Robots and Jobs: Evidence from Scandinavian markets

STUDY PROGRAMME: MSC IN BUSINESS – ECONOMICS

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Brief discussion of research topics

Our master thesis will be based on "Robots and Jobs: Evidence from US Labour Markets" by Acemoglu and Restrepo (2017). By using a model where human labour competes against robots in the production of different tasks, we will examine whether robots may reduce the employment rate and wages in Scandinavian labour markets. These local labour market effects of robots can be estimated by regressing the change in employment and wages on the exposure to robots in each local labour market – defined from the national penetration of robots into each industry and the local distribution of employment across industries (Acemoglu & Restrepo, 2017). Our master thesis title is:

"Robots and Jobs: Evidence from Scandinavian Labour Markets"

The economy is in continuous transition from being heavily dominated by manufacturing to having a much larger tertiary sector. This transition is partly due to robots, as they increase effectivity of labour and hence enables workers to transition from manufacturing into other parts of the economy. We will therefore analyse the effect that robots have had on different sectors of the economy in the period from 1993 until 2015.

There are differing views upon how robots are affecting labour markets, where some researchers are of the opinion that these workers that are replaced by robots will simply be left unemployed, while others believe that these workers can be reallocated into other parts of the economy. Klaus Schwab (2017) is looking at different occupations and ranking them according to how susceptible they are to automation, and more evidence has been published in recent years when it comes to the automation of low-skill and medium-skill occupations and how this contributes to wage inequalities and employment polarization. Some figures suggest that as much as half of today's current occupations are at risk of automation in the next couple of decades (Schwab, 2017). Manyika (2017) and Autor (2017) provide similar figures. This raises the question; how much of an impact does robots have on labour markets, and whether the redundant workers can be employed elsewhere.

Another important factor is that even though these figures are presented, it must make economic sense for the firms to automate their businesses, something that would depend on the relative cost of robots versus the cost of labour. Another possible outcome would be an automation of some sectors, while labour would be transferred to other sectors.

During our master thesis, we will attempt to confirm or discard the following hypotheses:
H0 Lower wages and employment.
H1 Higher wages and employment.
H2 No effect on wages and employment.

As changes in wages and employment will be our main focus for this master thesis, we will examine whether the Norwegian, Danish and Swedish labour markets fit these hypotheses. We know that these countries have differences in the number of robots and hope to find evidence of how these levels of automation are affecting the different labour markets.

Where Acemoglu and Restrepo (2017) used data on the US labour markets and robot stock, we will use data on the Scandinavian labour markets and robot stock. In addition, our data have a longer time span than Acemoglu and Restrepo (2017) - as their data spans from 1990 until 2007 and our data spans from 1993 until 2015. Our method of research will be similar to that of Acemoglu and Restrepo (2017), as we use the same database for the stock of robots (IFR) and will connect this to similar data when it comes to the labour markets. In other words, this master thesis will use the same methodology as Acemoglu and Restrepo (2017), but it will be based on different data sets as the focus will be on Scandinavia labour market and not the US labour market. Our research question is:

"What effect does robots have on the employment level and wage rate in Scandinavian labour markets?"

Brief discussion of related literature

Technological unemployment

"We are being afflicted with a new disease of which some readers may not have heard the name, but of which they will hear a great deal in the years to come – namely, technological unemployment" (Keynes, 1933).

"Labour will become less and less important. More and more workers will be replaced by machines. I do not see that new industries can employ everybody who wants a job" (Leontief, 1952).

These famous predictions concerning the anticipated technological progress did not materialize in the decades that followed, but with the advances in automation, robotics and artificial intelligence (AI), we are on the verge of seeing them realized (Ford, 2015). The vast amount of evidence pointing to automation replacing a range of low-skill and medium-skill occupations, adds to the wage inequality, employment polarization and the outlook that was presented roughly 90 years ago. Frey and Osborne (2017), have classified 702 occupations in the US by how exposed they are to automation, and concluded that 47 percent of US workers are at risk over the next two decades. Several institutions (McKinsey: 45 percent, World Bank: 57 percent in OECD countries) have concluded with similar figures.

However, these studies examined the outcome of what is technologically feasible, and there is obviously no guarantee that firms would automate even if the estimated technological progress materialize. Firms would have to evaluate the costs of substituting and look at new wage structures in response to the automation threat. Automation in one sector could also mean adjustments in other sectors, which may absorb the freed-up labour. Productivity improvements due to new machines may even expand employment in affected industries (Acemoglu & Restrepo, 2017).

In our paper we are looking to move beyond these feasibility studies and estimate the equilibrium impact of one type of automation technology, namely industrial robots, on the Norwegian, Swedish and Danish labour markets. The International

Federation of Robotics (IFR) defines industrial robots as “automatically controlled, reprogrammable, and multipurpose industrial robots” (IFR, 2017).

We will look into the effects of robot penetration into the economy. Which correlates negatively with the displacement effect (directly displacing workers from tasks they were previously performing) and positive correlations such as productivity effects (as other industries and tasks increase their demand for labour) (Acemoglu & Restrepo, 2017).

An outline of your research plan

January:

- January 15th: Delivery of preliminary thesis report.
- Continue with literature research about robots, automation, job polarization and labour market transition.
- Clarify research question to include both Sweden and Denmark.
- Gather labour market data for Norway, Sweden and Denmark.

February

- Continue to gather labour market data if not finished.
- Oral presentation of master thesis.
- Research how to regress data – decide whether to use Stata or MatLab.

March

- Start writing codes for regressing data using Stata/MatLab.

April

- Continue to work on codes for regressing data.
- Regress data and compute numbers and tables for analysis.

May

- Analyse the data.
- Write the thesis.

June

- Finish first draft.
- Work on corrections.
- Hand in second draft.

July

- Work on corrections on second draft.
- Submit final thesis.

September

- September 1st: Deadline for submitting final thesis.

Description of data

We have, as Acemoglu and Restrepo (2017), collected our main data from the International Federation of Robotics (IFR). These data sets consist of the count of robot stocks by industry, country and year. These data sets cover the use of robots in different sectors that are classified in the following way:

A-B - AGRICULTURE, FORESTRY AND FISHING

C – MINING AND QUARRYING

D – MANUFACTURING (CONTAINS DIFFERENT SUB-SECTORS)

E – ELECTRICITY, GAS AND WATER SUPPLY

F – CONSTRUCTION

P – EDUCATION/RESEARCH/DEVELOPMENT

90 – ALL OTHER NON-MANUFACTURING BRANCHES

99 – UNSPECIFIED

The manufacturing sector is classified in different sub-sectors, allowing for more detailed examination of industries such as the textile, electronics and automotive industry. There are some shortcomings in the data, as about 30 percent of the robots are unclassified and hence not assigned to either of the classifications. We will use the same approach as Acemoglu and Restrepo (2017), and allocate these unspecified robots to industries in the same proportion as the classified data. The data does not include information on dedicated industrial robots, something that is defined as automatically controlled machines that only are suited for one industrial application. When it comes to the data set for Denmark, the industry classification only started in 1996, so for 1993-1995 all robots are put in the unclassified sector. We will again use the same approach as Acemoglu and Restrepo (2017), where we will deflate the numbers from 1996 in order to classify robots to specific industries.

In order to measure the number of industrial robots per thousand workers in Norway, Sweden and Denmark, we use data with employment counts classified by industry from SSB, SCB and Statistics Denmark.

Preliminary results

Acemoglu and Restrepo (2017) found that one more robot per thousand worker reduced the employment to population ratio by 0.18-0.34 points and wages by 0.25-0.5 points. These results are for the United States' labour markets, but we expect to find similar results for the Scandinavian labour markets. We do however believe, as Autor (2017), that these effects are somewhat temporary, and that it might act as a job creator in other sectors or even create new occupations. As our data set is spanning over a significantly longer period, we hope to see some evidence of these effects in our findings.

Relevant references

"Robots and jobs: Evidence from US labor markets" (Acemoglu & Restrepo, 2017)

The structure of our thesis will be based on the framework and methodology used in in this research paper.

"Norges digitale tilstand" (Austlid, 2016)

This article provides a classification of the state of the IKT maturity in Norway by referring to a report (Global Technology Report) conducted by the World Economic Outlook. The report also includes ratings from Sweden and Denmark. The report points to a high level of IKT maturity across Scandinavia. However, the report also points to the lack of recruitment and education of people with IT competence. According to the report, the current recruitment situation will result in the lack of 3 of 4 necessary IT positions will remained unfilled in 2030.

Klaus Schwab – Fourth Industrial Revolution

This book focuses on how we can take collective responsibility into ensuring that the current development into what he labels “the fourth industrial revolution” will be of positive nature. He explains what kind of inventions that are likely to appear in the coming years, and what kind of occupations are most likely to be automated. He believes that this period of transition is more profound than any previous industrial revolution and that we need to take the correct measures in order to cope.

https://www.tu.no/artikler/roboter-kan-redde-norsk-industri/233084

This article focuses on how robots can help high-cost countries like Norway to maintain their manufacturing sector despite increased global competition. They stress that in order to benefit from the technological competence in Norway, robots are necessary to keep hold of industries. They further state that “homecoming” could be the new outsourcing.

http://www.cw.no/artikkel/digitalisering/norge-bremser-opp-digitaliseringen

After Norway was in the lead in 2015 when it comes to digitalisation, they are now placed in the group of countries that are slowing digitalisation together with Denmark and Sweden. They are said to be reflecting the challenges of sustaining growth (Chaturvedi, 2017).

David Autor: https://www.ted.com/talks/david_autor_why_are_there_still_so_many_jobs

David Autor provides two economic principles as reasons why there are so many jobs despite automation in sectors such as agriculture, banking etc. These are the O-ring principle and the "Never get enough" principle. Where the first principle deals with what type of occupations that are left, the second deals with how many jobs are left. He explains that though ATM's decreased the need for tellers in branches, it also decreased the costs of the branches, allowing for more branches to be opened. The tellers type of job was changed, and their tasks were shifted towards more cognitively demanding tasks than before. He believes that automation might be the source of invention and hence job creation, as the former automation of i.e. the agriculture sector has moved people from the agriculture sector to industries like finance and health care.

https://www.mckinsey.com/denmark/our-insights/a-future-that-works-the-impact-of-automation-in-denmark

This McKinsey report shows that 40 percent of Danish jobs could be automated by current technologies. The report offers seven key insights:

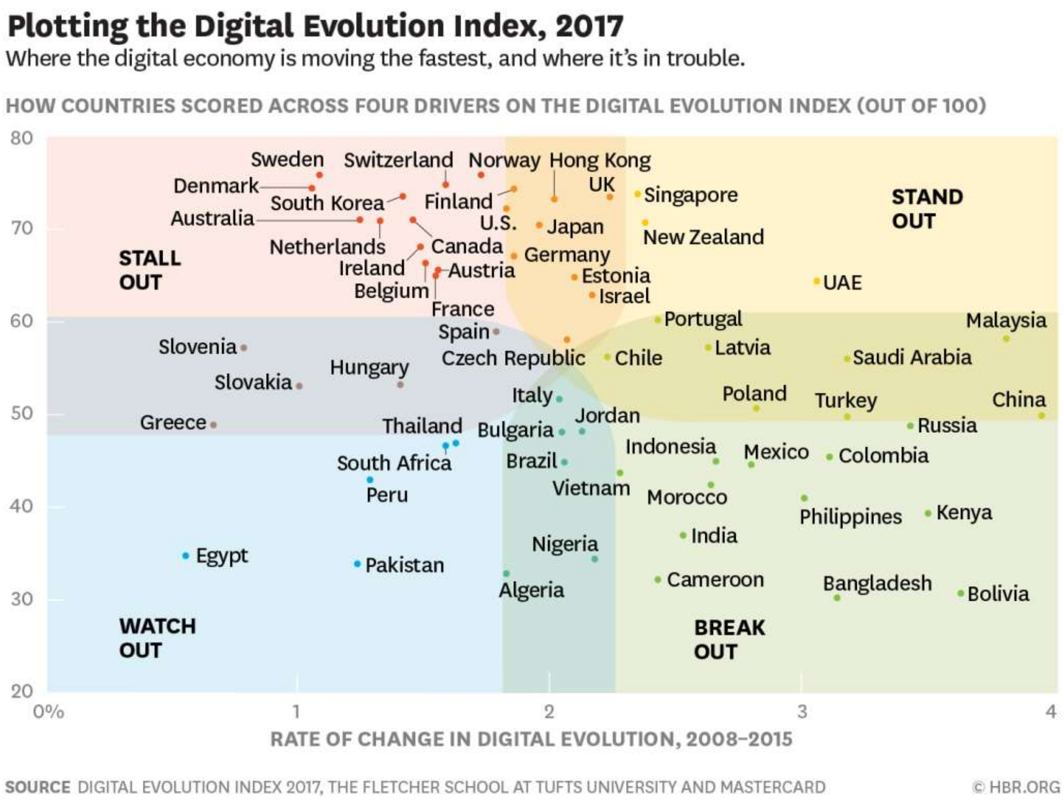
- 40 percent of working hours can be automated.
- Occupations with higher predictability in tasks are more prone to automation.
- Shorter education is correlated with susceptibility to automation.
- Middle-income jobs are more prone to automation than low- and high-income jobs.
- Across the Danish economy, there are significant differences in automation potential.
- Automation will affect the entire country of Denmark.
- The Danish automation potential is below the global average.

https://www.mckinsey.com/global-themes/europe/digitizing-sweden-opportunities-and-priorities-in-five-ecosystems

This McKinsey report suggests that through automation and digitalization, Sweden could increase their revenue by 850-1400 billion SEK per year. Just by automation and big data, this increase in revenue is expected to be between 475 and 695 billion SEK. This report is focusing on five sectors of the economy: healthcare, public sector, transportation, manufacturing and finance.

https://www.weforum.org/agenda/2017/07/these-are-the-worlds-most-digitally-advanced-countries

This article looks at, among other things, how digital technologies are going to change the future of work. It looks at how automation might open up new ways of harnessing human energy and how it might displace jobs and increase social inequity. In addition, the article focuses on the different categories of countries: stall out, stand out, watch out and break out – as illustrated in the following figure.



Interview subjects

We will conduct some interviews in order to gain a broader insight when it comes to the current developments in automation. We have therefore gotten some contact information for two interview subject, something that will help us attain a deeper understanding about the effects of automation in addition to the analysis that we are going to conduct.

These interview subjects are Halvor Lande – Head of Digital in DNB and Martin Bech Holte – Managing Partner McKinsey & Company. Martin has held lectures at the Virke conference two years in a row about Norway's position in the fourth industrial revolution and the changes in the labour markets as a result of this.

Research challenges

Our most prominent challenge for estimating unbiased results is choosing a feasible time period. Acemoglu and Restrepo (2017), states that they end their sample in 2007 to avoid potentially confounding effects from the Great Recession. We have temporarily chosen the time period 1993-2015. We will therefore have to be able to avoid bias from the exogenous effect from the financial crisis to avoid contamination in the results. If the confounding effects from the financial crisis proves to be inexpedient to eradicate we might have to adjust our data sample to 1993-2007. Our strategy would also be compromised if the changes in robots in corresponding advanced economies are correlated with other adverse shocks to Scandinavian industries (Acemoglu & Restrepo, 2017).

A further challenge/limitation addresses the definition of robots used by the IFR. The definition might not be broad enough, because the definition does not include dedicated industrial robots. Dedicated industrial robots refers to automatically controlled machines suited for only one industrial application. Examples of dedicated industrial robots include the storage and retrieval systems in automated warehouses, assemblers of printed circuit boards, and machine loading equipment (Acemoglu & Restrepo, 2017). As an example, the warehouse of Komplett.no is controlled by such an automated warehouse (Stokke, 2013). Such robots might have similar impact as industrial robots, but they are not included in the data collected by the IFR. The exclusion of dedicated industrial robots may therefore have an impact on the results.

References

Acemoglu, D., & Restrepo, P. (2017). Robots and Jobs: Evidence from US Labor Markets.

Autor, D. (2017). *Will automation take away all our jobs?* https://www.ted.com/talks/david_autor_why_are_there_still_so_many_jobs

Chaturvedi, R. (2017). *These are the world's most digitally advanced countries*. Retrieved from https://www.weforum.org/agenda/2017/07/these-are-the-worlds-most-digitally-advanced-countries/

Ford, M. (2015). *Rise of the Robots: Technology and the Threat of a Jobless Future*: Basic Books.

Frey, C. B., & Osborne, M. A. (2017). The future of employment: how susceptible are jobs to computerisation? *Technological Forecasting and Social Change, 114*, 254-280.

IFR. (2017). International Federation of Robotics. Retrieved from https://ifr.org

Keynes, J. M. (1933). Economic possibilities for our grandchildren (1930). *Essays in persuasion*, 358-373.

Leontief, W. (1952). Machines and man. *Scientific American, 187*(3), 150-164.

Manyika, J. (2017). *What's now and next in analytics, AI, and automation*. Retrieved from http://www.mckinsey.com/global-themes/digital-disruption/whats-now-and-next-in-analytics-ai-and-automation

Schwab, K. (2017). *The fourth industrial revolution*: Penguin UK.

Stokke, O. P. B. (2013). Slik fungerer robotlageret til Komplett.