Gender pay gap between men and women in Denmark for years 2013 to 2020

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Abstract **- This project examines the gender pay gap between men and women in Denmark from 2013 to 2020. The focus of the project is on visualizing the pay gap and analyzing it in different industries. In addition, a user input feature is also presented, this feature allows the users to compare their own job and salary information to the data. The findings show that the gender pay gap in Denmark is decreasing from 14.3 % in 2013 to 11.9 % in 2020. The pay gap is found to be particularly high in the financial and insurance industry with a 21.2 % difference, while the lowest pay gap was in the water supply, sewage, and waste management industry where women are on average earning more than men and the difference is 2.7 %. The findings suggest an opportunity for industries and politicians to act towards decreasing the gender pay gap in some industries, and for individuals to be aware of their own salary compared to their peers.**

1. Introduction

The gender pay gap has been, and still is, a major focus of conversation and debate in society, because it continues to be a pervasive issue in many countries around the world. The gender pay gap refers to the difference in earnings between men and women, typically measured as the difference between median earnings of men and women relative to median earnings of men in percent [fECoD22].

As a result of minimal progress in reducing the gender pay gap, women in many countries continue, on average, to earn less, even when they have the same level of education and experience [Com20]. Some of the reasons for the ongoing gender pay gap in Europe include discrimination, the fact that women are more likely to work part-time or in lower-paying industries, and that women are underrepresented in leadership positions [Com20] [oEiD20]. Efforts to close the gender pay gap include increasing transparency in pay, promoting equal pay for equal work, and supporting gender balance in leadership positions [New22b].

In Denmark, the gender pay gap in 2020 was 11.9 % according to Statistics Denmark [Den]. This means that women, on average, earn 11.9 % less per hour than men. However, the European Commission found that the gender pay gap in Denmark 2020 was 13.9 %, almost a percentage point higher than the average gender pay gap in the European Union at 13 % [Com20]. The gender pay gap has been narrowing over the past few decades. But it is a slow progress and at this current speed, the United Nations estimates that it will take more than 250 years to close the gap [nat20].

According to a report from Statistics Denmark, there is a majority of men in the workforce in almost all industries in the private sector. While in the public sector, women make up more than two-thirds of the workforce [Den20]. There are many factors that contribute to differences in salaries between industries, including whether you work in a public or private sector. The sectoral and industrial difference contributes to the pay gap with 39 %, if women and men were equally distributed one third of the gender pay gap would disappear, and this has the greatest influence on the highest earners of salary. Meaning the women at the top are losing the most on the gender pay gap and gendered labor market [KMRN20]. Understanding the pay gap between men and women in different industries could help enlighten, which industries contribute more to the high gender pay gap. This information can be used to identify industries where the gender pay gap can be addressed and thereby promote pay equity.

We present an interactive visualization tool to explore the gender pay gap between men and women in Denmark for the years 2013 to 2020. By visualizing salary data in combination with industry and management responsibility information, we can see how the gender pay gap varies across different industries. It helps identify which industries have the respectively largest and lowest pay gap between men and women. Overall, this will help to gain important insights into the gender pay gap in Denmark and could potentially contribute to producing strategies for reducing and eliminating the gender pay gap.

2. Related Work

A recognizable reporting of the gender pay gap is the physical gap with a man and woman climbing the cliff on each side, and the pay gap for different countries is shown as the physical gap [New22a] , but this conveys only little insight and details. It is difficult to balance the amount and the ease of consuming information. On the other hand, many analytical and academic reports are made with a lot of information and solid empirical insight but are long and relies more on text than visual reporting.

From these reports we know that in 2019, the gross gender pay

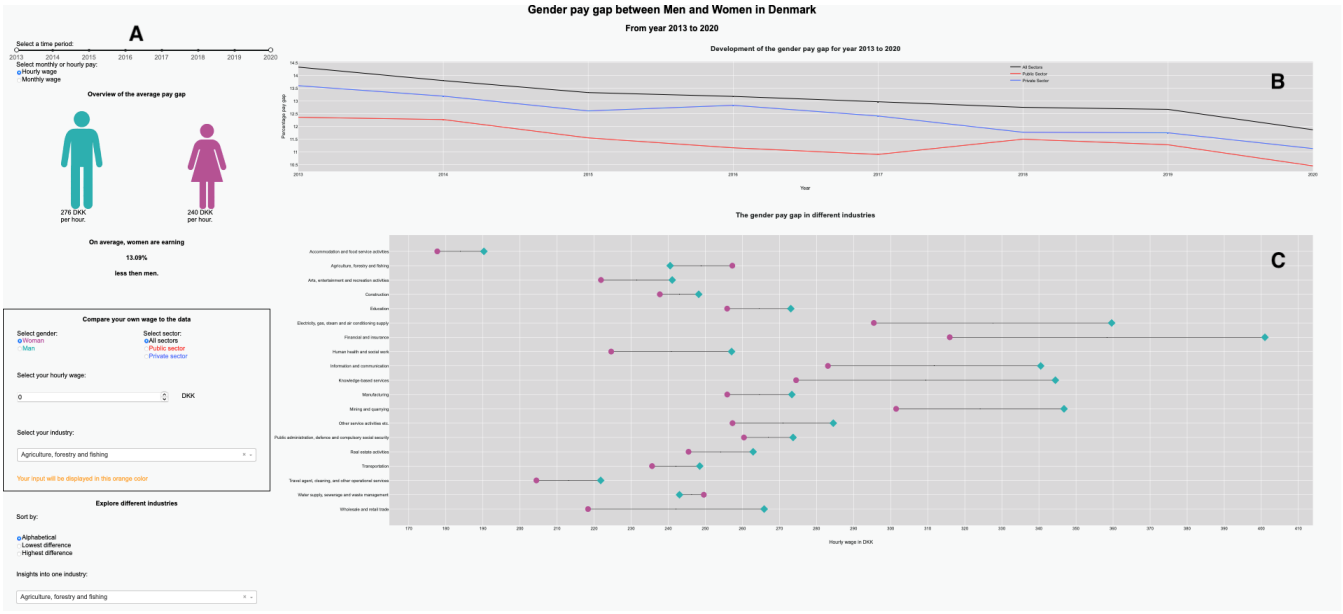

Figure 1: *A) the control panel where the user can change the variables, compare their own salary and displays the raw salary data for men and women. B) A line plot displaying the development of the gender pay gap in Denmark. C) Scatterplot showing the gender pay gap in different industries.*

gap is men earn 14.5 % more than women. On a sectoral level, the difference is biggest in the regional sector with men earning more than 24.7 % more than women, this is also the sector with the largest decrease in the pay gap; it has fallen 4.6 % points since 2013 to 2019 [oEiD]. The gender pay gap is falling but is still a real influence on gender inequality. Reports and analyzes point to employment in traditionally viewed women's work, and places of work with many female employees have lower wages, indicating that "women's work" is valued less [oAV20]. These text heavy rapports can make it difficult for people to read and get a fast and easy overview of the problem. A more visualized presentations of the data, will make it easier for people to process the information [Mun14].

Industries are often included when researching the gender pay gap in Denmark, however, when reporting findings, it is not a sole focus. As in the 2020 publication from VIVE, industries are joint with other factors to create a variable for "The gender-segregated labor market" [oAV20], and the pay gap in specific industries are overlooked. Other reports do go further into the industries, but focus mostly one area of industries [Lar13].

In 2017 DR published a news article with an interactive graphic of the gender pay gap in at the industrial level, using data for 2015 from Statistics Denmark. The user can search for a specific industry, and then see smaller sections of that industry, and reports some of the differences in the bottom of the article but has no total overview of the gender pay gap, making it impossible to compare larger industry categories. The gender pay gap is indicated in hourly pay in DKK for men and for women but does not show a percentage difference. Visually the pay gap is shown as horizontal bar plots, with the gender bars in layers, so the distance between each bar informs on the gender pay gap [fDR17].

3. Data

The visualization tool for exploration of the gender pay gap in Denmark is based on register data from Statistics Denmark. The data mainly used comes from the LONS40 data set. LONS40 has its data split into all the industries, but not a total category for all the industries together. This information is taken from LONS30. Although we had access to many more interesting variables in other data sets, we chose to limit the data in order to keep the scope of this project manageable, as using all of the available variables would have made the project too comprehensive. The attributes that we are making use of from the LONS40 dataset are as following:

- **Contents** is the value of the different pay components.
- **Components** are the types of payment, the types used in this study are standardized hourly earnings, standardized monthly earnings, benefits per standard hour, pension including ATP per standard hour, basic earnings per standard hour, lower quartile, median, upper quartile and number of fulltime employees in the earnings statistics.
- **Employment group** refers to employees without management responsibility and managers, this variable also includes total employees which combines both groups.
- **Industry** refers to the 19 unique industries there are in the data set.
- **Salary Group** refers to the pay type, which can either be paid by hour or a fixed salary. This variable also includes a combined salary which includes both types.

- **Sector** refers to the public or private sector. This variable also includes an overall sector which contains all individuals from the public and private sector.
- **Year** is the data of which years it is possible to look into, in this case years between 2013 and 2020.

4. Visualization design

The gender pay gap dashboard consists of five interactive graphs that allow users to study the gender pay gap in Denmark overall and in different industries. The dashboard also includes a control panel on the left side where various variables can be modified, such as the year, salary can be switched between hourly and monthly, and sorting of information. The user can also insert their own information to compare it to the data. This allows users to customize the dashboard and analyze the data in a way that is relevant to them.

The following points will outline the design and purpose of each interactive graph, providing information about how the graphs were created and which information they were intended to present:

- **Overview of the average pay gap (Figure1A):** This visualization consists of a man and woman figure, underneath the figures it displays information about the raw average salary of men and women in Denmark. The size of the figure indicates the percentage relation between men and women. The color of the figures displays the general color code for men (light blue) and for women (purple) in the dashboard. The figure also displays the average gender pay gap for the selected time period below the figures.
- **Development of the gender pay gap (Figure1B):** The visualization at the top is a line graph, which illustrates the development of the gender pay gap in Denmark over the years. It displays the percentage of women's earnings compared to men's earnings in all sectors and in the public and private sector. These sectors are depicted by black, red, and blue lines, respectively. The user input will calculate the gender pay gap against the opposite of the gender selected, and is represented by a distinctive orange line.
- **The gender pay gap in different industries (Figure1C):** The next visualization is a scatterplot which display the average difference in salary between men and women in the different industries. Men are represented by blue diamonds, while women are represented by purple circles. A line connecting the two symbols represents the salary difference, with the length of the line indicating the size of the pay gap. Industries with a long distance between the symbols have a larger pay gap. Users can hover over the symbols and the connecting line to see the exact salary for each gender and the difference between them for every industry. The salary can be switched between hourly and monthly salary on the x-axis, and the industries on the y-axis can be sorted either alphabetically, by lowest or highest difference. Input for user salary is also displayed in the graph, when an input is given, this data point is shown as an orange pentagon.
- **Employee and gender distributions in industries (Figure2A)** The purpose of the bar plot is to illustrate the ratio of men and women in a selected industry. It can show the ratio of men and women for three categories: employees in total, non-managerial employees, and general managers. By hovering over the bars, the user can see the number of men and women for each specific employee category for the selected industry.
- **Percentage difference of salary types (Figure2B)** The purpose of the bar plot is to illustrate the percentage difference in basic earnings, benefits and pension between men and women in a specific industry. The earnings of men in these three categories are set as the baseline at 100 percent. The salary of women can therefore be expressed as a percentage of the salary of men, with X representing the percentage of a man's salary that a woman earns. In other words, the woman's salary is X percent of a man's salary in this industry.
- **Wage distribution of employments groups for one industry (Figure2C)** The last visualization is a box plot, which displays the distributions of both men's and women's salary for each of the three employment group categories (employees in total, non-managerial employees, and general managers) in a specific industry. User input can also be displayed in the graph, this input is represented with an orange line. This feature allows users to compare their own data with the distribution of men and women across their own and all industries in general, also showing the aspect if there are any managerial responsibilities. This allows users to explore how their own situation compares to the overall development in the industries.

Overall, detailed information is displayed when hovering over the bars, scatter point or years in the line chart, making the graphs easier to decode. The user can also gain valuable information and impression of the trends, nuances and changes to the gender pay gap, and gain an accumulated knowledge that in a traditional article either would take a lot of reading to obtain or would leave out relevant information to keep it shorter and manageable for the average reader.

5. Results and discussion

The visualization presented shows that the overall gender pay gap in Denmark has been decreasing from 14.3 % in 2013 to 11.9 % in 2020. The pay gap is lower in the public sector (10.45 % in 2020) compared to the private sector (11.13 % in 2020). However, there are fluctuations for the two sectors over the years, but in general, the pay gap is decreasing. The line chart was chosen to display the development of the gender pay gap in Denmark as it is easy to follow and read the values in this type of chart.

Looking at the gender pay gap in the Danish industries, the highest pay gaps were found to be in the financial and insurance industry (21.2 %), knowledge-based services industries (20.3 %) and electricity, gas, steam and air conditioning supply (17.8 %). While industries with the lowest gender pay gap are the water supply, sewerage and waste management industry (women earn 2.7 % more than men) and the construction industry (4.2 %). The purpose of the scatterplot is to give a simple and clear overview of the gender pay gap in the different industries, the sorting function makes it easy to extract rankings of industries with the highest and lowest pay gap.

The industries with the lowest difference have in common that the percentage of women in the industry was significantly lower

than men. In the construction industry around 9 % of employees were women and most of these women were in the employment group general managers. For the financial and insurance industry, which has the highest pay gap, 48 % of employees in this industry are women. However, only 32 % of the general managers are women. Since 48 % of the employees in the industry are women, we would expect it to be the same for general managers, but we can observe a 16-percentage point difference.

The human health and social work industry is a great industry to look at when investigating wage distribution. When comparing the average basic earnings of men and women, we can see that women are earning 11.47 % less than men even though there are more women in the industry overall. When looking at the box plot, even though it is a women-dominated field, the male manager group is earning far more than the female managers. It would not be possible to observe these details without the box plot, which is the reason why we chose to use three graphs in combination to get a more complete understanding of the data.

While the data presented in this study provides valuable insights into the gender pay gap in Denmark, it is important to recognize that it may not be completely representative of the overall population. There are several factors that can impact the accuracy and comprehensiveness of the data, including limitations of the industry subdivision and the method of collecting data, which were not provided from Statistics Denmark, therefore there may potentially be some uncertainty and perhaps the potential for self-reporting biases. Another limitation of the data is that it only includes subdivisions of employment groups to be total employees, general managers, and non-managerial level employees. Another impact is women are more likely to work part-time than men [oEiD20], influencing their monthly salary. There are many different levels of managerial responsibility, and these differences are not reflected in the data. Increasing transparency and improving the representativeness of the data could be done by expanding the scope of data collection to include a more diverse range of industries. By considering this and other approaches, we can work towards building a more comprehensive and accurate understanding of the gender pay gap in Denmark.

Gender equality issues, as the gender pay gap, are often met with resistance and backlash in different forms, such as discourse of denial of the problem and legitimacy of the case for change from media, politicians and individuals, whereas other areas of reported research do not get the same level of criticism. News articles are often short, lack nuances and often have an angle, whereas statistical analysis reports and academic articles can be too long and lack an overview for lay people. Visualization of the data conveys a lot of information with little cognitive work, and with interaction the data allows the user to investigate areas, connections, and other factors they would normally criticize for lack of detail in a regular pivot table. This gives access to exploitative obtaining knowledge, and creation of several research questions based on the same data points. Here a transparent approach and reporting of the creation of data, variables and visualization is very important to establish trust with the users [Flo21] [Par22]].

6. Conclusion

The gender pay gap dashboard presented in this study offer valuable insights into the development of the gender pay gap in Denmark between the years 2013 to 2020. By examining the data and visualizations for the men's and women's earnings in the different industries and regarding salary for general managers, industries with high disparities can be identified and strategies to close the gap can be developed. While there are limitations to the data used in this study, the visualizations provide a useful tool for understanding and addressing the gender pay gap in Denmark and can be used to inform society about this important issue. Overall, the findings of this study suggest that there is still a significant pay gap between men and women in Denmark, particularly in certain industries such as the financial and insurance sector. However, the data suggests that the pay gap is decreasing over the years explored in this study.

References

[Com20] COMMISSION E.: The gender pay gap situation in the eu, 2020. URL: https://commission.europa.eu/strategy-and-policy/policies/justice-and-fundamental-rights/gender-equality/equal-pay/gender-pay-gap-situation-eu_en. 1

[Den] DENMARK S.: Gender equality in denmark. URL: https://www.dst.dk/en/Statistik/emner/borgere/demokrati/ligestillingswebsite#4. 1

[Den20] DENMARK S.: Erhvervslivet og verdensmålene, 2020. URL: https://www.dst.dk/Site/Dst/Udgivelser/GetPubFile.aspx?id=41578&sid=erhmal. 1

[fDR17] FOR DENMARKS RADIO D. B.: Interaktiv grafik så stor er lønforskellen inden for dit arbejdsområde, 2017. URL: https://www.dr.dk/nyheder/indland/interaktiv-grafik-saa-stor-er-loenforskellen-inden-dit-ar 2

[fECoD22] FOR ECONOMIC CO-OPERATION O. O., DEVELOPMENT": Gender wage gap (indicator), 2022. URL: https://doi.org/10.1787/7cee77aa-en. 1

[Flo21] FLOOD MICHEAL; DRAGIEWCZ M. P.-B.: Resistance and backlash to gender equality. *The Australian Journal of Social Issues* (2021). 4

[KMRN20] "K. M. R. NIELSEN" "C. TÖRNFELT" E. H. K. T.: Statistics denmark analysis - lønforskellen mellem mænd og kvinder skabes blandt de højst lønnede, 2020. URL: https://www.dst.dk/Site/Dst/Udgivelser/nyt/GetAnalyse.aspx?cid=36335. 1

[Lar13] LARSEN M.: LØnforskelle mellem mÆnd og kvinder i industrien (vive), 2013. URL: https://www.ft.dk/samling/20131/almdel/BEU/bilag/45/1294150.pdf. 2

[Mun14] MUNZNER T.: *Visualization Analysis and Design*. A K Peters/CRC Press, 2014. 2

[nat20] NATIONS U.: 250 years needed to bridge the pay gap, 2020. URL: https://unric.org/en/250-years-needed-to-bridge-the-pay-gap/. 1

[New22a] NEWS E. P.: Gender pay gap in europe: facts and figures - infographics, 2022. URL: https://www.europarl.europa.eu/news/en/headlines/society/20200227STO73519/gender-pay-gap-in-europe-facts-and-figures-infographic. 1

[New22b] NEWS" E. P.: "how to close the gender pay gap in the eu", 2022. URL: https://www.europarl.europa.eu/news/en/headlines/society/20200227STO73521/how-to-close-the-gender-pay-gap-in-the-eu. 1

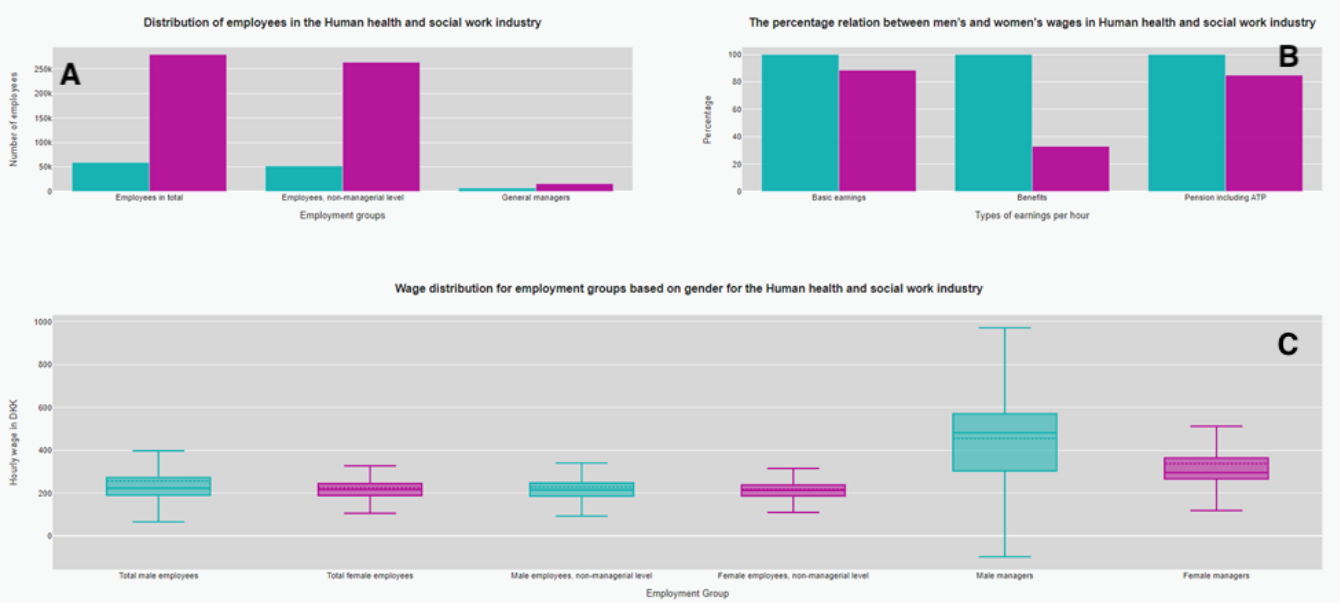

Figure 2: *A) Bar plot over the employee and gender distribution in the human health and social work industry . B) Bar plot displaying the percentage difference of types of salary in the human health and social work industry. C) Box plot for each employment group showing the wage distribution for the human health and social work industry.*

[oAV20] OG ANALYSECENTER (VIVE D. N. F.: Den 'uforklarede' del af forskellen mellem kvinders og mænds timeløn, 2020. URL: https://www.vive.dk/da/udgivelser/den-uforklarede-del-af-forskellen-mellem-kvinders-og-maends-timeloen-15412/. 2

[oEiD] OF EMPLOYMENT IN DENMARK T. M.: Mænd og kvinder på arbejdsmarkedet 2021. URL: https://bm.dk/arbejdsomraader/analyser-publikationer/rapporter-publikationer/rapporter-publikationer/2022/maend-og-kvinder-paa-arbejdsmarkedet-2021/. 2

[oEiD20] OF EMPLOYMENT IN DENMARK T. M.: Mænd og kvinder på arbejdsmarkedet 2020, 2020. URL: https://bm.dk/media/14895/maend-og-kvinder-pa-arbejdsmarkedet_2020.pdf?fbclid=IwAR05BdNLQtqdL0wEcpg_OD9aqkCwXN_RCYSg3SC_AtqmRMsRXg2xB68PnoY. 1, 4

[Par22] PARTH A.-M.: Backlash by men against the socio-economic and political promotion of women in europe. *Social Sciences 11* (2022). 4