2) ***Technologies are the same*** – the price equalisation will not happen if the countries have distinct production technologies, because the one with more advanced technology will tend to have higher wage and rental rates than the inferior country.
3) ***Trade actually equalises the prices of goods in the two countries*** – the total convergence of factor prices among countries is basically impossible due to barriers such as: transportation costs and trade barriers - tariffs, quotas and other regulations. (Krugman and Obstfeld, 2011: 68-70)

They further argue that it takes some time before the same factors move between different industries and start to earn the equal share, so equalisation is possible only in the long run. The unequal wages distribution in the past 40 years in the USA has considerably grown. The widely spread view that the main cause for this is the international trade with low – wage countries has some adherents, however, Krugman and Obstfeld disagree and point out that the main reason for the growing gap between low and high – skilled people in the USA is the technology, which has significantly devalued the former claim (Krugman and Obstfeld, 2011: 72).

Standing has a more extensive understanding of how globalisation affects inequality. Like Krugman and Obstfeld, he acknowledges that closely linked to the process of globalisation is the technological change that coupled with certain organisational and labour market arrangements can exacerbate income inequality.

To begin with, he argues that globalisation on one hand brings greater openness of the economies worldwide, but on the other hand the international pressure constraints the freedom of the governments with their national economic and social policies. In turn this has led to a greater capital mobility and a shift of the bargaining power from *labour* to *capital* (Standing, 2001). In his opinion the liberalisation and deregulation trends are the catalysts of income inequality, which thrives in conditions of technological advancement. As he puts it: *Globalisation is seen as threatening the viability of certain forms of welfare state and regulatory system, and has contributed -- to a smaller or greater degree according to one's perception – to the growth of economic inequality and labour insecurity* (Standing, 2001:6).

The technological change and the increased mobility of capital, have laid down the conditions for decentralised production, supporting various forms of organising labour and payment systems.

He further identifies seven forms of flexibility that have shaped the modern systems of labour protection and security:

1. *Organisational flexibility* – more turnover of firms, more use of sub-contracting and production 'chains', and a tendency to contract the employment function;
2. *Numerical flexibility* – more use of external labour, such as contract workers, outworkers, homeworkers, agency labour, temporary workers, and teleworkers;
3. *Functional flexibility* – greater change in work tasks, job rotation, and skill;
4. *Job structure flexibility* – more changes of restructuring jobs and occupational structures in production;
5. *Working time flexibility* – more continuous working, flexible hours, etc.;
6. *Wage system flexibility* – a shift from fixed to flexible wages, monetisation of remuneration, greater use of bonuses, etc.;
7. *Labour force flexibility* – less attachment to sectors, companies or occupational groups, erosion of 'collective labour', and greater tendency for workers to move in and out of the labour market and labour force (Standing, 2001:7).

The reliance on wages, as a main component of one`s income, coupled with the flexible working hours and flexible wages, the shrinking social benefits and the receding bargaining power of the collective labour groups has created a disadvantageous environment for the global worker. As mentioned before these changes are stemming from the processes of globalisation and liberalisation that also reinforce the diffusion of knowledge[9] and the pace of the technological change.

In addition to that, in the globalised market businesses can practically hire workers anywhere in the world. This means that workers compete with their skills and their wages on an international level. Since China and the rest of the developing world have opened to trade, a large percent of the American manufacture was dislocated there due to their low costs (Autor and Dorn, 2013). Nevertheless, since the mid – nineties the manufacture industry in China is sharing the same high – productivity and low – on – labour pattern of the USA. Automation is indisputably enhancing efficiency of the global worker (Brynjolfsson and McAfee, 2014: 183).Thereby, it is not the case that the foreign cheap labour is fully responsible for growing

[9] The diffusion of knowledge is crucial for the dislocation of the business activities in a way that its transferability depends on the type of knowledge. There are two types of knowledge – explicit and tacit. ***Explicit knowledge*** *– academic knowledge or ''know-what'' that is described in formal language, print or electronic media, often based on established work processes, use people-to-documents approach. Once codified, explicit knowledge assets can be reused to solve many similar types of problems or connect people with valuable, reusable knowledge.* ***Tacit knowledge*** *– practical, action-oriented knowledge or ''know-how'' based on practice, acquired by personal experience, seldom expressed openly, often resembles intuition* (Smith, 2001:314,315). The latter is the decisive factor determining which the operations will be displaced (outsourced or offshored).

unemployment in the low – skilled sectors in the USA. But this phenomena is not exclusive to manufacturing.

A common trend has begun in the service sector, e.g. some American companies are starting to automate jobs in call centres, instead of offshoring them as it was done so far. (Brynjolfsson and McAfee, 2014) emphasise that *offshoring is often a way station on the road to automation*; and *trying to fend off wages in technology by cutting wages is only a temporary protection.* The assumption that the digitisation is bringing back jobs to the USA might hold, considering that rational entrepreneurs would prefer a computer over Chinese workers if it can do the same job. It would be more cost – effective as production does not have to be exported overseas, but kept in the USA (Krugman and Sachs, 2015).

The American economist Lawrence Summers, also holds the view that income inequality can be exacerbated by both automation and production outsourcing to countries that compete with their low - paid labour.

For example, mechanization of what was previously manual work quite obviously will raise the share of income that comes in the form of profits. So does the greater ability to draw on low-cost foreign labour. (Summers, 2014)

He further argues that technology such as robots, 3D printing and artificial intelligence will rather rapidly take over blue and white – collar jobs[10], and the first ones to face these devastating changes would be workers performing routine tasks. He has sceptical inclination towards the mainstream claim that technological progress will create new jobs. In Summers` opinion artificial intelligence in the context of income inequality will be a much greater concern than the largely discussed issue of capital accumulation.

2.2.2 The impact of *technology* on income inequality

That technological change causes short – term job losses is a widely accepted idea in the economic theory (Mabry and Sharplin, 1986). Nevertheless, different streams of economic thought hold confronting views about the implications of the technological innovation on long

[10] ***Blue Collar*** *refers to types of occupations that are largely manual involving or supervising physical labour; and occupational skills are acquired in the job through apprenticeships or vocational training.* ***White collar*** *jobs are typically executed in an office or administrative setting and requires educational credentials and involves the mental manipulation of symbols, words and ideas. As the distinction between education and training implies, the main distinction that divides white collar from blue collar work enters on the opposition between mind and body or eye and hand* (Van Horn and Schaffner, 2003:54).

– term unemployment. The fact that technology could melt away the demand for human labour, was discussed by John M. Keynes in the years of the Great Depression. In his essay *Economic Possibilities for our Grandchildren* he had introduced the term *Technological Unemployment*, describing a situation in which majority of the employed labour would permanently become redundant due to the fast – paced spread of automation. He lays down the following prediction:
The increase of technical efficiency has been taking place faster than we can deal with the problem of labour absorption;
We are being afflicted with a new disease of which some readers may not yet have heard the name, but of which they will hear a great deal in the years to come--namely, technological unemployment. This means unemployment due to our discovery of means of economising the use of labour outrunning the pace at which we can find new uses for labour (Keynes, 1963: 389).
According to Keynes, the technical unemployment is not merely a result of the technological shift itself, but of the incapacity of the economic system to rapidly create new work places that would effectively match the current structure of the economy.
On the other side of the spectrum there are economists who hold the more prevalent notion, that technological change causes only temporary unemployment, and that the advancement would lead to the creation of more sophisticated and better jobs positions (Brynjolfsson and McAfee, 2014: 175).
Brynjolfsson and McAfee describe the latter - mainstream view, using two pillars. The first resting on economic theory and the second on two hundred years of historical evidence.

Theoretical explanation for technological unemployment – makes its observations through the following three mechanisms:

- Elasticity of demand: as technology increases labour productivity, then lower production costs may lead to lower product prices and consequently increase the demand for the product, which would finally result into a greater demand for labour. This cause - effect chain is dependent on the elasticity of the demand (Brynjolfsson and McAfee, 2014).[11]

In the case of relatively inelastic demand, lower prices and increased productivity do not (in most cases) lead to such increase in demand which would be sufficient to result in more labour being employed (Brynjolfsson and McAfee, 2014). Agriculture and manufacture are typical

[11] Mankiw describes the price elasticity of demand as a measurement of how much the quantity demanded responds to a change in price. (Mankiw, 2012)

examples of the *inelastic demand case.* Improved production efficiency and lower prices did not cause employment growth in these sectors – on the contrary automation has invariably reduced the necessity for workers. On the other hand, when the demand is highly elastic, increased productivity generates larger demand, which in turn creates new jobs.

In the long run, demand tends to move towards perfect elasticity – people consume less of the relatively older goods and services, causing decline in their prices. As a result of this, the demand for labour also decreases and more money are freed up in the economy to be spent on technological novelties (Brynjolfsson and McAfee, 2014). New work placements are created in these *advanced* industries, so that the same level of employment is preserved. This mechanism is supporting the observation of the mainstream economists, who claim that the technological unemployment is impossible, instead the technological shift is causing only temporary displacements of labour (Brynjolfsson and McAfee, 2014). That is to say that in the long run, the loss of some work places will be compensated with new, that are adjusted to the technologically salient demand. Keynes had a distinctive view on the nature of the demand in the long run. In his opinion it is more plausible that regardless of the low prices, at some point people would get satiated and consume less (Keynes, 1963). This would diminish the need of labour and of longer working hours.

- **Rapid change:** here Keynes argues that as the pace of the technology moves very fast, creating short - term maladjustments that are a result of the organisational and institutional lagging. After technology leaves certain groups of workers jobless, they would need some time to gain new skills in order to start in a new job (Keynes, 1963). This draws a certain parallel with structural unemployment only that in the case of the technological unemployment the worker that has become redundant cannot be moved to another sector which is a slower technology adopter (as it is possible with the structural). Technological unemployment will be present until the companies find new organisational ways of employing the human capital and until the workers reskill.

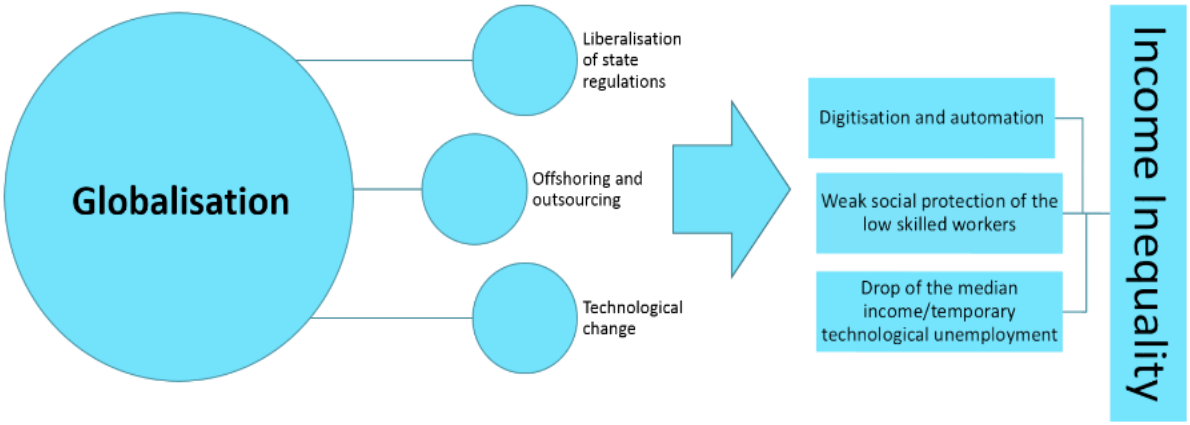
- **Severe inequality:** the technological progress has utterly distinctive impact on different population structures, creating winners and losers. Depending on the type of the technological change (whether is skill biased[12], capital biased or a *winner takes it all*[13] wealth accumulation)

[12] Skill biased and capital biased technological change are explained on pages 4 and 5

[13] The term *winner takes it all* is in this context used as an expression for the businesses (also called superstars) that achieve a monopoly-like power on the market. Helped by the globalisation and digitization, these industries become more important,

the gap between the population tends to become even greater as does the possibility of becoming technologically unemployed (Brynjolfsson and McAfee, 2014: 175-178).
The data showing these interconnections will be presented in the analytical part of this thesis.

Picture 1: *Inequality triggers in a nutshell*



Source: (own creation)

Although there are different opinions about the ways in which globalisation is channelling income inequality, they all seem to boil down to technology. The key determinant of the prices of labour in an open economy is productivity. This price is then additionally influenced by state tax and redistribution policies, and further negotiated by various groups such as unions, trade associations etc. According to the economists mentioned above in this chapter, the spread of automatization is a new way of saving on labour costs, which has a potential to replace the job offshoring. The incentive for the businessman is clear – the lower labour expenses enable reduction of the retail prices which in the long term boosts the competitiveness and secures higher profits. The *winners and the losers* of this shift depend on the nature of the technological change. What they have in common is that they increase the income gap between the different groups. In the case of capital-biased technological change, the rise of the productivity of the capital input subdues the productivity of the labour, encouraging substitution of the labour for capital, by raising the profits of capital owners and knocking down the share going to labour. Similarly the skilled-biased technological shift reduces the income of the demand for less skilled labour (usually performing manual or routine tasks) compared to the increased demand for the skilled ones, whose remunerations are remarkably higher. And lastly the fast-paced digitisation and information enabled the existence of superstar enterprises that can thrive as a

causing an increase in income inequality, because pay at the top pulls away from pay in the middle (Brynjolfsson and McAfee, 2014).

paramount in certain sector, gaining monopoly power, creating a divide between them and the others in that secor– (Brynjolfsson and McAfee, 2014) also call this *a luck -biased technological change.*

3. Income Inequality in the United States of America

As it was discusses in the previous chapter, the dominant forces that shape the state of income inequality are the laws of supply and demand helped by the technological change. The individuals that achieve a higher marginal productivity have higher gains. Therefore, the subjects with lower contributions to productivity are having lower incomes. The skills that one has, empowered by the technology are determining the level of productivity accomplished, so that the market forces reward the higher achievers accordingly. The implications of these market mediums (technological change and globalisation) on income distribution in the USA will be demonstrated in subchapter 3.1., following the century long income inequality decomposition, with special focus in the years since the 1970s till present time, as this period is crucial for the tax system reforms in the USA, which also overlaps with the kick-off of the information technology and the spread of globalisation. The secondary causes, derived specifically from the political and economic conditions of the USA are presented in subchapter 3.2.

The analysis of the US income inequality will use the same method as the Council of Economic Advisers of the president of the USA, who decompose income inequality in the following three components, all of which have different causes, dynamics and implications:

- *Inequality within labour income (wages, salaries, and benefits);*
- *Inequality within capital income (capital gains, dividends, and interest); and*
- *The division of aggregate income between labour and capital* (Economic Report of the President, 2016: 24).

The contribution of these components to the overall income inequality will be introduced in the subsequent chapter through presentation of some empirical data.

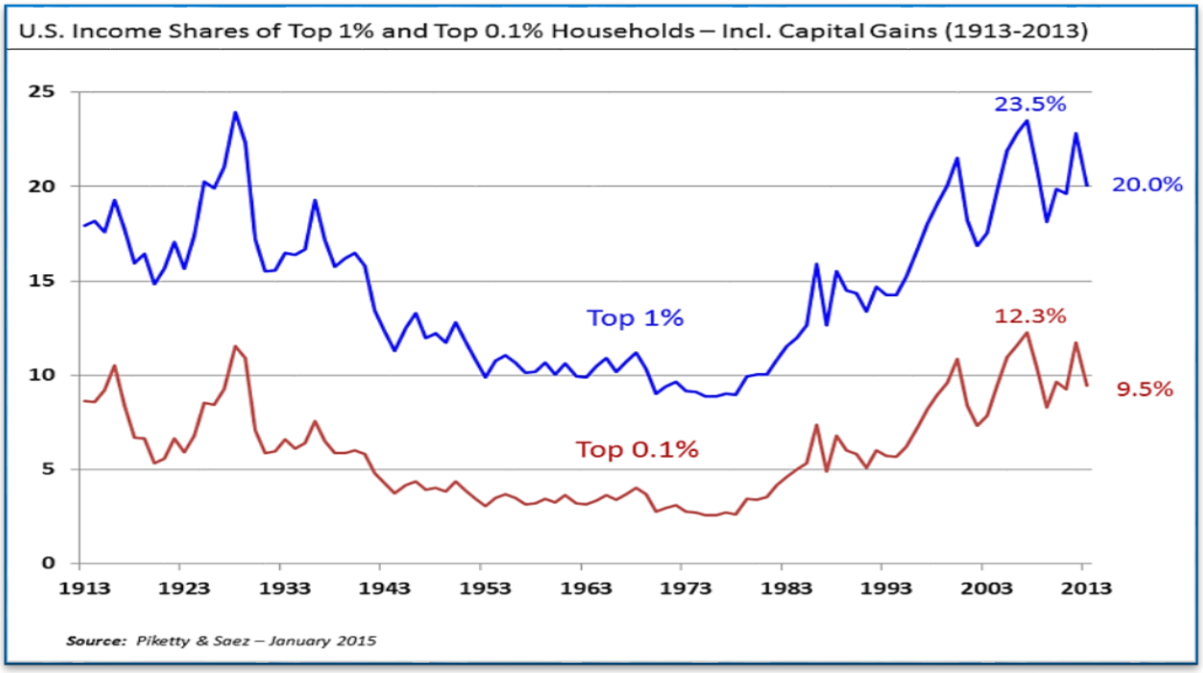
The American Nobel laureate Simon Kuznets argued that income inequality typically follows an inverse U – shaped development; – it starts rising with the technological change and industrialisation and thereafter is eventually reduced as the majority of workers are getting employed in the high productivity sectors (Kuznets, 1955). Regarding the Kuznets curve, Stiglitz argues that there is a plausible argument that holds for the inverse U-shaped inequality development. He explains this by a pattern of development that was prevalent since the spread of industrialisation in the USA, up until the 1980`s. The penetration of manufacturing made

the industrial sector more attractive for the American workers, as the industrial wages were exceeding the agricultural wages, which makes the standard indicators of inequality to go upwards. Once the urbanisation dominates, there are fewer low-income rural jobs that have little impact on inequality, which lastly leads to an increase in the wages in this sector (Stiglitz, 2015). USA followed this scheme until the late 1970`s.

This trend is presented in the work of (Saez, 2015) who collected data on incomes in America since the second decade of the twentieth century. The pattern is presented in Figure number 2, that shows the income shares of the top 1 % (the blue line) and the top 0,1 % (the red line) of the US households.

The outcome of their data shows a century long inverse U-shaped curve, which according to the authors is not merely an outcome of the Kuznets`s hypothesis (Atkinson,Piketty and Saez, 2007). As the income records (including both household incomes and capital gains) shows - in year 1913 the 1% of the American households got 18 % of the whole income in the country and as of 2013 it had reached 20 %, which is an even larger share of all the income going to this group (figure 2).

Figure 2: Income shares of the top 1 % and 0, 1 % U.S. Households (1913-2013)



Source: (Saez, 2015)

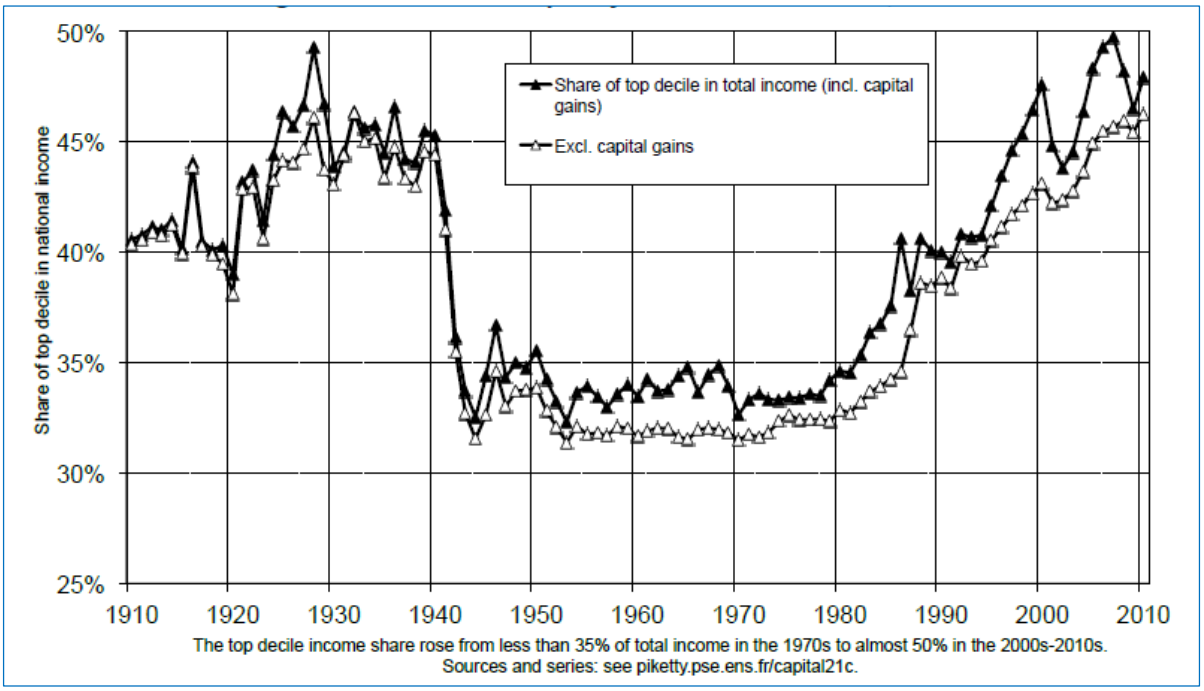
The red line represents a more privileged group the top 0.1 % of the American population. The data shows that they held 8 % of all the incomes in year 1913, and this number has risen up to 9,5 % one century later. In between these years there is a period of much lower income

inequality in both groups. Additionally, they find that the slumps in income in the first half of the century have occurred due to severe economic shocks that followed the World War I and the Great depression. In these years many businesses had been destroyed, which lead to less income inequality by depriving the business owners of high incomes (Atkinson, Piketty and Saez, 2007).

The years after World War II, are accompanied by a continuous drop of the curves. Stiglitz explains this as the period when the USA became a middle class society, marked by the rapid decline of the agricultural sector (dropping below 2 percent of employment by the 21st century) (Stiglitz, 2015 a). In this period all layers of the society had rising incomes, particularly those at the bottom that saw their incomes grow faster than those at the top.

On figures 2 and 3, it is noticeable how the American inequality reached its bottom in the decade of the 60`s. Figure 3 shows the share of total national income held by the top decile of the population on the USA. The bold line also includes the income earned through capital gains, whereas the line tightly below it is cleared from capital gains. Both curves follow the same trend and are at their lowest levels in the 60`s. The prosperous post war period, that Krugman refers to as *America that we love* has ended by the end of the 1970`s, when the growth has slowed down and larger inequalities were on the rise again (Piketty, 2015).

Figure 3: Income Inequality in the USA, (1910-2010)



Source: (Piketty, 2014)

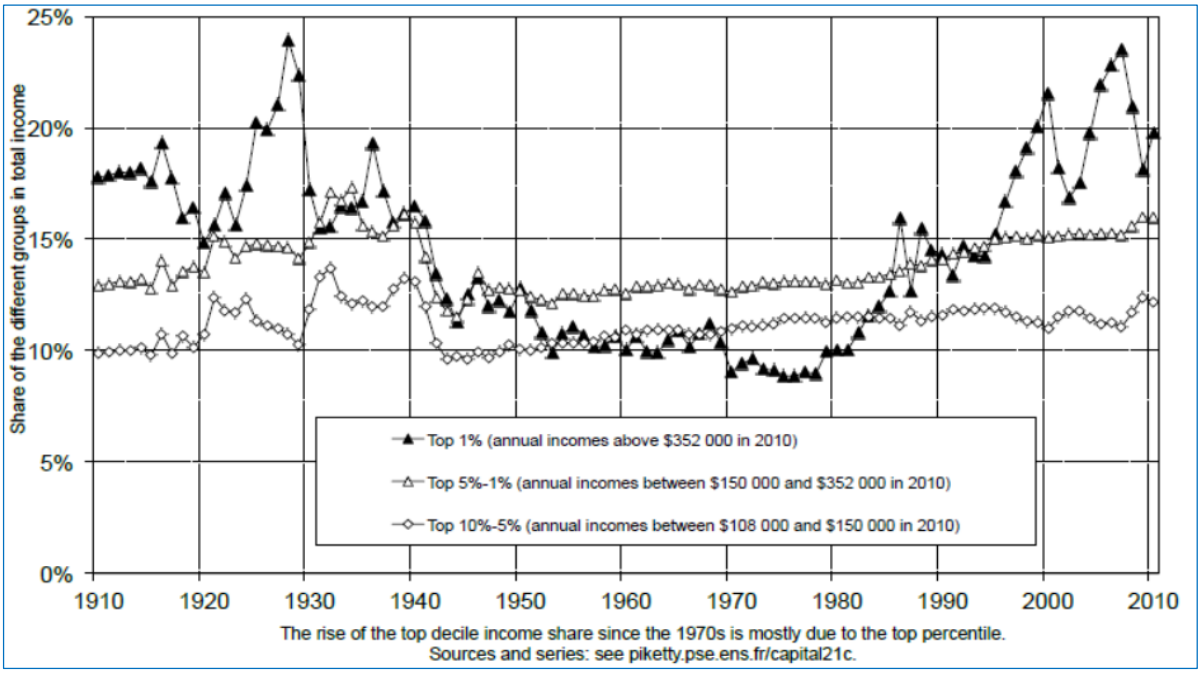
As presented on figure number 3, the record low level of (approx.30 % to 35 %) income shares belonging to the top 10 % of the Americans during the 1960`s, has rapidly jumped to 40 % by the ending of the 1980`s. These numbers continued to rise sharply, even in throughout the first decade of the 21st century, reaching 50 % in year 2010. In three decades beginning with the 1980`s the share of the US national income in the hands of the richest 10 % has increased by 15 percentage points[14]. Should this vast income inequality rise with the same intensity, it is estimated that the income share of the top decile might surpass 60 % of the total national income (Piketty, 2015). Despite the fact that both curves in figure number 3 follow the same trend, the biggest differences between them could be observed in the good years of the financial markets (slightly before the market bubbles). Piketty explains the divergence of the curves as a consequence of the capital gains that reach their maximum right before the economic slumps. In figure number 3 this is particularly observable in year 1928, before the great Depression, being the first captured record of maximum capital gains (3 % of the national income). The same pattern is observable in year 2000 before the dotcom (internet) bubble and again in 2007 before the Great Recession. Capital gains alone have also contributed to the income inequality, having a similar development as the rest of the income that is not a result of a return of capital. They have grown from 34 % in 1970`s to 46 % in 2010, which is an increase of 14 percentage points. During recessions income inequality tends to decrease, because the fall in capital gains is bigger than the fall in other types of income. According to Piketty`s point of view, the inequality upturn had contributed to the financial turmoil in the USA in 2008. As the share of income for the richest layers had been going up, the purchasing power of the American middle and low class had moved downwards, leading to their growing tendency of indebtedness that came as a result of the affordable loans offered in the years before the crisis that these humble households have been unable to return (Piketty, 2015). However, the occasional boom and busts of the US economy did not significantly change the long - term tendency of the income inequality, as there are other forces that mould its development (Piketty, 2015).

In order to more thoroughly see which particular group within in the top 10 % is the biggest contributor to the US income inequality, the top decile will be further dissolved into the highest

[14] The statistical series used in the graphs by (Piketty, 2013) are taken from WTID (The World Wealth and Income Database). These data take into consideration only the incomes stated in the tax declarations, not accounting the underestimation of the of the capital incomes, that are occurring legal and other reasons. This implies that due to the growing discrepancies of incomes reported in the American national accounts and the ones that are not captured in the statistics, figure number 3 underestimates the real increase in the income share of the top decile (Piketty, 2013). According to (Piketty, 2013) the income share held by the top 10 % had surpassed 50 % of the American national income; firstly in year 2008 (before the financial crisis) and afterwards again in the beginning of the 2010`s.

1 % (annual incomes higher than $ 352 000), highest 5 % to 1 % (annual incomes between $ 150 000 and $352 000) and finally highest 10 % to 5 % (annual incomes between $108 000 and $ 150 000) (figure number 4).

Figure 4: Decomposition of the top decile in the US (1910- 2010)



Source: (Piketty, 2014)

Following the respective curves for each of these three groups, it evident that in the recent years the top 1 % earners are significantly standing out from the others that earn less. This group has reached its record share of the US national income shortly before the Great Depression in year 1928, holding up to 24 % of it. Afterwards, particularly during the 50`s and 60`s their share had dropped to approx. 10 % whereas the lowest level of 9 % was reached during the 70`s. From then it has taken a sharp growth reaching numbers reminiscing of those during the 1928, i.e. in 2013 this share rose to 20 %. Compared to the other groups this one has been growing the most since the mid 1980`s, offering an evidence that in conditions of a certain economic structure and technological advancement, the biggest share of income is accumulated by the richest of the rich (the top 1 %), thereby contributing the most to the US income inequality. The overall increase in the share of income going to the top 1 percent from 1970 to 2010 is a result of three factors in the following proportions: 68 % is due to increased inequality within labour income; 32 % due to increased inequality within capital income; and 0 percent due to a shift in income from labour to capital. This finding puts the emphasis on labour income inequality, though it shows us that capital income is also an important driver of income inequality (Economic Report of the President, 2015).

The other two social groups from this decile, have also seen an increase in their incomes. In the years between 1970`s till 2011 the group *5 % to 1 %* saw an income boost of 3 percentage points, while the group *10 % to 5 %* extended its incomes for one percentage point. Altogether, the groups from the top decile had in the decade between 1970`s and 1980`s an increase in income larger than the average economic growth of the American economy of that time. (Piketty, 2015).

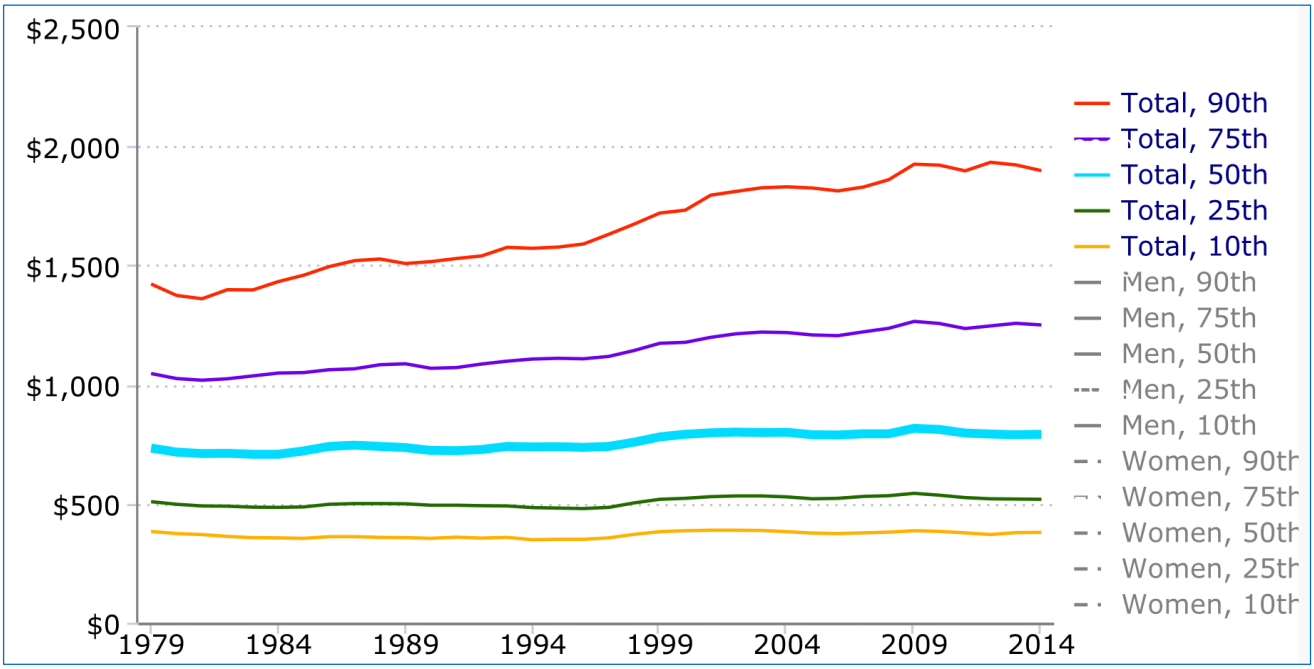
3.1 Primary Causes of Income Inequality in the USA. Wage and Productivity Analysis.

The importance of wage analysis stems from the fact that wages are a major determinant of changes in inequality, given that they represent about 80 % of household income in the United States (International Labour Organisation, 2015). Many prominent inequality researches have stated, that income inequality in the USA is by large caused by the extraordinary wage gaps between different social groups (Piketty, 2015). This analysis starts with an observation of the general wage inequality tendencies and continues further with the decompositions of the wages of workers according to the income percentile to which it belongs. Lastly it observes trends in productivity and compensation and tries to explain the reasons for those tendencies.

The data of the *US Bureau of Labour Statistics* suggests of a real (inflation adjusted) wage growth line that follows similar trend as the in the top incomes in figures 2 to 4. Over 35 – year span (figure number 5) the real earnings for the highest 10 % of the earners rose from $ 1422 per week in 1979 to $1898 per week in 2014, which is an increase of 33 %. For the median worker[15] things remained almost unchanged. They have started with $733 per week in 1979 reached $791 weekly by 2014, which is only an 8 % increase. Between these years the lowest earning decile has seen very little or no growth in their real weekly wages. In year 1979 their weekly earnings were less than $383 and less than $379 in 2014 (U.S. Bureau of Labour Statistics, 2015). The overall difference between the higher and the lower earners has grown since 1979. In 1979, the ratio of the 90th percentile compared to the ratio of the 10th percentile was 3.7, meaning that the salaries of the top earners were almost 4 times higher than those of the lowest 10 %. As of 2014 this ratio had risen to 5.

[15] The median weekly earnings are calculated for full-time wage and salary workers of age 16 and older. The salary numbers $733 and $791 mean that half of these workers earned at least $733 or $791 per week and half earned less than that amount.

Figure 5: Selected percentiles of usual weekly earnings of full-time wage and salary workers age 16 and older, in 2014 dollars, (1979-2014)



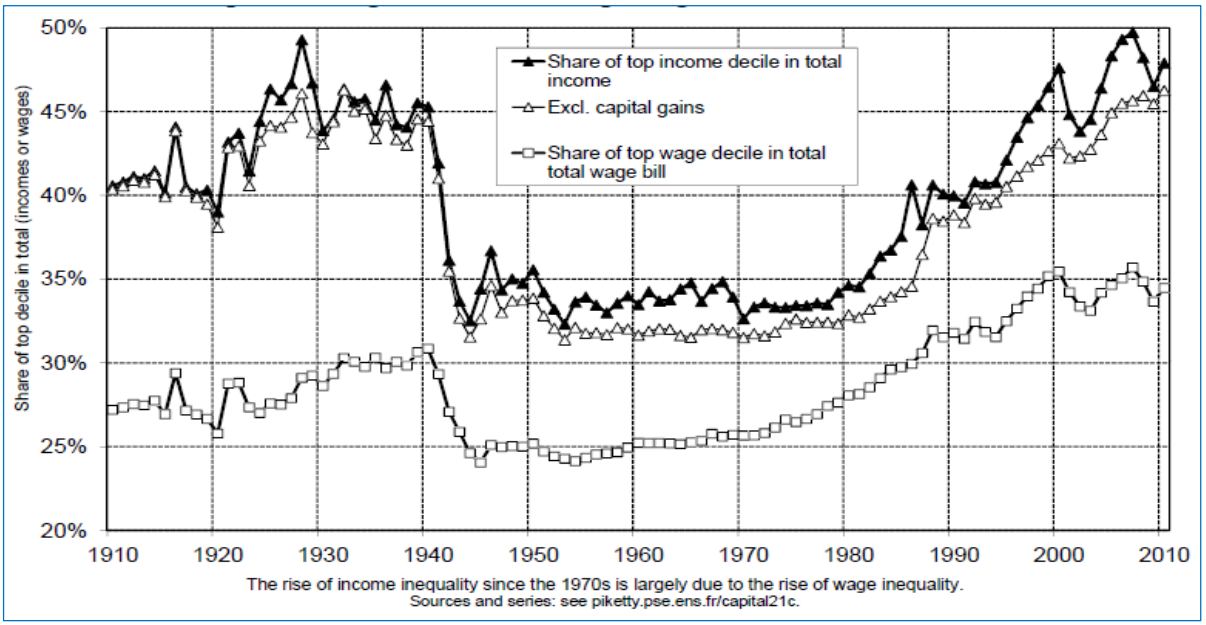
Source: (U.S. Bureau of Labour Statistics, 2015)

Decomposition of top earners

Figure number 6 shows the share of compensation for the top 10 % of the American earners. Piketty points out that behind these big numbers are the top managers of the big corporations, who are on the peak of the wage hierarchy due to their extremely high compensation. As in the case of the incomes analysed previously, the share of the top wages (without capital gains) recorded an increase in the years around the Great Depression and the Great Recession (approaching 46 % of the total income in both cases).

Historically these shares had been influenced by state policies that have mitigated the wage inequality, especially in the years of World War II up until mid-1970`s. From the 1970`s to 2010 the share of the top decile in total wage bill increased for 10 percentage points (from 25 % to 35 %, in figure 6). The wages of the top 10 %, particularly the top 1 % group have grown structurally faster than the average wage (Piketty, 2015).

Figure 6: High Incomes and high wages in the USA (1910-2010)



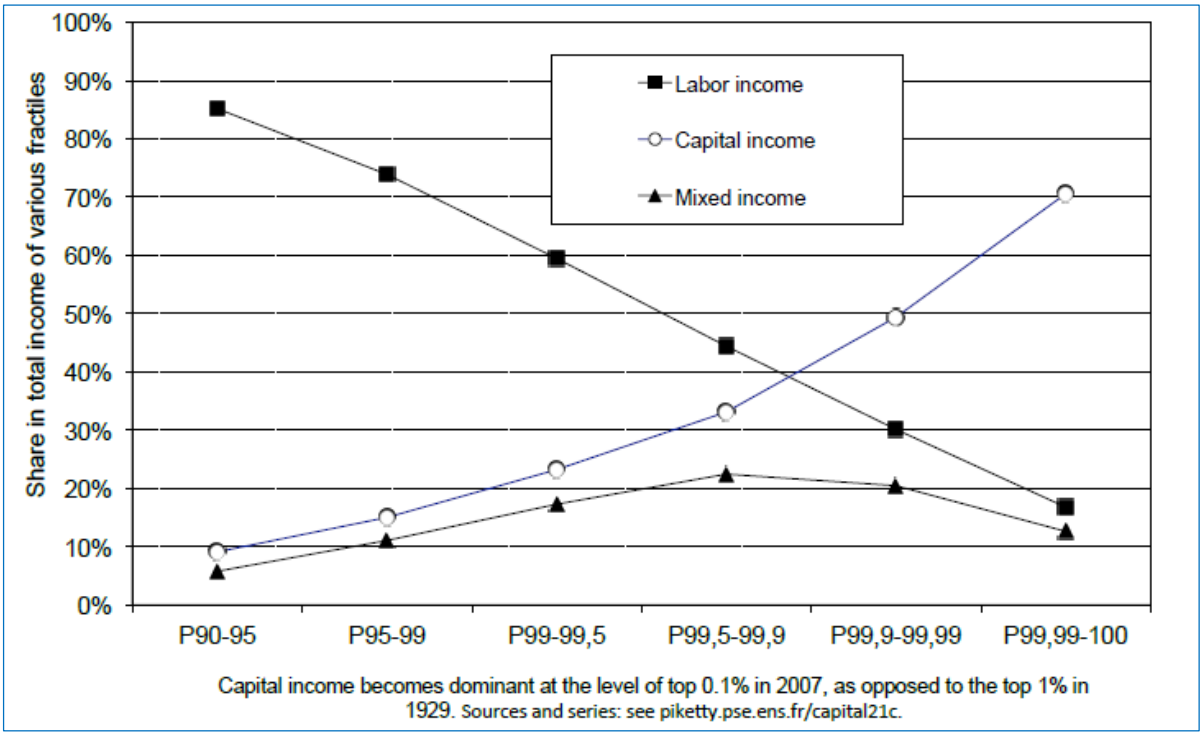
Source: (Piketty, 2014)

Besides these facts of the inconsistent growth of the wages between the highest social groups and everyone else, Piketty adds that these disparities were not compensated by wage mobility within one`s individual career (Piketty, 2015).

Wage mobility represents the ability of workers to climb up the wage hierarchy and it is often used as an argument that can relativize the reality of wage inequalities, by assuming that if everyone at some point of its working life starts earning super high wages (in other words - belong to the top decile). However, in Piketty`s view, it is unlikely that most of the American population will get to top management positions of the big US corporations (Piketty, 2015).

Regarding the sources of income of the richest in the USA, it can be concluded that the income of capital versus the income of labour are getting larger, as one is moving up the income hierarchy. The income sources for the groups within the top percentile are demonstrated in figure number 7.

Figure 7: The composition of the top incomes in the USA for year 2007



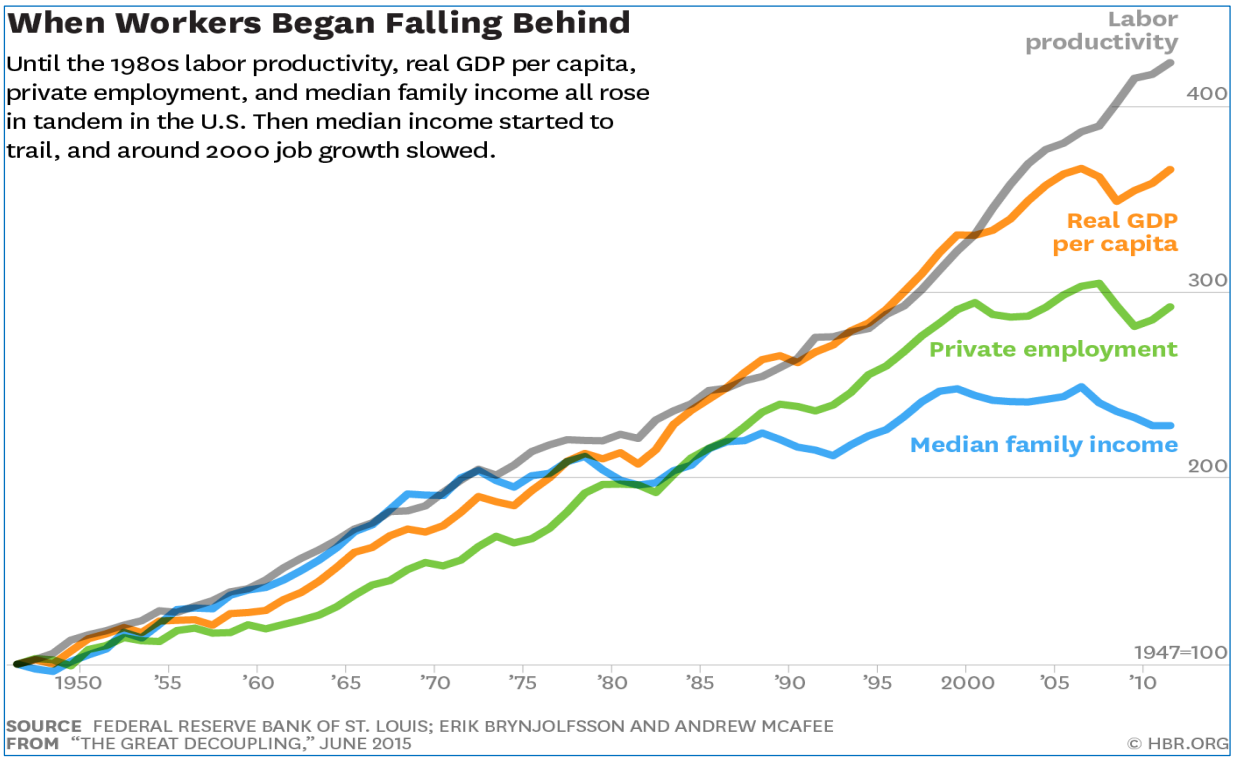
Source: (Piketty, 2014)

It is worth mentioning that the income of capital has a general tendency to surpass its average level in the years before economic crisis. This is observable in figure number 3, where incomes including capital gains reach their maximum level in year 2007. Implies that the ratios for income of capitals for year 2007 (figure 7) might be somewhat deflated. As the data form the figure show, for the top 0,1 % the capital income makes half of its income and this share is even higher for top 0,01 % since there it reaches up to 70 %. The labour income for these groups is contributing about 30 % and 18 % respectively. Moving downwards to the relatively less rich 10 %, the group consisting of the 90th to 95th percentile has a markedly different compositions of income. About 85 % of their earnings come from labour and only 10 % are from capital. This implies that within the US richest there are completely different sources of income for the earners on top and the earners on the bottom, whereas the former receive most of their income from capital and the latter from labour. Put simply, the richer one is, the bigger share of his/hers income is composed of capital as opposed to the poorer where the main generator of income is labour.

Decomposition of median incomes. Relationship between productivity and compensation

Compared to the vast income soar of 278 % in the earnings of the top 1 % of the US households between 1979 and 2007, those in the middle of the income distribution saw a modest increase of only 35 % (Brynjolfsson and McAfee, 2014).Taking into consideration the importance of wage compensation as a major income source for those of the lower social milieus (as seen previously from figure number 7, and not taking into account the role of social transfers) this part of the analysis will be focused on median income, counting on the fact that most of it is composed of labour income (wages).

Figure 8: Trends of the Labour Productivity, Real GDP per capita, Private Employment and Median Family Income in the USA (1950-2010)



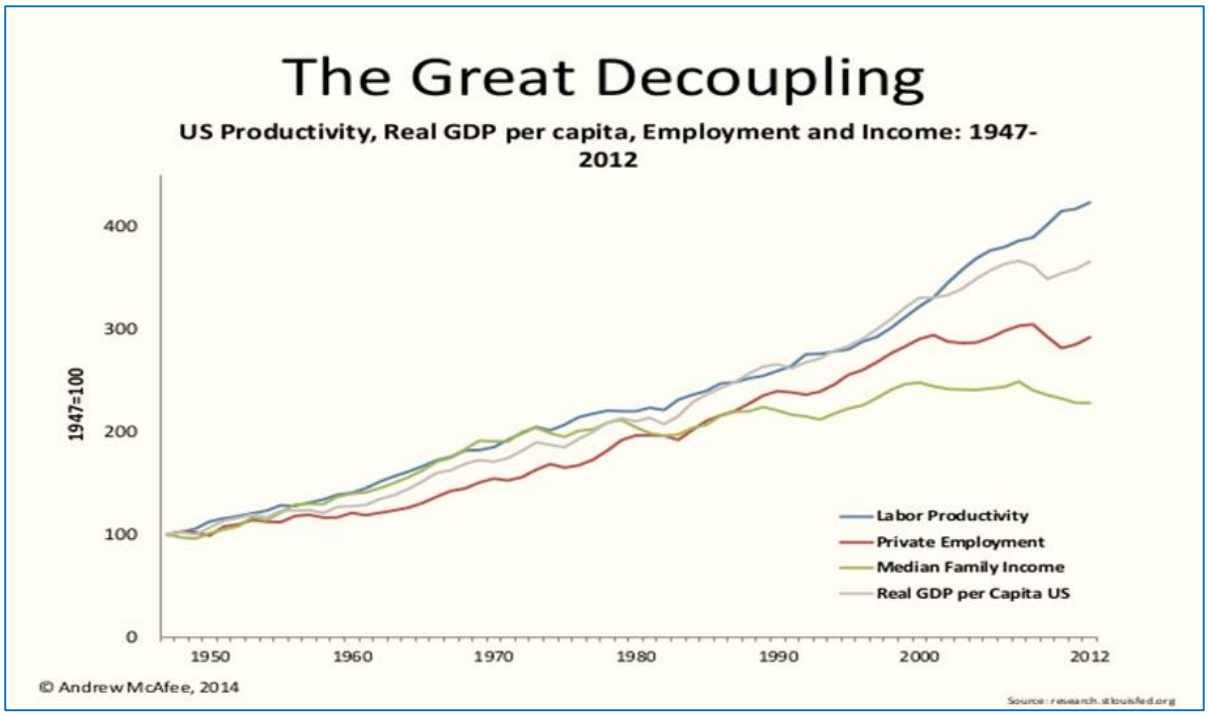
Source: (Brynjolfsson and McAfee, 2015)

Relying on the data about the US median income put together by (Brynjolfsson and McAfee, 2015), there is an evidence that it was increasing steadily from the 1950`s up until mid-1970`s in tandem with the productivity, the real GDP and employment (figure number 8). A period of divergence of the median family income has started after 1975, with it moving upwards only slightly, while productivity and GDP per capita growth have registered a sharp upsurge. The overall trend shows that from the late 1970`s until 2010 the income of the median household

has increased only moderately. It achieved its peak in 1999 and since then it has been stagnating (Brynjolfsson and McAfee, 2014).

One way to discover what group of the US households is benefitting from this growth, is to compare average with median income. In normal circumstances changes in average income (total income divided by the total number of people) should not diverge greatly from changes in median income (representing the income of the person in the middle of the distribution – half of the population earns less and the other half earns more) (Brynjolfsson and McAfee, 2014). According to figure number 9, in the past year (starting from 1975) these trends have remarkably decoupled.

Figure 9: Real GDP versus median income per capita; employment and productivity in the USA (1960-2012)



Source: (McAfee, 2014)

As it is shown on figure 9, the average income in the USA has seen a significant growth, while the median has barely changed. Brynjolfsson and McAfee explain that more skewed incomes, result in a larger divergence of the median from the mean. As the empirical evidence presented in the previous figures shows, productivity growth only provides the potential for rising income, as some groups have gotten a larger share of it and others have not seen any substantial changes or even experienced a decline in compensation (Mishel and Gee, 2012).

Figure 10: Growth in median hourly compensations and productivity for five subsequent business cycles (1973- 2011)

	1973–79	1979–95	1995–00	2000–11	1973–11
A. Basic trends (annual growth)					
Median hourly wage	-0.26	-0.15	1.50	0.05	0.10
Median hourly compensation	0.56	-0.17	1.13	0.35	0.27
Average hourly compensation	0.59	0.55	2.10	0.95	0.87
Productivity	1.08	1.29	2.33	1.88	1.56
Productivity-median compensation gap	0.52	1.46	1.21	1.53	1.30
B. Explanatory factors (percentage-point contribution to gap)					
Inequality of compensation	0.02	0.72	0.97	0.59	0.61
Shifts in labor's share of income	0.03	0.23	-0.40	0.69	0.25
Divergence of consumer and output prices	0.46	0.51	0.64	0.24	0.44
Total	0.52	1.46	1.22	1.52	1.29
C. Explanatory factors (percent contribution to gap)					
Inequality of compensation	4.8%	49.6%	80.0%	38.9%	46.9%
Shifts in labor's share of income	5.5%	15.4%	-32.5%	45.3%	19.0%
Divergence of consumer and output prices	89.7%	35.0%	52.5%	15.8%	34.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Note: Totals for panels A and B do not exactly match due to rounding

Source: (Mishel and Gee, 2012)

Table number 1 is a depiction of the trends of productivity and median compensation gaps for particular periods between 1973 and 2011. These five sub-periods represent business cycle peaks, when the US economy has achieved years of low employment. In order to more clearly identify the contribution of each factor in the median income – productivity decoupling, the two business cycles 1979-89 and 1989-2000 are divided into periods 1979-95 and 1995-2000 to divide the low productivity years from the period of accelerating productivity growth (and low unemployment) starting in 1995. The last period, 2000-11, runs from the end of 1990`s (period of recovery) to recent years (Mishel and Gee, 2012).

Panel A presents the annual growth rates of median hourly wages and compensation, average hourly compensation, and hourly productivity. According to this data the gap has been growing the fastest in the most recent 2000-2011 period followed by the slightly slower decoupling in the earlier 1979–95 period (Mishel and Gee, 2012). Productivity growth has been the strongest in the late 1990`s, keeping its levels in in the 2000-2011.

Panels B and C contain explanatory factors whose contributions to the median compensation-productivity gap are expressed in percentage points in panel B and percent in C. The first factor *inequality of compensation* represents the ratio of average hourly to median hourly compensation. The second, *shift in labour's share of income*, is depicted by changes in the nominal share of compensation in national output (GDP). The third factor *divergence of consumer and output prices* (terms of trade), is captured by the change in consumer prices relative to prices of national output (Mishel and Gee, 2012).

According to the analysis of (Mishel and Gee, 2012) (see table 1), the biggest contributors of the vast productivity-median income gap for the 2000-11 period were the growing compensation inequality and the decline in labour's share of income, having a respective share of 38, 9 % and 45, 3 % of the whole gap. The smallest contribution to the growing gap stems from the impact of the terms of trade, accounting for 15, 8 % of the total median compensation-productivity divide.

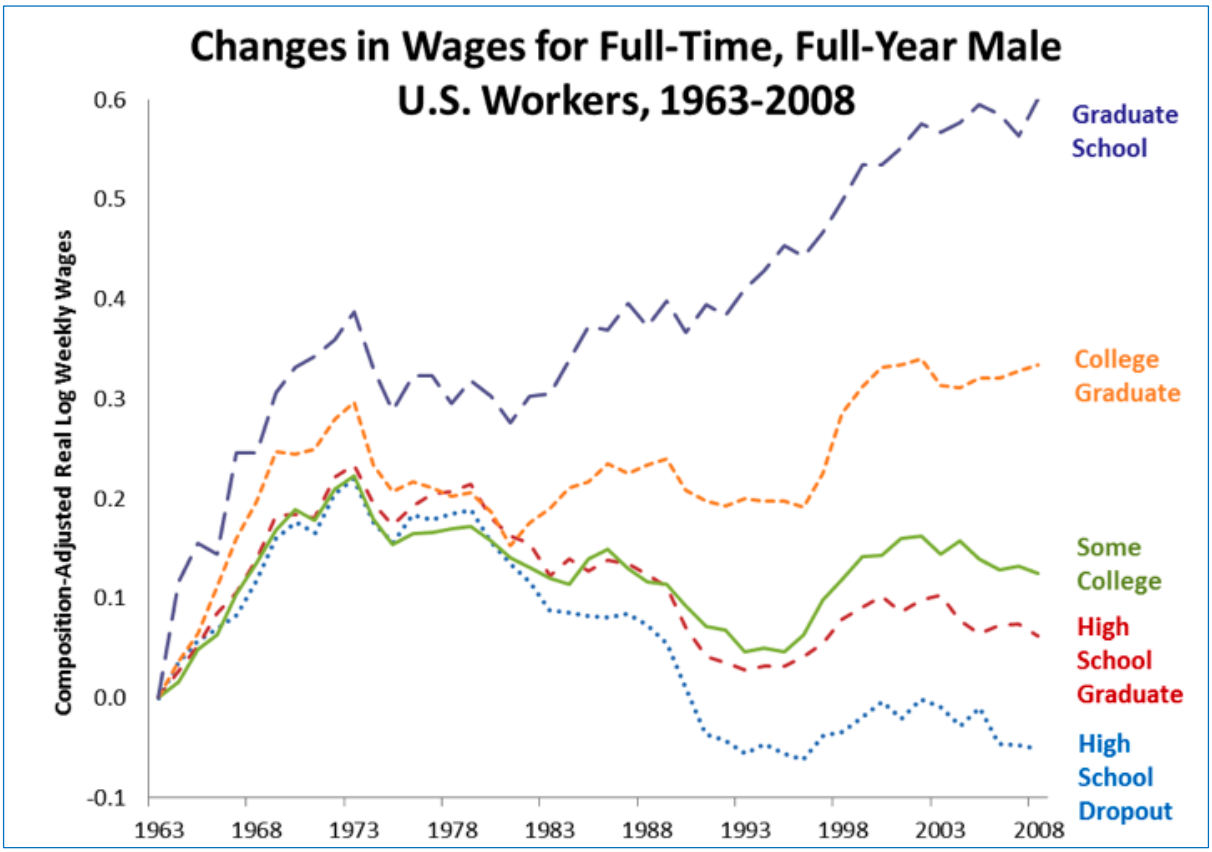
During the high productivity period of late 1990`s the median compensation has also accelerated, but at a slower pace, creating a yearly gap of 1, 21 % for the years between 1995 and 2000. This divergence was a consequence of deviating prices and a large soar in compensation inequality, occurring despite the increasing labour`s share of income. The earliest period 1973-79 was marked by a growing gap that was a reflexion of the price differences. Other than that, there was no substantial change in labour`s share of income nor a growth in compensation inequality (Mishel and Gee, 2012).

Summing up the for the entire 1973 to 2011 period, about half (46,9 %) of the growth of the median compensation-productivity gap was a result of the growing inequality of compensation, a third was caused by price differences and 19 % of the gap occurred due to a decline in labour's income share (Mishel and Gee, 2012). Brynjolfsson and McAfee have gotten to the same conclusion by claiming that most of the growth in productivity translates into comparable growth in average income and the reason behind the anaemic growth of median income is by large because of increases in compensation inequality (Brynjolfsson and McAfee, 2014).

In the previous subchapter it was discussed how technological change affects the compensation across different income groups by increasing overall productivity. However, as it was pointed out in the first chapter, technology does not affect all inputs with the same intensity. Recent technologies have contributed in enhancing labour productivity by replacing human labour in executing some routine tasks and creating demand for workers with particular skills. This trend

of favouring workers with more human capital[16] is the outcome of the *skill-biased technological change* (Autor, Katz and Krueger, 1998). The implications of it on the US wages will be analysed in the following part of this thesis.

Figure 11: Wage development for Full Time, Full-Year Male U.S. Workers 1963-2008



Source: (Acemoglu and Autor, 2010)

The effects of the skill-biased technological change are depicted in figure 11. The different curves represent five groups of workers ranked by their education level starting from the less skilled (high school dropouts) in the bottom and ending up with the most skilled ones (holding a graduate school degrees) at the upper end of the figure. According to (Acemoglu and Autor, 2010) these groups are corresponding to a certain percentile of the income distribution. The group *high school dropout* is compatible to the 5th percentile, *high school graduates* belong to the lowest 10th percentile of the income distribution, while those with *some college* are part of the 50th percentile. The *college graduate*s are part of the 90th and those with a degree from a *graduate school* represent the top 95th percentile (Acemoglu and Autor, 2010). The lines for

[16] Human capital is seen as an asset that can increase the workers` compensation. It can be a mix of various skills acquired through education, training or experience (Brynjolfsson and McAfee, 2014).

the years from the 1960s until 1973 are forming a trend of growing wages for all U.S. workers regardless of their skills. The wages of the bottom three categories were moving with basically the same pace, whereas the college graduates and graduate school attendees experienced somewhat higher compensation.

After 1973, the 10th and 50th percentiles continuously stagnate until the end of the decade. Only the 90th percentile of the distribution had diverged modestly from the median by the mid-1970s, offsetting the soar in compensation among post-college workers for that decade (Acemoglu and Autor, 2010). By comparing the 90th percentile with the median it is evident that the growth in real earnings is not evenly shared even between high earners. Between 1979 and 2007 there has been a steep growth of income of the 90^{th} percentile (Acemoglu and Autor, 2010). From 1980 to 1994 the median had been growing steadily, without any significant divergences. During the same period, the 10th percentile went through a steep plunge, developing a curve parallel to the high school dropout wages (Acemoglu and Autor, 2010). The median saw a rise during the mid-1990s (as it was discussed in the previous part – this was a period of productivity reaching its peak and of earnings growth in the US), the 10th percentile also caught up with the productivity growth (Acemoglu and Autor, 2010). In opposition to that the productivity explosion had a negative impact on the bottom 5^{th} percentile of the wage distribution, by drawing negative growth rate numbers for these workers.

In their book *Second Machine Age*, Brynjolfsson and McAfee make a case for the skill biased productivity growth by pointing out to the fact that the companies with the largest growth in productivity are those with the highest increase demand for the high skilled relative to unskilled workers. There is a threat of significant skill imbalances without a proper restructuration of the ways in which the businesses employ the new technology. This implies to the fact that the less skilled workers will be eliminated from the work process, while the rest (having a stronger educational background) will be augmented with predictable effects to the wage structure (Brynjolfsson and McAfee, 2014).

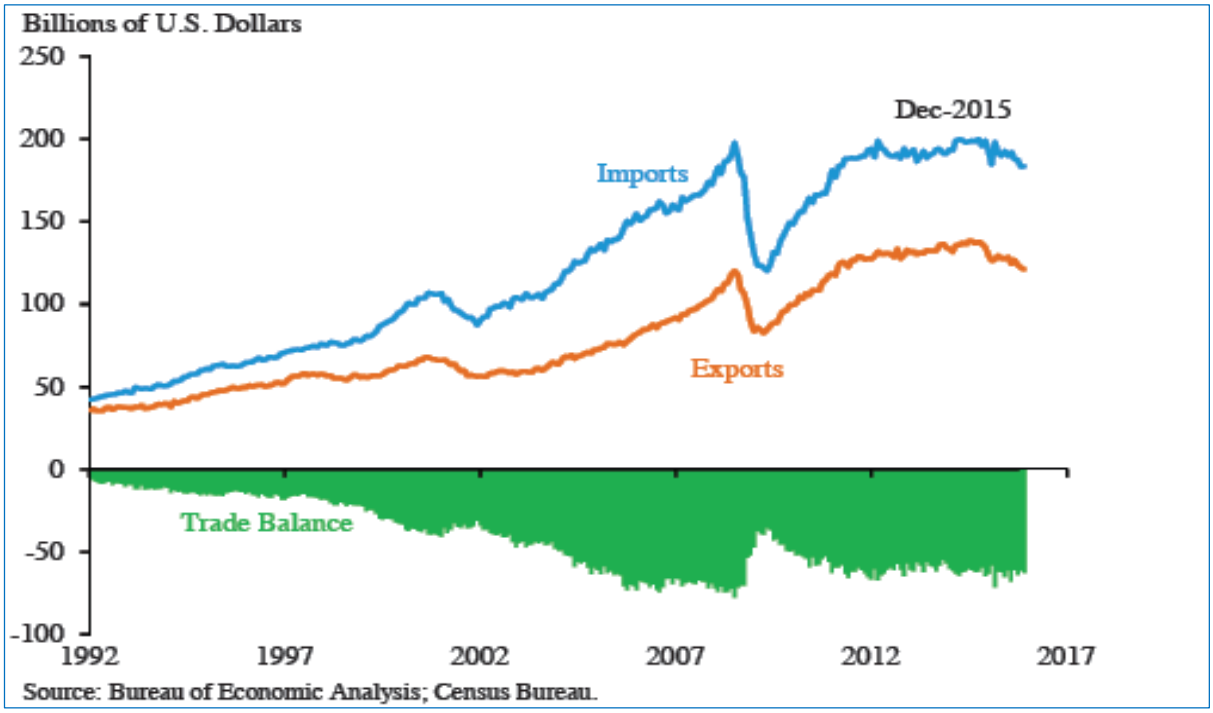
Impact of international trade and offshoring on the US wages and employment

In the second chapter of this thesis is argued that besides technological change, globalisation (international trade and offshoring) is one of the two principle causes of inequality. Globalisation aggravates the state of income inequality by having diminishing impact on the wages of the domestic workers and on job losses in certain sectors.

Since the 1980s, the U.S. economy has gradually opened up to cheap imports. This was accelerated mostly by signing the North American Free-Trade Agreement (NAFTA) (Economist, 2016a). The flow of cheap Mexican imports was later complemented by the entrance of China in the World Trade Organisation (WTO), which brought a new tsunami of cheap imports in America (Economist, 2016a). For the U.S. balance sheet this meant growing trade deficits with these partners.

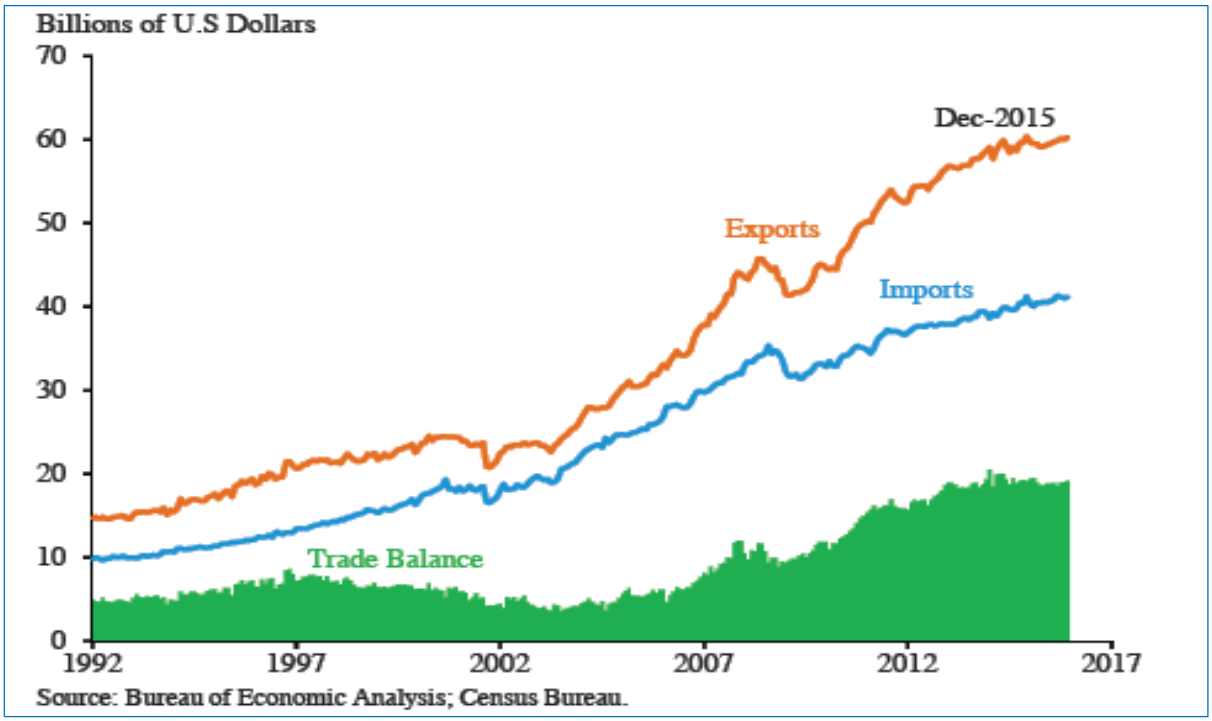
According to the most recent data for year 2015, it is evident that services exports still play the main role in the U.S. trade. Services make up 32 % of the total exports, but only 18 % of the imports (year 2015) (Economic Report of the President, 2016). That has shaped the structure of the American labour market and consequently, four out of every five American jobs are in the service sector. Estimates show that the service-oriented export structure has supported around 4, 6 million U.S. jobs in 2014. Since the start of the digital revolution in the 1990s, the U.S. exports in services are continuously exceeding the U.S. exports in goods (figures 12 and 13) (Economic Report of the President, 2016).

Figure 12: US Trade in Goods (1992-2015)



Source: (Economic Report of the President, 2016)

Figure 13: U.S. Trade in Services



Source: (Economic Report of the President, 2016)

The positive effects of the U.S. exports are manifested in the maintenance of nearly 12 million jobs and in the rise of wages, which on average are 18 % higher than in non-exporting businesses (Economic Report of the President, 2016). Exports contribute to the productivity growth, as the U.S. firms and sectors have an access to a larger market. Due to this, these highly productive firms that capable of employing a high share of the U.S. labour force. These facts are in accordance with the findings of the previous part that productivity growth leads to larger compensations, which are skill biased, as it productivity growth rewards highly educated and skilled workers and has almost no impact on the increase of wages of the less skilled workers. Even so, trade is an important supporter of the high paying jobs in the USA (Economic Report of the President, 2016).

However, when it comes to international trade, it`s overall impact on the economy is never only black or white. Although the cheap imports have outcompeted some of the American producers, for the U.S. costumers cheaper imports translate into falling consumer prices and widening the consumption choice. This effect has been proven by the two economists Robert Lawrence and Lawrence Edwards, whose estimations show that by 2008 trade with China alone has brought extra $250 a year for every American (The Economists, 2016a). The same can be derived from the analysis of (Fajgelbaum and Khandelwal, 2014), showing that openness to trade had positively influenced the purchasing power of American consumers. Their findings

on the distributional effects of trade are as follows: median income households are gaining more than 25 % of their purchasing power from U.S. trade, while for the lowest third of the income distribution, 50 % of their purchase power is a result of U.S. trade (Fajgelbaum and Khandelwal, 2014).

In the period of the 1980s the U.S. opening to imports from low-wage countries overlapped with the tendency of intensive production offshoring of many American businesses (figure 13). This era has also coincided with the increase of income inequality that has manifested in the loss of roughly 6 million job (Ebenstein, Harrison, McMillan and Phillips, 2009). Due to these developments many globalisation critics have expressed concerns that U.S. manufacturing jobs are being lost to abroad and American wages being pressed down (Ebenstein, Harrison, McMillan and Phillips, 2009).

Figure 14: Import penetration in the USA

Source: (Ebenstein, Harrison, McMillan and Phillips, 2009)

The following part of this paper examines whether these changes in the U.S. labour market are a result of the growing imports from the low-wage countries or of the offshoring tendencies to other countries. Thereafter will be analysed how trade and offshoring are affecting the U.S. wages and employment.

Through series of models (Cooke, Kemeny and Rigby, 2016) are trying to estimate the relationship between low-wage country import competition and plant exit for the U.S.

economy. By combining detailed U.S. data on low wage imports and manufacturing plant-level data across different industries, they have created an extended model of trade and exit.

Their findings show that the likability of plant exit depends on various variables; the size and the relative plant age influence the probability of exit in an opposite manner. The capital-intensive computing technology based manufactures stand a lesser chance to be closed, since they are based on large shares of capital investment. Higher total factor productivity plants have a stronger resistance to exit, although it was found that labour to capital ratio had no impact on the probability of closure (Cooke, Kemeny and Rigby 2016).

International trade also significantly figures in determining the likability of manufacture plant exit. (Cooke Kemeny and Rigby, 2016) point out to the importance of the import partner wage competitiveness for the outcomes of this model. They discovered that rising import competition positively correlates with plant exit. However they have measured that import competition from low-income country brings twice as higher probability for establishment closure than in case of high-wage import competition. The organisational structure of the establishment also depends on their exit probability. Multi-unit plants are more susceptible to exit than singe-unit plants in cases when there is an increased competition from low-wage countries. The same holds for the less productive and non-exporting manufactures. (Cooke Kemeny and Rigby, 2016).

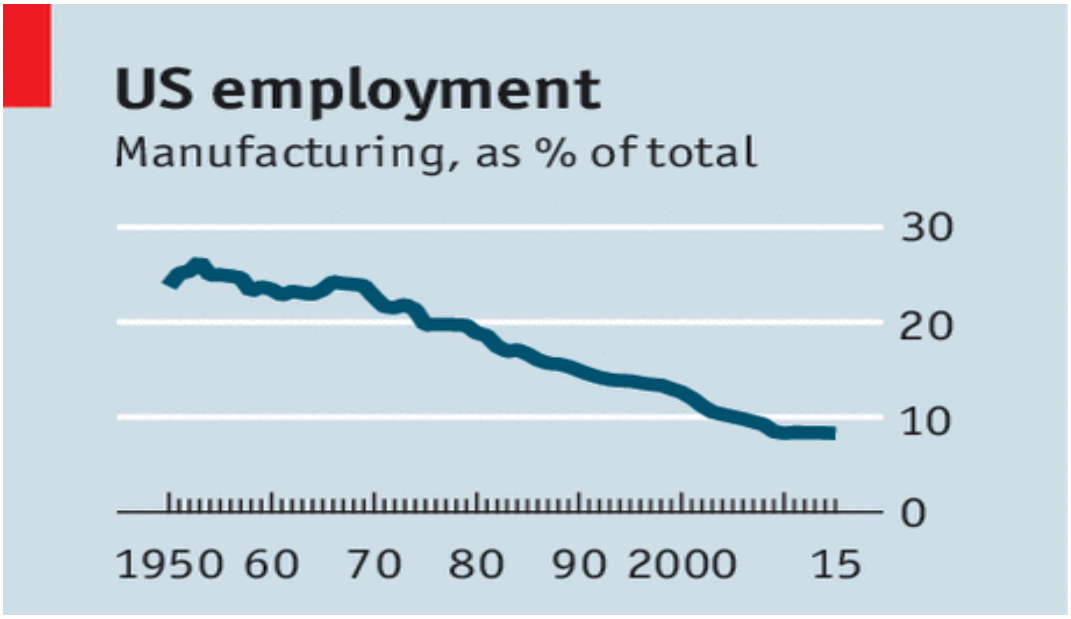
The implications of their finding are that the intense competition from low-wage countries for the past three decades does influence the sectoral structure of the U.S. economy. Multi-unit establishments generating lesser productivity and exports, are in the biggest threat of closure due to low-wage countries competition. These types of units are usually those that demand relatively low-skilled labour. This is how low-wage imports eliminate less skilled workers and shape the U.S. labour market to be in favour of relatively more skilled workers that match the high productivity industries.

Relying on this outcome, the inevitable question that follows is whether the U.S. responds to these competing imports by simply closing/offshoring these businesses or it responds by pressing the wages of the workers whose jobs are in question?

The impact of the globalisation forces on the U.S. wages was researched by Ebenstein, Harrison, McMillan and Phillips, who show that some groups of the U.S. workers are adversely affected by global competition, while other have drawn benefits from these changes. In order to measure the intensity of globalisation`s impact on U.S. wages and employment they combine

data on individual workers with international trade and offshoring information coming from the end of 1970s till the early years of the 2000s. As the facts show (figure 15), the percentage of the total of U.S. workforce employed in manufacturing has been sharply declining particularly from mid 1970s, when about 20 % of them were employed in manufacture, in opposition to the less than 10 % in 2015. The declines were the most apparent from 1980s.

Figure 15: US Manufacturing Employment, (1950-2015)



Source: (The Economist, 2016 b)

Nevertheless, it was found that the effects of the manufacture employment decline have an uneven impact across different groups of workers. The most affected are the workers without a college degree that were experiencing a substantial drops in manufacturing employment over the analysed period (1979-2002). Regarding more skilled workers, globalisation had the opposite effect. College graduates became more abundant in manufacturing jobs, so that they have replaced the workers with high school degrees (Ebenstein, Harrison, McMillan and Phillips, 2009).

In order to provide more evidence on the relation between globalisation and income inequality, these authors have also analysed the trend in hourly real manufacturing wages by education level (see figure 11 for weekly wages development by education for the general economy). Their data show that globalisation in the USA worked in favour for the manufacture workers with college degree. The ones holding advanced degrees have seen the biggest benefit, followed by the workers with at least some years of college. The only group in manufacturing

experiencing decline in wages are the least educated workers. These wage discrepancies decline at the lower end of the income distribution and soar at the upper end, have created a large gap in wage inequality (Ebenstein, Harrison, McMillan and Phillips, 2009).

Concerning manufacture dislocation and employment implications, Ebenstein, Harrison, McMillan and Phillips have found that there is a big movement of employees working in sectors that face a strong import competition. They have also discovered a correlation between offshore location and employment. Their calculations revealed that: *a 10 percentage point increase in offshoring to low-wage countries reduces employment in manufacturing by 0.2% while offshoring to high-wage countries increases employment in manufacturing by 0.8%* (Ebenstein, Harrison, McMillan and Phillips, 2009).

(Grossman and Hansberg, 2008) similarly argue that offshoring activities to high income countries activities can have a positive effect on domestic wages in a way that it increases compensation for workers staying at home by cutting costs for the companies that employ them.

U.S. workers benefit from the flexibility of their labour market, because they can easily move across different sectors as a response to import competition. This augments the negative effects of cheap imports on U.S. wages within affected industries, since those workers can move to another industry. Still it is not that easy when it comes to switching occupations (Ebenstein, Harrison, McMillan and Phillips, 2009). More about the U.S. labour market and its occupational structure will be discussed in chapter 4.

3.2 Secondary Causes of Income Inequality in the USA

The most prevalent explanation presented in standard textbooks is that the primary causes of income inequality are globalisation and technological change (Atkinson, 2015). Some empirical evidence on the role of technology and globalisation and their channels is presented in chapter 3.1. In order to attest to what extent these two forces account for the income inequality in the USA, this thesis also includes the impact of the so-called *secondary causes of inequality* that are obtained specifically from the U.S. political and economic settings. Derived from the recent literature on income inequality in the U.S., this part will integrate the most common additional factors that operate alongside technology and globalisation in aggravating income inequality. These are divided into political (tax and transfer policies, antitrust laws, declining unionisation) and economic forces (rent-seeking behaviour and short term profit orientation of firms). Part of them will be dissolved respectively in subchapters 3.2.1. and 3.2.2.

Some of the most prominent inequality scholars, Piketty and Saez claim that, although since the 1970`s the inequalities were on the rise again, (forming the pattern of the inverse U – curve) this development was not entirely due to a new industrial revolution, because according to Kuznets it should have eventually led to inequality decline as a growing number of workers would have benefitted from the innovations (Piketty and Saez, 2007). They further argue that the downturn and upturn of the top wage shares is too rapid to be a consequence of the technological change only, but rather it is a result of other factors including: changes in labour market institutions, fiscal policy, or more generally social norms regarding pay (Piketty and Saez, 2007). This opinion is also shared by Stiglitz who emphasises that even though market forces determine the share of income distribution, the inequalities are by large a consequence of policies (Stiglitz, 2015a). He supports his perspective by pointing out to the different degrees of inequality in countries with similar economic structures operating under the same economic laws (Stiglitz, 2015a). His argument, revolves around the claim that provided a certain legal and political environment, inequality could create a vicious circle:

There is a vicious circle in our democracies. Wealth and income inequality translate into political inequalities, especially in the United States, where our legal framework provides great scope for the influence of money. But then these political inequalities translate back into more economic inequalities (Stiglitz, 2015a: 4).

3.2.1 Political forces of income inequality

Tax and transfer policies in the USA

The market is not the single player in determining the state of inequality within an economy. The corrective instruments are in the hands of the state government. Although there are various types of economic policies[17], each of them is appointed to regulate different aspects of the national economy. Perhaps the most obvious one, used as a corrective arm of income inequality is the fiscal policy, more precisely its redistribution function (US president). It is executed

[17] Income inequality can be also influenced by the other economic policies, such as: monetary, fiscal, industrial etc. but due to the narrow aim of this thesis the emphasis will be put solely on the distributional policy. According to the Joseph Stiglitz, government sets the basic rules of the game through policy making laws such as: *ones that encourage or discourage unionization, corporate governance laws that determine the discretion of management, and competition laws that should limit the extent of monopoly rents. As we have already noted, almost every law has distributive consequences, with some groups benefiting, typically at the expense of others* (Stiglitz, 2012:64).

through the tax policies that determine the quantity of resources that later can be allocated in different areas of government through the state`s social expenditure function (Stiglitz, 2015b).

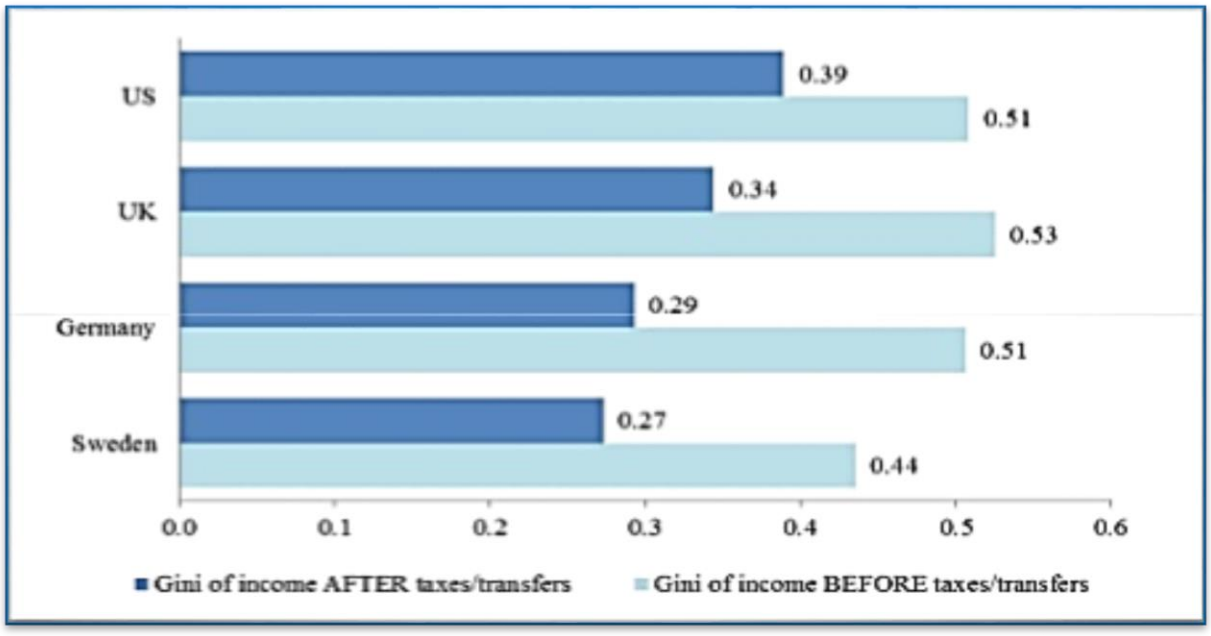
Even though the impact of taxes on the economy as whole is a broadly discussed topic, tax imposing divides politicians and economists into groups, out of which one thinks that taxation of the population of the higher income layer will reduce income inequality and poverty and boost the performance of the economy (Stiglitz, 2015a). The other group are the tax opponents arguing that taxing the more productive and therefore wealthier individuals could hinder the economic growth. Such representative is the economist Arthur Okun, who served as an economic advisor under the administration of President Johnson during the 1960s. He referred to higher taxes as to *the big trade off,* since he was convinced that they would weaken incentives and thereby weaken the economy (Stiglitz, 2015a). Four decades later, there has been a significant change in economic studies about the consequences of inequality. An opposite thesis is offered by Stiglitz, who in his 2012 book, *The Price of Inequality: How Today's Divided Society Endangers Our Future* he argues that the economy is paying a high price for inequality, particularly for the extreme levels of it, that are prevalent in the US. He adds that once policies succeed to lift the great levels of inequality, more equal societies will give rise to a stronger economy, higher growth, and more stability (Stiglitz, 2012). Stiglitz`s view has now been widely accepted and shared among many other economists (e.g. Galbraith, 2012; Atkinson, 2015; Piketty, 2015) and also supported by the IMF (Berg and Ostry, 2011).

According to analysis conducted by the Congressional Budget Office of the USA (furthermore only CBO), transfers and federal taxes reduce income inequality (Congressional Budget Office, 2011). Transfers tend to equalise incomes by boosting income for people at the bottom of the scale, and federal taxes tackle inequality by making income more equal through average tax rates. This is achievable because of the progressive taxation system in the USA, where a percentage of the household income is taxed. This percentage rises proportionally with the income, so that the highest earner also pays the highest tax. The opposite applies for transfers – they decrease as the market income rises. In addition, the earned income tax credit (EITC), which is a benefit for working people with low to moderate income has an effect on the income distribution similar to that of transfers by raising the after-tax income of lower-income households. It is a benefit that stands in the middle between a federal tax and a government transfer, because it reduces the due amount of tax that is owed, as it comes in form of a refund (Congressional Budget Office, 2011).

The effectiveness of transfers and taxes in reducing the income inequality can be established by comparing the Gini index for market income with the Gini index for after-transfer, before-tax income[18] and the Gini index for after-transfer, after-federal-tax income[19] (Congressional Budget Office, 2011). As mentioned above, the progressive tax and transfer system in the USA reduces the value of the Gini index (evidence in figure 16).

As it was evident from the third chapter, America's inequality has grown enormously over the past four decades, to the point where the upper 1 percent gains more than a fifth of the national income. Stiglitz points out to two disturbing facts about the American inequality: The USA have the highest level of inequality among the advanced countries, as well as some of the lowest levels of equality of opportunity (Stiglitz, 2012).

Figure 16: Value of the Gini coefficient before and after taxes/transfers for year 2011 in the US, UK, Germany and Sweden



Source: (Rattner, 2014)

To demonstrate the inequality discrepancies between the USA and other advanced market economies, this section will firstly work with pre-tax (caused by market forces) distribution

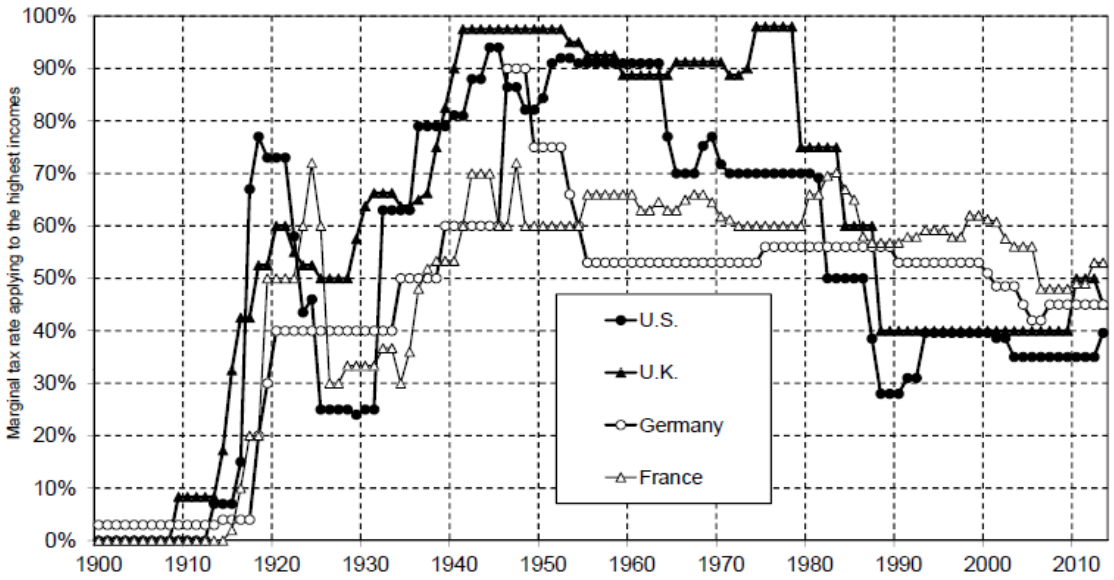
[18] **Before tax earnings** *are a company's earnings after all operating expenses, including interest and depreciation, have been deducted from total sales or revenues, but before income taxes have been subtracted. Because pre-tax earnings exclude taxes, this measure enables the intrinsic profitability of companies to be compared across locations where corporate taxes differ* (Investopedia, 2016).

[19] **After tax income** *is the amount of money that an individual or company has left over after all federal, state and withholding taxes have been deducted from taxable income. After-tax income represents the amount of disposable income that a consumer or firm has to spend on future investments or on present consumption* (Investopedia, 2016).

data from the USA and few other structurally similar countries. That outcome will be confronted with the post-tax inequality figures that will help to compare the strength of the redistribution policies between these counties and the USA (figures16 and 17).

In figure 16, it is evident from the comparable levels of the Gini index in the USA, UK and Germany, (slightly lower in Sweden) that the market forces in these economies follow the same patterns of income distribution. However, the after tax charts are somewhat different, showing the impact of the fiscal corrections in each countries. Judging by these figures, it is obvious that the US has the weakest social net among these, by doing less redistribution and therefore reduction of income inequality.

Figure 17: Top Income Tax Rates in the US, UK, Germany and France (1900-2010)



Source: (Piketty, 2014)

The analysis of figure 17, shows the development of tax rates of the top incomes in four advanced countries. The top marginal tax rates of income tax in the US peaked in the post war period up to 90 %, retaining the same level up to mid-1960s. From the 1970 up to 1980s, there was a significant drop of the US progressive taxation to 70 %. This coincides with the succession of the conservative economic policies of Ronald Reagan in the US and Margaret Thatcher in the UK, as these two countries with the highest top tax rate have seen a fast plunge during these years (Piketty, 2015). This has been the most evident on the decade of 1980 when the marginal tax rate fell from 70 % to 30 %. This liberal approach is deeply embedded in the economic policies of these countries, that regardless of the political rule they are held to a certain relatively low level of about 35 % to 40 %. This diagram showing the decline of taxation

in the period of the 1980s in the US, suggests that there might be some correlation with figures 2 to 6 that are showing the rising top incomes of the richest Americans over the same period. These developments suggest that the increase in the proportion of income retained (by the top earners), as a result of cutting top tax rates seems to be associated with rises in the top share of the total national income (Atkinson, 2015). Nevertheless, Atkinson argues that such simple comparison does not allow for drawing any conclusions about the causal relation between tax rates income distribution. He is categorical about the overall strong influence of globalisation on top incomes. According to Atkinson there are factors other than taxes that are determining the evolution of the top incomes.

The causal mechanisms is in this case not from taxes to top shares, but from globalisation to each of the variables separately (Atkinson, 2015: 181).

He is supporting this claim by giving an example of how as countries are becoming more integrated in the global economy the income top income shares are growing, but as a consequence of cutting tax rates to attract workers (Atkinson, 2015).

Those *factors/variables* that Atkinson is mentioning are thoroughly described in the previous chapters (particularly chapters 2.1 and 3.1), out of which technological change and globalisation have the strongest impact. The rest of the factors will be explained in the chapters to follow.

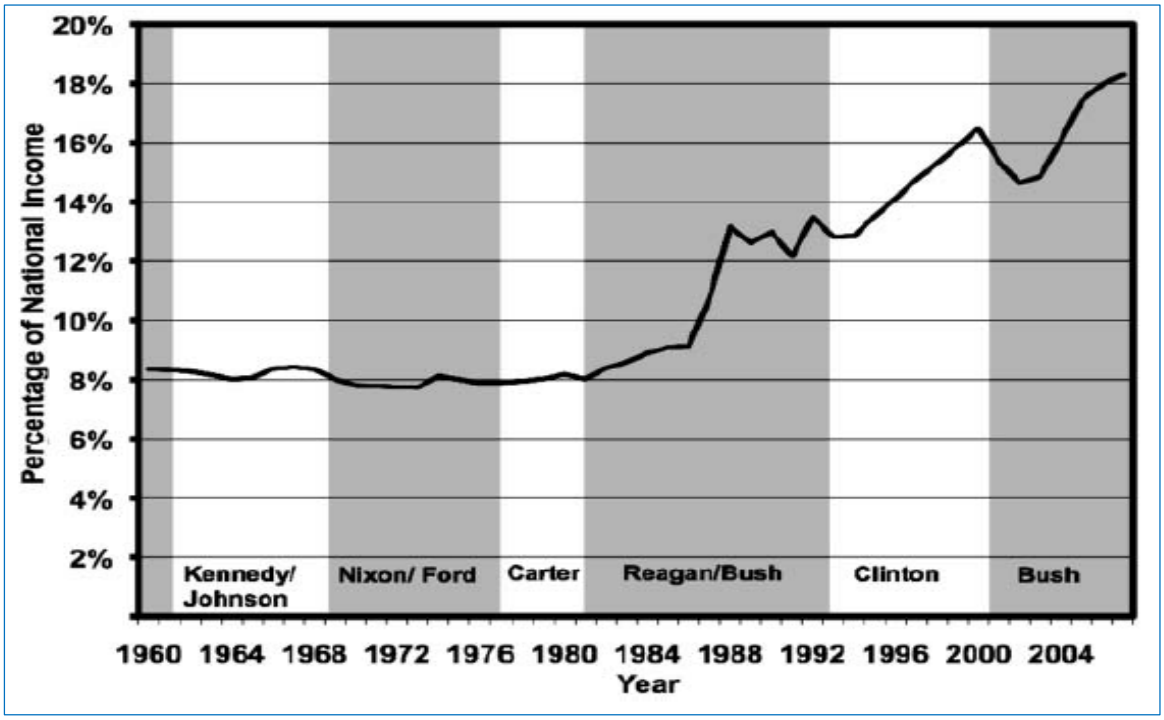
Declining unionisation in the USA

The political forces shape how incomes are handed even before taxation and redistribution are imposed. Many economists argue that in the period of deteriorating income inequality in the USA (from 1970s till nowadays), state policies have made it harder for the American labour to mobilise its bargaining power through unions and other organisational entities (Stiglitz, 2012; Atkinson, 2015; Hacker and Pierson, 2010 etc.). From the perspective of other social sciences, the most important feature of unionisation is the impact that it can make on the development of social policies (Hacker and Pierson, 2010). Stronger unions are suggestive of lower income inequality levels and solid social compensation. The decades long weakening of unionisation in the USA, is correlated with the decay of the American middle class, as it brings less pressure on policy makers to realise commitments of social protection, in such degree comparable with that of 1970s (Hacker, 2010).

The influence of trade unions in the US has been dramatically changed from the 50`s when it had reached its peak (Atkinson, 2015). Stiglitz offers a particularly strong evidence on this by claiming that: *the most important societal change is the decline of unions from 20,1 percent of wage- and salary- earning U.S. workers in 1980 to 11, 9 percent in 2010. This has created an imbalance of economic power and a political vacuum* (Stiglitz, 2012:64).

As Atkinson observes, the decline of the unions` influence is inseparable from the Conservative/Republican dominance in both the UK and US during the 1980s which have passed policies that have significantly restricted the activities of the unions (Atkinson, 2015). In the US this period has been coupled with the process of deregulation of the financial markets that has allowed for those working in this sector (i.e. hedge fund managers) to reap bigger benefits from these changes, while those depending upon the unions` protection (workers receiving salaries and wages) have seen a drop in overall power to influence their level of compensation (figure 18) (Hacker and Pierson, 2010). Later in the 1990s the democrats have embraced the republican legacy of winner-take-all policies of supporting the expansion of Wall Street.

Figure 18: The richest 1 percent of national pre-tax income in the context of the ruling administration in the USA (1960-2007)



Source: (Hacker and Pierson, 2010)

As Hacker and Pierson state the growing reliance of the U.S. economy of its financial sector, during the 1990s Democratic presidencies have been a result of industry's financial support for their campaigns (Hacker and Pierson, 2010). The overall relaxing of financial regulations have reinforced the importance of the financial sector. Its share in GDP increased from 2.8 % in the 1950s to 7.3 % in 2014 bringing more economic instability, and more unequal spread of income between the two ends of income distribution (Stiglitz, 2015b).

They sum up that democratic policies have not been too helpful for America`s working class as the result of their rule translated into offshoring of industrial jobs, demise of unions and stagnation of working-class incomes (Hacker and Pierson, 2010). In turn the US has reinforced its corporate lobby groups that spend large sums to influence legislation. The rise of corporate lobbying versus the decline of unions had created a setting in which the compensation-related interests of the average American are practically obliterated (Hacker and Pierson, 2010). This implies that besides political interests, the decline of the middle class in the US and the rise of overall income inequality has its roots in the spread of the complex process of globalisation.

Weak implementation of antitrust laws in the USA

As it was discussed in the beginning of chapter 3, in the years preceding the Great Recession, the top one percent was gaining two-thirds of all the profits generated in the U.S. economy. The group that has seen even bigger gains from the whole economy than the top 1 percentage is the top 0,01percent (approx. 14 558 families with incomes over $ 11 477 000, as of 2011) that hold about 6 % of the total U.S. national income (Brynjolfsson and McAfee, 2014). For these top U.S. earners Brynjolfsson and McAfee use the term *superstars*, and suggest that they are not all from Wall Street, but in many other industries media, entertainment, sports, law or entrepreneurs and senior executives. In addition they argue that the growing role of digitization had reinforced the creation of winner-take-all markets. The digitalisation of information, goods and services had enabled digital business owners to minimise costs as the marginal costs of production of such goods are close to zero. Their reproduction and spread to millions of customers could also cost next to nothing. This process empowered by digital technologies has created a large divide in the share of profit even between top superstar performers and the second best provider on the specific market (Brynjolfsson and McAfee, 2014). This gives the *superstars* an immense market power that contributes to growing inequalities. The laws of competition function in such manner that without the exercise of monopoly power, individuals

can in the short run accumulate only a limited amount of wealth (Baker and Salop, 2015). Market power contributes to growing inequality. The tendency of market power to raise the return to capital helps to perpetuate the disproportionate income distribution (Baker and Salop, 2015). Technological change facilitates market power by creating loose regulatory conditions in which this kind of superstar firms can thrive. This is done among other by reinforcing intellectual property protection or network effects, which can permit firms to achieve market power (Baker and Salop, 2015). According to Baker and Salop - Microsoft, Oracle, Google, Facebook, and Bloomberg, are part of the large superstar corporations that have gained the capability to exercise market power in this way.

The past three decades of increasing income inequality have been also marked by the adoption of looser antitrust regulation that had contributed to the growing disparities by increasing the market power for more business entities (Baker and Salop, 2015). The USA also faces weak antitrust enforcement that has led firms to charge excessive prices – much higher than the marginal costs, that finally affects the consumers by further narrowing their real income (Stiglitz, 2015b).

Antitrust law is seen as complementing instrument that could strengthen tax, labour and trade policies in combating inequality (Baker and Salop, 2015). The objective of such law is to achieve consumer welfare, as well as economic efficiency (Atkinson, 2015). Consumer welfare is understood as an aggregation of different interests that can be combined by evaluating the circumstances of the different groups (Atkinson, 2015).

The lack of access to particular goods or services by some groups, results from the incapability of markets to supply all the desired products to customers. For instance the limited number of suppliers on a given market may not be able to offer lower-quality, smaller packages of goods that would in turn have lower prices (Atkinson, 2015). As competition laws cannot altogether influence income distribution, it could have some influence of the ways in which companies situate themselves on the market and focus primarily on consumer protection.

3.2.2 Economic forces of income inequality

Rent-seeking behaviour and short-term orientation practices

As it was mentioned in the previous chapters the traditional view on income inequality suggest that it is caused by market force that reward the subjects accordingly to the productivity

generated by their labour or by their use of capital. But, many economists (i.e. Stiglitz, 2012; Piketty, 2013) have pointed out to another factor of growing income inequality – *economic rents* or also a *rent seeking behaviour* (Economic Report of the President, 2016). Rents are defined as *the unproductive income paid to labour or capital above what is necessary to keep that labour at work or capital invested* (Economic Report of the President, 2016:22). Economic rents in a specific textbook example could be explained in the following way: supposed it would take $10 per hour to motivate someone to work. If the offered wage were lower than $10, the subjects would prefer not to work at all. In case wages were $15 per hour, then the difference between what they are paid and what it gets them to work ($15-$10=$5) is called *economic rent* (Thoma, 2014). These arise when there is an imperfect competition in a given market. This market power allows them to cash sums that are way above their costs and reasonable returns of capital, and in this case the difference is again *economic rent* (Economic Report of the President, 2016). Stiglitz refers to this as a practice of generating wealth not by creating any valuable activity, but rather by taking it from others. Besides the influence that monopolies have on the markets of goods and services and on the labour market, these more powerful layers are capable of influencing political processes and law making. That channel enables them to shape the regulations in their favour, and as it is the case in the USA - to keep the top tax rates low (Stiglitz, 2015c). According to the economic councillors of the President of the USA, the prevention for growing inequality that is stemming from rent seeking behaviour should be addressed from a pro-growth perspective. One is to open the U.S. market to a wider set of competitors which would promote more equality of opportunity. The other is to reduce the abuse of market power that creates unproductive inequality (Economic Report of the President, 2016). Stiglitz on the other hand proposes massive changes to tax laws, regulations and reshaping of the financial sector. Put in concrete terms his suggestion is to increase the tax rate of the top 1 % by 5 %. This fair tax would in Stiglitz`s expectations curb the preferential tax treatment for the richest Americans and raise a substantial amounts that could help support the American welfare state in promoting larger income equality (Stiglitz, 2015c).

In addition to abuse of the market power, Stiglitz adds another, related variable to the income inequality puzzle – short-term profit generation practices. He argues that this is an indirect consequence of the economic structure of the US. The specific mix of the current competition regulations and the tax system that is rewarding short-term returns over long-term investment in people, technology, and equipment (Stiglitz, 2015b).

It is evident that market forces alone create some levels of inequality, but the economic setting that can be achieved through policy making is decisive in determining the shares of income distribution in a society. There is enough proof that since the adoption of free market policies in the 1970s, the powerful inequality sources of globalisation and technology could not be curbed to promote a farer wealth share in the USA. The political and economic forces of inequality are tightly linked and so far are working more in the advantage of the top richest population in the US. Their strong influence on political decisions affect market policies is and pose a big hurdle for the promotion of more equal opportunities in the American society. As Piketty and Stiglitz would agree - the American social state needs refurbishing and this could be primarily done by imposing larger taxes on the top earners. Although these more socially oriented policies might bear some fruit, the American mind-set of individualism and protestant hard-work ethic might not be a good match with such the schemes that were proven to work in societies such as Scandinavia, that are more concerned with the common welfare. Although the idea of anything close to socialism might not receive lot of praise in the USA, there are various other options that might effectively tackle this issue – beginning with social inventions such as the Universal Basic Income[20], up to change in individual behaviour of the populations that affect income distribution with their actions as workers, consumers, investors and savers. The systemic changes are always incepted within the transformation of the individual.

3.3 Pace of technological change and implications on U.S. jobs

Ever since the steam engine was invented, the speed of the technological growth and its particularly correlated social development index are accelerating at a speed that seems counterintuitive to people. A historical glance at the progress of the humanity makes this common misconception clearer, as the curve of technological and human development has risen sharply from the Industrial revolution onwards. While for humans this progress comes as a natural shift, which is regarded as a linear progression (the future changes at the same pace as the past), in reality the magnitude of technology moves at an exponential level (Kurzweil, 2001). Ray Kurzweil, one of the leading futurologists, predicts that in few decades this exponential growth of machine intelligence will surpass human intelligence – and this will lead to the Singularity which he explains as a technological change so rapid and profound it

[20] Universal Basic Income is defined as *an income unconditionally granted to all on an individual basis, without means test or work requirement* (BIEN, 2016).

represents a rupture in the fabric of human history (Kurzweil, 2001). Expressed in time the exponential growth would mean that 100 years of progress in today`s terms will be reached in 25 years, or put another way in 100 years the humanity will achieve 20 000 years of progress, or according to some other authors, expressed in a shorter term Moore`s law[21] forecasts doubling computer power every 18 months (Brynjolfsson and McAfee, 2014).

These observations project a science - fiction - resembling future, nevertheless, there are numerous of powerful technologies that are already existing, but before they are to put in use, one should consider their costs at the time of launching and the time needed before they become massively produced and their costs drop low enough to be considered as mainstream means of production.

In relation to Moore`s law, it is crucial to mention that as the technological progress goes exponentially upwards, the life cycle of the new coming technologies is narrowing that allows for their prices to decline. This has implications in the usability and affordability of the inventions. If the costs of these were to remain steady for a longer time, then the spread of the technological novelties would have taken a long time. In this sense Moore`s law stands a good chance to be sustained, since the technological field is a very competitive market and competitors are motivated to keep the technological pace going in order to sustain their share (Brynjolfsson and McAfee, 2014).

According to experts from this field, there are good chances that the technological progress will follow the course predicted by Moore`s law, unless there are some impediments that cannot be easily overcome (Jorgenson and Wessner, 2007: 3).

The essential components of the most of the human labour replacing technologies are the digital sensors as well as the semiconductors, whose production has a major significance for the economic growth and dynamism of the US. According to a study of the semiconductors` sector, the semiconductors play a key role to increasing the productivity of software development, keeping its prices down while sustaining performance improvements) (Jorgenson and Wessner, 2007: 55). The continuous fall in the prices of the semiconductors and the rise of their performance have positive implications on all industries that integrate them in their final product. Some examples of sectors that heavily rely on semiconductors besides IT and robotics

[21] *Moore`s law is a computing term which originated around 1970; the simplified version of this law states that processor speeds, or overall processing power for computers will double every two years.* [Or more precisely*], the number of transistors on an affordable CPU would double every two years.* (Mooreslaw.org, 2016)

are as well non-IT related areas such as: the aircraft, car, and then most areas of science and medical services. Accordingly, inversely proportional relation of falling prices and advancing productivity also applies to these non-IT industries. Besides their usage in industrial goods, semiconductors are widely spread in electronic consumer goods (such as the iPod), personal computers, cell phones, enabling innovation to new business solutions and processes (Jorgenson and Wessner, 2007: 32).

New types of technologies vs humans

The rapid technological advancement and the productivity growth in terms of lowering prices are good news for businesses, consumers and for the global economy as a whole. But, it also contains some negative aspects. One of them is the automation of jobs, which could in near future potentially make millions of workers redundant (only in the US).

As mentioned above the lowering cost of the means of production, that are becoming ever more sophisticated makes the new human labour – replacing technology attractive for the businesses. Today in the typical factory floor, even though scarce, people are still necessary to work besides machines – from low - skilled manual workers that would only handle the products on the conveyor belts for further processing that is fully automated, to highly skilled engineers that would re - program highly advanced machines as soon as they face an obstacle that is not embedded in their learning pattern. The renowned roboticist Hans Moravec has observed that while the artificial intelligence of the machines could quickly reach the same level as human intelligence, the performance of these entities would be restricted by imperfections in the dynamics of their hardware. According to him advanced reasoning requires less computation, making all the hard problems easy to solve, nevertheless executing low-level tasks (e.g. grasping objects) that require precise motion would be more complicated to achieve, because they depend upon extensive computational resources (Moravec, 1998). This claim is known as the Moravec paradox, which has been considered as valid, since fully automated production is rare if not impossible. But many technology producers have taken upon the challenge to change this and create machines with motoric abilities close to the ones` of humans.

It is widely known that computers are good at routine tasks that require precision and following rules. Also are good at manipulating with big mases of data and surpass human capabilities in calculating and predicting. At the present time, they show weaknesses at areas that cannot be

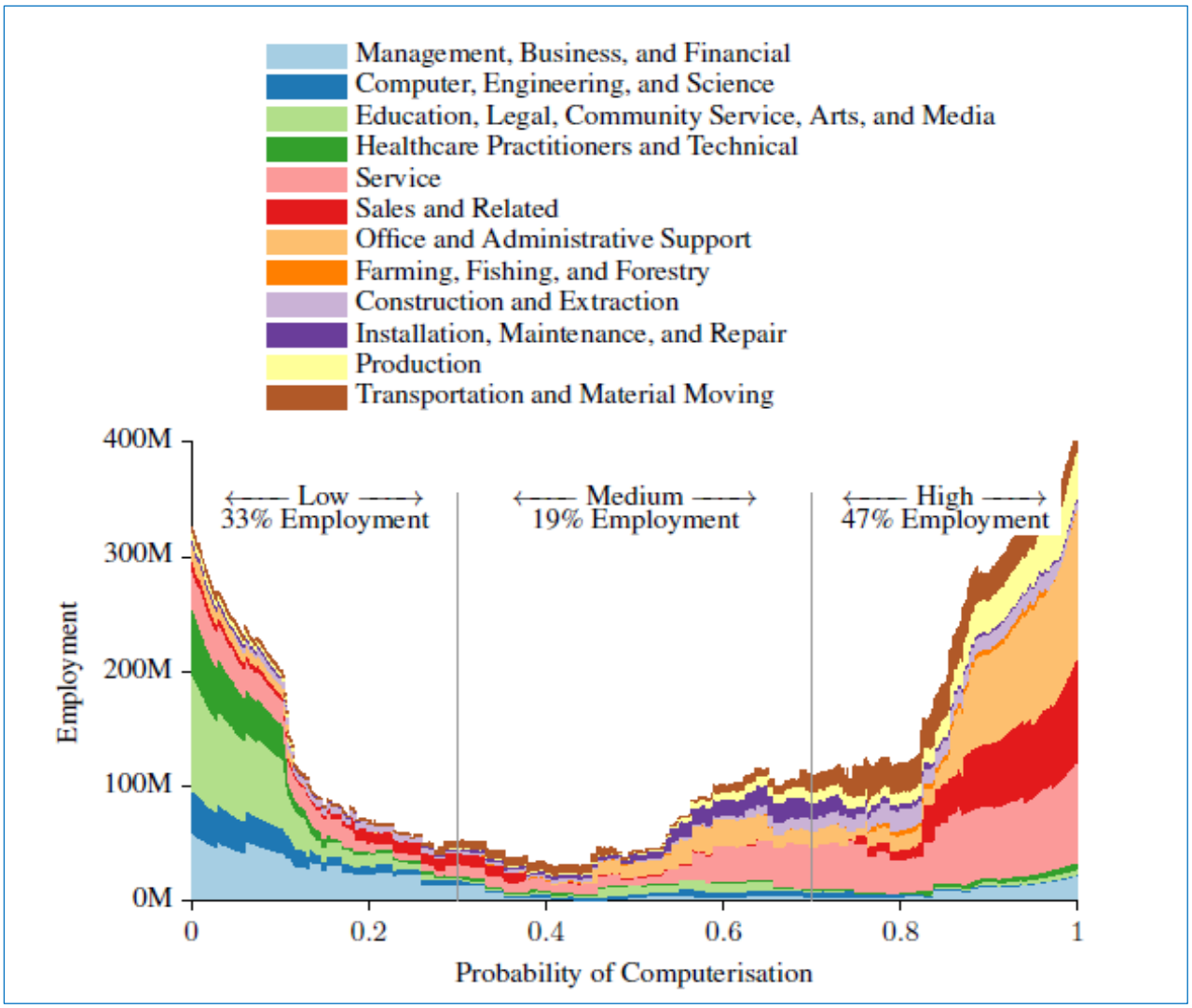
reduced to algorithms and require the human capability of patter recognition, sensing and more complex communication (Brynjolfsson and McAfee, 2014).

The advantage of computers when executing cognitive tasks is that they are not exposed to some of the human biases. People must fulfil some tasks that are non-related to their occupation (sleeping, eating etc.) and these are considered as constraints to their transparent and non-distorted decision making. Computer with their ability to detect trends in the big data and the ability for impartial decision making are a competent successor of people in numerous non – routine cognitive tasks (e.g. fraud detection, medical diagnostics, analysing data in legal and financial services) (Frey and Osborne, 2013).

Machine learning (furthermore ML) is perhaps one of the most important technological trends that would bring machines the closest to the human – level Artificial intelligence (furthermore AI). Self-driving cars and speech recognition are some of the outcomes of ML up-to–date, and with dozens of others waiting to be perfected in the years to come. ML is enables computers to build learning models based on data inputs, without strictly following program instructions (Bishop, 2006). Recently a new milestone of ML has been reached. The knowledge that one entity has acquired (e.g. a certain movement in robots) is stored in a central repository called RoboBrain, which is accessible to other robots. This implies that now machines can learn from each other, which will reduce the time spent on reprogramming and on facing unknown situations (MIT Technology Review, 2014).

Overall, as indicated by Fray and Osbourne (figure 19) around 47 % of the US jobs are susceptible to automation within the next decade or two, belonging in the high-risk-of-automation category (Frey and Osborne, 2013). This applies particularly to people employed in production, logistics and transportation, but it is not exclusive to the manual/physical work, it also applies to the administration and the services provided around them. Levy and Murnane in The New Division of Labour advise that people should focus on the activities in which they have a competitive advantage over computers – such activities are nowadays becoming scarce (Levy and Murnane, 2014). In the past, due to technological change workers from one sector were moving to another, more progressive one (e.g. from agriculture to industrial production). Nowadays, all three typical sectors (agriculture, manufacturing and service) are tackled by technological unemployment, making millions of workers redundant, as there is no other sectors to absorb those whose skills have become obsolete (Levy and Murnane, 2014).

Figure 19: Occupational employment over the probability of computerisation



Source: (Fray and Osborne, 2013)

As shown by (Fray and Osborne, 2013) in figure 19 and confirmed by (Levy and Murnane, 2014) the only new sector relatively less endangered by automation and computerisation is the knowledge sector (the probability is the lowest, estimated at 33 %). This sector is made up of jobs in science, computer programming, education, consultancy, technology, elite entrepreneurship etc. (Levy and Murnane, 2014).

Fray and Osborne have found that both wages and educational attainment are negatively correlated to the probability of computerisation. Their model implies that in near future (next decade or two) the computerisation will lead to labour market polarisation (Fray and Osborne, 2013). The prediction is that technological change will reduce the demand for low-skilled and low wage jobs. As it was described in chapter 3.1 and figure 11, this has already begun to

happen, with late 1980s tendency of low skilled workers to gain substantially lower compensation than those in the middle or upper scale of education.

In a nutshell, what this suggests is that the late 1970s trend of widening the gap of the incomes accordingly to education level will still continue. The differences in compensation between the high skilled and low skilled labour is likely to grow and to surpass the divide that is present today. The most worrying fact about these developments is that they pose a formidable economic difficulty. Policymakers need to come up with solutions to address the main problems arising from the growing number of jobs that are highly susceptible to automation, also unable to pay a living wage. That is, to provide a suitable social safety net and educational and training programmes that would help these layers to re-skill accordingly to the demands of the *second machine age*.[22]

[22] Reference to the title of 2014 book *The Second Machine Age* by Brynjolfsson and McAfee.

Conclusion

In order to examine the impact of the technological change on the income inequality in the USA, this thesis integrated theoretical and analytical findings derived from the political and socio-economic setting in the USA.

The discourse on income inequality can go back and forward between two opposed views; the first containing the negative outlook of the diminishing material, bargaining and political capacities of the majority of the population contrasted by the strengthening power of the elites. In the second interpretation inequality is seen as a driver for change and progress. Although some levels of income inequality can motivate breakthroughs, the levels recorded in the USA for the last 30 years are pointing out to a deep systemic dysfunctionality that actually hampers growth and prosperity.

As a field of study, income inequality stands somewhere between poverty and welfare. It covers more ground then the concept of poverty, because it deals with the total distribution of income among individuals and households. As for poverty - it is narrowed down only to the distribution below the poverty line. On the other hand, income inequality is not dependant on the mean of the distribution, as it is the case with the wider notion of welfare (Litchfield, 1999). To quantify the range of income inequality in the USA, this thesis was applying the following measurements: decile dispersion ratio, share of income of the poorest/richest x % and the Gini coefficient (World Bank, 2015). The first indicator tells how many times the average income of the richest x % of the population is larger than the average income of the poorest x%. In some cases it can be expressed in percentiles. The advantage of the second indicator is that it is easily interpretable and can be broken down into small groups (e.g.0, 01 % top earners) for deeper income inequality analysis (World Bank, 2015). The Gini coefficient is also a widely used measurement of income inequality. It gains values in the interval between 0 and 1, the former indicating perfect equality and the latter perfect inequality. If the high incomes are more evenly distributed between the middle and lower classes than it indicates lower values. But these values are reflecting absolute shares of wealth which can skew the real state of income inequality. It offers a more superficial image of the income inequality, as it cannot indicate where (among which social layer/population percentages) the distributional disparities happen (Bellu and Liberati, 2006). However it can be useful in cases of evaluating the total change in income distribution pre- and post- tax (as it was used in section 3.2.1 / figure 16).

The two major causes of income inequality are technological change and globalisation, which are mutually interconnected. Income inequality occurs when as a result of the interplay of the inequality triggers it comes to job loses, and also to inequalities between labour income (wages, salaries, benefits), inequalities between capital income (capital gains, dividends and interests) and discrepancies between income earned from labour and income earned from capital (Economic Report of the President, 2016).

By synthesising the different definitions, it can be concluded that technology represents a certain incorporation containing various sets of information that act as a facilitator in the transformation of inputs to quantitatively and/or qualitatively superior outputs. Technology also accounts for the capital and labour that it employs, and can be moulded within the institutional structures of the given production arrangement (Vlčková, 2013). The ratios of capital and labour input used in production can change, so that this can affect the quantity and the cost of the output. Upward shifts in technology can both reduce the cost and improve the quality of the given output. These improvements usually affect the production factors with different intensity – if it enhances the productivity of the capital it is dealt with capital-intensive technological change; and if it betters the productivity of labour, it is referred to labour-intensive technological change (OECD, 2001). Productivity is the main determinant of the wages in an open economy, however they are after reshaped by state regulations, unions, and other associations and by the interests of businesses to keep the cost of labour lower (Krugman and Obstfeld, 2011). But, the isolated influence of technological change on income inequality, depends on the nature of the technological change. If it is dealt with capital intensive technological change then the labour input is substituted by the more productive input – capital, which raises the returns of the capital owners and knocks down the share going to the labour (Krugman, 2012). On the other hand the skill-biased technological shift, causes gaps between the highly skilled and the less skilled labour, whereas the demand and the compensation of the latter goes down. Both of these types of technological change have contributed to the high level of income inequality in the USA.

Technological change also causes short-term job losses, as it takes some time for the economic system to create new job positions (Mabry and Sharplin, 1986). Nevertheless, the more concerning negative impact of technological change is that it might create long-term unemployment, by diminishing the demand for certain types of labour, whereas this new structure would be unable to absorb the newly-redundant workers that lack the required skills. This view was held by Keynes in the years of the Great Depression in the USA, who called this

phenomenon – *Technological unemployment* (Keynes, 1963). Many modern economists disagree with Keynes and argue that technological unemployment can be only temporary, and see it as a way station to more sophisticated job positions (Brynjolfsson and McAfee, 2014). Accordingly, different sectors will suffer diverse levels of technological unemployment, which are dependent on the elasticity of demand. In conditions of inelastic demand automation and new technologies will lead to increased productivity and lower prices, but this will not result in employment of more labour. Agriculture and manufacture are typical representatives of this case, and as it is observable its shares on the employment in the developed countries have significantly decreased. The opposite case is made by the highly elastic demand where higher productivity in turn creates new jobs. So this supports the notion of the temporary technological unemployment, because in the long run demand moves towards perfect elasticity (Brynjolfsson and McAfee, 2014). In the case of the USA, according to the predictions, the advanced technology of the 21st century might even take over some jobs in the service sector.

Globalisation has similar diminishing effect on the wages of the workers in the developed countries. In the globalised market businesses can hire workers from around the globe, and as a consequence of that, many jobs (mostly manufacture, but also some in the service sector) have been displaced from the developed countries where wages are higher (Ebenstein, Harrison, McMillan and Phillips, 2009). Since states have to compete in a globalised environment and create jobs for the population, this has led to common loose policies of flexibility that have disadvantaged the compensation, job security, social protection and the bargaining power of the global worker (Standing, 2001). These adjustments apply in the case of the USA.

The evidence of growing income inequality in the USA suggests that it is primarily a consequence of technological change and globalisation and is further enforced by the change in political and economic structure in the USA (Piketty, 2015; Atkinson, 2015; Stiglitz, 2012). Those secondary factors include: weak social protection stemming from the relaxed tax and re-distributional system; diminishing wage effect of declined unionisation; insufficient implementation of antitrust laws that has created strong corporation with enough power to shape the state policies and accumulate wealth on the back of the consumers; and lastly rent-seeking behaviours and favouring of short term profit goals of the U.S. businesses (Stiglitz, 2015a). These structural changes have roots in the conservative economic policies of the Republicans in the 1970s, and this legacy has not been influenced much even by the more socially-oriented Democrats. The impacts of the technological momentum in the USA are

particularly observable from the late 1970s that overlap with the set off of the globalisation. The century long data on the top U.S. incomes shows that the richest 1 % of the U.S. households gained a record high share of the national income in the recent years. These shares are comparable with the levels reached in the period before of the Great Depression. In the years in between they have been significantly diminished (especially in the 1950s-1960s period) and have started to pick up again since the late 1970s (Piketty, 2015).

The biggest contributor to the U.S. income inequality is the top 1 % income group that has seen a strong increase in earnings between 1970 and 2010 (Piketty, 2015). In contrast the most deprived are the lowest percentiles (which typically are including workers earning their income from a job in the first or the second sector). Largely affected is also the median worker, whose incomes have recorded an anaemic growth. The discrepancies between the top 1 % and the median U.S. households that have arisen in the 1970s-2010s period are enormous, as the curves of productivity growth and compensation of median worker experienced a significant decoupling, making the 1 % the largest beneficiary of the productivity growth and cutting the fair compensation of the median earners (Brynjolfsson and McAfee, 2014). This implies that higher productivity only provides the potential for increasing wages – their degree is further remoulded by state`s regulatory setting (Mishel and Gee, 2012).

The overall inequality growth in the USA is by large a consequence of increased income inequality among labour (68% of the total inequality rise is caused by it) and the rest is caused by unequal income shares of capital (32 %) (Economic Report of the President, 2016). This pattern of income division is mostly a result of technological advancement (Schwab, 2016).

The wages in the USA are also dependent on the educational level and skills of the workers. Since the 1970s the country has been going through a skill-biased technological change that is strongly affecting the lowest skilled workers. This is because the companies that are the largest contributors to the productivity growth in the USA are demanding high-skilled workers. Achieved education level also matters, as workers that do not hold a college degree are getting ever lower compensation (Brynjolfsson and McAfee, 2014).

Their position in the labour market is also worsening. As the technological advancement and the productivity growth are lowering the prices of production, the prospect of more intensive job automation in the USA is becoming a reality. Typically the most endangered types of jobs are those that do not need much use of cognitive skills and are usually found in manufacturing. Even though machines produce most of the outputs, humans are still needed in the factory

floors to deal with the tasks that need more precise motion. But since there are real chances that the rapid technological change can bring machines with motoric skills similar to those of human, these manufacturing workers face a real danger of being replaced by machines (Fray and Osborne, 2013).

Even those that work in the tertiary sector and are using their cognitive capabilities but perform routine tasks can be replaced by computers. This is a viable change because of *Machine Learning*, an important trend which is enabling machines to learn from each other, (self-programme) to perfect their pattern recognition and consequently their decision making (Bishop, 2006). Furthermore it could be strengthened by the fast development of other technological breakthroughs such as: artificial intelligence, robotics, the Internet of Things, autonomous vehicles, 3-D printing, nanotechnology, biotechnology, materials science, energy storage, and quantum computing (Schwab, 2016). More surprisingly, this could have unprecedented consequences even within the jobs of highly skilled individuals that execute non routine tasks (e.g. medical diagnostics, financial services and analytics) as they are also a victim of the growing machine intelligence.

The overall susceptibility of a near future automation of all U.S. jobs is (approximately 47 %). Those U.S. jobs that are part of the knowledge sector hold the smallest chance of computerisation in the decades to come and those at the lower end (the low skilled) are the most threatened by the emerging technologies (Fray and Osborne, 2013).

According to some scholars automation and computerisation would probably represent the next stage of job dislocation, but this time jobs that were outsourced due to lower labour costs would return the U.S (Krugman and Sachs 2016).

Altogether, technology scholars (Brynjolfsson and Mc Afee, 2014; Schwab, 2016) are arguing that the Fourth Industrial Revolution evolves at exponential pace (in contrast to the previous Industrial Revolutions that developed in linear manner), which could yield great levels of income inequality and deeply polarise the U.S. labour market. The analogy is that, the pattern of growing inequalities in the USA that is evident since the emergence of computerisation will be repeated and potentially surpassed, due to the different nature of the technological growth during the Fourth Industrial Revolution. Nevertheless, the implementation of these technologies depends on the speed of their spread that could be influenced by eagerness of adaptation, size of initial investment etc. They can also work in advantage of the humanity, if appropriate regulatory, social and reskilling programs are implemented by our governments.

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