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Ex Machina: The Effects of Automation on Employment and Skills



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1. Introduction

‘Robots are rapidly becoming more accessible, more reliable and cheaper. They are cheap, fast, never get sick and work for 24 hours a day,’ remarked the Dutch Deputy Prime Minister, ‘we have to prepare for a jobless future.’¹ *The Economist* reported on the ‘onrushing wave’ of automation², potentially leading to mass unemployment and that policymakers have to start ‘[preparing] for a robot invasion.’³ Even more ominous, from a panel of 1,896 robotics experts and analysts, 48 percent agreed that ‘robots and digital agents [will displace] significant numbers of both blue- and white-collar workers—with many expressing concern that this will lead to vast increases in income inequality, masses of people who are effectively unemployable, and breakdowns in the social order’ (Pew 2014, 5). Oxford scholars Frey and Osborne (2013, 38), who analysed automation on the United States (U.S.) labour market, provided evidence that a large set of non-routine tasks are at risk of automation:

‘In the first wave, we find that most workers in transportation and logistics occupations, together with the bulk of office and administrative support workers, and labour in production occupations, are likely to be substituted by computer capital.’

Frey and Osborne (2013, 44) concluded that the sectors threatened the most by automation in the next ten to twenty years employ 47 percent of the U.S. population. Developments in automation caught the attention of the media, because the use of the word ‘robots’ in newspaper articles has grown faster than exponentially in both the U.S. and the United Kingdom (UK) (Hueck and Went 2015; Graetz and Michaels 2015). However, there are other scholars and business leaders who welcome automation, because it may lead to the creation of many new professions and thus jobs. Sjaak Poppe, the spokesman of the ‘Port of Rotterdam Authority’, overseeing one of the most

¹ Source: <http://www.nu.nl/politiek/3890209/asscher-voorziet-baanloze-toekomst.html>.

² Source: <http://www.economist.com/news/briefing/21594264-previous-technological-innovation-has-always-delivered-more-long-run-employment-not-less>.

³ Source: <http://www.economist.com/news/leaders/21599762-prepare-robot-invasion-it-will-change-way-people-think-about-technology-rise>

automated ports in the world, told Dutch journalists that automation will lead to job losses in some places, but to job creation in others.⁴ In addition, Andes and Muro (2015) argued that ‘robots are increasingly essential to the competitiveness of a country’s manufacturing sector’ and that automation is not the prime explanation for the decline in manufacturing employment.⁵ Furthermore, the key observation of Auter’s (2014) paper is that scholars ‘overstate the extent of machine substitution for human labour and ignore the strong complementarities.’ In other words, it is more likely that humans and robots will work together, instead of being replaced entirely by machines and thus middle skill jobs are likely to persist. It is clear that they cannot both be right and as mentioned by Graetz and Michaels (2015, 2) there is a lack of hard evidence on the impact of robots on the global economy. The effects of robots on productivity and total hours worked have been implied, but direct evidence is rather scarce. Since most academic journals and newspapers focus on the effects of automation on the U.S., this thesis aims at providing evidence for the effects that automation has had on the European Union (EU) labour market. More research into the subjects of automation is important, because the effects of automation are already felt in most sectors of the economy. An increase in scholarly and journalistic attention should create an awareness amongst policymakers that even if the predictions by Frey and Osborne (2013) are not exactly right, it would be prudent to at least consider and evaluate their predictions. Besides, even if the disappearance of 47 percent of jobs might seem unreasonable, would not even a smaller percentage like 10 percent encompass millions of jobs and be reason for at least some concern? Do we have to agree with the Dutch Deputy Prime Minister that a ‘jobless future’ is likely to happen?

Considering the fact that several books can be written on the subject of automation in all economic sectors, this thesis will focus on the key components of a successful economy, namely transportation and logistics. Without a high quality transportation and logistics network, most economic activities will grind to a hold. Transportation enables the movement of goods, services and people across the EU, while logistics allows for its arrival at the right time, at the right place, for low costs and in quantities necessary. This thesis will use the ‘*Statistical Classification of*

⁴ Source: <http://www.bnr.nl/nieuws/696145-1503/vakbonden-rotterdamse-haven-woedend-om-automatiseringsplannen>.

⁵ Source: <http://www.brookings.edu/blogs/the-avenue/posts/2015/04/29-robots-manufacturing-jobs-andes-muro>.

Economic Activities in the European Community’ published by Eurostat (2008, 76) to decide which activities will be included under transportation and logistics. For the purpose of this study, transportation will cover the following business activities: rail transport (passengers and freight), land and road transport (passengers and freight), water transport (passengers and freight) and air transport (passengers and freight). Logistics will cover the following business activities: warehousing and storage, cargo handling and other transportation support activities. Transportation and logistics generate 7 percent of the EU GDP and account for around 5 percent of its employment (EC 2008a, 24). The European Commission (EC) and the European Parliament (EP) are actively working on the creation of a ‘Single European Transport Area’ and in April 2015 the EP Transport and Tourism committee published a report to that end, taking stock on the implementation of the 2011 White Paper published by the EC. In sum, transportation and logistics is a ‘key pillar of the single market’ and vital with regard to employment and the economic functioning and wellbeing of the EU and its citizens (Camp 2015, 2). However, the predictions by Frey et al. (2013, 44) mainly address transportation and logistics as one of the sectors where many jobs will be lost due to automation. It is for that reason relevant to see whether and how the EU prepares to cope with these cross-border developments. Another reason for the focus on transportation and logistics is that, just like manufacturing, automation is not just starting to affect the industry. Quite the opposite, the advent of information and communication technology (ICT) in the 1980s caused many labour intensive jobs to be streamlined, automated and computerised in the decades that followed. The Port of Rotterdam provides an especially striking example, because it was the world’s busiest port for over forty years and Maasvlakte 1 (MV1) based companies pioneered the development of terminal automation to improve efficiency and increase productivity. Studying one the EU’s biggest transportation and logistics hubs provides a unique opportunity to analyse the effects of automation on a more in-depth level. Maasvlakte 2 (MV2), the biggest civil engineering project in the Netherlands since the Delta Works, opened in 2013 and currently houses two fully automated container terminals from A.P. Møller–Mærsk Terminals (APM Terminals) and Rotterdam World Gateway (RWG).

These considerations lead to the following research questions: (1) *‘To what extent did automation change employment for high, medium, and low-skilled workers in the EU transportation- and logistics sector?’* In addition, (2) *‘To what extent did the EC address this in policy initiatives?’*

And finally, (3) *'How can the effects be discerned for the case of an important European port (Rotterdam) and the companies it houses?'*

2. Theoretical Framework and Literature Review

Humans have been confronted with technological developments that seem threatening to their livelihoods on several occasions. The Industrial Revolution is the earliest example of labourers resisting the seemingly unstoppable tide of technological progress. In the early 19th century, groups of self-named Luddites raged across the industrial counties of England, smashing the equipment of which they feared would take their jobs (Carr 2014). Their (small) successes notwithstanding, mechanisation could not be stopped and became so commonplace that workers could only consent to their new robotic co-workers. The machines took over the physically demanding and repetitive tasks that were previously done by human workers (Brynjolfsson and McAfee, 2014). Automation returned to the public's eye sixty years later when Marx (1992) published the first volume of his famous *Capital*, a critique on the capitalist mode of production. Marx was pessimistic about the evolution of worker's living conditions and argued that 'all methods for raising the social productivity of labour are put into effect at the cost of the individual worker.' He believed that capitalism would inevitably lead to an ever great reduction in real wages and thus logically lead to the replacement of human labour by machines, which he portrayed as 'dead labour' (Marx 1912; in Carr 2014). Right in the middle of the Great Depression of the 1930s, Keynes (1933) spoke of a 'new disease' when he described technological unemployment. He noted however that technological unemployment was only temporary and that what we now call automation would lead to a future of affluence and leisure for all. It seemed like Keynes had predicted the future when post-World War II economic expansion was huge and increases in real wages were high.

However, Keynes' predictions were put in the dustbin when economic stagnation hit the world economy in the early and mid-1970s, while the 2009 economic crisis of some thirty years later continues to this day (Siu and Jaimovich 2015, 10-11). The economic downturn led to new concerns about the replacement of human labour by robots and other forms of automation. The previously mentioned Frey et al. (2013) is just one of the more recent articles that found evidence for the *en masse* replacement of existing jobs by robots. While the concerns by Frey et al. (2013)

are limited by their focus on events that will or will not take place, research by Karabarbounis and Neiman (2014) and Elsby, Hobijn, and Sahin (2013) provides actual evidence and reason for concern. Karabarbounis and Neiman (2014, 61) show that the labour's share of national income has been falling since the 1980s on a global scale. Changes in technology (lower prices of investment goods) are a key factor in understanding this decline (Karabarbounis and Neiman 2014, 102). Elsby et al. (2013, 1) also document that the 'labour's share of income in the United States has trended downward.' Nobel laureate Michael Spence (2013) argued that growth and unemployment are 'diverging in advanced countries'⁶ and Goos, Manning and Salomons (2011, 5) offer support for his argument when they pooled sixteen European countries using data from the European Union Labor Force Survey and found that 'there is job polarization occurring in which employment rises fastest for the best-paying jobs and falls most for those in the middle of the earnings distribution.' Spence (2013) sees automation as the cause of unemployment, but the study by Goos et al. (2011) lacks definitive evidence on that account.

The technological explanation of job polarisation by Autor, Levy, and Murnane (2003), Plunkett and Pessoa (2013), Goos, Manning, and Salomons (2014), and Michaels, Natraj, and Reenen (2014) provides this evidence. Autor et al. (2003, 1279) find evidence for skill-biased technological change in the U.S., where computer technology replaces routine jobs, but complements higher-skilled jobs. In other words, the authors found a rising demand for college-educated workers in non-routine occupations and a declining demand for mainly low-skilled workers in routine occupations (Autor et al. 2003, 1296). In their analysis of sixteen Western European countries, the more recent article by Goos et al. (2014) explained the shift in favour of more educated workers. In addition to a higher demand for high-skilled employees, Goos et al. (2014, 2524) argued that the labour share of low-skilled workers is also rising in Western Europe. The labour share (in total hours worked) of medium-skilled occupations declined with 9.27 percent between 1993 and 2010, while the share of high-skilled and low-skilled jobs increased with 5.62 percent and 3.65 percent, respectively (Goos et al. 2014, 2522). Michaels et al. (2014, 61) uncovered ICT-based polarization, where medium-skilled workers are replaced by high-skilled workers. Their analysis included both Western European countries and the U.S. and Japan

⁶ Source: <http://www.project-syndicate.org/commentary/global-supply-chains-on-the-move-by-michael-spence>

(Michaels et al. 2014, 62). Industries with the fastest growth in ICT solutions also saw the fastest growth in demand for high-skilled professionals and the fastest fall in medium-skilled jobs (Michaels et al. 2014, 74). Finally, Plunkett and Pessoa (2013, 4) argued on the basis of their analysis of the UK and the U.S. labour market during the financial crisis that between 2008 and 2012 the share of employment for medium-skilled jobs declined, while low- and high-skilled occupations saw an employment rise. The general trend is clear, technological change has reduced the share of medium-skilled occupations in favour of low-skilled and high-skilled occupations.

The fact that skill-biased technological change it is not only an American phenomenon was made clear in the 2011 World Economic Outlook published by the International Monetary Fund (IMF). The researchers of the IMF found a decline in middle-income occupations between 1993 and 2006 in the euro area, the UK, the U.S. and Japan. The IMF called attention to the ‘striking hollowing out of medium-skill and middle-income jobs’ (IMF 2011, 41). Eurofound (2014, 1) provides additional evidence by showing that between 2011 and 2013 ‘net employment growth only [occurred] in jobs in the top quintile of the wage distribution.’ The study by Duarte and Restuccia (2010, 129) analysed the reallocation of labour across sectors in 29 countries, amongst which Germany, France, Italy and the UK. They discovered a shift away from the high-productivity industrial sector, to the relatively low-productivity services sectors. All advanced economies ‘exhibit an increasing share of hours in services’ (Duarte and Restuccia 2010, 135-136). As the IMF (2011, 41) notes, much of the services sector ‘remains dependent on low-skilled, low-income labour’ and is growing at the expense of medium-skilled occupations. The IMF argues that apart from technological change, particularly offshoring is to blame for this shift from high-productivity to low-productivity sectors, because manufacturing jobs are moved from advanced countries to the developing world (IMF 2011, 45). However, more recent studies by both Goos et al. (2014, 2518) and Gardiner and Corlett (2015, 14) show that the impact of offshoring is much smaller than the routineness of the occupation. As mentioned before, routine occupations can be automated and evidence shows that this is indeed happening. Offshoring has an unmistakable impact on the labour market, but technological change has more explanatory power. Will a more in-depth study of EC initiatives on technology, unemployment and education show that the EC has the same considerations?

The EC pays attention to the automation of transportation, because it aims to improve road safety and make transport environmentally friendly. In 2009, more than 35.000 people lost their lives on European roads and no less than 1.500.000 people were hurt in vehicle accidents. The EC (2010, 2) calculated that the social costs of these accidents were about € 130 billion in 2009. The figures of the ‘Netherlands Institute for Transport Policy Analysis’ (KiM) show that traffic fatalities decreased in the Netherlands over the past ten years.⁷ Traffic jams, traffic accidents and environmental damage have significant, although stable, financial costs ranging from between € 18 and € 23 billion in 2007 (KiM 2007, 107) to between € 20 and € 21 billion in 2013 (KiM 2013, 165). In addition, a study by Poczter and Jankovic (2014, 10) focusing on U.S. transportation found that automation can lead to more efficient road use and alleviate traffic congestion, since roughly ‘4.8 billion hours and nearly 1.9 billion gallons of fuel [are wasted] in the U.S. annually.’ If the EU and its member states want to improve road safety, reduce environmental damage and solve traffic jam issues, vehicle automation might just be the solution policymakers are looking for. In June 2014, the Dutch Minister of Infrastructure and the Environment, Melanie Schultz van Haegen, took the lead on this issue by informing the EP that she intends to use the Dutch European Council Presidency in 2016 to put the development of self-driving cars high on the European policy agenda.⁸ In sum, it makes economic and social sense to move towards further automation of the transportation sector and efforts are made towards that goal.

Transportation is an important part of the logistics chain on which global trade depends. Employment in the transportation sector increased from 5.5 million jobs in 1999, to over 10 million jobs in 2015 (EP 1994, 8; Camp 2015, 2). Logistics is defined as ‘the organised movement of materials and, sometimes, people’ by the Encyclopædia Britannica.⁹ For logistics, Frey and Osborne (2013, 21; my emphasis) found that ‘agricultural vehicles, forklifts and *cargo-handling vehicles* are imminently automatable.’ All the big, global ports use either battery-powered or diesel-powered automated guided vehicles (AGVs) that whizz around the ports’ many terminals for almost 24 hours a day, 7 days a week. The Port of Rotterdam is the busiest port in Europe and has invested in automation to make the loading and unloading of container ships cheaper, highly

⁷ Source: <http://www.kimnet.nl/en/traffic-safety>.

⁸ Source: <https://zoek.officielebekendmakingen.nl/kst-31305-210.pdf>.

⁹ Source: <http://www.britannica.com/EBchecked/topic/346422/logistics>.

efficient and environmental friendly. As Europe's main gateway for trade, most terminals operate for twenty-four hours a day, seven days a week.¹⁰ The ECT Delta terminal at the MV1 was the first to be largely automated as early as 1993, in the two decades after that many other terminals were constructed according to these specifications (Visser et al. 2007, 6). The recently opened APM Terminals MV2 is a good example of a modern, zero-emissions logistical masterpiece. Dozens of sophisticated battery-powered AGVs drive around the terminal with containers, which get lifted on and off containerhips by fully automated stacking cranes. The driver of this crane sits behind a desk in the company's office several hundreds of meters away from their machines. The newest generation of AGVs operational on the APM Terminals MV2 can temporarily rack containers, thus eliminating the need to wait a couple minutes for the stacking crane to spring into action.¹¹ Such efficiency takes the proverb, 'time is money', to a higher level. Operational since February 2015, the APM Terminals MV2 employs a relatively small number of people and almost all of them work outside the container yard.¹² The downside of these developments is that low-skilled dock workers will lose their jobs, since they are no longer needed to do the demanding physical activities. Aarts et al. (2012, 7) argued that 'the increasingly automatized port installations outside of the city produced high unemployment rates among the proud but low-skilled port workforce.' Many of these low-skilled dock workers will not be able to do the new high-skilled, complex occupations that automation creates, even with additional training, so 'more and more foreign workers are brought in by port companies, such as highly skilled Spanish engineers' (Aarts et al. 2012, 7). The anticipated shortage of high-skilled workers to fulfil the high-skill jobs in the Port of Rotterdam will lead companies to employ even more foreign workers in the future (Merk and Notteboom 2013, 76). The recent deal between the container terminals operators and the Port of Rotterdam Authority without involving the port workers' trade unions (FNV Havens and CNV Vakmensen) shows that the struggle between extensive automation and employment is far from over.¹³

¹⁰ Source: <http://www.portofrotterdam.com/en/Port/port-statistics/Documents/Port-infrastructure-and-equipment.pdf>.

¹¹ Source: <http://www.portofrotterdam.com/en/Business/containers1/Pages/container-workhorse-style.aspx>.

¹² Source: <http://www.maersk.com/en/markets/2014/august/maasvlakte-ii-coming-alive>.

¹³ Source: <http://www.nltimes.nl/2015/03/16/port-automation-will-scrap-700-jobs-union>.

This section has discussed a significant part of the existing literature on the topic of automation and technological unemployment and shows the challenges that low-, medium- and high-skilled employees currently face on a rapidly changing labour market. On the one hand, there are economic and social incentives to strive for more automation, both from (supranational) government and multinational corporations. On the other hand, it is clear that (many) occupations will be lost during this transition, which will put pressure on the relationship between governments, labour unions, workers and corporations alike. According to the EC (2013, 2) the transport industry ‘employs more than ten million people, accounting for 4.5% of total employment in the EU, and representing 4.6% of gross domestic product (GDP).’ Studying the effects that automation has on this sector will shed light into whether precautions should be taken to shield workers from future mass unemployment.

2.1 – Hypotheses

These considerations lead to the formulation of the following hypotheses:

- 1) If automation has significantly changed the transportation- and logistics sector, then more people will be unemployed as a direct result of automation, especially the low-skilled and medium-skilled workforce.

It is important to explain what is meant by ‘significantly changed.’ The analysis of Frey et al. (2013) showed that in the U.S. jobs in the transportation- and logistics sector are most at risk by automation. This analysis has been replicated for the EU, but only for the European labour market as a whole and not specifically for the transportation and logistics sector.¹⁴ This thesis wants to assess whether many jobs in this sector have already been lost, or are in the process of being diminished. In other words, significant changes would encompass a decline in the availability of jobs and total workforce since the beginning of the new millennium. Furthermore, it was shown in the literature review that most of the jobs that vanished were in the medium-skilled workforce, while employment in lower and higher occupations increased over the years. It is expected that a

¹⁴ Source: <http://www.bruegel.org/nc/blog/detail/article/1394-the-computerisation-of-european-jobs/>

downward trend in low- and medium-skilled occupations can be found in the transportation and logistics sector. This also leads to the following sub-questions:

- 2) If skill-biased technological change is actually the case, then we can expect that EU policymakers have addressed this issue on numerous occasions in their policy initiatives.

Many of the developments related to automation have the potential for greater wealth and lots of new jobs, but it does not mean that policymakers should simply sit on their hands in the meantime. Considering the fact that the EC (2013, 23) sees automation as ‘an aspect for future research’ one might wonder whether they do not regard automation as such a pressing issue at the moment. One of the most feasible and not very drastic solutions to changing labour market conditions is providing students with the right skills for the future through better education and retraining for people already in the workforce. Most EU member states regard education as (very) important and is for that reason more likely to be addressed. Other solutions like the unconditional basic income are controversial and rather difficult to realise in the current European political climate.

- 3) If these changes can be seen in the Port of Rotterdam, then most low-skill and medium-skill jobs will be in constant decline or will vanish in the near future.

The Port of Rotterdam employs approximately 180.000 people, of which nearly 90.000 work in the port on a daily basis.¹⁵ Especially with the completion of MV2, changes in the workforce of the port are expected. It is expected that a relatively minor share of port occupations became redundant since the 1980s and that most of the jobs that disappeared were among the low- and medium-skilled workforce. An increase in job opportunities for high-skilled workers is expected. Focusing on quantitative data alone will not provide me with enough insight into the labour market trends, automation could for example lead to more jobs in the medium to longer term. Interviews will be conducted to provide this thesis with the necessary insight and context for the process of automation.

¹⁵ Sources: <http://www.portofrotterdam.com/en/Business/about-the-port/Pages/facts-figures.aspx>;

<http://www.portofrotterdam.com/en/Port/port-statistics/Pages/employment.aspx>.

3. Research Design and Methodology

Automation is evident in all sectors of the economy, but in order to make the analysis manageable the focus will be on the transportation- and logistics sector. A mixed methods approach will be used, implementing both quantitative and qualitative sources of information into this thesis' analysis. The starting point of the thesis will be 1980 until the beginning of the financial crisis in 2008, because this is the final year for most of the data. It is useful to start in 1970 for the first part of the analysis, if the data is available, to see whether the pace of change in the 1980s, 1990s and 2000s is faster than in the decade when ICT was about to be introduced. Setting 2008 as the final year of this thesis will mean that the effects of the worst financial crisis since the Great Depression in the 1930s and the unemployment that it caused will not skew the findings of the various analyses. This thesis will look at labour market trends from 1970 until 2005 – 2007 to see whether the total amount of hours worked by the average employee and educational attainment in the transport and logistics sector has changed over the course of nearly thirty years and whether these changes are significant.

The second part of this thesis will apply the method of process tracing to look into the emergence of automation as a policy issue and analyse EU recommendations on the field of education since the 1980s, more specifically recommendations on the development of skills to address the challenges of automation. The process of automation started in the 1980s with the ICT revolution and accelerated in the 1990s and 2000s. George and Bennett (2005, 206) define process tracing as a method that 'attempts to identify the intervening causal process – the causal chain and causal mechanism – between an independent variable (or variables) and the outcome of the dependent variable.' The EC will be the European institution analysed for this thesis. The EC will be analysed, because it has the right of initiative to make policy proposals. Article 17 of the Treaty on European Union (EU 2008, 25) stipulates that the EC 'shall promote the general interest of the Union and take appropriate initiatives to that end' and that 'Union legislative acts may only be adopted on the basis of an EC proposal, except where the Treaties provide otherwise.' The role of the EC in policymaking is vital, because there will be no legislation without initiatives by the EC. In addition, the three interviews conducted for this thesis cover an employer, an organisation for employees and the administration of the Port of Rotterdam. The EC takes into account the wishes of all three

such groups, because its initiatives are (e.g.) formed by the member states, organisations of employers and employees, (multinational) companies and other European institutions like the EP. The initiatives taken by the EC give a picture of what is considered important by different pressure groups involved in European policymaking. This means that the EC can provide this thesis with a comprehensive EU perspective on technological change, labour market developments, education and skill formation.

The third and final part of this thesis will be a case study of the Port of Rotterdam, the world's busiest port for over forty years (from 1962 until 2002, currently the Port of Shanghai) and still the busiest port in Europe. The transportation- and logistics sector employs 335.000 people in the Netherlands and is one of the nine economic top sectors in the Netherlands, which means that these are the economic sectors in which the Netherlands excels (CBS 2012, 44).¹⁶ The Port of Rotterdam is particularly interesting to analyse, because it is a major logistics hub and seen as the gateway to Europe due to its geographical location. The OECD (2014, 8) explained that this can be traced back to early specialisation in ICT, which allowed the Netherlands to take the European lead in transshipment and container traffic. The ECT Delta container terminal at the MV1 was the first to be largely automated as early as 1993, in the two decades after 1993 many other container terminal operators constructed modern terminals after the pioneering example by ECT (Visser et al. 2007, 6). The recently completed MV2 is the crown jewel of the Port of Rotterdam and the only port in Europe able to welcome the largest ships in the world. The world's largest vessel ever constructed, the Pioneering Spirit of the the Allseas company, is currently completed in the MV2. The OECD (2012, 44-45) reported that the port is vital to Dutch exports and plays a large role in the growth of the Dutch economy. Losing international competitiveness to other ports in Europe like the Port of Hamburg (second largest port of Europe) or the Port of Antwerp (third largest port of Europe) can have a profound impact on the Dutch economy, because of decreasing trade volumes. The application of ICT, automation and robotisation will allow the Port of Rotterdam to remain the largest, most accessible and most innovative port of Europe, but will this be at the cost of lower employment?

¹⁶ The other eight are agro and food, chemistry, creative industry, energy, high-tech systems and materials, life sciences and health, horticulture and water (CBS 2012, 12).

For this thesis, three interviews were conducted with key players involved in the Port of Rotterdam, namely the Port of Rotterdam Authority itself, APM Terminals and *Federatie Nederlandse Vakbeweging Havens* (FNV Havens). Mr. Henk de Bruijn of the Port of Rotterdam was interviewed, because his company is ‘responsible for the development, construction, management and operation of the port and industrial area in Rotterdam.’¹⁷ Mr. De Bruijn is currently the ‘Director Social Affairs’ and before that he was employed as the ‘Director Corporate Strategy’ of the Port of Rotterdam. He was interviewed on the 28th of May 2015 in his office on the thirteenth floor of the World Port Center at the Wilhelminapier in Rotterdam. The interview took 45 minutes and the audio of the interview was recorded on a memo recorder. The questions that Mr. De Bruijn were asked are included in the appendix of this thesis, but it should be noted that Mr. De Bruijn reformulated some of the questions during the interview. An interview with Mr. Joost van der Lecq of FNV Havens was conducted, because his trade union represents the employees of the Port of Rotterdam and other ports in the Netherlands and consults with both the Port of Rotterdam Authority and the container terminal operating companies like Europe Container Terminals (ECT), Rotterdam World Gateway (RWG) and APM Terminals.¹⁸ Mr. Van der Lecq’s role as union leader puts him at the heart of his organisation’s decision-making process and he is very knowledgeable about past and future developments in the Port of Rotterdam. The interview was conducted on the 1st of June 2015 in his shared office at the regional office of FNV Havens on the Pegasusweg 200, Rotterdam. The interview took just over one hour and the audio of the interview was recorded on a memo recorder. Finally an interview was conducted with Mr. Hans de Vries, ‘General Manager Human Resources’ of APM Terminals. Speaking with a representative of one of the largest and most innovative container terminal operators provides this thesis with necessary insight into their policy on employment and automation. He was interviewed on the 28th of May 2015 in his office at the main office of APM Terminals on the Coloradoweg 50, Maasvlakte. The interview took one hour and the audio of the interview was recorded on a memo recorder. These persons were interviewed, because they represent the key relationship in the port between the administration (Port of Rotterdam Authority), the employers (APM Terminals) and the employees (FNV Havens).

¹⁷ Source: <http://www.portofrotterdam.com/en/Port-Authority/Pages/default.aspx>.

¹⁸ Source: <https://www.cnvvakmensen.nl/wie-we-zijn/cao-en-sectornieuws/nieuws/overleg-met-container-werkgevers-en-havenbedrijf>.

The representatives of the organisations interviewed are all important stakeholders in the port's social dialogue.

The information gathered from the organisations can be considered as generalizable. The Port of Rotterdam Authority is the only administration of the port, so there is no leeway in that regard. Mr. De Bruijn, a self-proclaimed realist, is a confident and convincing representative of his organisation. However, he is probably more outspoken than his colleagues. This means that his point of view does not necessarily correspond with views of many of his colleagues (and superiors). Furthermore, APM Terminals is one of the largest, most effective and most innovative container terminal operators on the MV1 and MV2, which means that their outlook to developments in the port will probably be more optimistic than for example from ECT, which fears mass layoffs and social carnage.¹⁹ Finally, FNV Havens usually takes a more direct and confrontational approach than CNV Vakmensen. FNV Havens is a hard negotiator and will probably show a greater dislike of container terminal operators and the Port of Rotterdam Authority than CNV Vakmensen, whether sincere or not. It should also be noted that attempts were made to make an interview appointment with a representative of RWG, ECT, and CNV Vakmensen, but these attempts were unsuccessful.

3.1 – Independent and Dependent Variables

Independent variables:

It should be noted that the independent variables used in this thesis are not exhaustive and more likely than not do not cover all the aspects related to changes in employment. It is plausible that relationships between variables not identified here exist and contain a higher explanatory power than either of the ones identified for this thesis. This is a common hazard of academic research and cannot effectively be removed from the equation. However, it nonetheless seems that the independent variables used in this thesis will be quite adequate in providing an explanation for the skill-biased technological change affecting employment in Europe.

¹⁹ Source: <http://nos.nl/artikel/667266-tweede-maasvlakte-is-bloedbad.html>

Automation: The *Encyclopædia Britannica* has the following definition: ‘the application of machines to tasks once performed by human beings or, increasingly, to tasks that would otherwise be impossible [...] automation has revolutionized those areas in which it has been introduced, and there is scarcely an aspect of modern life that has been unaffected by it.’ For the purpose of this study, the terms *robotics* and *automation* will be used interchangeably, because they tend to refer to the same thing, or robotics is at least part of the bigger whole which is termed automation. Even more, the industrial robots used in manufacturing are one example of an automated process, they are part of the automation chain. Robots fulfil tasks traditionally done by human beings.

EC policy initiatives: If we heed the words by the Dutch Deputy Prime Minister, the EU has to prepare for technological unemployment. Automation is likely a cross-border issue, so the EU is the best candidate to formulate new policy initiatives. This thesis will analyse documentation of the EC, because it is the executive body of the EU responsible for proposing legislation. Other institutions are worth consideration, but either represent the EU's member states like the Council of the European Union and the European Council, or lack political clout like smaller EU institutions. Although the EC is funding several robotics initiatives, EU legislation is non-existent.²⁰ It is however unlikely that the EC did not recognise the technological developments taking place during and after the 1980s, so this thesis will analyse policy initiatives back from when the Information Age started somewhere around the late 1970s. The analysis of Communications by the EC will not be exhaustive. The EC released thousands of documents over the last decades partly or largely related to current day automation and changes in employment. Since many other developments like mechanisation, robotisation, information technologies and micro-electronic technology are related to automation, the analysis of this thesis cannot possibly contain all available documentation. It can however show the general trends and developments within the institution with regard to its stance over time on issues of technological change and the effect it has on employment and skill formation. The analysis will focus on key documents

²⁰ Source: <http://www.europarl.europa.eu/news/en/news-room/content/20150422STO43701/html/Mady-Delvaux-Robotics-will-bring-about-a-revolution>

published by the EC in which it addresses technological change. Documents released by the EC are commonly known as ‘Communication from the Commission’, or COM.

Economic crises: Starting from the 1980s, several financial crises affected the EU. The early-1980s and the early-1990s saw two rather short-lived economic crises with limited economic growth. The dot-com boom and bust in the early 2000s mostly affected the U.S. economy, not so much the European economies. This changed when the 2007 Global Financial Crisis, triggered by the bursting of the United States housing bubble, led to a major economic recession in the EU starting in 2009. The recession caused massive job loss and an overall decline in consumer spending and economic output, which led to a slowdown in economic activity and growth. Transshipment, the most important trade activity of the Port of Rotterdam, declined with 10.8% in 2009 compared to the same period in 2008.²¹ The last year used for the analysis will be 2008, because data from later years will be distorted by the financial crisis. In sum, economic crises directly influence employment and will be measured on the basis of economic growth. In times of low economic growth or even economic contraction, job losses will occur.

Labour productivity: This is influenced by automation, because automation improves productivity (Graetz and Michaels 2015, 21). This can be analysed with the EU KLEMS database, which will be explained in greater detail on the next page. This database has information on both gross output and compensation of employees in millions of purchasing power parity-converted Euros. In general, output growth keeps equal pace with the growth of employee compensation, because it implies economic growth and more prosperity. Once these two measures diverge, it is likely that output (and thus productivity) has increased on a faster rate than wages. Such a trend would be consistent with declining labour shares, because more output can be generated with fewer workers. It is expected that these productivity gains are mainly achieved by automation, which can be analysed by looking at several ‘growth accounting’ variables in the EU KLEMS database. From the EU KLEMS data the labour compensation can be calculated for each type of labour, this thesis will calculate high-skilled, medium-skilled and low-skilled labour shares of value added.

²¹ Source: <https://www.maasvlakte2.com/nl/index/show/id/406/concurrentie-en-wereldeconomie-profiel-e-m>.

Dependent variable:

Change in employment: This thesis will focus on changes in the total amount of hours worked, not on the total number of people employed. By only looking at total employment in transportation and logistics, one might overlook a decline in working hours. This thesis thus shows the relative change in employment, which means that some occupations may still show growth in absolute terms (more people employed), but an overall decline in total hours worked by employees. In addition, the highest degree attained will be used as a proxy for skill level. Automation might lead to more jobs being created, but if the skill-level of these new jobs is too high, some people will not be able to get proper employment.

3.2 – Data

The source of data is the ‘EU KLEMS Growth and Productivity Accounts’ dataset from 2008, because the 2011 update does not provide information on labour skill level.²² The data contains information on total hours worked and total compensation for three groups of employees, among other variables.²³ These three groups are high-skilled (at least tertiary education), medium-skilled (at least secondary education) and low-skilled (at most a primary education) (Timmer et al. 2007a, 28-31). The dataset covers 25 EU member states, excluding the countries (Bulgaria, Romania and Croatia) that joined the EU after 1 May 2004, from 1970 until 2005 (Timmer et al. 2007b, 3). Data from 1970 until 2005 will be used, but for some parts of the analysis data from 1980 until 2005 will be used. Starting in the 1970s provides this thesis with pre-automation data, as opposed to the 1980s, 1990s and 2000s when automation gradually gained ground.

²² EU KLEMS stands for Capital (K), Labour (L), Energy (E), Materials (M) and Service (S) inputs.

²³ The individual datasets can be found on: <http://www.euklems.net/euk08i.shtml>;

<http://www.euklems.net/euk09ii.shtml>.

4. Analysis of Automation

This part of the thesis will focus on the EU KLEMS data and discuss the changes over time in working hours, educational attainment, gross output growth and labour compensation. Educational attainment will only be studied for individual cases, because the EU-15 and EU-10 datasets do not include labour skill as a variable. The analysis will include two groupings of countries, namely the EU-15 representing the EU member states as of 1 January 1995 (Austria, Belgium, Denmark, Spain, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Sweden and the UK) and the EU-10 representing the new EU member states that joined on 1 May 2004 (Cyprus, Czech Republic, Estonia, Hungary, Lithuania, Latvia, Malta, Poland, Slovakia and Slovenia). Two high-income northern European countries, Germany and the UK, and one high-income southern European country, Spain, will also be analysed on an individual basis. Germany will be analysed, because its central position in Europe (both politically and geographically) makes it essential to much of Europe's road, rail, air and water transport. In addition, Germany is home to some of the busiest ports and airports in Europe (Port of Hamburg, Port of Bremerhaven and Frankfurt Airport) and the EU KLEMS dataset for Germany is extensive. The UK will be studied, because being an island will make transportation all the more crucial. The UK's transportation network is extensive and includes the world's busiest airport systems by passenger traffic (Heathrow, Gatwick, Stansted, Luton, City, and Southend Airport). Furthermore, the EU KLEMS dataset on the UK is very extensive and includes information from as early as 1970 for educational attainment. Spain is analysed, because it is an important trade link between Africa and Europe and has a large coastline with many busy ports. Additionally, Spain's EU KLEMS dataset is rather extensive in comparison with other Southern European countries. For countries from Eastern Europe there was not enough data from before 1995 (especially educational data), making it very difficult to discern any trends within such a short time period (timespan of only ten years from 1995 until 2005). For that reason these countries will only be analysed as a group and not on an individual basis.

In addition, the changes in educational attainment have been analysed for statistical significance with SPSS Statistics. The results are referenced throughout this chapter of the thesis and a more detail account of the statistical analysis can be found in the appendix, section 10.1 on page 65 and

66. The paired samples t-test was used to measure for in-group change of the average labour compensation share of high-skilled, medium-skilled and low-skilled labour. For Germany and the UK three timespans were used, one from 1970 until 1981, one from 1982 until 1993, and one from 1994 until 2005. These smaller groups all have the same amount of cases and three instead of two timespans allows for more accurate results of the statistical analysis. For Spain two timespans were used, because the earliest data available was 1980. This means that the first timespan covered 1980 until 1992 and the second timespan covered 1993 until 2005. In comparison with Germany and the UK, for the Spanish timespans thirteen data points were used instead of twelve data points per group.

4.1 – EU-15

For the EU-15, results in terms of working hours since 1980 can be found in Table 1. Trends in productivity and compensation of employees have been analysed since 1970 to discern whether productivity growth during the 1970s was different from the 1980s, 1990s and early 2000s and the results can be found in Figure 1.

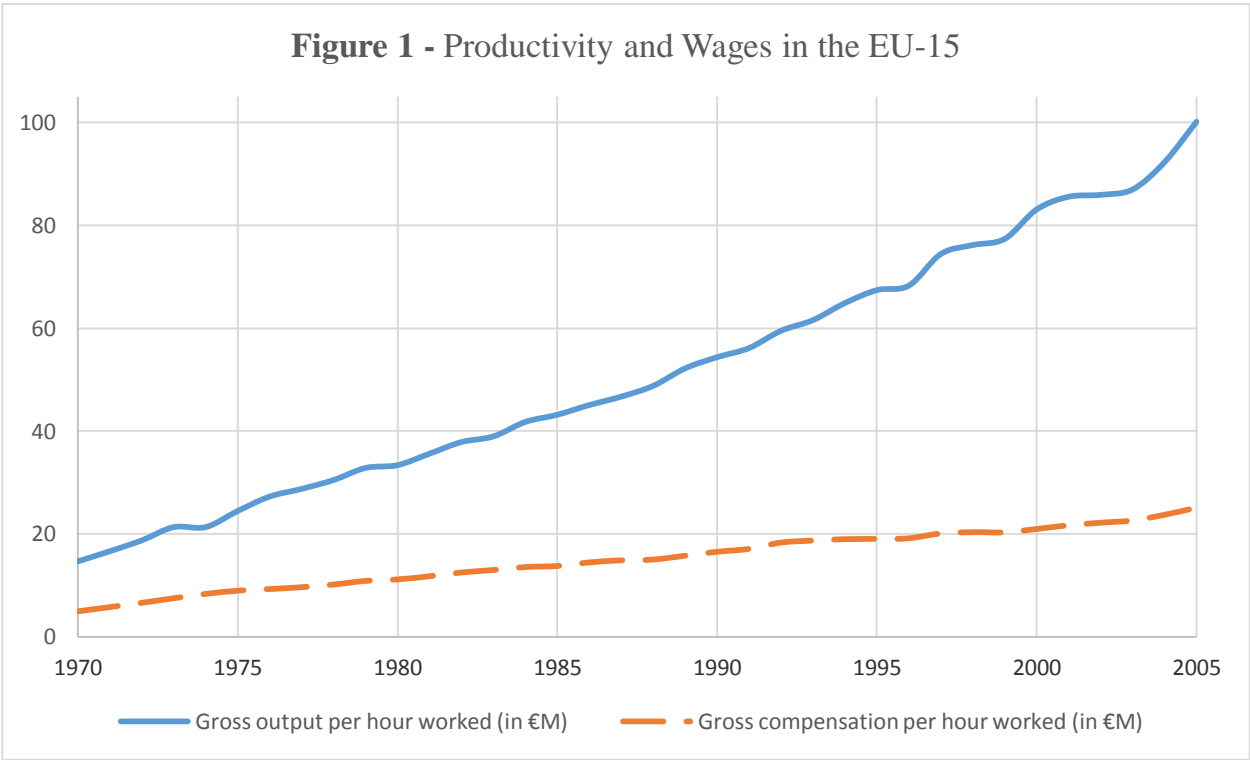
Table 1 – EU-15: Total hours worked per week in the transportation and logistics sector

Year	Total hours worked by employees (millions)	Number of employees (thousands)	Total hours worked by an individual per week
1980 - 1984	53.005	27.152	37.5
1985 - 1989	51.977	27.038	37
1990 - 1994	52.612	28.065	36.1
1995 - 1999	52.507	28.224	35.8
2000 - 2004	56.978	31.502	35.8
2005 - 2007	35.622	19.788	34.6

Source: Own calculations on the basis of the EU KLEMS EU-15 dataset

Table 1 shows a noticeable decrease in total hours worked across the EU-15 in the transportation and logistics sector. The average workweek of an employee declined from 37.5 hours a week in the early 1980s to 34.6 hours a week in the 2000s, which entails an average decline of 2.9 hours a

week. It should be noted that the average workweek remained the same between 1995 and 2004, with a rather large increase in employment compared to earlier years. Figure 1 shows that the growth in productivity in the earliest EU member states accelerated in the 1980s and grew even faster around the late-1990s. What this implies is that the huge growth in gross output and the wealth it created did not end up with the employees who created the output, implicating that a significantly higher output and economic growth does not imply significantly higher wages. It also provides evidence for productivity increases caused by automation, since the gap between gross output and gross compensation opened up during the 1970s.



Source: Own calculations on the basis of the EU KLEMS EU-15 dataset

4.2 – EU-10

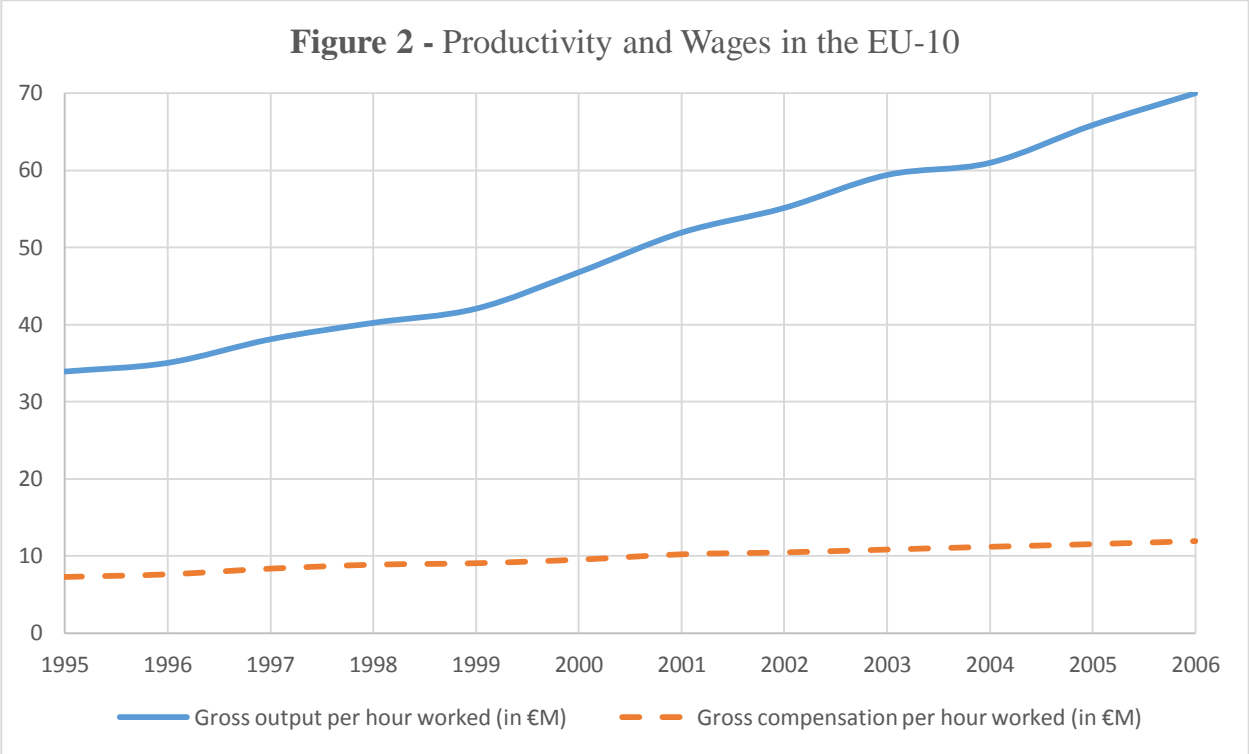
For the EU-10, trends in working hours since 1995 (earliest year available) have been analysed and the results can be found in Table 2. Trends in productivity and compensation of employees have been analysed since 1995 (earliest year available) and even with this relatively short timeframe of just over ten years, the trend in Figure 2 is still very clear.

Table 2 – EU-10: Total hours worked per week in the transportation and logistics sector

Year	Total hours worked by employees (millions)	Number of employees (thousands)	Total hours worked by an individual per week
1995 - 1996	5.133	2.674	36,9
1997 - 1998	5.047	2.655	36,5
1999 - 2000	4.840	2.536	36,7
2001 - 2002	4.561	2.428	36,1
2003 - 2004	4.527	2.423	35,9
2005 - 2006	4.572	2.428	36,2

Source: Own calculations on the basis of the EU KLEMS EU-10 dataset

Table 2 shows a rather minor decrease in total hours worked during the average workweek in the Eastern European transportation and logistics sector. Although total hours worked and employment decreased, the average workweek of an employee declined with ‘only’ 0.7 hours from 36.9 hours a week in the mid-1990s to 36.2 hours a week in the timespan 2005 – 2006. When compared with the 1995 – 2004 trends in the EU-15, employment in the EU-10 declined during a period of employment growth in the EU-15. Figure 2 shows that the growth in productivity in the newest EU member states is almost linear and way larger than the increase of compensation for employees. The difference between productivity and compensation is even larger in the EU-10 (almost seven times larger), than in the EU-15 (almost five times larger). Many EU-10 countries were just emerging from Soviet domination when the earliest data used for this thesis was published (1995). These countries still needed a lot of time to catch up to the richer EU-15 countries. It is for that reason understandable that the average compensation was almost twice as low in the EU-10, than in the EU-15. Productivity of the EU-10 countries did not lag as much however, only about 1.5 times as much. What this implies is that the growth in gross output and the wealth it created did not end up with the employees who created the output, even less than in the EU-15 countries. The implication for EU-10 countries is the same as for EU-15 countries, higher output does not lead to higher wages in Eastern Europe.



Source: Own calculations on the basis of the EU KLEMS EU-10 dataset

4.3 – United Kingdom

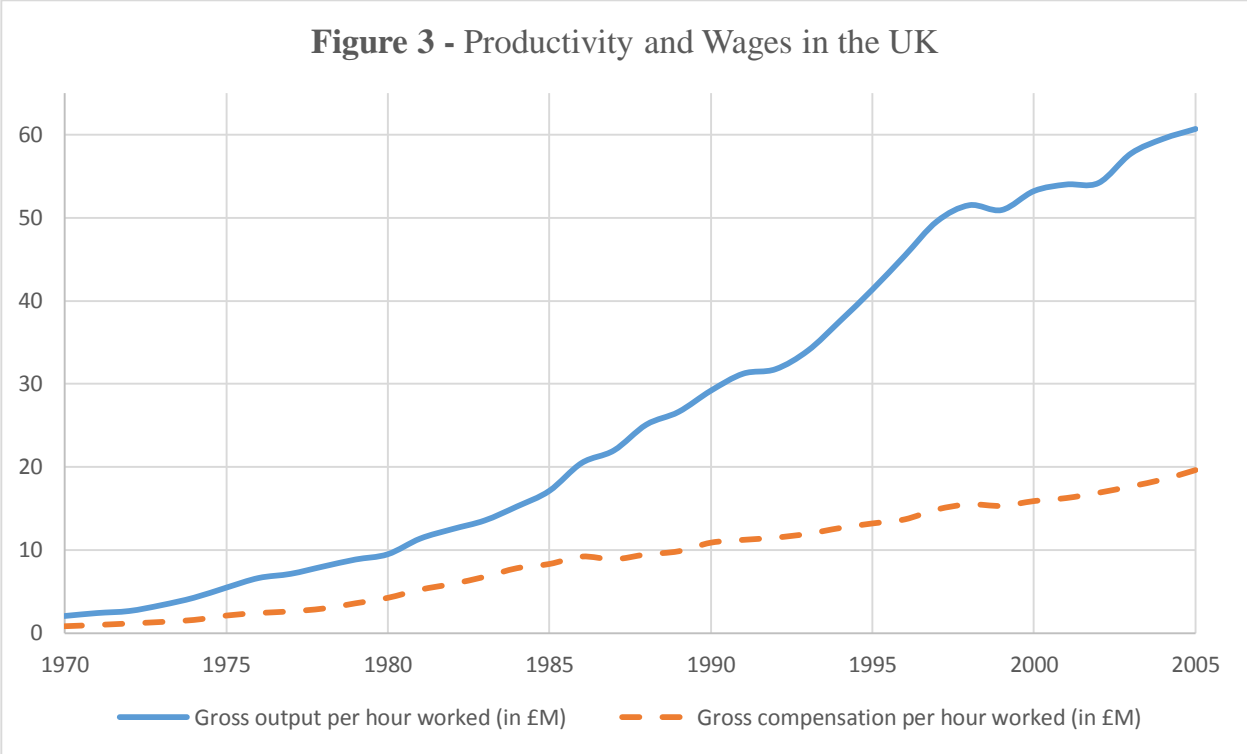
For the UK, trends in working hours since 1980 have been analysed and the results can be found in Table 3. Trends in productivity and compensation of employees have been analysed since 1970 to discern whether productivity growth during the 1970s was different from the 1980s, 1990s and early 2000s and the results can be found in Figure 3. In addition, an analysis of skill and share of labour compensation has been added to see whether the labour composition in the UK has changed since the 1970s, to be found in figure 5. In the EU KLEMS dataset for the UK, high-skill is defined as having a university degree, medium-skilled is defined as having a Higher National Diploma, Higher National Certificate, Business and Technology Education Council, teaching qualification, nursing qualification, A level or equivalent, trade apprenticeship, O level or equivalent, Business English Certificates, TEC GENERAL, City and guilds, and low-skilled is defined as having no qualifications (Timmer et al. 2007, 29).

Table 3 - UK: total hours worked per week in the transportation and logistics sector

Year	Total hours worked by employees (millions)	Number of employees (thousands)	Total hours worked by an individual per week
1980 - 1984	9.249	4.495	39,6
1985 - 1989	8.502	4.029	40,6
1990 - 1994	8.556	4.174	39,4
1995 - 1999	8.724	4.302	39
2000 - 2004	9.454	4.865	37,4
2005 - 2007	5.926	3.087	36,9

Source: Own calculations on the basis of the EU KLEMS UK dataset

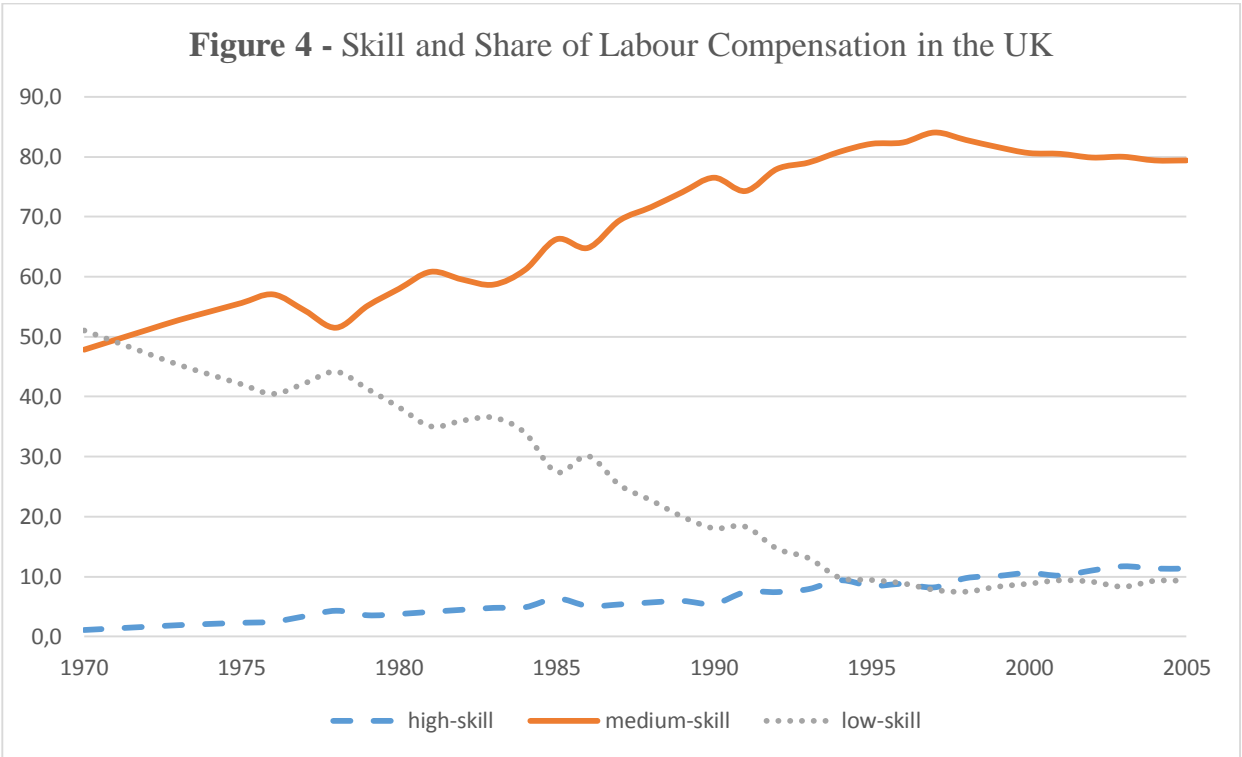
Table 3 shows a rather fluctuating decrease in total hours worked in the UK between 1980 and 1995. After 1995, the average workweek of a British transportation and logistics employee declined from an average of 39 hours a week between 1995 and 1999 to an average of 36.9 hours a week between 2005 and 2007, which entails an average decline of 2.1 hours a week. The shorter workweek may be explained by the 1997 general elections and the rise to power of the Labour Party at the expense of the Conservative Party that ruled the UK from 1979 till 1997. The Labour Party has different values when it comes to employment, possibly facilitating the unemployed to work part-time jobs. Figure 3 shows that the growth in productivity in the UK is less pronounced than in the EU-15 and EU-10, but the analysis still implies that the compensation for work did not keep equal pace with productivity. The decrease in working hours also suggests that automation caused more people to work less hours per week.



Source: Own calculations on the basis of the EU KLEMS UK dataset

Educational attainment has changed rather drastically in the UK in just over thirty years. Low-skilled people were the majority in the first year of the analysis, but dropped below ten percent in 1994. This decrease of the low-skilled compensation share is significant ($t(11) = 14.08, p < .05$ and $t(11) = 6.64, p < .05$). The medium-skilled group rapidly grew during the 1970s and 1980s, but its share slowly declined after 1998. The increase of the medium-skilled compensation share is significant ($t(11) = -10.89, p < .05$ and $t(11) = -4.83, p < .05$). The high-skilled group started out with a share of the labour compensation of just over one percent, but its share increased every year and this trend is expected to have continued in the years after 2005. The share of high-skilled compensation has increased significantly between 1970 – 1981 and 1982 – 1993 ($t(11) = -13.45, p < .05$) and increased significantly between 1982 – 1993 and 1994 – 2005 ($t(11) = -15.09, p < .05$). However, as the literature suggested, on the one hand the share of low-skilled work has not declined further and has even slowly risen and the share of high-skill labour is constantly rising. On the other hand, the share of mediums-skilled labour declined after 1997, suggesting that automation is starting to reach medium-skilled occupations. To sum up, employment in British

transportation and logistics decreased in the 1980s, but slowly recovered and the sector eventually employed more people (for less hours per person) in 2000 – 2004 than it did during the early 1980s.



Source: Own calculations on the basis of the EU KLEMS UK dataset

4.4 – Germany

For Germany, trends in working hours since 1980 have been analysed and the results can be found in Table 4. Trends in productivity and compensation of employees have been analysed since 1970, in the same fashion as for the UK, and the results can be found in Figure 5. The analysis of skill and share of labour compensation can be found in Figure 5 and data from the EU KLEMS West Germany dataset for the 1970 – 1990 period was used, because the earliest data for a unified Germany starts in 1991. The data from Western Germany did not cause breaks in the time series, because it uses the same standards for defining and observing educational attainment over time. The EU KLEMS dataset for Germany, high-skill is defined as having a university degree, medium-skilled is defined as intermediate, and low-skilled is defined as having no formal qualifications (Timmer et al. 2007, 29). The rather broad definition of medium-skilled includes everyone

between university graduates and those without formal qualifications, but it is currently the best data available.

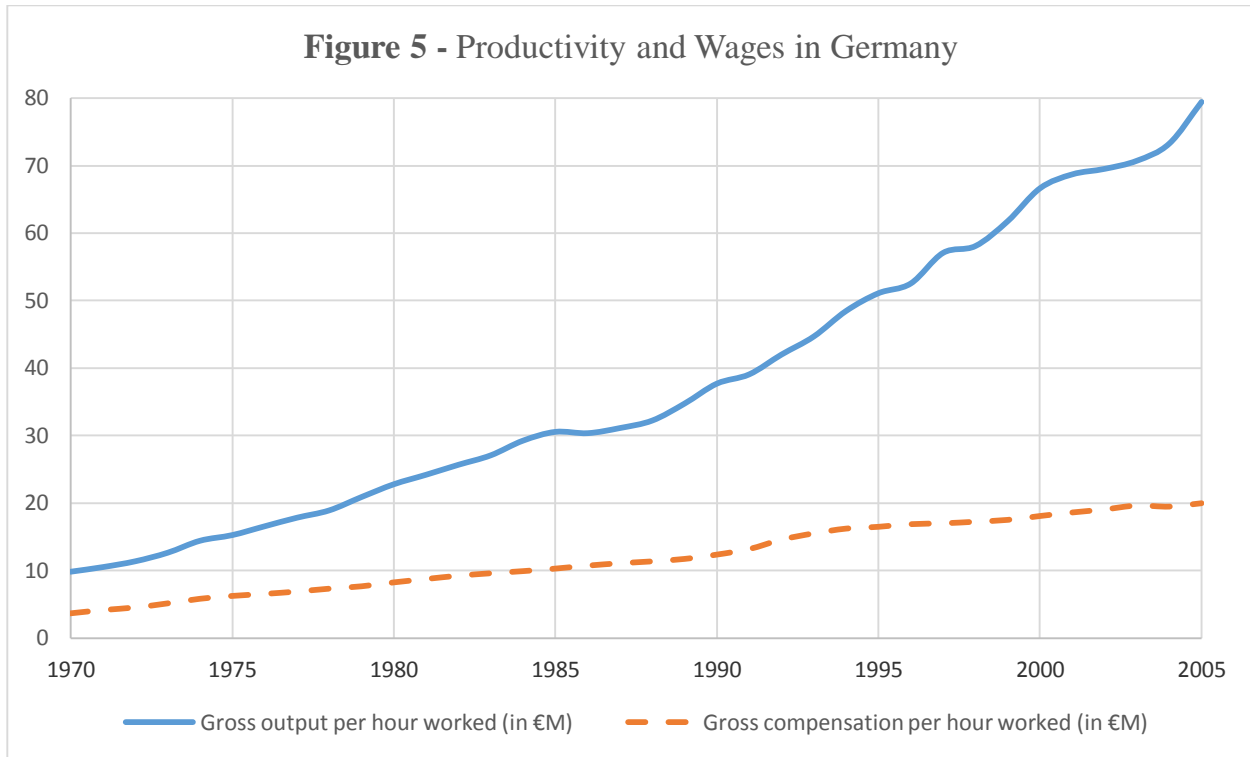
Table 4 - Germany: total hours worked per week in the transportation and logistics sector

Year	Total hours worked by employees (millions)	Number of employees (thousands)	Total hours worked by an individual per week
1980 - 1984	13.729	6.751	39.1
1985 - 1989	13.537	7.096	36.7
1990 - 1994	13.802	7.635	34.8
1995 - 1999	12.261	6.986	33.8
2000 - 2004	12.140	7.373	31.7
2005 - 2007	7.245	4.514	30.9

Source: Own calculations on the basis of the EU KLEMS Germany dataset

Table 4 shows a rather drastic decrease in total hours worked between 1980 and 2007. Between 1980 and 1984, the average employee working in German transportation and logistics worked on average 39.1 hours a week. This declined with 8.2 hours to 30.9 hours between 2005 and 2007. One explanation for this rapid decline is the fact that Germany is a relatively wealthy country and the increase in employment points to more part-time employees. Between 1983 and 2005, an average of 14.2 percent of total employment in Germany was part-time work.²⁴ It is also possible that this increase is related to investments in automation, when people are forced to leave their full-time jobs and accept a part-time one. Germany is one of the world's biggest investors when it comes to robotics and a shorter average workweek can be related to that. Figure 5 shows that the growth in productivity in Germany outstrips the compensation for work. The difference is even larger than in the UK, where productivity was three times larger than compensation in 2005. For Germany, productivity in the transportation and logistics sector is four times larger than the hourly compensation of employees. The two lines start to (strongly) diverge in the late 1970s, which suggests that it is caused by automation.

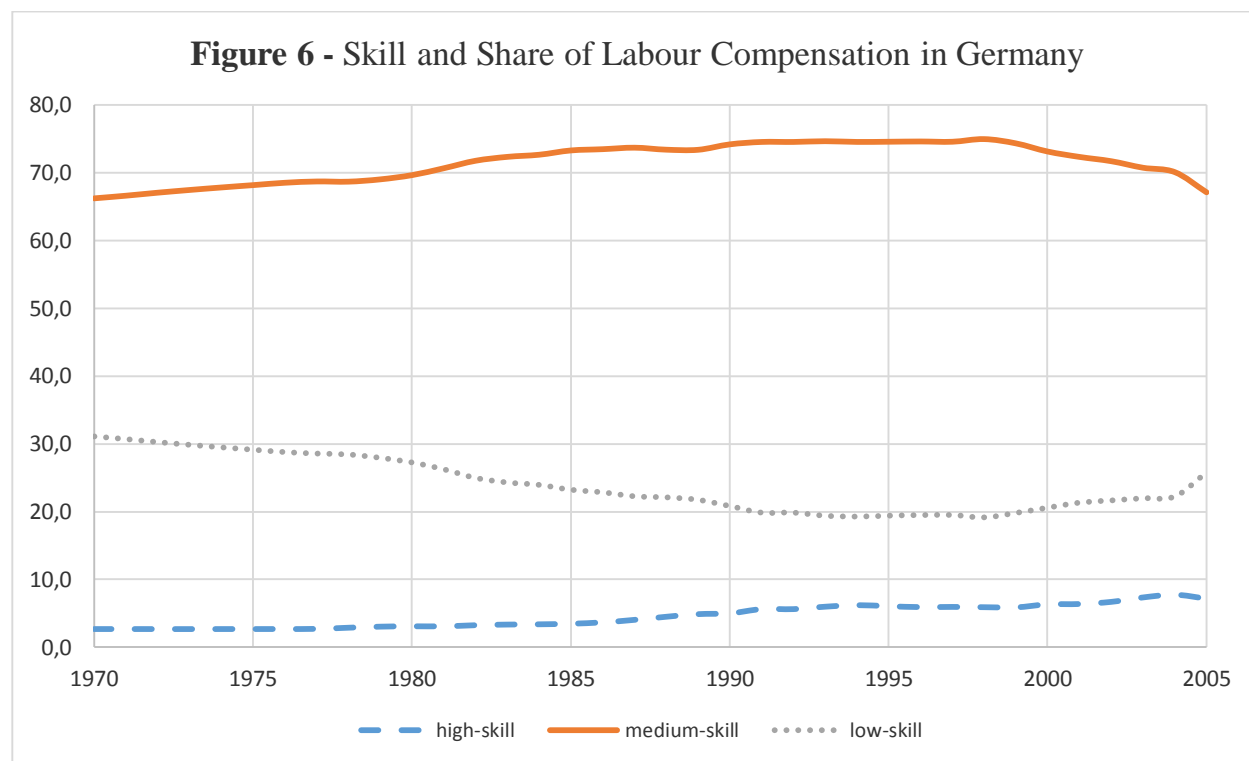
²⁴ Source: http://stats.oecd.org/Index.aspx?DatasetCode=FTPTC_I#



Source: Own calculations on the basis of the EU KLEMS Germany dataset

Educational attainment has not changed all that much over the course of thirty years (see Figure 6). Medium-skilled people were the majority in the first year of the analysis, which is remarkable when compared to the UK where the majority of transportation and logistics sector employees did not have a formal education in 1970. This cannot be related to a definitional issue, because both countries qualified low-skilled workers as having no qualifications. In the years that followed 1970, the low-skill share dropped from just over thirty percent to below twenty percent in 1995. However, after then the share of low-skilled workers slowly increased, while the compensation share of medium-skilled workers declined. The decrease of the low-skilled compensation share is significant for 1970 – 1981 and 1982 – 1993 ($t(11) = 41.83, p < .05$), but non-significant for 1982 – 1993 and 1994 – 2005 ($t(11) = 1.2, p > .05$). It is likely that automation caused the decline in low-skilled labour compensation, but caused an increase in demand for higher skilled workers. The increase of high-skilled compensation is significant ($t(11) = -6.66, p < .05$ and $t(11) = -13.56, p < .05$). This once again changed in the late-1990s when medium-skilled occupations were automated and the jobs that remained were either high-skill, or low-skill and not worth the financial investment to automate. The share of medium-skilled compensation increased significantly

between 1970 – 1981 and 1982 – 1993 ($t(11) = -33.12, p < .05$), but the decline of medium-skilled labour compensation is non-significant between 1982 – 1993 and 1994 – 2005 ($t(11) = .862, p > .05$).



Source: Own calculations on the basis of the EU KLEMS Germany dataset

4.5 – Spain

For Spain, trends in working hours since 1980 have been analysed and the results can be found in Table 5. Trends in productivity and compensation of employees have been analysed since 1970 until 2005, in the same fashion as for the UK and Germany, and the results can be found in Figure 7. The analysis of skill and share of labour compensation can be found in Figure 8 and uses data starting from 1980 until 2005. The EU KLEMS dataset for Spain defines high-skill as having a university degree, medium-skilled is defined as higher education below degree, low intermediate and vocational education, and low-skilled is defined as having no formal qualifications (Timmer et al. 2007, 29).

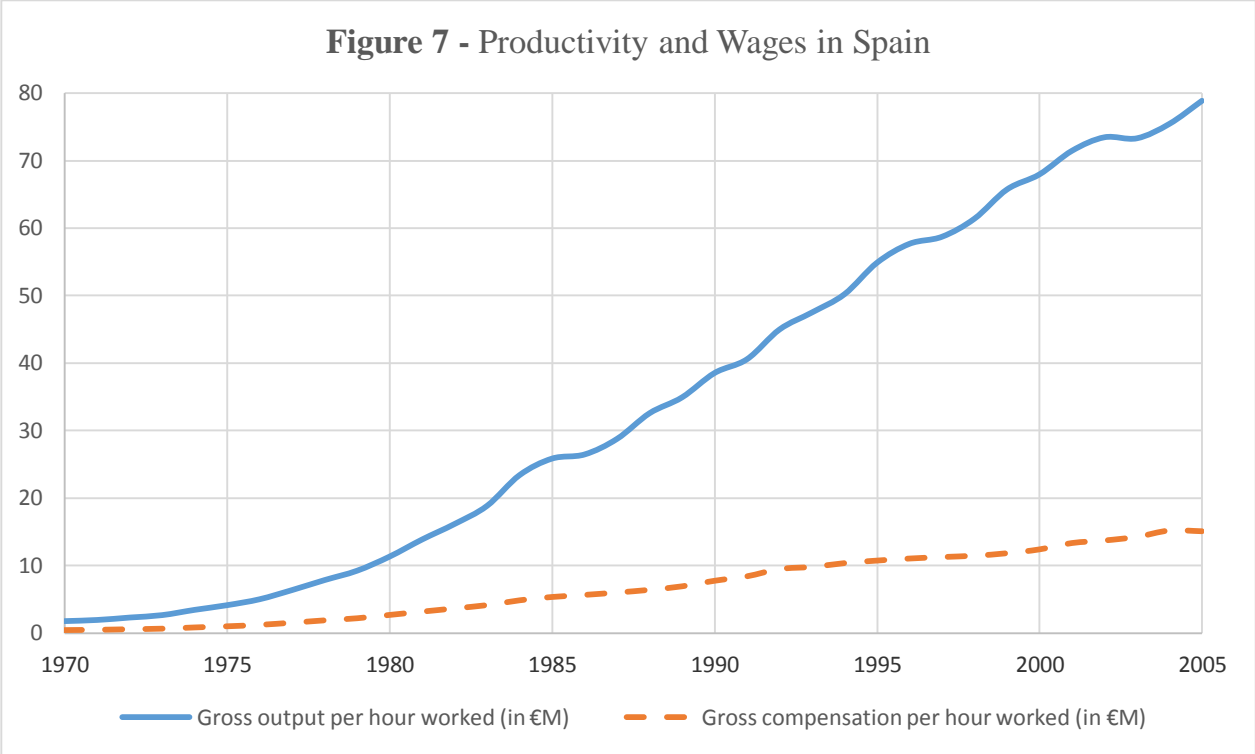
Table 5 - Spain: total hours worked per week in the transportation and logistics sector

Year	Total hours worked by employees (millions)	Number of employees (thousands)	Total hours worked by an individual per week
1980 - 1984	4.061	1.986	39.3
1985 - 1989	3.610	1.884	36.8
1990 - 1994	3.774	1.979	36.7
1995 - 1999	4.193	2.208	36.5
2000 - 2004	5.197	2.803	35.7
2005 - 2007	3.651	2.054	34.2

Source: Own calculations on the basis of the EU KLEMS Germany dataset

Table 5 shows a decrease in total hours worked between 1980 and 2007. Between 1980 and 1984, the average employee working in Spanish transportation and logistics worked on average 39.3 hours a week. This declined with 5.1 hours to 34.2 hours between 2005 and 2007. Part-time work might explain this decline, because employment in the transportation and logistics sector significantly increased between 1980 and 2004. The amount of hours worked increased as well, but relatively slower than the increase in employment. Between 1987 and 2005, 6.8 percent of the Spanish people were part-time employed.²⁵ That is hardly sufficient to explain the rather large decline in total hours worked by Spanish employees. Figure 7 shows that the growth in productivity in Spain outstrips the compensation for work. The difference is even larger than in the UK and Germany, with productivity being five times larger than compensation in 2005. This points, especially when one looks at the relatively small difference in the early- and mid-1970s, to increased automation as an explanation for the increasing difference between productivity and wages.

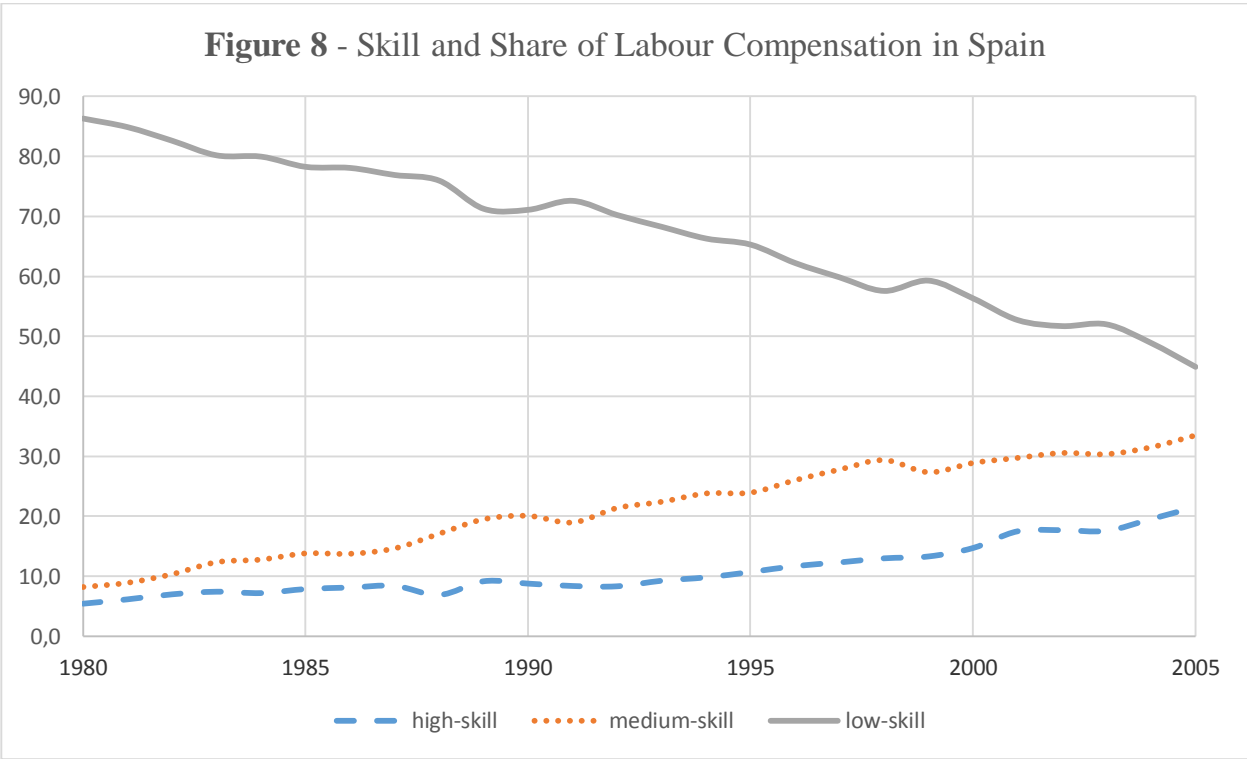
²⁵ Source: http://stats.oecd.org/Index.aspx?DatasetCode=FTPTC_I#



Source: Own calculations on the basis of the EU KLEMS Spain dataset

The labour compensation share of medium- and high-skilled employees has significantly increased at the cost of low-skilled labour (see Figure 8). Early automation mainly decreased the supply of low-skilled occupations, something which can be seen happening here. The decrease of high-skilled compensation is significant ($t(12) = -7.68, p < .05$) It also shows that the developments in Western Europe of a slightly diminishing labour share for medium-skilled employees has not yet reached Spain. The increase of medium-skilled compensation is significant ($t(12) = -30.810, p < .05$). This is likely related to the lower GDP per capita of Spain in comparison with the UK and Germany.²⁶ Additionally, Spain's rather low ICT diffusion index in comparison with most other European countries might also be a good explanation as to way in the more recent years of this analysis developments in skill level did not coincide with the ones in the UK and Germany (UNCTAD 2005, 49). Furthermore, the increase of high-skill compensation is much steeper than in the UK and Germany, with over twenty percent of the labour compensation share in 2005. The increase of medium-skilled compensation is significant ($t(12) = -7.68, p < .05$).

²⁶ Source: <http://ec.europa.eu/eurostat/tgm/table.do?tab=table&plugin=1&language=en&pcode=tec00114>



Source: Own calculations on the basis of the EU KLEMS Spain dataset

4.6 – Conclusion

The analysis of EU KLEMS data provides evidence in support of the **first hypothesis**.²⁷ Since the 1980s employment in the European transportation and logistics sector changed, presumably caused by automation. The average workweek in the EU-15, EU-10, the UK, Germany and Spain became shorter and hourly productivity increased rapidly, while hourly labour compensation increased relatively slightly. Even more, the educational attainment in the UK, Germany and Spain showed statistically significant changes in total share of labour compensation. The analysis suggests that the decline in low-skilled labour is caused by automation, making many of these occupations redundant. The increase in medium- and high-skilled labour is related to the fact higher skilled occupations are complemented by technological developments. However, the analysis provides evidence that the share of medium-skilled labour started to decline in the late 1990s.

²⁷ Hypothesis 1 is: ‘If automation has significantly changed the transportation- and logistics sector, then more people will be unemployed as a direct result of automation, especially the low-skilled and medium-skilled workforce.’

5. Analysis of European Policy

The general trend on the labour market in recent years is a decline in the availability of medium-skilled occupations. This decline started some twenty years ago and with the loss of medium-skilled jobs, the availability of lower and higher paid occupations increased. This presents policymakers with three related problems. First of all, the economic consequence of unemployment or underemployment is how affected people will sustain themselves. All European countries struggle in one way or another with the financial burden of their welfare programs and many people feel the financial cuts their respective government had to make in order to keep their debt in check. Without active participation as consumers, the economy (and employment) will suffer. Second, apart from supporting oneself financially with a job, having an occupation is linked to one's identity and self-worth. While people tend to complain about their work and much prefer to be doing something else,²⁸ psychologists Csikszentmihalyi and LeFevre (1989; in Carr 2014) described the paradoxical phenomenon in which 'people were happier, felt more fulfilled by what they were doing, while they were at work than during their leisure hours. In their free time, they tended to feel bored and anxious.' Once the availability of well-paying occupations dwindles due to technological change, what remains 'would probably feel less like paradise than like a cruel practical joke' (Arendt 1958; in Carr 2014). People tend to define themselves by how they earn their money and how they spend it. In her 1958 book *The Human Condition* Arendt pointed that automation confronts us with the 'prospect of a society of labourers without labour, that is, without the only activity left to them. Surely, nothing could be worse' (Arendt 1958; in Carr 2014). To make matters even more urgent, Baker and Hassett (2012) note that unemployment can lead to severe physical and psychological issues including, but not limited to, serious illness and a rise in mortality.²⁹ Most humans are unfit to do nothing and European policymakers should acknowledge this while discussing new legislation. Finally, the growing group of un- and underemployed people may cause (minor) social disruptions due to disillusionment with their position in society. The recent hollowing out of medium-skilled jobs described in this thesis could lead to increasing

²⁸ The average, commercial radio station is constantly telling its listener that it is almost time to go home, or that the weekend is near.

²⁹ Source: <http://www.nytimes.com/2012/05/13/opinion/sunday/the-human-disaster-of-unemployment.html>

polarisation between high-income and low-income groups. One way to address these issues is by reforming and improving the educational system to enable people to perform the jobs that require a different set of skills. Policymakers on the EU level are especially well positioned to find solutions and discuss educational reform for cross boundary issues such as automation. As mentioned in the introduction, especially the transportation and logistics sector will feel the pinch of automation in the coming decades. For workers to avoid being left behind by technological progress, they must upgrade their skills. This view is shared by the famous Gordon Moore, who predicted ‘Moore’s Law’ on the exponential growth of computational power. In an interview with Thomas Friedman, Mr. Moore argued that we are currently living in a ‘two-class society separated by education.’³⁰ In other words, education is vital to one’s place in society, now more than ever.

5.1 Initiatives by the European Commission

5.1.1 – The 1980s

Prior to the emergence of automation in the 1980s and its accelerated application in the 1990s and 2000s, the EC published *COM(79) 650 final* in which it explained that most European countries were already an ‘information society’. The 1979 Communication was preceded by the establishment of the European Monetary System (EMS) under the Jenkins Commission, preparing for further economic integration. The successful establishment of the EMS elicited optimism about future European integration and allowed the EC to tackle one of the most difficult future challenges, namely new technologies. The EC recognised the broad impact that information technologies would have on employment in occupations with a repetitive nature and worried whether enough new jobs could be created to employ these people (EC 1979, 1–2). Back then new technologies were mostly seen as a threat, but unmistakably a source of future economic growth and employment. In order to adapt to these new technologies, education was seen as crucial to familiarise pupils with new information technologies (EC 1979, 18–20). *Employment and the New Micro-Electronic Technology* published in 1980 by the EC was the first comprehensive document

³⁰ Source: <http://www.nytimes.com/2015/05/13/opinion/thomas-friedman-moores-law-turns-50.html>

to address the issues raised in the COM from the year before.³¹ The impact that these new technologies (e.g. computerisation and microelectronics) would have on employment could be alleviated by consistent high levels of economic growth, by actively helping (peripheral) regions and sectors mostly affected by new technologies (e.g. regions with a lot of manufacturing plants), by investing in these new high-tech economic sectors, and by active financial and policy support by the EC to make sure that everyone benefits from these developments (EC 1980, 3–4). Consulting the annex of *COM(80) 16 final* shows that most academic research into the impact of new technologies started in the late 1970s, which means that the EC quickly recognised this new trend and swiftly responded (EC 1980, Annex, p 11–14). Former Commissioner Étienne Davignon remarked a year later that ‘there is no doubt that major problems will arise in the field of employment in Europe’ (CEDEFOP 1981, 4). The first documents published by the EC show a general fear that new technologies will lead to unemployment, or as noted by Mr. Davignon: ‘in Europe innovation is frequently looked upon as a menace, above all as regards employment’ (CEDEFOP 1981, 4). One of the most pressing issues with the approach set out in *COM(80) 16 final* was high and persistent unemployment in Europe and the lack of strong GDP growth. The, at the time, ten member states had a registered number of some 8.5 million unemployed, many of whom were young Europeans, and the countries lacked the necessary economic growth to create new jobs (EC 1981, 11). It is striking to see that the short-, medium- and long-term effects were simply unknown at the time that *COM(81) 578 final* was published, with the term ‘technological unemployment’ making one of its first appearances in an official EC document (EC 1981, 11). The Standing Committee on Employment concluded that ‘there are as yet no reliable forecasts of the quantitative impact of micro-electronics on the level of employment in the coming years’ (EC 1981, 12). In other words, although the response of the EC to new technologies was swift, Commissionaires lacked insight into their impact on the labour market and thus the new skill requirements (EC 1981, 13).

One year later, in 1982, the EC followed up on previous initiatives with a plan for the 1983–1987 timespan (EC 1982, 1). The EC recognised that new technologies would bring about new skill requirements, but it still remained unclear which skills should be taught (EC 1982, 12–13). One of

³¹ COM(80) 16 final

the most interesting ideas in the 1982 Communications was to offer adults continuous education and do away with the ‘one-and-for-all approach to training [that] has been rendered even less appropriate by the advent of the new technologies’ (EC 1982, 3). This initiative can be seen as a precursor of the *Lifelong Learning Programme* launched in 2007 by the EC, giving employees the opportunity to appropriately update their skills at any stage of their lives. Even though progress was made in some areas during the five years after the release of *COM(79) 650 final*, progress on skill development through education and training was going very slow. *COM(84) 6 final* showed that education and training in new technologies still had ‘considerable quantitative and qualitative shortcomings’ (EC 1984, 3). According to the EC it was clear that the ‘consequences of failure to adopt the new technologies would be far more serious in the medium and long term than those directly arising from their application’ (EC 1984, Annex, 1). In other words, efforts had to be made to better connect educational policy with training in new technologies to ‘futureproof’ the workforce. The 1984 Communication made some first efforts to calculate job loss and job creation, but the range was still very wide. For example in the manufacturing industry it was estimated that between 160.000 and 400.000 jobs would be lost, and the EC admitted that competition in the industries directly related to the new technologies was so intense that reliable predictions were hard to make (EC 1984, Annex, 1–2).

The complexity of the subject prompted the EC to publish one of its most comprehensive documents on technological developments after the 1979 Communication, a Green Paper³² titled ‘Towards a Dynamic European Economy’, or *COM(87) 290 final*. Although the main focus of the Green Paper was on telecommunications liberalisation in Europe, it did include a chapter on the economic aspects of new technologies. New technologies could lead to a ‘potentially decisive increase in the productivity – in qualitative and quantitative terms - of the whole economy’, the data analyses in the previous chapter proved that such a ‘decisive increase’ did indeed happen (EC 1987, 46). The EC also worried that peripheral regions would be isolated from the benefits that new technologies provide, noting that a ‘substandard telecommunications infrastructure’ would

³² ‘Green Papers are documents published by the European Commission to stimulate discussion on given topics at European level. They invite the relevant parties (bodies or individuals) to participate in a consultation process and debate on the basis of the proposals they put forward. Green Papers may give rise to legislative developments that are then outlined in White Papers.’ Source: http://europa.eu/legislation_summaries/glossary/green_paper_en.htm.

‘represent a larger danger of isolation than mere geography ever did’ (EC 1987, 47). The 1987 Green Paper is clear on the effects of new technologies on employment, the ‘macro-economic growth effects point clearly in the direction of overall job creation’ (EC 1987, 54). These predictions are rather hard to evaluate, because (structural) unemployment was one of the main issues during the 1980s and 1990s. The 1980 Communication mentioned that consistent strong economic growth was necessary for society to fully benefit from new technologies. In addition, the skills these new technologies require are not discussed in the Green Paper and remained a contentious issue almost ten years after the 1979 Communication was published. Even in the 21st century policymakers struggle with what these ‘new skills’ should be. The 1987 Communication does mention that in order to fully benefit from, and implement these new technologies, ‘appropriate schemes for retraining and mobility of personnel are needed’ (EC 1987, 55). It is thought that although technological developments will create new jobs, some jobs will be lost during the transition and require ‘intensive dialogue with the social partners at the national and the Community level’ (EC 1987, 55). The theme of solidarity between and inclusiveness of all of Europe’s social groups is formulated in a more direct way in the following decade and after then remained a vital part of the EC’s vocabulary.

5.1.2 – The 1990s

In the wake of the 1992 Maastricht Treaty, which led to the creation of the euro, the 1993 White Paper³³ titled ‘*Growth, Competitiveness, Employment: the Challenges and Ways Forward into the 21st Century*’ articulated the vision of the Delors Commission on the development of the information society. It was a monumental document of well over a hundred pages, far exceeding most (if not all) other documents on technological developments released in the previous decade by the EC. The very first question of the 1993 White Paper is ‘Why this White Paper?’ The answer is clear: ‘The one and only reason is unemployment. We are aware of its scale, and of its consequences too. The difficult thing, as experience has taught us, is knowing how to tackle it’

³³ ‘Commission White Papers are documents containing proposals for Community action in a specific area. In some cases they follow a Green Paper published to launch a consultation process at European level. When a White Paper is favourably received by the Council, it can lead to an action programme for the Union in the area concerned.’ Source: http://europa.eu/legislation_summaries/glossary/white_paper_en.htm.

(EC 1993, 9). In the early 1990s, the EU was faced with high unemployment and the EC sought for new ways to stimulate economic growth. Technological developments were more of a menace in the 1979 Communication, but at this point (in 1993) it was already fully embraced as a creator of economic growth and new jobs. The linkage between employment and technological development was explained in the fifth chapter titled '*The Changing Society, the New Technologies*' and established the EC's position relating skill-biased technological change:

'The competitiveness of the European economy will to a great extent depend both on the conditions of utilization and on the development and application of these technologies. Since they are amongst the highest growth activities in industrialized countries, and they are also highly skilled labour activities, their potential for employment creation is considerable, in particular for the creation of new services. At the same time, potential drawbacks of widespread use of these new technologies, such as the risk of non-skilled people being left behind by progress in information technologies, should be combated through positive policies' (EC 1993, 92).

It is laudable that the EC (1993, 13) saw the massive benefits of the information society by stating that 'the dawning of a multimedia world (sound - text - image) represents a radical change comparable with the first industrial revolution,' but at the same time argued in favour of solidarity between the highly educated 'winners' of technological change and the low-skilled 'losers' in danger of falling behind. The plea for an 'economy characterized by solidarity' between those with and without a job, the young and old, the rich and poor and 'most importantly, in the fight against social exclusion' shows that the EC finds it essential that no one gets left behind in a largely computerised world (EC 1993, 15–16). The EC (1993, 23) mentions that the 'worldwide dissemination of new technologies is inevitable' and the call for solidarity makes sense when the EC states that technological change must not be stopped, but '[controlled] in order to avoid the dramas which marked the adjustments in the last century but would be unacceptable today.' The EC (1993, 130) believes that in order to increase the competitiveness of its member states and citizens, particular attention should be given to 'continuous training and upgrading skills, basic and introductory training and new technology skills.'

Although the 1993 White Paper was a rather extensive and in-depth document, its effects are questionable. Several years later, in 1996 to be precise, *COM(96) 589 final* was published by the EC and the main issue was still job creation. The new action plan argued that ‘Europe’s weakness in creating jobs must be seen in terms of its lack of innovation’, while the 1993 White Paper aimed to foster European innovation (EC 1996a, foreword). In addition, the acquisition of new skills by students and the workforce alike was a major theme in the 1980s and still showed relatively little progress. The Communication remarks that ‘educational grounding is essential to facilitate ongoing adaptation to the new skills that innovation requires’ and that training of the current workforce will be a necessity throughout their lives, much like one of key themes discussed in *COM(82) 296 final* (EC 1996a, 28). Furthermore, the conclusions of *CSE(96) 1 final* show that European countries are slow to include training in new skills into the curriculum of schools (EC 1996b, 20) and that ‘the unemployment statistics are terrible’ and a ‘lack of confidence is sapping our energy and curbing investment for the future’ (EC 1996b, 27). This causes concern in the EC, because it is ‘absolutely essential for the future of all sectors of the economy and for Community citizens that Europe succeeds in [information and communication] sectors’ (EC 1996c, 2). The fact that the necessary changes were not happening does not mean that the 1993 White Paper can be dismissed, it did not yield the results that were expected in the short term, but the later documents on ‘eEurope’ show that it did not fail to promote initiatives in the new millennium.

COM(1999) 687 final on eEurope is an example of a Communication that builds upon the 1993 White Paper’s foundation. The Commission’s eEurope initiative aims to put forward ideas on how to manage the transformation brought about by new technologies, much like the 1993 White Paper proposed. The Communication called the impact that new technologies will have on employment, economic growth and productivity during the following decades profound and thinks of technological change as ‘an opportunity, not a threat’ (EC 1999, 2). Furthermore, by arguing in favour of inclusive prosperity and social cohesion, the Communication reiterates the 1993 White Paper’s goal of increased solidarity between European citizens and businesses alike (EC 1999, 2). Around the time that *COM(1999) 687 final* was published, the term ‘internet’ was rather new to the general public. The 1993 White Paper did not mention the terms internet or World Wide Web even once, mainly because it was used by relatively few people back then and certainly not as

common and indispensable as it is now. This means that the 1999 Communication was one of the first EC initiatives to include the ‘mastering of the Internet and multimedia resources’ as a key goal (EC 1999, 7). Education formed the cornerstone of this innovation effort, because achieving future European economic prosperity starts at school by ‘using these new resources to learn and acquire new skills.’ It set out to provide all citizens (those who want it) with access to the World Wide Web and make sure that ‘all pupils [are] "digitally literate" by the time they leave school’ (EC 1999, 7–8). In hindsight, the early recognition of the EC that acquiring computer skills would be important has proven to be crucial and made most children of the 1990s significantly more proficient in the use of technology than their parents.

5.1.3 – The 2000s

The eEurope strategy was further developed in *COM(2002) 263 final* with a so-called action plan on an information society for all with improved employment and social cohesion (once again echoing the 1993 White Paper’s solidarity). Relating to skill development, the aim of the 1999 Communication to make pupils digitally literate was progressing, because ‘almost all companies and schools are connected [to the internet]’ (EC 2002, 6). This meant that most schools could, if they wanted to and had the necessary expertise, offer pupils basic training in computer skills. In the 2002 Communication the newest action plan was to reskill adults for the knowledge society by financially supporting member states to provide their middle-aged citizens with ‘key skills needed for the knowledge society’ and make sure that even more computers connected to the internet found their way into schools (EC 2002, 11–12). The key skills for adults were digital literacy (the skills required to achieve digital competence, e.g. basic computer skills) and ‘higher order skills such as teamwork, problem solving, project management, etc.’ (EC 2002, 12) Especially the last three aims were rather open-ended and did not seem to include a learning objective or a roadmap towards achieving these skills, implying that the EU member states were supposed to give these aims substance. In *COM(2005) 229 final*, the European Information Society 2010 (i2010) strategy was developed using the previous eEurope initiatives of 1999 and 2002 and had three main goals: a single European information space, innovation and investment in research (mainly ICT), and inclusion, better public services and quality of life. Especially the last of the three main goals is interesting, because the EC reiterated that ‘ICT [should] benefit all citizens’, including the young

and disadvantaged groups (EC 2005, 9). Once again, strong emphasis was given to ‘providing people with basic digital competence’ like in the decades before the i2010 strategy (EC 2005, 9). The i2010 strategy believed that a single European information space would lead to sustained economic growth and job creation, although the financial crisis and the subsequent decline in economic growth has squished the potential of the i2010 strategy. Shortly before the i2010 would be evaluated the EC made a recommendation ‘on media literacy in the digital environment for a more competitive audio-visual and content industry and an inclusive knowledge society’ (EC 2009, 9). One of the key concerns of the EC remained the inclusiveness of technological change, already discussed to great extent in the 1993 White Paper by the Delors Commission. The recommendation argued that ‘media literacy is today regarded as one of the key prerequisites for an active and full citizenship in order to prevent and diminish risks of exclusion from community life’ (EC 2009, 10).

To sum up, the main aim of the i2010 strategy, eEurope 2005, eEurope 2002 was to use the large potential of ICT and the internet to promote innovation, economic growth and job creation. Furthermore, since digital literacy was considered to be of great importance, initiatives were launched to train pupils and adults in basic computer skills. The *leitmotiv* of all initiatives remained inclusiveness. The last document discussed in this analysis was published in the early stages of the European debt crisis, the final evaluation of the i2010 strategy published as *COM(2009) 390 final*. The 2009 Communication noted that ‘the close correlation between ICT skills and inclusion in society and the labour market [is a given]’ and that the EC staff carried out a ‘comprehensive review on digital literacy in Europe’ (EC 2009, 8). This review, titled *Digital Literacy Report: A Review for the i2010 eInclusion Initiative*, was published in 2008 and stated in the introduction that digital literacy is seen by the EC as an essential skill for the future (EC 2008b, 4). The report is an evaluation of EC efforts to promote digital literacy and provide more economic opportunities to its member states’ citizens. Such a review is important, because those ‘without sufficient ICT skills are disadvantaged in the labour market and have less access to information to empower themselves as consumers’ (EC 2008b, 4). The assessment of the experts consulted for the report is positive, because ‘clear progress [is] made in Internet regular use and computer and Internet skills but a lot remains to be done to extend these benefits to all sections of the population’ (EC 2008b, 5). The benefits of digital literacy have and had yet to reach ‘the elderly, less educated, people

outside the labour force, manual workers and those living in regions that are economically lagging behind' (EC 2008b, 5). Nowadays, initiatives by the EC are still dealing with this problem of reaching the groups that are the hardest to reach, but also part of European society. The issues raised in the 1987 Green Paper about the peripheral regions and the less educated lagging behind still needs to be solved more than twenty years later. This remains a major challenge for the future and the analysis of automation of this thesis shows that it is imperative that these groups are reached. Otherwise, despite the well-intentioned calls for solidarity and inclusive economic growth, they will end up as the 'losers' of technological change.

5.2 – Conclusion

The analysis of Communications by the EC provides ample evidence for the **second hypothesis** and does not need to be rejected.³⁴ The EC published many documents on the issue of automation and more generally new technologies throughout the 1980s, 1990s and 2000s. It focused on education, training and skill formation as crucial parts for inclusive economic growth and solidarity among European countries to overcome social and economic challenges that would inevitably arise with technological change. Furthermore, the themes raised in the documents show that the initiatives were rather slow to initiate policy change, maybe because automation is not an explicit component of the EU treaties. It is for that reason questionable to what extent the initiatives by the EC actually impacted the behaviour of member states' governments. In the EC's defence, new technologies were introduced rapidly and on occasion disappeared overnight, which makes anticipatory initiatives on technological developments difficult.

³⁴ Hypothesis 2 is: 'If skill-biased technological change is actually the case, then we can expect that EU policymakers have addressed this issue on numerous occasions in their policy initiatives.'

6. Case Study of the Port of Rotterdam

Based on the interviews with Mr. De Vries of APM Terminals, Mr. De Bruijn of the Port of Rotterdam Authority and Mr. Van der Lecq of FNV Havens and the additional information provided to me by them, the short answer to the third hypothesis³⁵ would be ‘yes’, at least partly. Although the decline of employment in the Port of Rotterdam has been rather small in comparison with for example the finance sector (where tens of thousands of jobs were lost of the last couple of decades), none of the representatives interviewed for this thesis disagreed with the idea that total direct employment would decline and is declining. Most of the job losses will occur amongst the ranks of low-skilled labour, of which there is a lot in the port. All interviewees agreed that there is a shift from low-skilled work to higher-skilled work, but none were convinced of a trend.

6.1 – Employment

The large benefits of dockworkers from America's West Coast are regularly reported on by the American media and have a long history of intense union work. Mr. De Vries commented that the American port labour unions are exceptionally influential. The average dockworker on the American West Coast earns \$147,000 a year, with crane operators being particularly well paid. It has to be noted that the labour port unions in the U.S. are extraordinarily strong, with astronomical wage costs as a result. As a consequence, experts expect automated container terminals to increase tenfold over the next ten years.³⁶ The average salary of a Dutch dockworker is also higher than that of a same skill employee in other industries, Mr. De Bruijn remarked, in line with comment of last year that dockworkers made redundant by automation do not want to work for the *Rotterdamse Elektrische Tram* (RET) because the wages are too low.³⁷ FNV Havens was livid and did not appreciate the comments made by Mr. De Bruijn, arguing that the dockworkers fear a loss

³⁵ Which is: ‘If these changes can be seen in the Port of Rotterdam, then most low-skill and medium-skill jobs will be in constant decline or will vanish in the near future.’

³⁶ Source: <http://delta.tudelft.nl/artikel/de-havenindustrie-is-conservatief/29637>.

³⁷ Source: <http://www.ad.nl/ad/nl/1038/Rotterdam/article/detail/3790302/2014/11/14/Havenwerkers-vinden-salaris-RET-te-laag.dhtml>.

of job security by trading permanent contracts for a fixed term contracts.³⁸ It is indeed true that most dockworkers have a permanent contract and earn more in relation to other occupations. This does make people more willing to work in the port, even though some occupations in the port are considered to be dangerous. The workforce of the port is ageing, but filling these vacant positions will not be difficult, especially with the prospects of a high wage and job security (Smit 2013, 403). Technological developments have already made their mark on employment in the port, the traditional longshoremen have all but disappeared. This was mainly caused by the container, named the greatest invention of the last hundred years (Kuipers 2014, 14–20). The replacement of general cargo by cargo bundled up in a container changed the bargaining position of dockworkers, with them having less control over the goods.

Developments in automation are expected to continue and the autonomy of terminal operators is likely to decline even further, for example through the consortium behind RWG consisting of Dubai Ports World, American President Lines (APL), Mitsui O.S.K. Lines (MOL), Hyundai Merchant Marine (HMM), and Compagnie Maritime d'Affrètement - Compagnie Générale Maritime (CMA CGM). CMA CGM, APL, MOL and HMM are all part of the twenty biggest container shipping lines in the world and their combined market share in twenty-foot equivalent unit (TEU) of 16.8 percent exceeds the market share of 15.3 percent of APM-Maersk, which is the world's leading shipping company.³⁹ Mr. Van der Lecq thinks that these companies will prefer to use the fully-automated RWG terminal on MV2 to keep container handling in-house and lower costs, since they will be using their own facility. Mr. De Vries estimates that this will indeed happen and since most of these shipping lines use the ECT container terminals, ECT is going to lose a couple of their largest clients. However, few ECT employees will be employed by RWG in the future and this will surely decrease employment according to Mr. De Vries, especially since RWG prefers to use contractors (a point echoed by Mr. Van der Lecq). This means that the bargaining position of the other container terminal operators, the ones that do not own shipping lines, declines and the relative power of shipping companies in the port increases. It is hard to say whether this will be a bad development, but it will surely change the balance of power in the port.

³⁸ Source: <http://www.fnvhavens.nl/k2/item/625-havenbedrijf-rotterdam-bakt-het-wel-erg-bruijn.html>.

³⁹ Source: <http://www.alphaliner.com/top100>.

The influence of crane operators is likely to increase in the future, since their tasks are hard to fully automate and unloading containerships will be slow and inefficient without them.

According to Mr. De Bruijn, one of the main goals of the Port of Rotterdam Authority is transparency, both with regard to their partners and the general public. When questioned about big data and cybersecurity, he remarked that all information about the port should be available to the public, except for the three to four percent of information that the public should not know. Indeed, most information on cargo handling and employment is available to the public. Their yearly financial statements are extensive and detailed, but on some occasions refer to documents no longer available on the internet. This allows for a more substantive overview of employment in the port, specifically since the late 1970s when the container was well-established and the ICT-revolution started. Labour market analysis by the Port of Rotterdam Authority showed several trends, the first being an overall reduction in employment during the 1980s and 1990s of around two percent a year. From 2000 until 2007, the labour market stabilised, but the financial crisis meant that employment took another hit. In a recent report the Dutch Employee Insurance Agency (UWV) argued that in 2015 there would be job growth in the greater Rotterdam area, but that the expected job growth on the MV2 has not been realised. A spokesperson of the UWV said that many businesses recruit from their foreign branches and not from the local jobseekers. UWV is still waiting for the *spin-off* to happen and they are worried that it will never come.⁴⁰ It could also reflect a point Mr. De Vries made during the interview that most of the current MV2 staff is from the MV1 terminal, meaning that APM Terminals MV2 created few new jobs. In addition, before the financial crisis the container business averaged nearly double digit growth rates and an even larger increase in trade was expected for the future. This was one of the main reasons why MV2 was created in the first place, to meet growing international trade. Alas the financial crisis put a damper on all expectations, and thus on the growth in employment.

Mr. De Vries mentioned that his APM Terminals MV1 was the most efficient port of Europe, America and Africa combined in terms of moves per minute and that only a couple of Asian ports were faster in transferring containers to and from container ships. Vessels get larger and larger,

⁴⁰ Algemeen Dagblad, print, 4 June 2015.

exceeding 19.000 TEU nowadays, so efficiency has become a mere necessity and crucial to maximize profit for both the container terminal operators and shipping companies. Mr. De Vries was not entirely correct in his evaluation of APM Terminals MV1's efficiency, probably because it was based on out-of-date information. APM Terminals MV1 was indeed the world's most efficient port except for Asia in 2012, but the efficiency improvements in other ports over the world were rather drastic. The latest berth productivity publication by *The Journal of Commerce* reported that the most efficient container terminal in the world is one of Mr. De Vries' own company, APM Terminals Yokohama (JOC 2014, 19). This facility boasts 163 moves per-ship, per-hour (from 150 in 2012), compared with 99 moves per-ship, per hour of APM Terminals MV1 (from 92 in 2012). Euromax Terminal Rotterdam is the most efficient terminal in Rotterdam, giving them the leading edge with 100 moves per-ship, per hour (from 77 in 2012) (JOC 2014, 20). Productivity is important when one looks at the total number of containers handled at the port, a number that has increased practically every year since 1970 (see table 6). The number of containers increased more than tenfold in the 1970s, almost doubled in the 1980s and grew with nearly sixty percent in the 1990s. Business was (and arguably still is) booming, but this did not result in increased employment.

Table 6 – Container Handling in the Port of Rotterdam

Year	Number of containers	Percentage change, previous year	Average growth per decade
1970	242.328		
1971	319.367	31,8	
1972	430.182	34,7	
1973	653.479	51,9	
1974	750.375	14,8	
1975	722.143	-3,8	
1976	816.181	13,0	
1977	896.107	9,8	
1978	1.085.263	21,1	
1979	1.187.424	9,4	20,3
1980	1.310.070	10,3	
1981	1.446.940	10,4	
1982	1.492.214	3,1	
1983	1.618.547	8,5	
1984	1.791.357	10,7	

1985	1.866.708	4,2	
1986	1.977.129	5,9	
1987	1.962.026	-0,8	
1988	2.255.253	14,9	
1989	2.488.137	10,3	7,8
1990	2.489.051	0,0	
1991	2.525.656	1,5	
1992	2.746.592	8,7	
1993	2.775.318	1,0	
1994	2.989.246	7,7	
1995	3.135.498	4,9	
1996	3.206.019	2,2	
1997	3.514.373	9,6	
1998	3.800.926	8,2	
1999	3.988.988	4,9	4,9
2000	3.948.434	-1,0	
2001	3.826.844	-3,1	
2002	4.069.984	6,4	
2003	4.412.515	8,4	
2004	5.088.453	15,3	
2005	5.636.570	10,8	
2006	5.846.433	3,7	
2007	6.488.646	11,0	
2008	6.485.464	0,0	
2009	5.900.114	-9,0	4,2
2010	6.746.802	14,4	
2011	7.184.197	6,5	
2012	7.183.675	0,0	
2013	7.006.598	-2,5	
2014	7.386.528	5,4	4,8

Source: Port of Rotterdam Authority

Container traffic increased with 2948 percent between 1970 and 2014, but employment in the container sector increased with only 617 percent (see table 7). This increase in employment was nowhere near sufficient to offset the decrease in general cargo employment. In 1970, 11.100 were employed in general cargo, but this dropped to 440 in 2010, because they were made redundant by the way more efficient container terminals. The decrease in total employment in transshipment is largely related to disappearance of the traditional dock worker. Containers led to an unprecedented reduction in costs and a strong rise in productivity and since the breakthrough of the container in

the 1970s and 1980s coincided with strong technological progress in automation and computerisation it meant that a small workforce could handle much more cargo. However, Mr. De Vries mentioned that there currently is a shortage of personnel and that APM Terminals is currently recruiting sixty new employees. Critics argued that those new employees are only recruited to absorb the losses of people that moved to MV2 and will be made redundant when the new MV2 terminal reaches high efficiency around 2017.

Table 7 - Employment in Transshipment between 1970 – 2014

	1970	1975	1980	1985	1990
Container terminals	500	900	1.200	2.200	2.100
Total transshipment	14.100	14.600	12.700	10.300	8.972
	1995	2000	2003	2010	2014
Container terminals	2.418	3.014	2.703	3.537	3.588
Total transshipment	7.269	6.554	5.741	5.699	

Source: Meeuse, Boele and Asselbergs (1996); Smit (2013); FNV Havens (2014)

Is declining employment due to automation an irreversible trend? Mr. De Vries explained that APM Terminals MV2 will employ ‘twenty to twenty-five percent fewer people’ than APM Terminals MV1. It is thus likely that automation leads to job loss, but according to Mr. Van der Lecq, who’s certainly not against automation, the Port of Rotterdam Authority could soften this effect by spending some of its profits on job creation. FNV Havens firmly believes that the Port of Rotterdam Authority only cares about rising goods throughput and not about the people who make it possible, the dock workers. The Port of Rotterdam Authority has invested hundreds of millions of euros in the creation of MV2, but Mr. Van der Lecq argues that they are hesitant to invest in human capital. He is correct in his assertion that the profits of the Port of Rotterdam Authority are high, it has even surpassed 200 million euros in recent years (see table 8).

Table 8 – Net Profit of the Port of Rotterdam Authority (in €M)

Year	Net Profit of the Port of Rotterdam Authority (in €M)
1994	18
1995	40
1996	36
1997	46
1998	60
1999	65
2000	79
2001	61
2002	56
2003	56
2004	5
2005	73
2006	120
2007	114
2008	149
2009	167
2010	154
2011	195
2012	228
2013	227
2014	215

Source: Port of Rotterdam Authority

However, Mr. De Bruijn explained that the Port of Rotterdam Authority *is* investing in human capital. The Education and Information Centre Mainport Rotterdam is just one initiative by the Port of Rotterdam Authority to enthuse pupils and students to pursue a career in the port. It receives over 20.000 visitors every year and regularly organises trips to the port's industries, or sends representatives to schools and universities. The goal of this initiative is to improve people's knowledge about the port's important international position and to 'increase the affinity of students with regard to technical professions.'⁴¹ Mr. De Bruijn is not worried about declining employment, he argued that this would mean that people have more leisure time and can pursue the things they really care about, on the condition that people who lose their jobs can financially sustain themselves. Furthermore, total employment in the port did decline in the last twenty years, but not

⁴¹ Source: <http://www.eic-mainport.nl/xeng-home/>

nearly as much as in (for example) the financial sector where, according to Mr. De Bruijn, total employment declined from 120.000 to 70.000. In addition, Mr. De Bruijn called the wages in the port ‘ridiculously high’, something with which Mr. Van der Lecq disagrees, because he argued that wages in other sectors are way too low. Mr. De Bruijn argued that automation is crucial to Dutch economic prosperity and that people and organisations who fight against it, like FNV Havens, do not recognise the economic benefits (for the entire society) of such a trend.

6.2 – Skills, Education and Training

The interviews with Mr. De Vries and Mr. De Bruijn provided insight into the investments of APM Terminals and the Port of Rotterdam Authority in human capital. APM Terminals spent over three million euros (out-of-pocket expenses) last year in education and training of their own staff, but it also funded the education of young people for specific occupations. According to Mr. De Vries this was a ‘massive investment.’ Since January 2014, APM Terminals has organised ‘over 2000 courses for around 600 people.’ The Shipping and Transport College in Rotterdam and the ROC A12 in Ede are just two organisations which offer courses to the current APM Terminals workforce, ‘paid by the company itself.’ With the opening of the automated MV2 terminal, an internal recruitment process was used to fill up most of the 400 available vacancies. The ‘new’ employees were retrained to work on the MV2 container terminal, for example the crane operators. The crane operators used to be physically present in a small cabin on the cranes themselves, but now they had to control their crane and its cargo from behind a desk. This required new skills, while removing the need for a flexible neck and back. Although the ‘new’ crane operators would no longer feel the wind tugging at their containers, it was essential that all the crane operator vacancies would be filled by people with experience on actual cranes. In this case, automation did not lead to job loss, especially since crane operators would still only have control over only one crane. It might be possible that in the near future crane operators will control more than one crane at the time (RWG plans to do so in the future according to Mr. De Vries), although the attention span of the operator (which has to be high all times according to Mr. De Vries) and safety will make this difficult. Mr. De Vries expects, and already sees, developments towards higher educational requirements and explained that his company is already training people for these higher-skilled occupations.

Mr. De Bruijn mentioned that most of the employment in the port is either low-skilled or high-skilled work and his estimation is correct. Analysis of the labour market conducted by the Port of Rotterdam Authority shows that eighty percent is low-skilled (secondary education or lower) and twenty percent high-skilled (tertiary education, e.g. MBO, HBO, University). The prospects for low-skilled workers are negative, students of the lowest two of the available four levels of MBO education are no longer qualified enough to fulfil the vacancies. For many vacancies, at least MBO level three is required and in some cases HBO or University. It is expected that automation will lead to less employment for low-skilled workers in all port sectors, specifically for those without a formal education and MBO level one and two (Zandvliet 2015, ii). This transition has already started, because current unemployment consists largely of low-skilled workers, while few high-skilled persons are unemployed (Zandvliet 2015, iii). There is a rising demand for better skilled (technical) personnel in the port and an effort should be made by stakeholders to motivate young people to continue studying after high school (Zandvliet 2015, vi). This is complicated by the fact that for years the port has struggled with connecting education with work. The criticism of the Shipping and Transport College is that they have a lot of motivated students who simply cannot get a traineeship post in the port, even with the higher demand for high-skilled employees.⁴² Automation causes low-skilled jobs to disappear and high-skilled jobs to take their place, but without the necessary investments in recruitment and traineeship positions, people aspiring to fulfil these vacancies will have a hard time actually getting there. This is something which will need a lot of work in the coming years.

6.3 – Role of the European Commission and the European Parliament

The EC launched three initiatives to liberalise European cargo handling, Port Package 1, 2 and 3. The main goals of the internal market are free movement of goods, services, capital and persons and sea ports fulfil a vital role in the functioning of the European economy. The Port Packages aimed to improve the competitiveness of ports, but port labour unions throughout Europe feared that the liberalisation of European ports would decrease job and wage security. Two EC initiatives

⁴² Source: <http://www.stc-group.nl/Pages/News/1033/shipping-and-transport-college-surprised-by-results-labor-market-survey-by-port-of-rotterdam-and-deltalinqs.aspx>.

have met their Waterloo in the EP, where Port Package 1 received 229 votes against and 209 votes in favour in 2003 and Port Package 2 received 532 votes against and 120 votes in favour in 2006.⁴³ The third package proposed by the EC did not, at least for now, include cargo handling and FNV Havens thinks this choice is related to the financial crisis.⁴⁴ Protests by the European port labour unions during times of economic downturn could have major financial consequences for shipping company. For now, the policy review exercise for Port Package 3 started in 2011 and the latest information on the EC website and FNV Havens shows that the new package has not left the consultation stage and will not do so for some time.⁴⁵ In the interviews, Mr. De Bruijn and Mr. Van der Lecq were asked whether they were visited by Members of European Parliament (MEPs) at their offices. Mr. De Bruijn mentioned that ‘a lot of’ MEPs have visited the Port of Rotterdam Authority on numerous occasions to talk about developments in the port, not specifically related to employment, and that their knowledge about the port was reasonable. However, Mr. Van der Lecq mentioned that his office was never visited by MEPs, which is interesting. While the influence of the FNV and its European counterparts might not be huge, it is far from trivial.

6.4 – Conclusion

The case study of the Port of Rotterdam provides partial evidence for the **third hypothesis**, but does not need to be rejected.⁴⁶ On average, low-skilled labour is declining every year and job prospects for low-skilled work are bad, because vacancies are only for high-skilled labour (at least MBO level three/four). Total employment in the port’s transshipment sector decreased, while container traffic increased with 2948 percent. Medium-skilled labour is too uncommon to draw conclusions from this group about employment and job prospects in the port. Companies on the MV1 and MV2 invest in education and training, although the link between education and work could be better.

⁴³ Sources: <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+WQ+E-2012-000190+0+DOC+XML+V0//EN> and <http://rotterdam.sp.nl/nieuws/2003/11/port-package-weggestemd>.

⁴⁴ Source: <http://www.fnvhavens.nl/sectorraad/item/468-europese-havenvakbonden-behalen-wederom-succes.html>

⁴⁵ Source: <http://www.europarl.europa.eu/sides/getDoc.do?type=WQ&reference=E-2012-000190&language=EN>

⁴⁶ Hypothesis 3 is: ‘If these changes can be seen in the Port of Rotterdam, then most low-skill and medium-skill jobs will be in constant decline or will vanish in the near future.’

7. Conclusions and Future Research

This thesis had three research questions, the first was ‘To what extent did automation change employment for high, medium, and low-skilled workers in the EU transportation- and logistics sector?’ The second was ‘To what extent did the EC address this in policy initiatives?’ And finally, ‘How can the effects be discerned for the case of an important European port (Rotterdam) and the companies it houses?’ In order to answer these questions a mixed methods approach was used utilising both quantitative and qualitative research tools. The findings of the previous chapters contribute to an understanding of the impact of automation on employment in the transportation- and logistics sector, especially with regard to employment of low-skilled labour. As predicted, automation has made many low-skilled occupations redundant in the last thirty years, although the effects of automation on medium-skilled occupations are harder to decipher due to the lack of data from more recent years. The EC has addressed technological change in several of its Communications, but the actual influence it had on the developments taking place in Europe seems rather small. Most of the issues the EC defined in the 1980s were still an issue in the 2000s. Furthermore, these changes are apparent in the Port of Rotterdam where the workforce consists of mainly low-skilled labour with some high-skilled labour, mainly in technical occupations. There is an increasing demand for higher-skilled (technical) labour, while most employment is lost amongst employees with very little or no formal education.

First, the findings of the data analyses suggest that on the macro-level automation has had significant negative effects on the share of labour compensation of low-skilled labour in transportation and logistics, implying that many jobs with this specific skill level have been lost due to automation. In addition, productivity in transportation and logistics has increased remarkably since the 1980s, much faster than total labour compensation. In the case of the EU-15, the UK, Germany and Spain the average workweek became shorter over the course of thirty years, while total employment remained rather stable and even slightly increased. However, the shorter workweek means that fewer people work full-time, and more part-time, likely caused by automation, which led to less time spent on fulfilling remaining tasks.

Secondly, the method of process tracing used for the analysis of EC documents indicates that the EC did see a connection between new technologies and changes in employment. Especially in the 1980s was technological change seen as threatening and it was uncertain to what extent it would cause unemployment. The 1993 White Paper advocated solidarity between the fortunate and less fortunate groups in society and expected that the benefits of a European information society would be massive. The eEurope initiatives throughout the 2000s reiterated the theme of inclusiveness and solidarity, while digital literacy was high on the new technologies agenda. In general, the initiatives by the EC were rather slow to elicit change in EU member states and key issues were raised on numerous occasions throughout the decades. It is thus uncertain whether the initiatives by the EC did actually contribute to controlled technological change, like it advocated in the 1993 White Paper.

Thirdly, the case study of the Port of Rotterdam contributes to the understanding of automation on the micro- and meso-level. Since the 1970 with the introduction of containers and automated processes, total employment in the transshipment sector dropped from 14.100 in 1970 to 5.699 in 2005. Increases in employment on container terminals does not offset this development. Furthermore, rather large investments are made in education and training, with a focus on technical jobs and overall skill development. The transition from education to work is still problematic and has to be assessed by the port's stakeholders. Finally, the port has come to the attention of the EC and EP. The aim of the EC is to liberalise the port to improve the free movement of goods, services, capital and persons. The EP has voted against these liberalisation efforts and MEPs regularly visit the Port of Rotterdam Authority, but very rarely (if ever) visit the port labour unions.

This thesis cannot entirely generalise its findings, nor draw any firm conclusions on the basis of the several analyses. Technological change and specifically automation seems to have had a negative effect on low-skill labour and to a much smaller extent on medium-skilled labour, but a positive effect on high-skill labour. Future research on the effects of automation has to examine a broader range of cases, be it states or organisations, to test whether the findings of this thesis hold under different conditions.

8. List of Acronyms

AGV	Automated Guided Vehicle
APL	American President Lines
APM	A.P. Møller–Mærsk
CEDEFOP	European Centre for the Development of Vocational Training
COM	Communication from the Commission
CMA CGM	Compagnie Maritime d'Affrètement - Compagnie Générale Maritime
CNV	Christelijk Nationaal Vakverbond
EC	European Commission
ECT	Europe Container Terminals
Eurofound	European Foundation for the Improvement of Living and Working Conditions
EMS	European Monetary System
EP	European Parliament
EU	European Union
EU KLEMS	Capital (K), Labour (L), Energy (E), Materials (M) and Service (S) inputs
FNV	Federatie Nederlandse Vakbeweging

HBO	Hoger Beroepsonderwijs
HMM	Hyundai Merchant Marine
i2010	European Information Society 2010
ICT	Information and Communication Technology
IMF	International Monetary Fund
JOC	Journal of Commerce
KiM	Kennisinstituut voor Mobiliteitsbeleid
MBO	Middelbaar Beroepsonderwijs
MOL	Mitsui O.S.K. Lines
MV1	Maasvlakte 1
MV2	Maasvlakte 2
OECD	Organisation for Economic Co-operation and Development
RET	Rotterdamse Elektrische Tram
RWG	Rotterdam World Gateway
TEU	Twenty-foot Equivalent Unit
UWV	Employee Insurance Agency

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10. Appendix

10.1 – Statistical Analysis

United Kingdom

High-skill share of labour compensation

There was a significant difference in the high-skill share for 1970 – 1981 ($M = 2.64$, $SE = .32$) and the high-skill share for 1982 – 1993 ($M = 5.88$, $SE = .33$), $t(11) = -13.45$, $p < .05$. There was a significant difference in the high-skill share for 1982 – 1993 ($M = 5.88$, $SE = .33$) and the high-skill share for 1994 – 2005 ($M = 10.07$, $SE = .34$), $t(11) = -15.09$, $p < .05$.

Medium-skill share of labour compensation

There was a significant difference in the medium-skill share for 1970 – 1981 ($M = 54.03$, $SE = 1.06$) and the medium-skill share for 1982 – 1993 ($M = 69.46$, $SE = 2.09$), $t(11) = -10.89$, $p < .05$. There was a significant difference in the medium-skill share for 1982 – 1993 ($M = 69.46$, $SE = 2.09$) and the medium-skill share for 1994 – 2005 ($M = 81.14$, $SE = .42$), $t(11) = -4.83$, $p < .05$.

Low-skill share of labour compensation

There was a significant difference in the low-skill share for 1970 – 1981 ($M = 43.34$, $SE = 1.3$) and the low-skill share for 1982 – 1993 ($M = 24.67$, $SE = 2.37$), $t(11) = 14.08$, $p < .05$. There was a significant difference in the low-skill share for 1982 – 1993 ($M = 24.67$, $SE = 2.37$) and the low-skill share for 1994 – 2005 ($M = 8.79$, $SE = .21$), $t(11) = 6.64$, $p < .05$.

Germany

High-skill share of labour compensation

There was a significant difference in the high-skill share for 1970 – 1981 ($M = 2.8$, $SE = .05$) and the high-skill share for 1982 – 1993 ($M = 4.41$, $SE = .28$), $t(11) = -6.66$, $p < .05$. There was a significant difference in the high-skill share for 1982 – 1993 ($M = 4.41$, $SE = .28$) and the high-skill share for 1994 – 2005 ($M = 6.44$, $SE = .18$), $t(11) = -13.56$, $p < .05$.

Medium-skill share of labour compensation

There was a significant difference in the medium-skill share for 1970 – 1981 ($M = 68.23$, $SE = .37$) and the medium-skill share for 1982 – 1993 ($M = 73.53$, $SE = .26$), $t(11) = -33.12$, $p < .05$.

There was a **non-significant** difference in the medium-skill share for 1982 – 1993 ($M = 73.53$, $SE = .26$) and the medium-skill share for 1994 – 2005 ($M = 72.73$, $SE = .71$), $t(11) = .862$, $p > .05$

Low-skill share of labour compensation

There was a significant difference in the low-skill share for 1970 – 1981 ($M = 28.93$, $SE = .41$) and the low-skill share for 1982 – 1993 ($M = 22.08$, $SE = .53$), $t(11) = 41.83$, $p < .05$. There was a **non-significant** difference in the low-skill share for 1982 – 1993 ($M = 22.08$, $SE = .53$) and the low-skill share for 1994 – 2005 ($M = 20.83$, $SE = .56$), $t(11) = 1.2$, $p > .05$.

Spain

High-skill share of labour compensation

There was significant difference in the high-skill share for 1980 – 1992 ($M = 7.66$, $SE = .30$) and the high-skill share for 1993 – 2005 ($M = 14.51$, $SE = 1.08$), $t(12) = -7.68$, $p < .05$.

Medium-skill share of labour compensation

There was a significant difference in the medium-skill share for 1980 – 1992 ($M = 14.75$, $SE = 1.21$) and the medium-skill share for 1993 – 2005 ($M = 28.09$, $SE = .92$), $t(12) = -30.810$, $p < .05$.

Low-skill share of labour compensation

There was a significant difference in the low-skill share for 1980 – 1992 ($M = 77.59$, $SE = 1.46$) and the low-skill share for 1993 – 2005 ($M = 57.36$, $SE = 1.97$), $t(12) = 29.61$, $p < .05$.

10.2 – Interview APM Terminals (Mr. Hans de Vries)

The interview was conducted in Dutch, hence the interview questions will be in Dutch.

- 1) Hoe denken jullie na over de combinatie mens en machine? Wordt de automatisering doorgevoerd met de werknemer in gedachten, of is het andersom? Als voorbeeld: de truckchauffeurs zullen door een volledig geautomatiseerde poort heenrijden, hebben jullie ook over zijn/haar (mogelijke) ervaringen nagedacht?
- 2) Merken jullie dat het personeelsbestand veranderd? Vind er een verschuiving plaats in functies van laag- en middengespoold personeel in de richting van hooggespoolde arbeid?
- 3) Zetten jullie in op herscholing en/of training van het huidige personeel om de gevolgen van automatisering op te vangen?
- 4) Hoe reageren jullie op aantijgingen van enkele grote vakbonden dat de APM Terminal MV2 zal leiden tot massaontslagen?
- 5) Werken jullie samen met de havenvakbonden en op wat voor manier?
- 6) Zijn er conflicten geweest waarin havenarbeiders zich hebben verzet tegen de technologische vooruitgang?
- 7) Hoeveel mensen zijn er betrokken bij de afhandeling van één enkele container op de APM Terminal MV2 in vergelijking met de APM Terminal MV1?
- 8) Hoeveel banen verwachten jullie te creëren met de nieuwe terminal op zowel directe als indirecte basis? Zullen deze banen ook voor lagergespoolden geschikt zijn?
- 9) In hoeverre is cybersecurity een issue? Dan denk ik voornamelijk aan de gevaren die hacking met zich mee kan brengen, zoals criminelen die de inhoud van containers kunnen bekijken. Een

bekend voorbeeld van een dergelijk beveiligingsrisico is Stuxnet, die ongemerkt de motoren van de Iraanse nucleaire centrifuges versnelden en vertraagden.

10) Wat zijn de drijfveren achter de automatisering van de container terminals? In hoeverre wordt werkgelegenheid hierin meegewogen?

11) Zijn de kinderziektes van de APM Terminal MV2 verholpen? Hoeveel efficiënter en veiliger is de nieuwe terminal in vergelijking met de terminal op de MV1?

12) In hoeverre is de mens een risicofactor op een geautomatiseerde terminal? Op jullie nieuwe MV2 terminal mogen op bepaalde plekken geen mensen meer komen, alleen technisch personeel wanneer dat nodig is.

10.3 – Interview Port of Rotterdam Authority (Mr. Henk de Bruijn)

The interview was conducted in Dutch, hence the interview questions will be in Dutch.

1) Hoe heeft de werkgelegenheid in de haven zich ontwikkeld sinds de jaren '80? Midden jaren '80 begon de ICT-revolutie, vanaf de '90 en '00 nauw verbonden met automatisering en robotisering.

2) Is er een tendens richting meer werkgelegenheid voor hoogopgeleiden (hogeschool en universiteit) en minder werkgelegenheid voor lager- (niveau middelbare school of lager) en middenopgeleiden (niveau MBO e.d.)?

3) Als er hier in de haven wel/geen sprake van is, zijn daar werkgelegenheidsstatistieken van?

4) In hoeverre zet het Havenbedrijf Rotterdam in op omscholing van huidige werknemers en hulp bij het kiezen van een opleiding voor scholieren/studenten?

5) Kunt u een voorbeeld geven van een proces waarin mens en machine samenwerken en samen tot een beter resultaat komen?

6) Hoeveel mensen zijn er momenteel betrokken bij de afhandeling van één enkele container in vergelijking met begin jaren '80 (of eerder)?

7) Wat zijn de belangrijkste drijfveren achter verregaande automatisering in de Rotterdamse haven? Spelen de concurrentiepositie en veiligheid een grote rol?

8) FNV Havens en CNV Vakmensen zijn bezorgd over de werkgelegenheid in de Rotterdamse haven, vooral door automatisering. Het Financieel Dagblad rapporteerde in maart 2015 dat de vakbonden woedend zijn over het laatste akkoord met de container terminals en zelfs vrezende voor massaontslagen. Hebben de bonden redenen om bezorgd te zijn?

9) De nieuwe terminal van APM is ontzettend efficiënt en er zullen volgens het blad MV2 uit augustus 2013 ongeveer 300 mensen werken. Is dit weinig in vergelijking met andere terminals?

10) Merken jullie dat de Europese Unie, voornamelijk de Europese Commissie, interesse toont in de innovatie in de haven en de haven aan zich?

10.4 – Interview FNV Havens (Mr. Joost van der Lecq)

The interview was conducted in Dutch, hence the interview questions will be in Dutch.

1) Hoe heeft de werkgelegenheid in de haven zich ontwikkeld sinds de jaren '80? Midden jaren '80 begon de ICT-revolutie, vanaf de '90 en '00 nauw verbonden met automatisering en robotisering.

2) Is het personeelsbestand van de haven veranderd? Vind een verschuiving plaats in functies van laag- en middengediplomeerd personeel in de richting van hooggeschoold personeel?

- 3) Hoe kijkt de gemiddelde werknemer van de Rotterdamse haven aan tegen de veranderingen die technologie met zich meebrengt?
- 4) Is de werkdag van de gemiddelde Rotterdamse havenarbeider in de afgelopen dertig jaar veranderd?
- 5) FNV Havens heeft duidelijk laten horen dat er wordt gevreesd voor massaontslagen. Het Havenbedrijf Rotterdam en enkele professoren van de Erasmus Universiteit zijn het hier niet mee eens. Zij wijzen erop dat veel jongeren niet meer in de haven willen werken, te ver weg, te zwaar, te gevaarlijk. Werknemers zijn moeilijk te vinden, dus in andere woorden, ze moeten wel automatiseren. Wat is uw reactie op deze stellingname?
- 6) Op de nieuwste APM terminal op de MV2 werken 400 mensen. Is dit weinig in vergelijking met de andere container terminals in de haven?
- 7) Werken jullie samen met het Havenbedrijf Rotterdam en de container terminal operators? Is deze samenwerking op gelijkwaardige basis?
- 8) Hebben jullie het idee dat automatisering de werknemers kan ondersteunen in het vervullen van hun taken, of is het eerder andersom, of allebei?
- 9) Staan de werkzekerheid en de loon- en arbeidsvoorwaarden onder druk doordat de haven steeds efficiënter werkt?
- 10) Technologische veranderingen hebben altijd tot meer werkgelegenheid geleid. Heeft u het idee dat, dat nu anders is?
- 11) Hebben jullie contact met de Europese Unie, voornamelijk de Europese Commissie en het Europees Parlement, om werkgelegenheid en automatisering te bespreken?