Computerization and the Future of Jobs in Norway

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Abstract

In this report, we analyze how digitalization affects the future of jobs in Norway. We compare the results from Norway primarily with Finland, where we have consistent data available. Our study has been inspired by the article by Frey and Osborne (2013) titled "The Future of Employment: How Susceptible are Jobs to Computerisation".

The novelty of the Frey and Osborne analysis lays in relating technical possibilities of computerizing various job tasks and then deriving a probability of computerization for each occupation. In this report, as in the Finnish case, we employ the probabilities of computerization for occupations constructed by Frey and Osborne and then do some basic analysis in regard to labor market outcomes. We find that one third of Norwegian employment is highly susceptible to computerization in the next decade or two. While this share is large, it is at the same level as in Finland and over ten percentage points less than the corresponding share in the United States. A recent report shows that Sweden is on the same level as the US (SSF, 2014). The difference between the similar levels in Finland and Norway, on one hand, and the similar levels in US and Sweden, on the other, reflects differences in the occupational structures.

Low wage and low skill occupations appear the most threatened. Service and public sector jobs are relatively more sheltered than manufacturing and private sector jobs. To some extent computerization will nevertheless affect all occupations. The method used in the study ignores that both the content of tasks within occupations and the mix of occupations are in a constant flux. It also ignores social forces slowing down technological advance.

Despite these caveats, our findings suggest major future changes in the labor market. There can be considerable difficulties for economies to adjust in the shorter run, simply because there may be too much job destruction and not enough job creation. We do not, however, believe that estimated impacts imply mass unemployment in the longer run, since we know from more than two centuries of increased division of labor and mechanization that the labor effort saved is, in due time, transferred to other economic activities. The digital transformation of society itself creates a lot of new needs; and a good way to respond to these needs is to put emphasis on giving the workforce appropriate and adaptable competences through education and training.

Sammendrag

I denne rapporten analyserer vi hvordan digitalisering vil påvirke ulike yrker i Norge i tiårene som kommer. Vi sammenligner resultatene fra Norge først og fremst med resultatene fra Finland, hvor vi har sammenlignbare data. Analysen er inspirert av og bygger på en artikkel av Frey og Osborne (2013) med tittelen «The Future of Employment: How Susceptible are Jobs to Computerisation». Det nye i Frey og Osborne-studien ligger i forsøket på å relatere muligheten for automatisering av ulike arbeidsoppgaver og på den måten komme fram til sannsynligheter for at et yrke er utsatt for datamaskinbasert automatisering.

I denne analysen bruker vi de sannsynlighetene for automatisering som Frey og Osborne konstruerte og gjør deretter noen enkle analyser av hva dette kan bety for syssselsettingsstrukturer. Vi finner at en tredjedel av den norske sysselsettingen i stor grad vil bli utsatt for automatisering i løpet av de neste tyve årene. Selv om dette er en høy andel, så er det på lik linje med Finland og ti prosentpoeng lavere en den tilsvarende andelen i USA. En fersk svensk rapport som bruker samme metode viser at Sverige er på samme nivå som USA (SSF, 2014) Forskjellen mellom Finland og Norge på den ene siden og USA og Sverige på den andre gjenspeiler forskjellene i yrkesstruktur.

Lavtlønns- og lavkompetanseyrker ser ut til å være mest utsatt. Tjenesteyrker og yrker i offentlig sektor er mer skjermet enn industri og andre yrker i privat sektor. Digitalisering og datamaskinell automatisering vil imidlertid påvirke praktisk talt alle yrker til en viss grad. Den metoden som er brukt her tar ikke hensyn til at både arbeidsoppgavene som et yrke består av og yrkesstrukturen er i stadig endring. Metoden tar heller ikke hensyn til sosiale krefter som «forsinker» teknologisk framgang.

Til tross for disse forbeholdene tyder våre resultater på forholdsvis store endringer i den framtidige yrkesstrukturen. På kort sikt kan det være klare tilpasningsproblemer, ganske enkelt fordi jobber blir automatisert raskere enn økonomien klarer å skape nye jobber som tilfredsstiller nye behov – eller gamle behov på en ny måte. Vi tror derimot ikke at de beregnede effektene vil føre til massearbeidsløshet på litt lengre sikt, fordi vi vet, fra over to hundre år med økt arbeidsdeling og mekanisering at den arbeidskraften som blir frigjort med tida blir overført til andre økonomiske aktiviteter. Den digitale transformasjonen av samfunnet skaper i seg selv nye behov og en god måte å være i forkant av denne utviklingen på er å bedre arbeidskraftens kompetanse og endringsevne gjennom relevant utdanning og opplæring.

Contents

1. Digital Disruption

Deepening digitalization, or computerization, has induced an ongoing societal transformation that may ultimately prove to be comparable with the original industrial revolution as a consequence of the ever increasing possibilities for computer-based automation of work processes. The initial gain in efficiency by an increased division of labor in Adam Smith's pin factory was followed by an increasing mechanization of such isolated simple task. The conveyor belt in Charlie Chaplin's movie "Modern Times" is a symbol of this "Fordist" mode of production. As information and communication technology (ICT) emerged and matured, so-called flexible automation and just in time production modified important aspects of Fordism. While large scale automation was characteristic of the industrial economies in the first three decades after the WWII, the last forty years has witnessed the steady spread and deepening of flexible, computer-based automation, and the changing of production methods, jobs and occupations.

The past ten years have been particularly disruptive both for the providers of the underlying ICT solutions and for their users. This distribution will have considerable implications for the labor market, especially in high-income countries with well-established "industrial era" institutions. In this report we consider how digitalization impacts the future of jobs in Norway, with a comparison particularly to Finland, building on Pajarinen and Rouvinen (2014), which in turn was inspired by the work of Frey and Osborne (2013) entitled "The Future of Employment: How Susceptible are Jobs to Computerisation".

The digital disruption is attributable to three interrelated bundles of forces:

First, mankind's abilities to produce, store, process, and transmit digitally coded information have grown exponentially for several decades. The celebrated Moore's Law refers to the ability to pack transistors in an integrated circuit ever more densely; similar "laws" have been ongoing in several other relevant domains (with the notable exception of battery efficiency). The economic outcome of these engineering feats has been that the global volume of data, and capabilities to exploit it, has roughly doubled every one to two years. A feature of this exponential growth is that initially modest increments eventually become huge, like the doubling of the number of rice grains on a chess-board. This may be illustrated with this anecdote (The Economist, 3 Jan. 2015, http://v.gd/U0h57t): "According to Benedict Evans of Andreessen Horowitz, the new iPhones sold over the weekend of their release in September 2014 contained 25 times more computing power than the whole world had at its disposal in 1995."

Second, there are three important phenomena that were virtually unknown to global masses of people just a decade ago: cloud computing, mobile internet, and social media. Kushida, Murray, and Zysman (2015) discuss how "cloud" transforms computing from a scarce to an abundant resource. They note that abundant, ubiquitous, and cheap ICT resources – brought about by cloud computing and related business dynamics – have the potential to alter competitive dynamics in most industries also outside the core sectors. Mobile internet underlies emerging real-time and often location-based service solutions such as Uber, a controversial but globally expanding taxi service. Even if – in advanced markets – mobile devices and their diffusion have remained broadly-speaking the same in the last few years, the impact of mobility continues to deepen at a surprising pace, even in the Nordic countries. For example, in Finland, internet searches made via a mobile device roughly quadrupled in 2013 and doubled again in 2014. Some see social media as a waste of time, but if

people globally spend in excess on one billion hours every day on something (from effectively nil a decade ago), it is bound to be a major societal force. And even though we continue to proxy social media by Facebook, Twitter, and perhaps a few others, the phenomenon is expanding more rapidly than what we readily observe. For instance, in certain contexts Facebook and Twitter are dwarfed by WhatsApp, an online messaging service, although it is not even characterized to be a part of social media.

Third, the digital revolution that has so far largely lived on "screens" is starting to mesh with our physical surroundings. Robotics is hardly a new phenomenon, but they have recently gained better senses (sensors) and become much more intelligence (software algorithms; processing capacity). At the same time the quality-adjusted price of a robot has plummeted; previously very expensive robotic lawnmowers and vacuum cleaners have become mass-consumer products. A bundle of technologies known as 3D printing or additive manufacturing holds a promise of turning the world of physical objects in a fully-personalized on-demand infofacturing. With internet of things, or even "of everything" (Evans, 2012), emerges rapid expansion of the possibilities to let computers do increasingly complex tasks, since we can make increasingly complete models of our physical world. These models in their turn make us able to "master" the physical world by means of computers to an increasing degree. From GPS navigation of cars – to the driverless car.

The above three interrelated bundle forces have a few aspects in common. Each of them is undeniably a major global phenomenon. Each of them has experienced huge changes in the last decade and is evolving rapidly. And they all relate to underlying hardware and software. Yet, they are all just enablers; they only have a social impact if they are embedded into day-to-day lives of individuals and organizations in such a way that behaviors and structures are adjusted to reflect the possibilities that have opened with technological advance. Because this complementing non-digital human-centric investment is quite large, perhaps ten times as large as the needed digital investment (Brynjolfsson & Hitt, 2000), and because people and organizations often take years or even decades to fully adjust, the full impact of the recent tsunami of technological advance will unfold in the next two to three decades; even if one would wrongly assume that no further scientific and technological advance will take place. The purpose of this report is to give a rough idea of the magnitude of this change in the Norwegian labor market.

2. Changes in the Work Place

Autor, Levy, and Murnane (2003) suggest considering *work* in two dimensions (Figure 1):

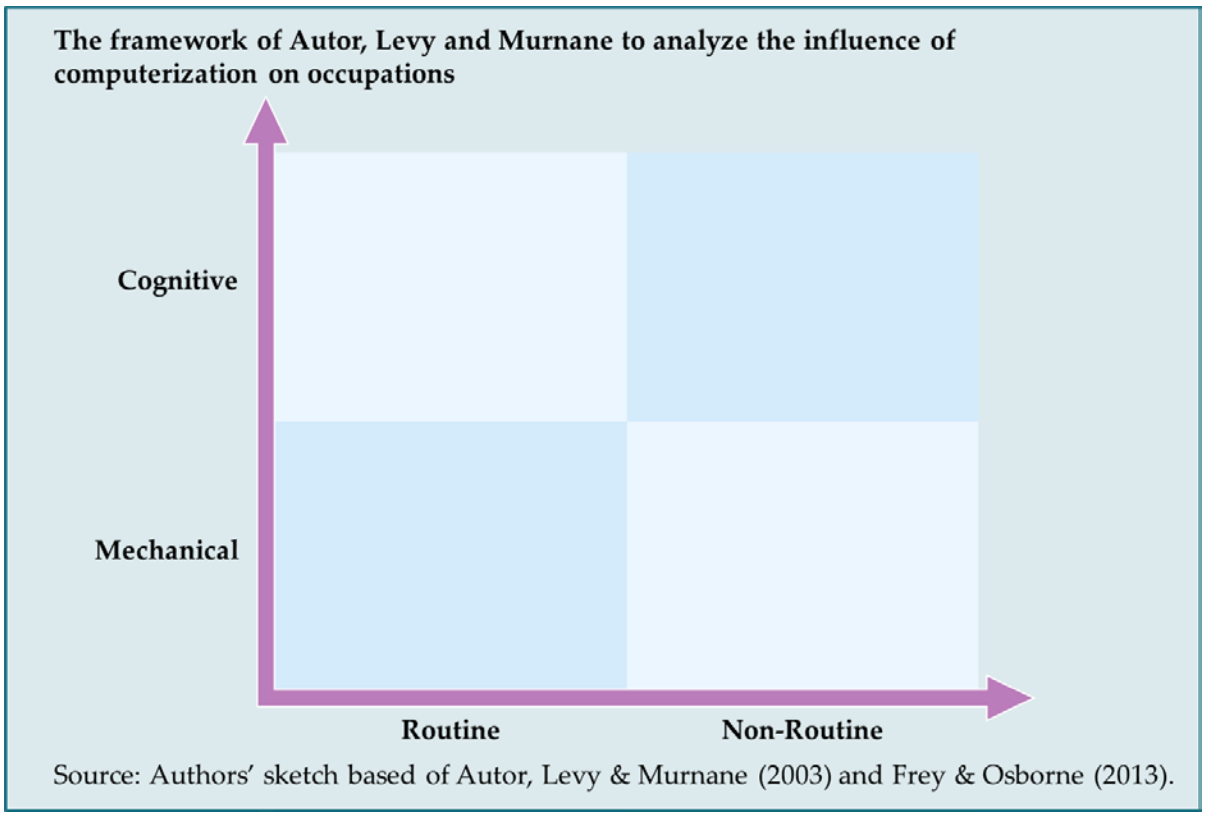
- To what extent is it all about "muscle versus brain" work (mechanical *versus* cognitive)?

- And to what extent are there clear rules to put on the work *versus* the work which is not formed as a predetermined pattern (routine versus non-routine)?

Steam and electricity related to mechanical routine job substitution. According to Autor, Levy and Murnane (2003), digitalization will lead to the substitution of jobs in cognitive routines, such as basic accounting tasks, too. In 2003, they did not consider digitalization to have a significant impact on, say, to the work of a plumber and a number of other service professions described by mechanical

non-routine work. Their key conclusion was that digitalization supplements non-routine cognitive work. The conclusions were similar also in a subsequent study of Autor, Dorn, and Hanson (2013).

Figure 1



But "big data", and automated analytics related to it, enables human work to be replaced also in the non-routine cognitive tasks. And the robots with better sensors and intelligence are invading the mechanical non-routine tasks in factories and health care, too.

In fact, Frey and Osborne (2013, p. 23) state that *"… it is largely already technologically possible to automate almost any task, provided that sufficient amounts of data are gathered for pattern recognition."*

The *replacement* of occupations and work is a bit misleading term in this context. Rather, it is the case that the work will be *redistributed* so that robots and other machines make the elements of the work, in which they have a competitive advantage and humans deal with work which is difficult to machines. And obviously the work time saved may be employed in altogether new tasks possibly made conceivable by the very same technological advance.

Once upon a time, the shoemaker made a shoe from start to finish. In the shoe factory the manufacturing of shoes was divided in to numerous simple tasks. It was the sum of the reorganization of work and the utilization of the benefits of machines, which also included the modifying of the final product so that it was more suitable for industrial production. Something

similar seems to be happening to “brain work”. Moreover, bar codes, IP-numbers and other unique identifiers attached to “everything” are the basic building blocks of structures of concepts (ontologies) which mean that asking “Where is the nearest open Pizza bar with vegetarian pizza?” is a question that can be asked and answered by an increasingly “semantic” Internet[1]. Such standardization processes makes it possible to create a lot of advanced highly customized self-service products and services.

3. Matching Techniques and Their Diffusion with Tasks

Our study follows the example of Frey and Osborne (2013), who quantify what computerization means for the future of employment.[2] They (p. 38) find that *“… 47 percent of total US employment is in the high risk category, meaning that associated occupations are potentially automatable over some unspecified number of years, perhaps a decade or two.”* [3] They (p. 42) also note *“… that computerization will mainly substitute for low-skill and low-wage jobs in the near future.”* In this report, we provide corresponding estimates for Norway and Finland.

Frey and Osborne match current and forthcoming technologies to tasks within occupations. While the employed term is **computerization**, they consider a broad set of technologies falling under *machine learning*,[4] *mobile robotics*, and *task restructuring* (the exercise is mostly about predicting how already existing technologies might diffuse). The novelty of their analysis is in relating technical possibilities with job tasks and then deriving a *probability of computerization* measure for each occupation. The authors assume a technological capabilities point of view, *i.e.*, they do not consider political or social forces that may influence technology adoption. Typically these forces tend to hinder or even altogether prevent the exploitation of certain possible. For example, self-driving cars can be in wide-spread use only if they are legal, which in turn means that complex juridical issues such as liabilities in case of an accident must be resolved.

Consumers ultimately desire a bundle of goods and services that provide them with the highest overall quality of life for a given income. As such, they are mostly indifferent to the ways how that bundle is provided. On the “supply side”, employers’ desire to substitute labor for capital is driven by continuing rapid decline in the real quality-adjusted cost of computing and related technologies. So far, computerization (including robotics) has mostly influenced manual and cognitive routine tasks (Autor & Dorn, 2013). In years and decades to come, this influence extends to non-routine tasks. In fact, we go as far as arguing that, in decades to come, the largest change is felt in the appreciated and nice office jobs that currently employ the bulk of the middle-class in the developed countries.

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[1] Wikipedia: The **Semantic Web** is a collaborative movement led by international standards body the World Wide Web Consortium (W3C).[1] The standard promotes common data formats on the World Wide Web. By encouraging the inclusion of semantic content in web pages, the Semantic Web aims at converting the current web, dominated by unstructured and semi-structured documents into a "web of data".

[2] Offshoring, and globalization more generally, is another and related threat to current employment, but we do not address that issue here. As we employ the probabilities of computerization constructed by Frey and Osborne this procedure obviously assumes that the task contents of occupations are similar in Norway, Finland and the US. Naturally we also directly replicate possible omissions embodied in the original analysis.

[3] The high risk category is defined to include occupations that have over 70% probability to be replaced by computer-controlled equipment.

[4] Including data mining, digital sensing and actuation, machine vision, computational statistics and other sub-fields of artificial intelligence.

4. Considering the Impact of Computerization One Occupation and One Task at a Time

The essence of the Frey and Osborne approach is to consider the task composition of each occupation and then evaluate task-by-task, whether or not each task in each occupation will be computerized in the next two decades (Box 1). In practice, a group of experts has evaluated the tasks in about 10% of all the occupations, after which the full list of occupations have been estimated.

The value of the work by Frey and Osborne ultimately depends on three things:

1. How well the tasks per occupation are defined (by BLS in the US).

2. How well the group of experts at Oxford University managed to relate the tasks of the seventy selected occupations, 10 % of total number of occupations, to existing and future technologies, including possible technological breakthroughs.

3. How representative the tasks of the 10 % sample that were evaluated in detail are for the tasks of the full list of occupations.

Upon applying the approach in other countries (without replicating the above three steps), a further question is, how well the US probabilities apply in the national context in question. And if the reference year differs by more than a year or two, one might also wonder how well the probabilities apply over time, both because possibilities change and, more importantly, because occupations change as the most rewarding points for computerization are being exploited. It should also be emphasized that this approach does **not** consider possibly emerging new occupations or new/expanding tasks within existing occupations.

Even though there are a few issues of concern, in our understanding building on the Frey and Osborne is indeed a valid way to gain some qualitative and quantitative understanding on how computerization may impact the future of jobs in Norway. We wish to emphasize, however, that the numbers we derive are rough approximations, not exact truths.

5. The Frey and Osborne method – a bit more detailed

In this chapter we try to describe the Frey and Osborne method in a bit more detail, hopefully "roughly right" in the outline and certainly "precisely wrong" regarding mathematical detail. This is in order to try to spell out in a much less technical way than in their paper how they construct the probabilities. It is important to keep in mind that the first, and clearly the most decisive step, is to decide in the first entirely "subjective" stage, that is based on expert best guesses of what technological break-troughs will happen and their consequences for computerization.

The starting point is the 903 occupations described in detail in the O*NET, an online thesaurus of occupations. Frey and Osborne map those 903 O*NET occupations into 702 SOC (Standard Occupational Classification) occupations. That gives Frey and Osborne a lot of detailed description of the different tasks related to an occupation since the O*NET has detailed descriptions of "direct work activities" to each of its occupations. The basic idea is then to classify these tasks as more or less susceptible to computerization.

Frey and Osborne start out with three domains of human activity where computers must do the task cheaper and with a comparable quality before computers start to replace humans. They call them computerization bottlenecks. These domains are

- perception and manipulation
- creative intelligence
- social intelligence

These three domains are then subdivided into sub domains:

Perception and manipulation into:

- finger dexterity
- manual dexterity
- cramped work spaces and/or awkward positions

Creative intelligence into:

- originality
- fine arts

Social intelligence into:

- social perceptiveness
- negotiations
- persuasion
- assisting and caring for others

The next step was, to single out 70 [of the 702] occupations where Frey and Osborne was confident that it was either fully automatable or not at all. They took part in a workshop held at the Oxford University's Engineering Sciences Department in order to examine the potential for automatization of a wide range of tasks that helped their subjective assessments. The criterion for labelling an occupation 1 or 0 was: "Can the tasks of this job be sufficiently specified, conditional on the availability of big data, to be performed by state of the art computer-controlled equipment?"(p. 30).

Frey and Osborne do not discuss by using concrete cases which they regarded as a clear 1, a clear 0 or a borderline case, so the reader does not get very much of an impression of how they thought about various tasks. For example Blinder (2009) devotes ten pages to a discussion of how O*NET can be used to assign probabilities for "offshoreability".

Frey and Osborne only state that: "Thus, we only assigned a 1 to fully automatable occupations, where we considered all tasks to be automatable. To the best of our knowledge, we considered the possibility of task simplification, possibly allowing some currently non-automatable tasks to be automated. Labels were assigned only to the occupations about which we were most confident" (p. 30).

Given the rather "generic" character of the task descriptions there is clearly a fairly wide range of subjective judgment in deciding which occupations are "fully automatable" and that the results are

probably rather sensitive to those judgments. Regrettably Frey and Osborne do not describe this more subjective process in any detail. It would have been interesting to see what they considered obvious examples and borderline cases.

The authors then discuss two other ways of assigning probabilities for a certain outcome connected to an occupation based on the characteristics of that occupation. One is "pure subjectivity" as in Blinder (2009) or algorithm based as in Jensen and Kletzer (2005). The latter approach gave some very questionable results, for example classifying lawyers and judges among the most tradeable/offshorable occupations and data entry keyers as the least.

Frey and Osborne conclude that a combination of the two methods might be optimal and use "probabilistic classification" for the algorithmic part of the job. The essence of the method is to:

Create a 9 variable vector, (x1, x2…x9), where x1 for example can be "finger dexterity", which can have three levels,

- **low**, "screwing in a light bulb",
- **medium**, "packing oranges in crates as quickly as possible"
- **high**, "perform open-heart surgery with surgical instruments"

So for each of the 70 occupations, there is a 9-element vector, giving a column vector ***y*** of 1's and 0's and a 70 by 9 matrix of skill domains, from "finger dexterity" to "caring for others", with a number indicating the level of the skill subdomain.

Next step is to relate the fact that y is 1 or 0, to the numbers in the vector. This results in a new 70 element vector consisting of the probabilities that certain "process" should have assigned 1 and 0 based on the total pattern of numbers in each vector in the 70x9 matrix.

This new, 70 item long column vector of probabilities is given by

P(y = 1), given f) = 1/(1+exp(-f), where f is a so-called discriminant function.

The P(y=0) is just 1-P(y-1).

The authors then test various possible discriminants, i.e. f-functions, which all turn out to work fairly similarly and well.

To check the robustness of the method they split the 70 cases in randomly selected halves and see how good they can predict the other half being labelled (classified) as 1 or 0. The results show that there was a fairly systematic relation between the data in the 9-data vector and the labels and as a consequence the P(y) probabilities.

The last step is then to do this exercise for the remaining, 632 unlabeled occupations, which do not get a label, only a probability. The complete list of occupations and their probability, "susceptibility" for computerization is in the annex of the Frey and Osborne working paper with all the 70 key occupations listed.

6. Applying the Frey and Osborne Approach in the Nordic Context

Frey and Osborne (2013) employ O*NET data and the *Standard Occupational Classification* by the *US Department of Labor*. They end up considering 702 occupations in 2010. In what follows, we employ the same US data updated by two years in 2012, Statistics Norway data in 2013, and Statistics Finland's data in 2011.

We convert the probabilities defined for US occupations to *International Standard Classification of Occupations* (conversion tables are available at http://v.gd/grjSKN). Due to differences in the two classification systems, the number of occupations drops to 410 in the Finnish case and to 374 in the Norwegian case, respectively[5]. Our data nevertheless cover practically all workers with a valid occupation code in these countries.

Figure 2 in this report, as well as figures in Appendix 1, are analogous to *Figure III* of Frey and Osborne (2013, p. 37), although we neither employ the rolling average window of width 0.1 (our email exchange with Frey and Osborne on 13 Nov. 2013) nor provide a breakdown by main occupational categories.

In Figure 2, the horizontal axis is the probability of computerization in five percentage point intervals.[6] The vertical axis measures the headcounts of workers in the occupations that fall within the probability of computerization interval specified in the horizontal axis.

Figure 2 reveals that in all three countries – Norway, Finland and the US – there are distinct peaks at both ends of the distributions, which means that workers are typically either *quite sheltered* from or *quite threatened* by computerization rather than somewhere in between.

In Frey and Osborne (2013), occupations that have *under 30%* probability of computerization are characterized as *low risk* and occupations with *over 70%* probability as *high risk*.

Our replication of Frey and Osborne, using data for 2012 rather than 2010, suggest that 49% of US employment is in the high risk category. The corresponding share for Norway is 33% and for Finland 35%, respectively, i.e. 14–16%-points less than in the US. Compared to the US, Norway and Finland seem to have more mass in the middle in the distributions. While this is mostly due to the fact that the occupational structures are more similar in Norway and Finland and indeed different from the US, to a lesser extent this is driven by the fact that, upon moving from the US to the international classification, we have been forced to average over occupational groups, which induces a slight "converge towards the middle" phenomenon.[7] In order to gauge the magnitude of this effect, we re-calculated the US numbers employing the ISCO classification. With the original classification, 49% of

[5] In Appendix X is given a short description of the preparation of the Norwegian data.

[6] The value labels in the figures are by 10 percentage point intervals, e.g. "100" indicates probability of computerization of 95–100%.

[7] For instance, the probability of computerization for freight handlers (ISCO-08 group 9333) is an average over four occupational categories in the US classification including both managerial positions and blue-collar jobs; in the US case the probabilities range from 7% for aircraft cargo handling supervisors to 85% for manual freight, stock, and material movers (upon deriving the probability used in the case of Norway and Finland, we simply took an arithmetic means of the four US probabilities). On a related note, a few relatively large occupations are not assigned a probability in the original data but they may get one in upon our averaging. For example, there is no probability for nursing assistants (SOC2010 31-1014) but there is for psychiatric aides (SOC2010 31-1013). These two occupation groups convert to health care assistants (ISCO-08 5321), which gets a probability of computerization of 47% (i.e., the US probability for psychiatric aides).

US employment is in the high risk category in 2012; with the alternative classification, this share drops to 45%. The share is still remarkable higher in the US case compared to Norway and Finland.

In Norway, there are two occupation groups which employ over 100,000 workers and are expected to be highly ($p > 0.95$) susceptible to computerization: shop sales assistants and general office clerks. Also accounting and bookkeeping professions, contact center salespersons, and receptionists have the high probability of computerization. In the other end, large occupations least susceptible to computerization include professions related to nursing and health care, teaching, engineering and managerial tasks (see Appendix 3 for more complete listings by occupations). See Appendix 4 for Norwegian translations of the different occupations.

Figure 2. The distribution of occupational employment over the probability of computerization in Norway, Finland and the United States

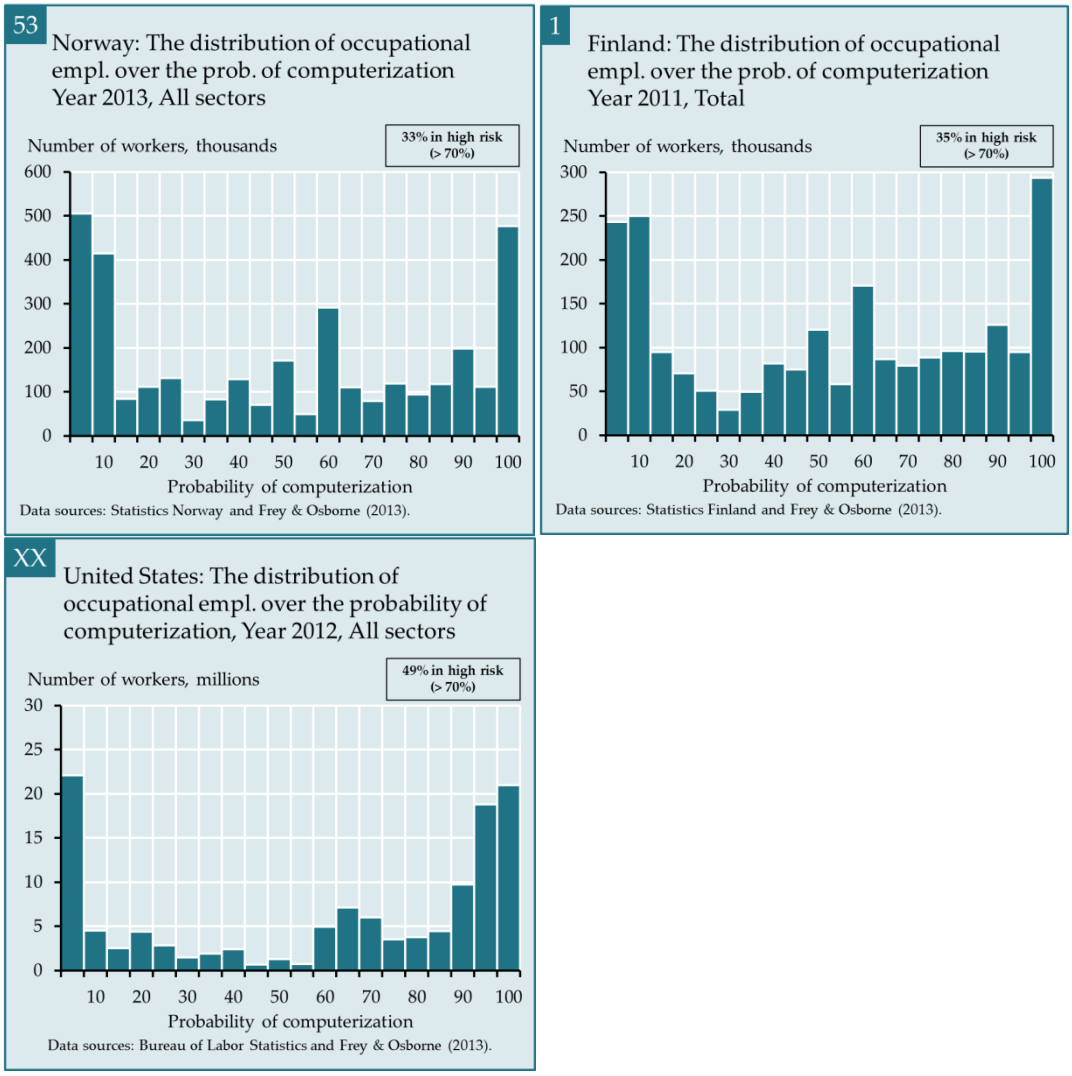
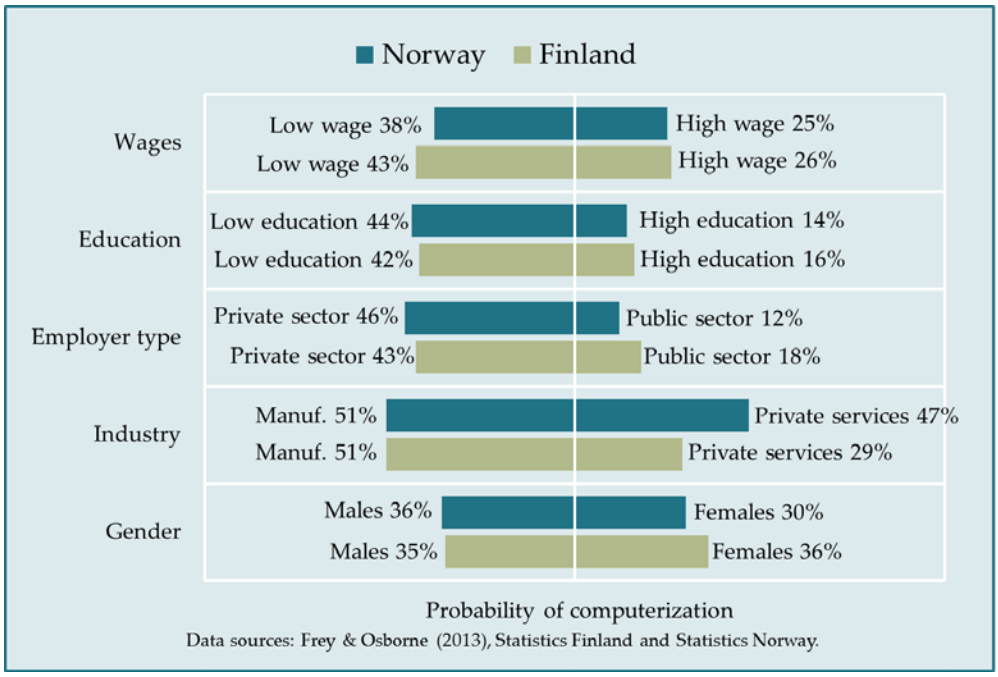


Figure 3 considers the susceptibility of computerization by different employer and worker characteristics in Norway and Finland.[8] We report here only the shares of high risk probabilities of computerization; the complete distributions are reported in Appendix 1. The high risk proportions regarding wages, education, employer type, and industry characteristics depict the same kind of picture in the both countries: high-wage, high-education, service industries and public sector jobs are more secured from the computerization than low-wage, low-education, manufacturing, and private sector jobs.[9] In respect to gender there is slightly variation between the countries. In Norway, females seem to be more sheltered from the computerization than males, whereas in Finland the probabilities are almost equal.

Figure 3 suggests certain general tendencies. In doing so, it also hides considerable variables. For instance, it is **not** the case that all highly educated workers would somehow be "safe" when it comes to computerization. While a high (and versatile) education background indeed reduces the consequences of the ongoing turmoil induced by technological advance some occupations of highly educated workers – such as some accounting professions – may experience large changes.

Figure 3. The proportions of high risk of computerization by worker and employer characteristics



[8] We do not have fully comparable data on the US regarding the dimensions analyzed, so we concentrate here on Finland and Norway.

[9] High/low wage occupations are categorized by the median wage level of all occupations in the economy; high education group includes workers with university degree (ISCED 1997 classes 6–8) and low education consists of all other workers; employer type (private/public) is based on business register information; manufacturing sector includes Nace Rev. 2 industry codes 10–43 and private services Nace Rev. 2 industry codes 45–82. In the Appendix 1, there are also charts for Norway on primary production (01–09), and public and miscellaneous services (84–99).

7. Computerization Offers Global Welfare Gains but Their Distribution is difficult to estimate

Despite continuous fears to the contrary, at least since the dawn of the industrial revolution, concerns over mass unemployment caused by technological progress have not materialized. While huge amounts on labor effort have been saved, in due time it has invariably found new uses.

It is nevertheless the case that, in the ongoing transition, there is no guarantee that the relative balance between job creation and destruction would remain favorable. And even if it would, possibly increasing labor market churning may lead to a higher "natural" rate of unemployment, as an increasing share of people is engaged in job search or in acquiring new skills.

Our study ignores that both the content of tasks within occupations and the mix of occupations are in a constant flux. It also ignores powerful societal forces that hinder changes in occupational structure, which include at least the following: laws and regulations, conventions and standards, attitudes and values, as well as difficulties in implementing complementing organizational changes and powerful vested interests of "yesterday's winners" that influence politics.

Computerization affects all input and output markets worldwide. Technology will substitute for certain labor tasks and workers will have to reallocate their labor supply. Productivity gains and intensifying competition will put downward pressure on market prices supporting workers' buying power. New industries and occupations will emerge. Especially for innovation-intense countries, it becomes important who develops, provides, implements, maintains, and refines the technologies we refer to by computerization.

As far as labor market impacts are concerned, in our understanding the current phase of computerization is arguably unique in its magnitude and speed of change. Furthermore, the phenomenon is truly worldwide and very general purpose in the sense that the range of technologies we refer to finds applications in all walks of life.

While we are optimistic on economies ability to adjust in the longer run, we foresee considerable difficulties in the shorter run, simply because there seems to be too much job destruction and not quite enough job creation. These difficulties may manifest themselves in stubborn and relatively high unemployment. A further concern is that the most lucrative business positions in the digital space – inventions of business models enabled by technological advance, provision of popular digital platforms that establish multi-side markets (e.g., AirBnB, Apple AppStore, Google Search, DropBox, and Uber), and control of associated brands – are largely held by foreign entities.

While computerization most likely increases global welfare, it is far from certain how these gains are distributed across countries. Whether or not technology races ahead of workers' ability to re-employ old and acquire new skills, computerization is one of the forces causing polarization in the labor market, which should be fought with increasing emphasis on education and training.

8. The Ongoing Disruption Will Re-Define the Concept of Work

In our numerical calculations, we find that one third of Norwegian employment is highly susceptible to computerization in the next decade or two. While this share is large, it is at the same level as in Finland and over ten percentage points less than the corresponding share in the United States, which

reflects cross-country differences in occupational structures. Low wage and low skill occupations appear more threatened. Service and public sector jobs are relatively more sheltered than manufacturing and private sector jobs.

The estimated impacts do **not** imply future mass unemployment, since as argued above we know from more than two centuries of increased division of labor and mechanization that the labor saved is sooner or later transferred to other economic activities. The method used does not take into account changes in the task content within occupations or the evolution in the mix of occupations. It also ignores power societal forces hindering technological advance. Despite these caveats, our findings suggest major future changes in employment.

Software and machines which operate autonomously, understand well the context they are operating within and interact smoothly with their environment will revolutionize work in the next few decades. These advances can increase also the productivity of human tasks, and thus attainable standard of living may rise.

The future is not about humans *versus* machines. It is about humans and machines working together for more fulfilling professional and private lives (of humans worldwide).

9. What tasks will human workers occupy in Year 2030?

This is of course an wide-ranging an d complex question and it is clearly beyond the scope of this report to give an exhaustive answer. But we think it might be useful to briefly discuss the domains of tasks we believe to be primarily human, as opposed to machine driven also in 2030. The tasks allocated to humans must relate to the weaknesses of machines and to the fact that the end users of products are ultimately always other humans - with all of their human characteristics that hardly change over time.

Intuition, creativity, invention

Even if the term “artificial intelligence” is commonly employed, it is obvious that that machines do not actually “think” in the way humans do. They rather employ predefined algorithms incredibly fast. Thus, the human role in the future will be to identify new opportunities and problems, to evaluate the pros and cons related to dealing with those and to refine inputs to be suitable for machine assisted applications for further processing. And when the results are be achieved, to evaluate the meaningfulness of them, as well as when appropriate, to change parameters to get the more desirable output. This conceptualization of “big picture” and acting on the basis of it may be called meta-thinking. It is also associated with “jumping outside of the box", i.e. changing the perspective and approach to a wholly new one. The value of meta-thinking is increasing because its fruits can be leveraged better in a digital world.

As already mentioned even the best machines do not show signs of a truly creative, independent thinking. Therefore the core tasks related to innovations, entrepreneurship, business managing, as well as sales and marketing professions will be retained to humans even if the machines shall assist humans by gathering and processing the information needed.

Today, “expertise” in part means that one masters details of a complex matter and is able to mechanically apply the rules related to it. This type of expertise is in threat of extinction. Instead, the significance of genuine creativity will increase.

Social interaction

In physical encounters between people a relatively small proportion of communication is related to speech and its content: story structure, the double meanings and metaphors, gestures and body language and tone of voice as well as things like dressing play a key role. The interaction is based on all of these elements, and also takes into account a previous history (and perhaps the assumed future).

Machine-human interaction is yet not very deep, even from the basic information content point of view, not to mention the spectrum of the above-described interaction elements. Although the communication will be more technical, a human will remain a superior communicator with another human in 2030.

Human’s superior senses and motoric skills

Evolution has processed human senses and motoric skills to levels which technologically are very hard to reach. A human-shaped humanoid robot still fails to climb the ladders to the roof and not even the best machine vision finds a butterfly from a meadow. Although the machines are making

progress, humans will maintain their lead in these aspects over the coming decades. Many construction sites or hospital tasks will be carried out by humans, even if in the latter, diagnoses, for example, may become more and more software-assisted.

Ethics, morality and politics

Ethics and morality issues are linked to the prevailing attitudes and culture. Often they involve balancing of conflicting principles, desires and goals. Policy making faces the same challenges; it also includes a reconciliation of objectives and demands of divergent groups by complex negotiations and trade-offs. Ethics, morality and policy issues seem not suitable for automation. And we as human beings even would not like to do that, do we?

Motivation, education and entertainment

Motivation, education and entertainment are already heavily digitalized. Since the end user of these functions is always a human, another human's role however will remain at least to a certain extent. Ultimately, it of course depends on the customer's desire and capability to pay and the seller's potential and the ability to respond to the demand. Anyway, we suggest that we are, for instance, more motivated in the group physical training exercise when a trainer is really sweating in front of us; and she has all the possibilities to maintain the role in spite of technical progress.

The technology itself

The digital transformation of society leads to ever deepening technological orientation which creates a lot of new needs. It is often overlooked that the replacement of a job creates a job elsewhere. More generally, new technological applications are invented, developed, manufactured, marketed, sold, used, maintained and ultimately recycled. In this, humans as well as machines have a role to play.

Humans and machines together

Humans will eventually work in tasks which are difficult for machines to complete, which are in abundance and are on a whole perhaps the most relevant ones. Although the view of full automation may be a fascinating scenario, we believe that instead interactive human-machine combinations will be introduced first, and may often show themselves to be superior to full automation.

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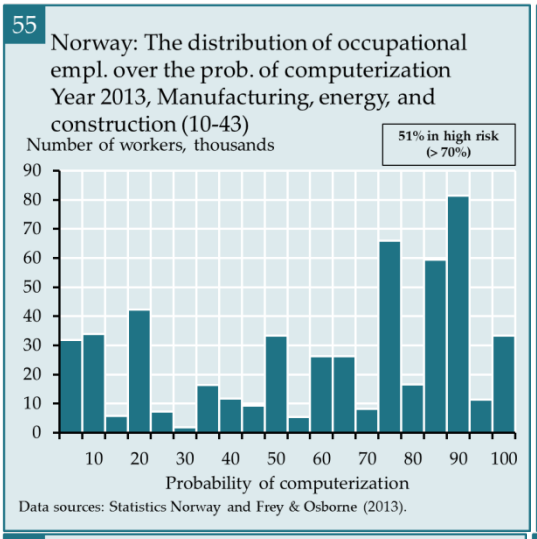
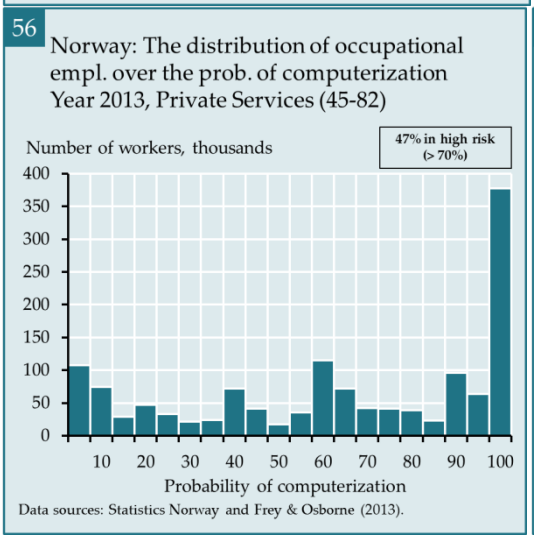
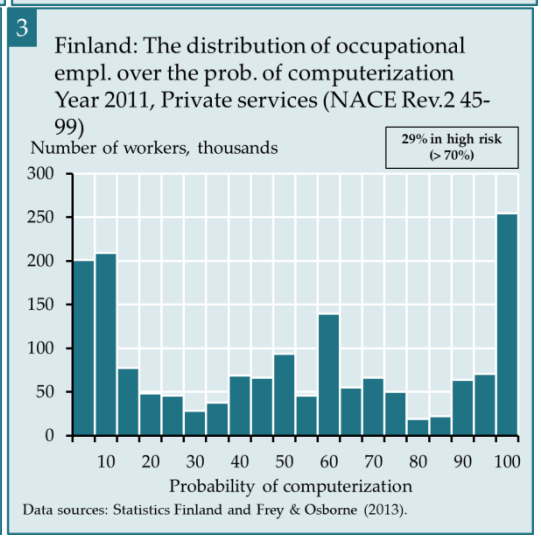
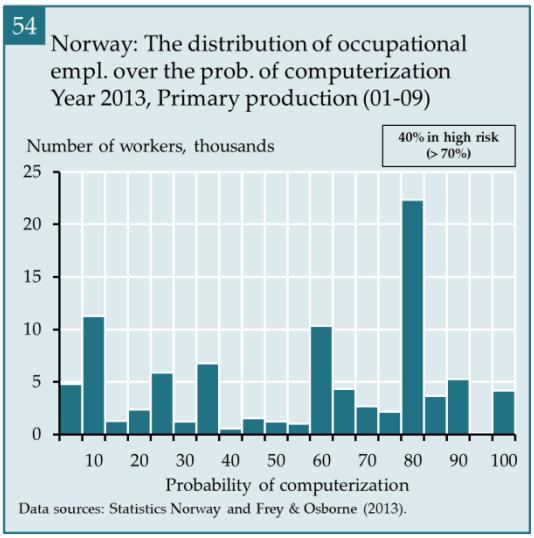
12. Appendix 1. The probabilities of computerization by employer and worker characteristics

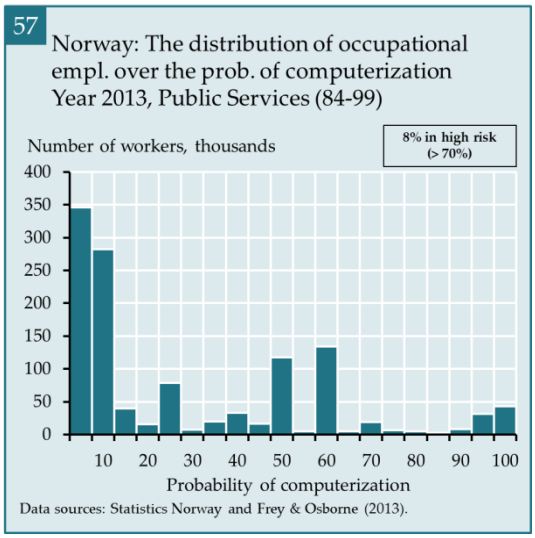
This appendix reports the probabilities of computerization by employer and worker characteristics in Norway and Finland. Manufacturing sector includes Nace Rev. 2 industry codes 10–43 and private services Nace Rev. 2 industry codes 45–82. In the case of Norway there are also charts on primary production (Nace Rev. 2 codes 01–09), and public and miscellaneous services (Nace Rev. 2 codes 84–99). High education group includes workers with university degree (ISCED 1997 classes 6–8) and other education consists of all other workers. Employer type (private/public) is based on business register information and High/low wage occupations are categorized by the median wage level of all occupations in the economy. The charts have been organized such that on the left are the charts for Norway and on the right are the charts for Finland, respectively, apart from the primary production and public and miscellaneous services charts which are available only for Norway.








54
Norway: The distribution of occupational empl. over the prob. of computerization Year 2013, Primary production (01-09)
Number of workers, thousands
40% in high risk (> 70%)
25
20
15
10
5
0
10 20 30 40 50 60 70 80 90 100
Probability of computerization
Data sources: Statistics Norway and Frey & Osborne (2013).


57
Norway: The distribution of occupational empl. over the prob. of computerization Year 2013, Public Services (84-99)
Number of workers, thousands
8% in high risk (> 70%)
400
350
300
250
200
150
100
50
0
10 20 30 40 50 60 70 80 90 100
Probability of computerization
Data sources: Statistics Norway and Frey & Osborne (2013).

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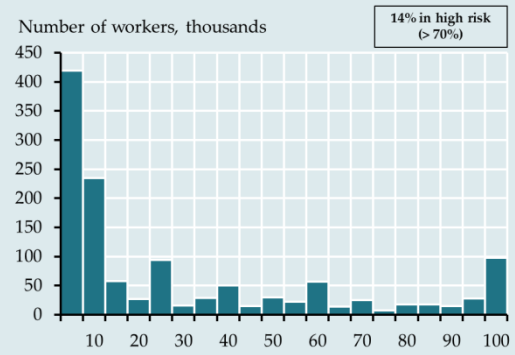
58 Norway: The distribution of occupational empl. over the prob. of computerization Year 2013, University degree (6,7,8)

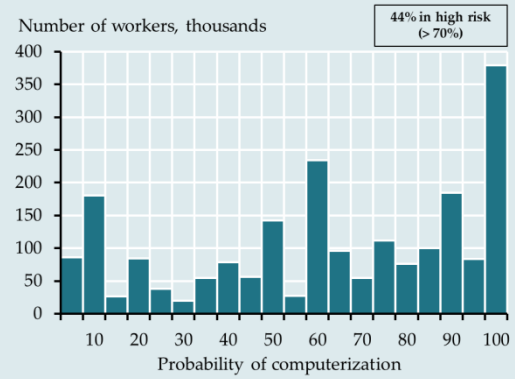


Data sources: Statistics Norway and Frey & Osborne (2013).

4 Finland: The distribution of occupational empl. over the prob. of computerization Year 2011, University degree (6,7,8)

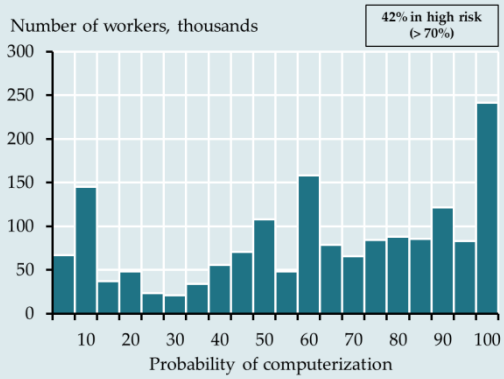
Data sources: Statistics Finland and Frey & Osborne (2013).

59 Norway: The distribution of occupational empl. over the prob. of computerization Year 2013, Other education



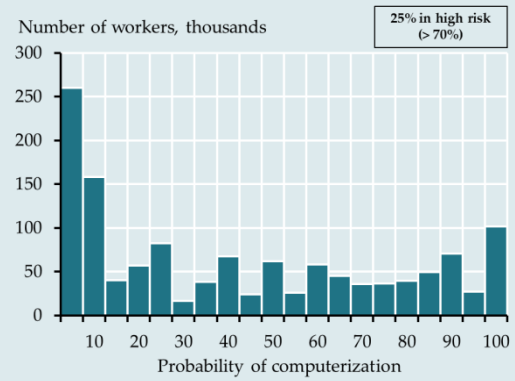
Data sources: Statistics Norway and Frey & Osborne (2013).

5 Finland: The distribution of occupational empl. over the prob. of computerization Year 2011, Other education



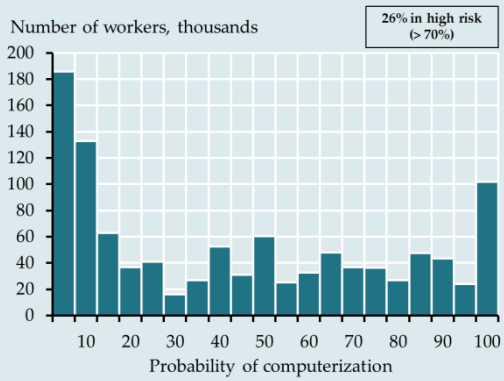
Data sources: Statistics Finland and Frey & Osborne (2013).

60 Norway: The distribution of occupational empl. over the prob. of computerization Year 2013, High wage



Data sources: Statistics Norway and Frey & Osborne (2013).

6 Finland: The distribution of occupational empl. over the prob. of computerization Year 2011, High wage



Data sources: Statistics Finland and Frey & Osborne (2013).

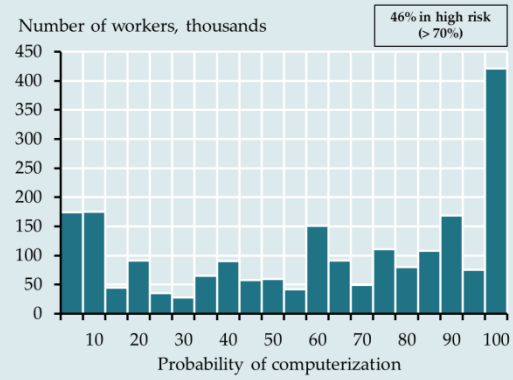
61 Norway: The distribution of occupational empl. over the prob. of computerization Year 2013, Low wage

Data sources: Statistics Norway and Frey & Osborne (2013).

7 Finland: The distribution of occupational empl. over the prob. of computerization Year 2011, Low wage

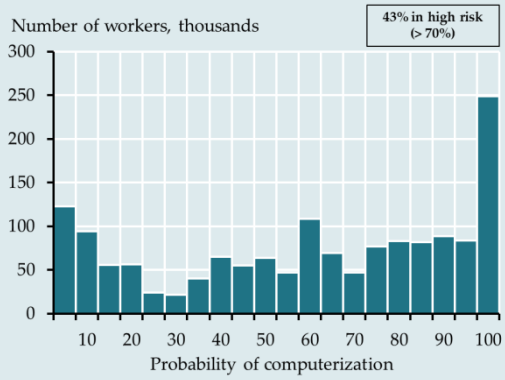
Data sources: Statistics Finland and Frey & Osborne (2013).

62 Norway: The distribution of occupational empl. over the prob. of computerization Year 2013, Private sector employers



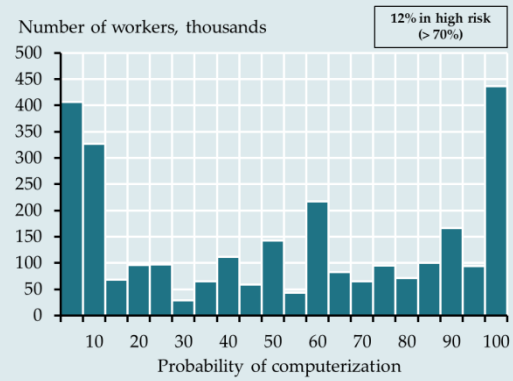
Data sources: Statistics Norway and Frey & Osborne (2013).

8 Finland: The distribution of occupational empl. over the prob. of computerization Year 2011, Private sector



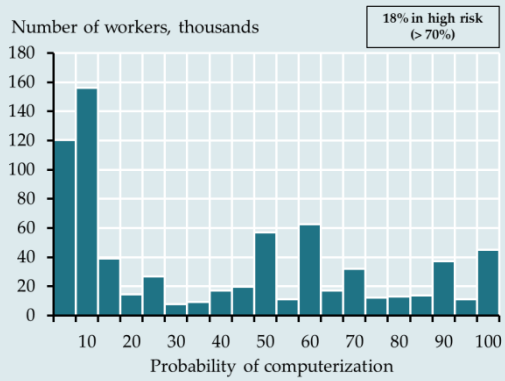
Data sources: Statistics Finland and Frey & Osborne (2013).

63 Norway: The distribution of occupational empl. over the prob. of computerization Year 2013, Public sector employers



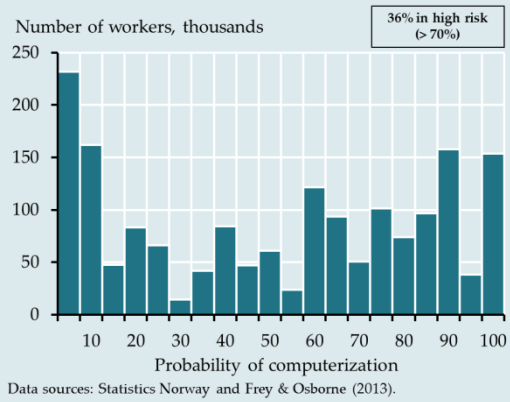
Data sources: Statistics Norway and Frey & Osborne (2013).

9 Finland: The distribution of occupational empl. over the prob. of computerization Year 2011, Public sector



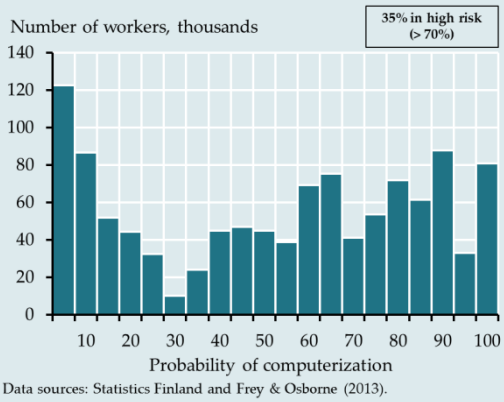
Data sources: Statistics Finland and Frey & Osborne (2013).

64 Norway: The distribution of occupational empl. over the prob. of computerization Year 2013, Males



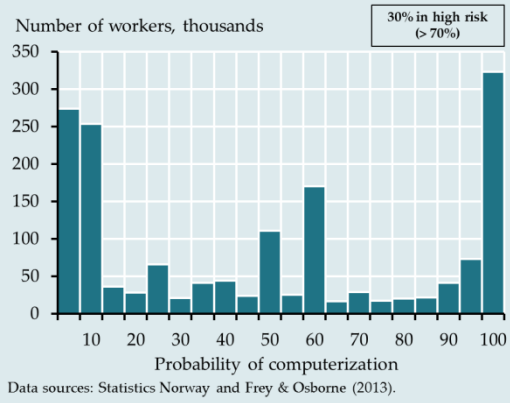
Data sources: Statistics Norway and Frey & Osborne (2013).

10 Finland: The distribution of occupational empl. over the prob. of computerization Year 2011, Males



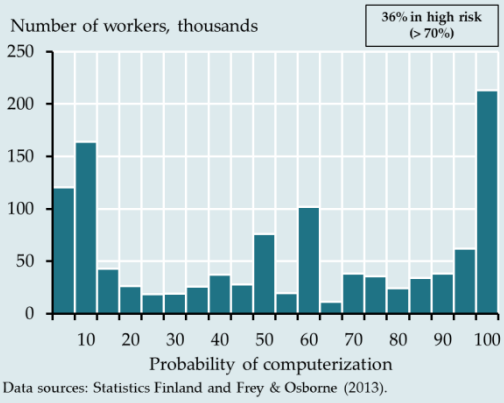
Data sources: Statistics Finland and Frey & Osborne (2013).

65 Norway: The distribution of occupational empl. over the prob. of computerization Year 2013, Females



Data sources: Statistics Norway and Frey & Osborne (2013).

11 Finland: The distribution of occupational empl. over the prob. of computerization Year 2011, Females



Data sources: Statistics Finland and Frey & Osborne (2013).

13. Appendix 2. The preparation of the Norwegian data

Among labour marked statisticians it is a well-know fact that occupational classification is not easy. The fundamental reason is that occupation is not a standardized concept in everyday life. Employers and employees do not have to use occupational titles and they are certainly not forced to use a standardized classification in a systematic way. The choice of titles is influenced by many factors, not the least "title fashion", there is a tendency to "job title inflation"[10]. Titles with negative associations are replaced by more "modern" and/or "neutral" titles, very often containing less information than the old titles where one know more what kind of work task it did consist of. Some titles commonly used are very general, like secretary, advisor etc.

In addition to these more fundamental problems of occupational classification there are other more technical problems, which of course reflect the basic problems of occupational classification. First of all there is no system in place in Norway that gives the self-employed occupational codes. Statistic Norway's official statistics use imputation based on education, industry, age etc. to classify the self-employed into occupational groups. In this context, we have chosen not to use these imputations. The imputation algorithm is constructed in order to give results at a more aggregate level similar to the occupational distribution in the Norwegian Labour Force Survey, so the imputation does not create the detailed 4-digit ISCO-08 codes needed to replicate the Finnish and US studies for all occupations. Since the study is not focusing primarily on the actual numbers, but more on the share of the workforce susceptible to computerization we did not want to introduce the extra uncertainty that using imputed data would introduce even those cases where the imputation is on the 4-digit level.

Table 1 Occupations by industry, 2013, Norway

	1. Primary production (01-09)	2. Manuf., energy, construct. (10-43)	3. Private Services (45-82)	4. Public Services (84-99)	Total
0 Public sector wage codes	3 493	3 740	44 606	206 230	258 069
1 Managers	10 041	52 405	137 876	71 844	272 1
2 Professionals	19 784	36 637	148 778	194 878	400 077
3 Technicians and assoc. prof.	18 764	70 728	252 206	355 800	697 498
4 Clerical support workers	3 764	33 939	132 312	35 978	205 993
5 Service and sales workers	1 551	15 024	396 741	414 987	828 303
6 Agricultural, forestry and fishery	19 063	790	1 581	1 052	22 486
7 Craft and related trades workers	12 190	223 927	72 379	8 176	316 672
8 Plant and machine operators	19 849	117 862	88 855	6 059	232 625
9 Elementary occupations	3 508	34 397	104 576	29 938	172 419
Missing, invalid codes	43 520	39 665	171 501	129 135	383 821

[10] about:Tabshttps://www.iser.essex.ac.uk/files/esec/events/isco-classification/UpdatingISCO88.doc

Totalsum	**155 527**	**629 114**	**1 551 411**	**1 454 077**	**3 790 129**

The table shows the distribution of occupations on a one-digit, "main group" level and also the Public sector wages codes and Missing codes. We see that the public sector wage codes typically codes advisor, senior adviser etc., that are more an indication of your position in the hierarchy in the work-place and your wage than what you actually do. These codes are then, by taking into consideration other information about the person and the work place, recoded into ISCO-08 four digit level codes. Since the "wage codes" in most cases are coded into rather general manager, professional or assoc. professional ISCO codes, our hypothesis is that this does not create any severe biases. There is probably a tendency to rather recode into more general groups, than to more specific ones.

The other occupational codes are supplied by the employer in ISCO-88 codes, which then are recoded into ISCO-08, but again our hypothesis is that this does not create any major problems, the conversion from ISCO-88 to ISCO-08 is fairly straightforward and the difference between the 1988 standard and the 2008 standard should not move many groups from occupations with very different probability of being computerized. Below is the table in percentages.

Table 2 Occupations by industry, 2013, Norway, percent

	1. Primary production (01-09)	**2. Manuf., energy, construct. (10-43)**	**3. Private Services (45-82)**	**4. Public Services (84-99)**	**Total**
0 Public sector wage codes	2,2	0,6	2,9	14,2	6,8
1 Managers	6,5	8,3	8,9	4,9	7,2
2 Professionals	12,7	5,8	9,6	13,4	10,6
3 Technicians and assoc. prof.	12,1	11,2	16,3	24,5	18,4
4 Clerical support workers	2,4	5,4	8,5	2,5	5,4
5 Service and sales workers	1,0	2,4	25,6	28,5	21,9
6 Agricultural, forestry and fishery	12,3	0,1	0,1	0,1	0,6
7 Craft and related trades workers	7,8	35,6	4,7	0,6	8,4
8 Plant and machine operators	12,8	18,7	5,7	0,4	6,1
9 Elementary occupations	2,3	5,5	6,7	2,1	4,5
Missing, invalid codes	28,0	6,3	11,1	8,9	10,1
Totalsum	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**

Although far from marginal, especially in the public services sectors, the "wage code" category is a bit less than 7 %, and still not more than 7,6 % if we look at only those with a valid code, that is disregarding the 10,1 % with a missing or invalid code.

If we take a closer look at the persons that are employed, but with a missing code by looking at their distribution by industry using a 98, so-called two digit[11], sectorial break-down, we find (not shown here) that the sectors, 18 of 98, with more than 15 % missing occupational codes, that is clearly above the 10,1 average has just below 360 thousand employees out of 2,9 million, that is 12,5 %.

[11] Two digit means using the first two digits of the 5-digit numerical part of the NACE industrial classification.

Table 3 Five sectors with a high share of missing occupational codes

NACE 2-digit sector	Missing code	Valid code	Total no employees	Percent missing
Land transport	13 730	62 950	76 680	17,9 %
Crop and animal production, hunting	32 348	41 991	74 339	43,5 %
Real estate, sale and managment	7 105	27 043	34 148	20,8 %
Other personal service activitie	7 353	23 292	30 645	24,0 %
Creative, arts and entertainment activities	10 299	15 832	26 131	39,4 %
Fishing and aquaculture	9 362	15 168	24 530	38,2 %
Sport and leisure activities	4 552	18 659	23 211	19,6 %

The table shows the five sectors with the largest number of employees of the sectors with more than 15 % missing occupational codes. The largest, “land transport” is number 10 of the 98, two-digit sectors, Sport and leisure activities is number 34 in that ranking. This level of missing occupational codes clearly influences the final results, but to which degree is more difficult to estimate, because we do not know which occupational codes become underrepresented. A comparison with the occupational structure in other countries is not an easy task either, because at this fairly detailed level industrial structures are different, the technologies used are different and that in itself makes a direct comparison difficult. In addition the systems of data collection are different, so to do such a comparative study was clearly beyond the scope of this project. Our hypothesis is that since the level of missing codes is not more than 10 % and that the distribution if fairly evenly spread it will not influence the results in a very significant way.

Even after having converted all valid ISCO-88 and all “wage codes” to ISCO-08, there were some minor coding issues. The “biggest” one was a trivial recoding of different groups of nurses into Nursing professionals and Nursing associate professionals

So while there clearly are some problems of coverage and quality, we do not think they have any major impact on the results. The key issues relating to how to interpret the results is clearly connected to the Frey and Osborne method, the choice of the computerization probabilities in particular.

14. Appendix 3. Probabilities of computerization by occupation in Norway in 2013

This appendix reports the probabilities of computerization and the number of workers by 4-digit ISCO-08 codes in Norway in 2013. Data source of employment is Statistics Norway and the probabilities of computerization are based on Frey & Osborne (2013). Due to conversion of the probabilities defined for US occupations to ISCO, the probabilities as well as task contents by occupation may differ from those reported in Frey & Osborne (2013). Occupations with less than 20 workers have been omitted from the list.

ISCO-08 code	ISCO-08 title	Number of workers	Probability of compurerization
2351	Education methods specialists	3544	0.004
1411	Hotel managers	970	0.004
2265	Dieticians and nutritionists	776	0.004
2266	Audiologists and speech therapists	204	0.005
1345	Education managers	14593	0.007
1342	Health services managers	12639	0.007
2634	Psychologists	8948	0.007
1344	Social welfare managers	3421	0.007
2330	Secondary education teachers	43065	0.008
2221	Nursing professionals	118417	0.009
2359	Teaching professionals not elsewhere classified	3201	0.009
2511	Systems analysts	22890	0.011
2269	Health professionals not elsewhere classified	20439	0.012
2262	Pharmacists	19979	0.012
2352	Special needs teachers	2588	0.012
2132	Farming, forestry and fisheries advisers	798	0.012
1221	Sales and marketing managers	18953	0.014
3341	Office supervisors	6878	0.014
2424	Training and staff development professionals	955	0.014
2356	Information technology trainers	44	0.014
1341	Child care services managers	5505	0.015
3122	Manufacturing supervisors	1359	0.016
2636	Religious professionals	3526	0.017
2145	Chemical engineers	675	0.017
2161	Building architects	6679	0.018
1223	Research and development managers	2931	0.018
2143	Environmental engineers	248	0.018
2142	Civil engineers	29966	0.019
2264	Physiotherapists	8319	0.021
2261	Dentists	3146	0.021
3431	Photographers	1556	0.021
2133	Environmental protection professionals	340	0.025

ISCO-08 code	ISCO-08 title	Number of workers	Probability of compurerization
1222	Advertising and public relations managers	1706	0.027
2163	Product and garment designers	845	0.029
2141	Industrial and production engineers	709	0.029
1321	Manufacturing managers	15907	0.030
2522	Systems administrators	842	0.030
2521	Database designers and administrators	479	0.030
3514	Web technicians	361	0.030
2310	University and higher education teachers	53004	0.032
2149	Engineering professionals not elsewhere classified	8397	0.034
2611	Lawyers	9924	0.035
1330	Information and communications technology service managers	5193	0.035
3151	Ships' engineers	4627	0.035
3332	Conference and event planners	715	0.037
2250	Veterinarians	1234	0.038
2651	Visual artists	319	0.038
2635	Social work and counselling professionals	7704	0.043
2652	Musicians, singers and composers	4108	0.045
2162	Landscape architects	757	0.045
3311	Securities and finance dealers and brokers	5494	0.046
1311	Agricultural and forestry production managers	1596	0.047
1312	Aquaculture and fisheries production managers	220	0.047
3258	Ambulance workers	8607	0.049
2166	Graphic and multimedia designers	5051	0.049
7413	Electrical line installers and repairers	7027	0.050
3230	Traditional and complementary medicine associate professionals	119	0.055
1112	Senior government officials	4786	0.059
2619	Legal professionals not elsewhere classified	606	0.060
3351	Customs and border inspectors	1355	0.061
2113	Chemists	810	0.061
2653	Dancers and choreographers	544	0.067
1211	Finance managers	12813	0.069
3154	Air traffic controllers	865	0.069
2355	Other arts teachers	189	0.070
1323	Construction managers	13764	0.071
2421	Management and organization analysts	7713	0.071
3423	Fitness and recreation instructors and program leaders	3717	0.075
2342	Early childhood educators	38564	0.079
5311	Child care workers	115506	0.080
2131	Biologists, botanists, zoologists and related professionals	1232	0.080
2642	Journalists	12271	0.082
1412	Restaurant managers	2458	0.083
1343	Aged care services managers	3624	0.084
2146	Mining engineers, metallurgists and related professionals	15486	0.085

ISCO-08 code	ISCO-08 title	Number of workers	Probability of compurerization
2512	Software developers	4603	0.086
2341	Primary school teachers	111655	0.087
1120	Managing directors and chief executives	50468	0.087
5411	Fire-fighters	5157	0.087
2151	Electrical engineers	2676	0.100
2632	Sociologists, anthropologists and related professionals	1189	0.106
2434	Information and communications technology sales professionals	792	0.110
1346	Financial and insurance services branch managers	9096	0.114
2654	Film, stage and related directors and producers	1404	0.118
2152	Electronics engineers	5709	0.122
3412	Social work associate professionals	29735	0.130
2354	Other music teachers	6170	0.130
5165	Driving instructors	2195	0.130
2164	Town and traffic planners	1141	0.130
2144	Mechanical engineers	5717	0.132
2320	Vocational education teachers	1237	0.134
2267	Optometrists and ophthalmic opticians	3278	0.140
1114	Senior officials of special-interest organizations	3922	0.142
2120	Mathematicians, actuaries and statisticians	581	0.148
7411	Building and related electricians	39695	0.150
3152	Ships' deck officers and pilots	9033	0.150
1420	Retail and wholesale trade managers	37672	0.160
5221	Shopkeepers	24	0.160
2433	Technical and medical sales professionals (excluding ICT)	3819	0.163
3432	Interior designers and decorators	2252	0.169
3123	Construction supervisors	7334	0.170
1431	Sports, recreation and cultural centre managers	2812	0.170
3121	Mining supervisors	125	0.170
3355	Police inspectors and detectives	12440	0.172
2633	Philosophers, historians and political scientists	351	0.173
2432	Public relations professionals	3607	0.180
7541	Underwater divers	535	0.180
3259	Health associate professionals not elsewhere classified	105	0.187
2111	Physicists and astronomers	415	0.190
2643	Translators, interpreters and other linguists	1120	0.210
2523	Computer network professionals	209	0.210
2519	Software and applications developers and analysts not elsewhere classified	18045	0.220
2529	Database and network professionals not elsewhere classified	2595	0.220
2422	Policy administration professionals	90616	0.230
3116	Chemical engineering technicians	2484	0.240
1322	Mining managers	7670	0.250
1349	Professional services managers not elsewhere classified	7268	0.250
1439	Services managers not elsewhere classified	1516	0.250

ISCO-08 code	ISCO-08 title	Number of workers	Probability of compurerization
1213	Policy and planning managers	157	0.250
3153	Aircraft pilots and related associate professionals	2511	0.253
4221	Travel consultants and clerks	5891	0.261
3211	Medical imaging and therapeutic equipment technicians	3578	0.262
2423	Personnel and careers professionals	12859	0.263
5169	Personal services workers not elsewhere classified	258	0.279
5222	Shop supervisors	7372	0.280
3421	Athletes and sports players	2307	0.280
2656	Announcers on radio, television and other media	488	0.296
3339	Business services agents not elsewhere classified	128	0.298
3256	Medical assistants	11832	0.300
5413	Prison guards	5696	0.313
2114	Geologists and geophysicists	3360	0.322
2431	Advertising and marketing professionals	7774	0.324
1212	Human resource managers	2918	0.324
7127	Air conditioning and refrigeration mechanics	4146	0.326
2641	Authors and related writers	1892	0.328
5141	Hairdressers	13878	0.329
3119	Physical and engineering science technicians not elsewhere classified	30520	0.342
5113	Travel guides	1318	0.348
1219	Business services and administration managers not elsewhere classified	38434	0.355
7232	Aircraft engine mechanics and repairers	3384	0.356
3324	Trade brokers	925	0.360
3434	Chefs	5010	0.365
9122	Vehicle cleaners	3264	0.370
2655	Actors	1072	0.370
5163	Undertakers and embalmers	942	0.370
9311	Mining and quarrying labourers	39	0.370
5142	Beauticians and related workers	2858	0.371
3422	Sports coaches, instructors and officials	4206	0.374
5111	Travel attendants and travel stewards	3746	0.376
9321	Hand packers	1854	0.380
2621	Archivists and curators	1213	0.383
5112	Transport conductors	1560	0.389
3353	Government social benefits officials	1130	0.390
7534	Upholsterers and related workers	484	0.390
3322	Commercial sales representatives	58852	0.392
5322	Home-based personal care workers	15738	0.402
2412	Financial and investment advisers	11465	0.405
8332	Heavy truck and lorry drivers	33823	0.410
7535	Pelt dressers, tanners and fellmongers	183	0.410
3143	Forestry technicians	891	0.420
5245	Service station attendants	5305	0.429

ISCO-08 code	ISCO-08 title	Number of workers	Probability of compurerization
2631	Economists	2410	0.430
3240	Veterinary technicians and assistants	1300	0.445
7312	Musical instrument makers and tuners	54	0.457
2413	Financial analysts	11026	0.460
5419	Protective services workers not elsewhere classified	2544	0.463
5164	Pet groomers and animal care workers	145	0.464
7314	Potters and related workers	31	0.467
5321	Health care assistants	117662	0.470
7234	Bicycle and related repairers	136	0.471
3214	Medical and dental prosthetic technicians	1204	0.475
3115	Mechanical engineering technicians	9560	0.477
9611	Garbage and recycling collectors	6488	0.480
7542	Shotfirers and blasters	1919	0.480
8344	Lifting truck operators	1345	0.480
7126	Plumbers and pipe fitters	19758	0.485
7549	Craft and related workers not elsewhere classified	1575	0.509
3312	Credit and loans officers	25352	0.510
5242	Sales demonstrators	349	0.510
3118	Draughtspersons	3964	0.513
9333	Freight handlers	3625	0.514
2622	Librarians and related information professionals	3211	0.520
2612	Judges	1342	0.520
7318	Handicraft workers in textile, leather and related materials	310	0.520
7536	Shoemakers and related workers	97	0.520
3257	Environmental and occupational health inspectors and associates	5284	0.530
7532	Garment and related pattern-makers and cutters	84	0.532
3141	Life science technicians (excluding medical)	1555	0.535
7421	Electronics mechanics and servicers	2354	0.536
3433	Gallery, museum and library technicians	230	0.538
7311	Precision-instrument makers and repairers	867	0.558
5312	Teachers' aides	15352	0.560
8312	Railway brake, signal and switch operators	168	0.563
3112	Civil engineering technicians	22879	0.565
7321	Pre-press technicians	2723	0.565
8322	Car, taxi and van drivers	23523	0.568
6111	Field crop and vegetable growers	256	0.570
9112	Cleaners and helpers in offices, hotels and other establishments	87244	0.573
3117	Mining and metallurgical technicians	17809	0.575
4224	Hotel receptionists	8514	0.575
7422	Information and communications technology installers and servicers	4424	0.583
7119	Building frame and related trades workers not elsewhere classified	4002	0.585
5329	Personal care workers in health services not elsewhere	90993	0.587

ISCO-08 code	ISCO-08 title	Number of workers	Probability of compurerization
	classified		
1324	Supply, distribution and related managers	10161	0.590
3251	Dental assistants and therapists	1114	0.595
3132	Incinerator and water treatment plant operators	1414	0.597
3521	Broadcasting and audio-visual technicians	1854	0.600
3435	Other artistic and cultural associate professionals	1942	0.610
8331	Bus and tram drivers	20137	0.612
3131	Power production plant operators	1785	0.614
4212	Bookmakers, croupiers and related gaming workers	1256	0.616
7233	Agricultural and industrial machinery mechanics and repairers	24425	0.622
2165	Cartographers and surveyors	1196	0.630
3333	Employment agents and contractors	13102	0.640
9334	Shelf fillers	1029	0.640
3323	Buyers	6877	0.643
9622	Odd job persons	3381	0.643
7412	Electrical mechanics and fitters	7826	0.644
7231	Motor vehicle mechanics and repairers	25295	0.645
8343	Crane, hoist and related plant operators	2614	0.654
5153	Building caretakers	30813	0.660
9123	Window cleaners	117	0.660
3321	Insurance representatives	12237	0.662
6113	Gardeners, horticultural and nursery growers	6027	0.670
2112	Meteorologists	323	0.670
7515	Food and beverage tasters and graders	92	0.675
8311	Locomotive engine drivers	1811	0.677
3334	Real estate agents and property managers	5818	0.679
3343	Administrative and executive secretaries	10606	0.680
3212	Medical and pathology laboratory technicians	6845	0.685
9111	Domestic cleaners and helpers	727	0.690
8111	Miners and quarriers	1249	0.696
6222	Inland and coastal waters fishery workers	380	0.700
8157	Laundry machine operators	2780	0.710
3254	Dispensing opticians	1474	0.710
7214	Structural-metal preparers and erectors	6895	0.713
7115	Carpenters and joiners	61035	0.720
8350	Ships' deck crews and related workers	10163	0.725
7125	Glaziers	1889	0.730
8152	Weaving and knitting machine operators	1116	0.730
5120	Cooks	28009	0.732
7544	Fumigators and other pest and weed controllers	539	0.733
7124	Insulation workers	1617	0.735
8171	Pulp and papermaking plant operators	3441	0.740
4222	Contact centre information clerks	7023	0.755
6130	Mixed crop and animal producers	6809	0.760

ISCO-08 code	ISCO-08 title	Number of workers	Probability of compurerization
6221	Aquaculture workers	5869	0.760
6121	Livestock and dairy producers	4124	0.760
6122	Poultry producers	214	0.760
5132	Bartenders	7448	0.770
8113	Well drillers and borers and related workers	18334	0.772
7222	Toolmakers and related workers	2436	0.773
7212	Welders and flamecutters	8400	0.775
3155	Air traffic safety electronics technicians	1950	0.775
3511	Information and communications technology operations technicians	22153	0.780
7213	Sheet-metal workers	6265	0.780
9629	Elementary workers not elsewhere classified	1058	0.790
8341	Mobile farm and forestry plant operators	914	0.790
6210	Forestry and related workers	1001	0.792
9313	Building construction labourers	8891	0.800
7132	Spray painters and varnishers	5026	0.800
8211	Mechanical machinery assemblers	2171	0.805
7131	Painters and related workers	8762	0.810
7211	Metal moulders and coremakers	628	0.810
8143	Paper products machine operators	584	0.810
4131	Typists and word processing operators	44	0.810
8181	Glass and ceramics plant operators	1834	0.813
8160	Food and related products machine operators	29539	0.816
7112	Bricklayers and related workers	6187	0.820
7122	Floor layers and tile setters	1947	0.820
8141	Rubber products machine operators	598	0.822
3113	Electrical engineering technicians	5830	0.825
3134	Petroleum and natural gas refining plant operators	2152	0.825
7322	Printers	2195	0.830
9216	Fishery and aquaculture labourers	664	0.830
9129	Other cleaning workers	35	0.830
7315	Glass makers, cutters, grinders and finishers	185	0.837
3114	Electronics engineering technicians	14317	0.840
9329	Manufacturing labourers not elsewhere classified	10386	0.840
3522	Telecommunications engineering technicians	991	0.840
7531	Tailors, dressmakers, furriers and hatters	618	0.840
7511	Butchers, fishmongers and related food preparers	2723	0.845
8131	Chemical products plant and machine operators	11840	0.847
9412	Kitchen helpers	19804	0.850
3133	Chemical processing plant controllers	351	0.850
4321	Stock clerks	42512	0.857
4412	Mail carriers and sorting clerks	15422	0.860
8172	Wood processing plant operators	6452	0.860
7113	Stonemasons, stone cutters, splitters and carvers	878	0.860
9215	Forestry labourers	649	0.870

ISCO-08 code	ISCO-08 title	Number of workers	Probability of compurerization
7223	Metal working machine tool setters and operators	5291	0.871
9312	Civil engineering labourers	16794	0.880
8121	Metal processing plant operators	11193	0.880
4322	Production clerks	7361	0.880
8114	Cement, stone and other mineral products machine operators	2566	0.880
3135	Metal production process controllers	373	0.880
7114	Concrete placers, concrete finishers and related workers	11904	0.883
9621	Messengers, package deliverers and luggage porters	4647	0.885
7512	Bakers, pastry-cooks and confectionery makers	2416	0.890
7215	Riggers and cable splicers	1612	0.890
8153	Sewing machine operators	1377	0.890
8112	Mineral and stone processing plant operators	268	0.890
8182	Steam engine and boiler operators	29	0.890
8342	Earthmoving and related plant operators	26964	0.892
5414	Security guards	17972	0.895
9623	Meter readers and vending-machine collectors	252	0.895
5131	Waiters	30177	0.900
7121	Roofers	1688	0.900
5230	Cashiers and ticket clerks	769	0.900
4416	Personnel clerks	327	0.900
8142	Plastic products machine operators	3425	0.906
4225	Enquiry clerks	331	0.910
7522	Cabinet-makers and related workers	1640	0.915
3213	Pharmaceutical technicians and assistants	5807	0.920
8212	Electrical and electronic equipment assemblers	4500	0.922
8189	Stationary plant and machine operators not elsewhere classified	283	0.922
7224	Metal polishers, wheel grinders and tool sharpeners	186	0.925
5246	Food service counter attendants	19653	0.930
9612	Refuse sorters	803	0.930
7221	Blacksmiths, hammersmiths and forging press workers	287	0.930
3352	Government tax and excise officials	61	0.930
3359	Regulatory government associate professionals not elsewhere classified	31350	0.940
5151	Cleaning and housekeeping supervisors in offices, hotels and other establishments	3571	0.940
4227	Survey and market research interviewers	1634	0.940
5211	Stall and market salespersons	751	0.940
5243	Door to door salespersons	511	0.940
9520	Street vendors (excluding food)	406	0.940
5152	Domestic housekeepers	304	0.940
4415	Filing and copying clerks	529	0.945
5223	Shop sales assistants	240209	0.950
9214	Garden and horticultural labourers	1684	0.950
4214	Debt-collectors and related workers	1654	0.950

ISCO-08 code	ISCO-08 title	Number of workers	Probability of compurerization
7313	Jewellery and precious-metal workers	545	0.950
7323	Print finishing and binding workers	440	0.950
3315	Valuers and loss assessors	1190	0.953
2411	Accountants	16535	0.957
4226	Receptionists (general)	14139	0.960
4323	Transport clerks	11158	0.960
8151	Fibre preparing, spinning and winding machine operators	177	0.960
4223	Telephone switchboard operators	2927	0.965
4211	Bank tellers and related clerks	2303	0.965
4312	Statistical, finance and insurance clerks	169	0.968
4110	General office clerks	101093	0.970
4311	Accounting and bookkeeping clerks	27939	0.970
4313	Payroll clerks	2996	0.970
5249	Sales workers not elsewhere classified	1165	0.970
3142	Agricultural technicians	749	0.970
4411	Library clerks	461	0.970
8154	Bleaching, dyeing and fabric cleaning machine operators	229	0.970
8219	Assemblers not elsewhere classified	163	0.970
8156	Shoemaking and related machine operators	68	0.970
3313	Accounting associate professionals	27789	0.980
8183	Packing, bottling and labelling machine operators	1787	0.980
3342	Legal secretaries	1151	0.980
3331	Clearing and forwarding agents	6206	0.985
5244	Contact centre salespersons	15627	0.990
4132	Data entry clerks	443	0.990
8132	Photographic products machine operators	227	0.990

15. **Appendix 4. Probabilities of computerization** (Norske yrkestitler)

	Tittel	Antall	Sannsynlighet
1411	Hotellsjefer	970	0.004
2265	Ernæringsfysiologer	776	0.004
2351	Spesialister i pedagogikk	3544	0.004
2266	Audiografer og logopeder	204	0.005
1342	Ledere av helsetjenester	12639	0.007
1344	Ledere av sosialomsorg	3421	0.007
1345	Ledere av utdanning og undervisning	14593	0.007
2634	Psykologer	8948	0.007
2330	Lektorer mv. (videregående skole)	43065	0.008
2221	Spesialsykepleiere	118417	0.009
2359	Andre lærere	3201	0.009
2511	Systemanalytikere/-arkitekter	22890	0.011

	Tittel	Antall	Sannsynlighet
2132	Sivilagronomer mv.	798	0.012
2262	Farmasøyter	19979	0.012
2269	Kiropraktorer mv.	20439	0.012
2352	Spesiallærere / spesialpedagoger	2588	0.012
1221	Salgs- og markedssjefer	18953	0.014
2356	Andre IKT-lærere	44	0.014
2424	Rådgivere innen kompetanseutvikling	955	0.014
3341	Arbeidsledere for kontorpersonell	6878	0.014
1341	Ledere av omsorgstjenester for barn	5505	0.015
3122	Arbeidsleder, industri	1359	0.016
2145	Sivilingeniører (kjemi)	675	0.017
2636	Geistlige yrker	3526	0.017
1223	Forsknings- og utviklingsledere	2931	0.018
2143	Sivilingeniører (miljøteknikk)	248	0.018
2161	Sivilarkitekter	6679	0.018
2142	Sivilingeniører (bygg og anlegg)	29966	0.019
2261	Tannleger	3146	0.021
2264	Fysioterapeuter	8319	0.021
3431	Fotografer og filmfotografer	1556	0.021
2133	Miljøvernrådgivere	340	0.025
1222	PR- og informasjonssjefer	1706	0.027
2141	Sivilingeniører (industri og produksjon)	709	0.029
2163	Produkt- og klesdesignere	845	0.029
1321	Ledere av industriproduksjon mv.	15907	0.030
2521	Databasedesignere og -administratorer	479	0.030
2522	Systemadministratorer	842	0.030
3514	Internett-teknikere	361	0.030
2310	Universitets- og høyskolelektorer/-lærere	53004	0.032
2149	Andre sivilingeniører (unntatt elektroteknologi)	8397	0.034
1330	Ledere av IKT-enheter	5193	0.035
2611	Jurister og advokater	9924	0.035
3151	Skipsmaskinister	4627	0.035
3332	Konferanse- og arrangementsplanleggere mv.	715	0.037
2250	Veterinærer	1234	0.038
2651	Skulptører, kunstmalere og andre billedkunstnere	319	0.038
2635	Rådgivere innen sosiale fagfelt	7704	0.043
2162	Landskapsarkitekter	757	0.045
2652	Dirigenter, komponister, musikere og sangere	4108	0.045
3311	Finansmeglere	5494	0.046
1311	Ledere i skogbruk, gartnerier mv.	1596	0.047
1312	Ledere innen akvakultur mv.	220	0.047
2166	Grafiske- og multimediadesignere	5051	0.049
3258	Ambulansepersonell	8607	0.049
7413	Energimontører	7027	0.050

	Tittel	Antall	Sannsynlighet
3230	Yrker innen alternativ medisin	119	0.055
1112	Toppledere i offentlig administrasjon	4786	0.059
2619	Andre juridiske yrker	606	0.060
2113	Kjemikere	810	0.061
3351	Tollere	1355	0.061
2653	Koreografer og dansere	544	0.067
1211	Finans- og økonomisjefer	12813	0.069
3154	Flygeledere	865	0.069
2355	Andre lærere i estetiske fag	189	0.070
1323	Ledere av bygge- og anleggsvirksomhet	13764	0.071
2421	Organisasjonsrådgivere mv.	7713	0.071
3423	Sports- og aktivitetsinstruktører	3717	0.075
2342	Førskolelærere	38564	0.079
2131	Biologer, botanikere, zoologer mv.	1232	0.080
5311	Barnehage- og skolefritidsassistenter mv.	115506	0.080
2642	Journalister	12271	0.082
1412	Restaurantsjefer	2458	0.083
1343	Ledere av eldreomsorg	3624	0.084
2146	Sivilingeniører (geofag, petro-leumsteknologi, metallurgi mv.)	15486	0.085
2512	Programvareutviklere	4603	0.086
1120	Administrerende direktører	50468	0.087
2341	Grunnskolelærere	111655	0.087
5411	Brannkonstabler	5157	0.087
2151	Sivilingeniører (elkraftteknikk)	2676	0.100
2632	Rådgivere/forskere, samfunnsvitenskap	1189	0.106
2434	Salgskonsulenter innen IKT-produkter	792	0.110
1346	Ledere av forsikring og finansvirksomhet	9096	0.114
2654	Regissører	1404	0.118
2152	Sivilingeniører (elektronikk)	5709	0.122
2164	Arealplanleggere	1141	0.130
2354	Andre musikklærere	6170	0.130
3412	Miljøarbeidere innen sosiale fagfelt	29735	0.130
5165	Kjøreskolelærere	2195	0.130
2144	Sivilingeniører (maskin- og marin-teknikk)	5717	0.132
2320	Yrkesfaglærere	1237	0.134
2267	Ergoterapeuter	3278	0.140
1114	Toppledere i interesseorganisasjoner	3922	0.142
2120	Matematikere, statistikere mv.	581	0.148
3152	Dekksoffiserer og loser	9033	0.150
7411	Elektrikere	39695	0.150
1420	Varehandelssjefer	37672	0.160
5221	Innehavere av kiosk/liten butikk	24	0.160
2433	Salgskonsulenter innen tekniske og medisinske produkter	3819	0.163
3432	Interiørdesignere og dekoratører	2252	0.169

	Tittel	Antall	Sannsynlighet
1431	Sports-, rekreasjons- og kultursenterledere	2812	0.170
3121	Arbeidsleder, bergfag	125	0.170
3123	Arbeidsleder, bygg og anlegg	7334	0.170
3355	Politibetjenter mv.	12440	0.172
2633	Rådgivere/forskere, humanistiske fag	351	0.173
2432	Informasjonsrådgivere	3607	0.180
7541	Yrkesdykkere	535	0.180
3259	Andre helseyrker	105	0.187
2111	Fysikere og astronomer	415	0.190
2523	Nettverksansvarlige	209	0.210
2643	Oversettere, tolker mv.	1120	0.210
2519	Andre programvare- og applikasjonsutviklere	18045	0.220
2529	Sikkerhetsanalytikere mv.	2595	0.220
2422	Høyere saksbehandlere i offentlig og privat virksomhet	90616	0.230
3116	Kjemiingeniører	2484	0.240
1213	Strategi- og planleggingssjefer	157	0.250
1322	Ledere av olje- og gassutvinning mv.	7670	0.250
1349	Andre ledere av produksjon og tjenesteyting	7268	0.250
1439	Andre daglige ledere i tjenesteytende virksomheter	1516	0.250
3153	Flygere	2511	0.253
4221	Reisebyråmedarbeidere mv.	5891	0.261
3211	Radiografer mv.	3578	0.262
2423	Personal- og karriererådgivere	12859	0.263
5169	Andre personlige tjenesteytere	258	0.279
3421	Idrettsutøvere	2307	0.280
5222	Butikkavdelingssjefer	7372	0.280
2656	Programledere i TV og radio	488	0.296
3339	Andre yrker innen forretningstjenester	128	0.298
3256	Helsesekretærer	11832	0.300
5413	Fengselsbetjenter	5696	0.313
2114	Geologer og geofysikere	3360	0.322
1212	Personalsjefer	2918	0.324
2431	Reklame- og markedsføringsrådgivere	7774	0.324
7127	Kuldemontører mv.	4146	0.326
2641	Forfattere mv.	1892	0.328
5141	Frisører	13878	0.329
3119	Andre ingeniører	30520	0.342
5113	Reiseledere og guider	1318	0.348
1219	Andre administrative ledere	38434	0.355
7232	Mekanikere innen flytekniske fag	3384	0.356
3324	Handels- og skipsmeglere	925	0.360
3434	Sjefskokker	5010	0.365
2655	Skuespillere	1072	0.370
5163	Begravelsesbyrå- og krematoriearbeidere	942	0.370

	Tittel	Antall	Sannsynlighet
9122	Bilvaskere	3264	0.370
9311	Hjelpearbeidere i bergverk	39	0.370
5142	Kosmetologer mv.	2858	0.371
3422	Trenere og idrettsdommere	4206	0.374
5111	Flyverter, båtverter mv.	3746	0.376
9321	Håndpakkere mv.	1854	0.380
2621	Arkivarer og kuratorer	1213	0.383
5112	Konduktører	1560	0.389
3353	Saksbehandlere innen sosiale ytelser	1130	0.390
7534	Møbeltapetserere mv.	484	0.390
3322	Selgere (engros)	58852	0.392
5322	Hjemmehjelper	15738	0.402
2412	Finans- og investeringsrådgivere	11465	0.405
7535	Skinnberedere og garvere	183	0.410
8332	Lastebil- og trailersjåfører	33823	0.410
3143	Skogteknikere	891	0.420
5245	Servicemedarbeidere (bensinstasjon)	5305	0.429
2631	Rådgivere/forskere, samfunnsøkonomi	2410	0.430
3240	Dyrepleiere	1300	0.445
7312	Musikkinstrumentmakere og -stemmere	54	0.457
2413	Finansanalytikere	11026	0.460
5419	Andre sikkerhetsarbeidere	2544	0.463
5164	Dyrepassere og - trenere mv.	145	0.464
7314	Keramikere mv.	31	0.467
5321	Helsefagarbeidere	117662	0.470
7234	Sykkelreparatører mv.	136	0.471
3214	Protese- og tannteknikere	1204	0.475
3115	Maskiningeniører	9560	0.477
7542	Skytebaser og sprengningsarbeidere	1919	0.480
8344	Truckførere	1345	0.480
9611	Renovasjonsarbeidere	6488	0.480
7126	Rørleggere og VVS-montører	19758	0.485
7549	Andre håndverkere	1575	0.509
3312	Kundebehandlere lån og kreditt	25352	0.510
5242	Demonstrasjonsselgere	349	0.510
3118	Tekniske tegnere	3964	0.513
9333	Laste- og lossearbeidere	3625	0.514
2612	Dommere	1342	0.520
2622	Bibliotekarer og andre informasjonsarbeidere	3211	0.520
7318	Vevere, strikkere mv. (innen husflidsproduksjon)	310	0.520
7536	Skomakere	97	0.520
3257	Helse- og miljøkontrollører	5284	0.530
7532	Gradører	84	0.532
3141	Bioteknikere (ikke-medisinske laboratorier)	1555	0.535

	Tittel	Antall	Sannsynlighet
7421	Serviceelektronikere	2354	0.536
3433	Tekniske konservatorer	230	0.538
7311	Presisjonsinstrumentmakere og -reparatører	867	0.558
5312	Skoleassistenter	15352	0.560
8312	Skiftekonduktører mv	168	0.563
3112	Bygningsingeniører	22879	0.565
7321	Førtrykkere	2723	0.565
8322	Bil-, drosje- og varebilførere	23523	0.568
6111	Korn- og grønnsaksprodusenter	256	0.570
9112	Renholdere i virksomheter	87244	0.573
3117	Ingeniører innen petroleum, bergverk og metallurgi	17809	0.575
4224	Hotellresepsjonister	8514	0.575
7422	Tele- og IKT-installatører	4424	0.583
7119	Andre bygningsarbeidere	4002	0.585
5329	Andre pleiemedarbeidere	90993	0.587
1324	Ledere av logistikk og transport mv.	10161	0.590
3251	Tannpleiere	1114	0.595
3132	Kontrolloperatører ved forbrennings- kjøle- og vannrenseanlegg mv.	1414	0.597
3521	Teknikere innen radio og tv	1854	0.600
3435	Andre yrker innen estetiske fag	1942	0.610
8331	Bussjåfører og trikkeførere	20137	0.612
3131	Energikontrolloperatører	1785	0.614
4212	Bingoverter, bookmakere mv.	1256	0.616
7233	Anleggsmaskin- og industrimekanikere	24425	0.622
2165	Landmålere, kartografer mv.	1196	0.630
3333	Arbeidsformidlere	13102	0.640
9334	Varepåfyllere	1029	0.640
3323	Innkjøpere	6877	0.643
9622	Altmuligmann	3381	0.643
7412	Automatikere	7826	0.644
7231	Bilmekanikere	25295	0.645
8343	Kran- og heisførere mv.	2614	0.654
5153	Vaktmestre	30813	0.660
9123	Vinduspussere	117	0.660
3321	Forsikringsagenter	12237	0.662
2112	Meteorologer	323	0.670
6113	Gartnere	6027	0.670
7515	Prøvesmakere og kvalitetsbedømmere av mat og drikke	92	0.675
8311	Lokomotiv og T-baneførere	1811	0.677
3334	Eiendomsmeglere og - forvaltere	5818	0.679
3343	Sjefssekretærer	10606	0.680
3212	Bioingeniører	6845	0.685
9111	Renholdere i private hjem	727	0.690

	Tittel	Antall	Sannsynlighet
8111	Bergfagarbeidere	1249	0.696
6222	Fiskere	380	0.700
3254	Optikere	1474	0.710
8157	Renseri- og vaskerimaskinoperatører	2780	0.710
7214	Platearbeidere	6895	0.713
7115	Tømrere og snekkere	61035	0.720
8350	Dekks- og maskinmannskap (skip)	10163	0.725
7125	Glassarbeidere	1889	0.730
8152	Operatører innen tekstilproduksjon mv.	1116	0.730
5120	Kokker	28009	0.732
7544	Desinfeksjonsarbeidere og skadedyrbekjempere	539	0.733
7124	Isolatører mv.	1617	0.735
8171	Operatører innen treforedling	3441	0.740
4222	Kundesentermedarbeidere	7023	0.755
6121	Melke- og husdyrprodusenter	4124	0.760
6122	Egg- og fjærfeprodusenter	214	0.760
6130	Plante- og husdyrprodusenter (kombinasjonsbruk)	6809	0.760
6221	Havbruksarbeidere	5869	0.760
5132	Bartendere	7448	0.770
8113	Operatører innen boring mv.	18334	0.772
7222	Verktøymaker, låsesmeder mv.	2436	0.773
3155	Teknikere innen luftfartssikkerhet	1950	0.775
7212	Sveisere	8400	0.775
3511	Driftsteknikere, IKT	22153	0.780
7213	Kopper- og blikkenslagere	6265	0.780
8341	Jordbruks- og skogbruksmaskinførere	914	0.790
9629	Andre hjelpearbeidere	1058	0.790
6210	Skogbrukere	1001	0.792
7132	Overflatebehandlere og lakkerere	5026	0.800
9313	Hjelpearbeidere i bygg	8891	0.800
8211	Montører av mekaniske produkter	2171	0.805
4131	Stenografer mv.	44	0.810
7131	Malere og byggtapetserere	8762	0.810
7211	Støpere	628	0.810
8143	Operatører innen papirprodukter	584	0.810
8181	Operatører innen glass- og keramisk produksjon	1834	0.813
8160	Operatører innen næringsmiddelproduksjon	29539	0.816
7112	Murere	6187	0.820
7122	Gulv- og flisleggere	1947	0.820
8141	Operatører innen produksjon av gummiprodukter	598	0.822
3113	Elkraftingeniører	5830	0.825
3134	Kontrolloperatører ved olje- og naturgassraffineringsanlegg	2152	0.825
7322	Trykkere	2195	0.830
9129	Andre rengjørere	35	0.830

	Tittel	Antall	Sannsynlighet
9216	Hjelpearbeidere innen havbruk	664	0.830
7315	Glasshåndverkere	185	0.837
3114	Elektronikkingeniører	14317	0.840
3522	Teknikere innen telekom	991	0.840
7531	Skreddere, buntmakere mv.	618	0.840
9329	Andre hjelpearbeidere i industri	10386	0.840
7511	Slaktere, fiskehandlere mv.	2723	0.845
8131	Operatører innen kjemisk industri	11840	0.847
3133	Kontrolloperatører innen kjemisk prosessindustri	351	0.850
9412	Kjøkkenassistenter	19804	0.850
4321	Lagermedarbeidere og material-forvaltere	42512	0.857
4412	Postbud og postsorterere	15422	0.860
7113	Steinhoggere mv.	878	0.860
8172	Operatører innen trelastproduksjon	6452	0.860
9215	Hjelpearbeidere i skogbruk	649	0.870
7223	Metalldreiere mv.	5291	0.871
3135	Kontrolloperatører innen metallproduksjon	373	0.880
4322	Logistikkmedarbeidere	7361	0.880
8114	Operatører innen produksjon av betong mv.	2566	0.880
8121	Operatører innen metallurgiske prosessfag	11193	0.880
9312	Hjelpearbeidere i anlegg	16794	0.880
7114	Betongarbeidere	11904	0.883
9621	Bud mv.	4647	0.885
7215	Riggere og spleisere	1612	0.890
7512	Bakere, konditorer mv.	2416	0.890
8112	Prosessoperatører (oppredning)	268	0.890
8153	Industrisyere	1377	0.890
8182	Fyrkjele- og turbinoperatører	29	0.890
8342	Anleggsmaskinførere	26964	0.892
5414	Vektere	17972	0.895
9623	Måleravlesere mv.	252	0.895
4416	Personalkontormedarbeidere	327	0.900
5131	Servitører	30177	0.900
5230	Billettselgere	769	0.900
7121	Taktekkere	1688	0.900
8142	Operatører innen plastprodukter	3425	0.906
4225	Informasjonsskrankemedarbeidere	331	0.910
7522	Møbelsnekkere	1640	0.915
3213	Reseptarer	5807	0.920
8189	Andre stasjonære maskinoperatører	283	0.922
8212	Montører av elektriske og elektroniske produkter	4500	0.922
7224	Metallslipere	186	0.925
3352	Skattefunksjonærer	61	0.930
5246	Gatekjøkken- og kafémedarbeidere mv.	19653	0.930

	Tittel	Antall	Sannsynlighet
7221	Smeder	287	0.930
9612	Gjenvinningsarbeidere	803	0.930
3359	Andre yrker innen offentlig forvaltning	31350	0.940
4227	Intervjuere	1634	0.940
5151	Renholdsledere i virksomheter	3571	0.940
5152	Husholdere	304	0.940
5211	Torghandlere	751	0.940
5243	Dørselgere	511	0.940
9520	Gateselgere (ikke matvarer)	406	0.940
4415	Arkivassistenter	529	0.945
4214	Inkassomedarbeidere mv.	1654	0.950
5223	Butikkmedarbeidere	240209	0.950
7313	Gull- og sølvsmeder, gravører mv.	545	0.950
7323	Innbindere mv.	440	0.950
9214	Hjelpearbeidere i gartneri mv.	1684	0.950
3315	Takstmenn	1190	0.953
2411	Revisorer, regnskapsrådgivere	16535	0.957
4226	Resepsjonister (ekskl. hotell)	14139	0.960
4323	Transportfunksjonærer	11158	0.960
8151	Spinne- og nøstemaskinoperatører	177	0.960
4211	Kundebehandlere, bank og postkontor	2303	0.965
4223	Sentralbordoperatører	2927	0.965
4312	Forsikrings- og finansmedarbeidere	169	0.968
3142	Agroteknikere	749	0.970
4110	Kontormedarbeidere	101093	0.970
4311	Regnskapsmedarbeidere	27939	0.970
4313	Lønningsmedarbeidere	2996	0.970
4411	Bibliotekassistenter	461	0.970
5249	Andre salgsmedarbeidere	1165	0.970
8154	Operatører innen tekstilbearbeiding	229	0.970
8156	Operatører innen skinn og lærprodukter	68	0.970
8219	Andre montører	163	0.970
3313	Regnskapsførere	27789	0.980
3342	Advokatsekretær	1151	0.980
8183	Pakke-, tappe- og etikettmaskinoperatører	1787	0.980
3331	Speditører og befraktere	6206	0.985
4132	Dataregistrere	443	0.990
5244	Telefon- og nettselgere	15627	0.990
8132	Operatører innen produksjon av fotofilm og -papir mv.	227	0.990